Blue Crab Derelict Traps and Trap Removal Programs

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INTRODUCTION

The wire crab trap has dramatically influenced the Gulf of Mexico blue crab (*Callinectes sapidus* Rathbun) fishery. Crab traps were introduced in Louisiana and Texas as early as 1948 and by the middle 1950s were widely accepted throughout the Gulf of Mexico. During the 1950s and 1960s, the blue crab fishery gradually evolved from a trotline to a trotline-drop net to a trap dominated fishery (Guillory et al., 1998). The total number of traps increased dramatically because of the cumulative effects of increases in the number of trap fishermen and number of traps per fisherman. By the late 1970s trap landings contributed 98%-99% of total Gulf landings. Commercial landings also expanded in association with increased utilization of the highly efficient crab trap. While adoption of the crab trap has had a positive impact on fishing efficiency and harvest, proliferation of traps has resulted in user group conflicts and an increase in the problems associated with lost or discarded (derelict) traps (Guillory et al., 2001). For purposes of this report, a derelict trap is defined as any trap not actively fished. These traps may or may not be buoyed or capable of ghost fishing. Ghost traps are derelict traps which are capable of capturing and retaining blue crabs and/or bycatch.

Certain fishing practices and physical characteristics of traps contribute to ghost trap impacts by either facilitating trap loss or by magnifying ghost fishing mortality; these include the large number, unattended nature, poor size selectivity, and high durability of vinyl-coated traps. Unattended gear is prone to loss, and the number of ghost traps is directly related to the number of actively-fished traps. Traps are effective in capturing blue crabs but inefficient with respect to size selection. Traps retain excessive numbers of sublegal (<127 mm carapace width, CW) blue crabs (Guillory and Prejean, 1997; Guillory and Hein, 1998a and 1998b; Guillory, 1998), and ghost fishing mortality is directly related to the number of retained blue crabs (Arcement and Guillory, 1993).

In general, gear use and losses in trap or pot fisheries appear to be increasing concurrent with a shift to more durable gear and designs (Carr and Harris, 1997). This generalization is applicable to the blue crab trap fishery, where historic changes in trap wire along with the increased number of traps have exacerbated ghost trap impacts. The replacement of galvanized wire by vinyl-coated wire in the 1970s resulted in more durable traps with a longer ghost fishing period. In addition, one and one-half inch square mesh traps have become popular in Louisiana and other areas. These traps are constructed of a heavier gauge wire (Guillory, 1996) and catch significantly higher numbers of sublegal crabs (Guillory, 1998; Guillory and Hein, 1998b; Guillory and Prejean, 1997) than do hexagonal mesh traps. Consequently, square mesh traps would likely demonstrate higher rates of ghost fishing mortality, longer ghost fishing periods, and greater potential for vessel or motor damage than hexagonal mesh traps.

This report provides a review of the literature and available data regarding derelict blue crab traps and trap removal programs. Recommendations are suggested for reducing trap loss and ghost fishing mortality and for removal of derelict traps.

DERELICT TRAP REVIEW

Origin of Derelict Traps

Derelict traps may result from abandonment of fishable traps by fishermen who leave the fishery seasonally or permanently. In a Gulfwide survey of blue crab fishermen, 25% of the individuals interviewed fished six months or less (Guillory et al., 2001). There is a strong economic interdependency among the oyster, shrimp, and crab fisheries that may account for some of this seasonality (Steele and Perry, 1990). The fishery is also characterized by a high rate of turnover among commercial blue crab fishermen. Guillory and Merrell (1998) found that 29% of surveyed Louisiana fishermen had crabbed less than five years. In addition to abandonment by fishermen, improper disposal of unfishable traps poses a significant problem for the fishery. Factors that encourage trap abandonment or improper disposal of unfishable traps include: 1) logistical problems associated with the transport of traps for either temporary storage or permanent disposal, 2) availability of temporary storage sites, and 3) acceptability at landfills and disposal fees. Inadvertent loss of actively-fished traps may result from: uncontrollable weather or hydrological factors (i.e., tides, currents, or storm surges); senescence of buoys, lines, or knots; negligence by fishermen in assembling and maintaining buoys and buoy lines; use of plastic jugs or bottle floats that may become brittle, deteriorate, and sink; clipping of float lines by vessel propellers; and intentional cutting of buoy lines by vandals (Guillory, 1996).

Number of Derelict Traps

The number of derelict traps in the Gulf of Mexico is currently unknown. There are, however, some annual estimates of trap disposal and overall trap loss; the latter also includes trap loss due to theft. Estimates of annual trap loss on a percentage basis for each Gulf state range widely: 30%-50% in Florida (Anne McMillen-Jackson, personal communication); 20%-50% in Alabama (Leslie Hartman, personal communication); 20%-30% in Mississippi (Traci Floyd, personal communication); up to 100% in Louisiana (Guillory and Merrell, 1998); and 35%-50% (approximately 30,000 traps) in Texas (TPWD, unpublished data). According to surveyed commercial blue crab fishermen, an average of 257 traps per fisherman in Louisiana (Guillory and Merrell, 1998) and 103 traps per fisherman in Texas (Shively, 1997) were either lost or stolen annually. Trap losses may be higher immediately after hurricanes or severe storms.

Although an accurate count of derelict traps in the Gulf of Mexico is currently unavailable, data on the number of fishermen, average traps per fisherman, and trap loss can be used to generate a rough estimate of the total number of derelict traps added each year. The National Marine Fisheries Service (NMFS) estimated that there were 605,000 traps in 1993 in Florida, Alabama, Mississippi, and Louisiana; these data, however, probably underestimated the actual number of traps (Guillory and Perret, 1998). Recent (1999 or 2000) numbers of licensed commercial crab fishermen by state are: Florida West Coast-2,381, Alabama-174, Mississippi-256, Louisiana-3,347, and Texas-259; however, not all license holders actively fish (Guillory and Merrell, 1998; Guillory et al., 2001). Recent estimates of the average number of traps per fishermen were 152 in Florida (Steele and Bert, 1998), 150 in Alabama (Heath, 1998), 250-270 in Louisiana (Guillory and Merrell, 1998), and 200 (maximum allowed by statute) in Texas (Hammerschmidt et al., 1998). Based on a survey of commercial blue crab fishermen in the Gulf of Mexico, Guillory et al. (2001) estimated the number of traps per fishermen ranged from 25 to more than 2,000 with the following percent frequencies: 33%, <200 traps; 29%, 200-299 traps; 17%, 300-399 traps; 9%, 400-499 traps; 12%, >500 traps. Conservatively assuming a total of 5,000 commercial trap fishermen each using 200 traps and an annual trap loss/abandonment rate of 25%, approximately 250,000 derelict traps would be added each year in the Gulf of Mexico. This figure underestimates the actual number of derelict traps because of the cumulative addition of derelict traps over time and exclusion of traps used by recreational fishermen. However, not all derelict traps continue to fish because some are located on land or emergent vegetation, and older derelict traps eventually deteriorate and become incapable of ghost fishing.

Impacts of Derelict Traps

The problems associated with derelict crab traps are multi-faceted. The traps contribute to mortality of blue crabs and bycatch, exacerbate user group conflicts, create visual pollution, and may cause damage to sensitive habitats.

Mortality of Blue Crabs

Overall ghost fishing mortality is dependent upon number of ghost traps, location of traps, season, length of the ghost fishing period, and mortality rate per trap (Guillory, 2001). Ghost fishing mortalities continue until the trap deteriorates sufficiently for holes to develop in the wire mesh, allowing captured individuals to escape. The life expectancy of vinyl-coated wire traps averages two years or more, depending upon salinity (Shively, 1997). Heavier gauge square mesh traps probably exhibit longer life expectancies than hexagonal mesh traps, although no quantitative data are available.

Blue crab mortalities associated with ghost fishing may result from adverse environmental conditions, predation or injuries by other crabs or fish bycatch, starvation, or disease (Breen, 1990; Guillory, 1993). These effects, individually or in combination, may result in immediate (occurring in the trap) or delayed (occurring after escape from ghost traps) mortalities (Guillory, 2001). Hypoxic conditions have caused blue crab mortalities in traps (Tatum, 1982; Van Engel, 1982). Small blue crabs (Spier et al., 1996) and soft post-molt crabs (Vincent Guillory, personal communication) may suffer high mortalities in traps due to conspecific predation by larger individuals. Blue crabs are notoriously aggressive under crowded conditions and may inflict lethal and non-lethal injuries to other crabs. Blue crabs in traps may be more susceptible to bacterial infections. Johnson (1976) compared bacterial infection rates of blue crabs caught in traps and shrimp trawls. She found that the incidence of infection was 86% in crabs caught by traps but only 15% in crabs taken by shrimp trawls.

Blue crab mortalities in ghost traps have been documented in several studies. Mortalities in Louisiana averaged 25.8 crabs/trap over one year (Guillory, 1993). Arcement and Guillory (1993) found mortalities of 17.3 crabs/trap (without escape rings) and 5.3 crabs/trap (with escape rings) over a three-month period. Whitaker (1979) concluded that annual mortality in South Carolina ranged from 20-60 crabs/trap (x=40). Mortalities in Chesapeake Bay were estimated to be 7.7 crabs/trap (100% mortality) from January to March (Casey and Wesche, 1977) and 7.5 crabs/trap (33% mortality) from August to September (Casey and Wesche, 1980).

Blue crabs that escape from ghost traps may be subjected to delayed mortalities, reduced growth, and behavioral modifications because of inflicted injuries and stress (Guillory, 2001). Arcement and Guillory (1993) and Guillory (1993) found that 34% and 56%, respectively, of blue crabs caught in ghost traps eventually escaped. Mortality of escaped blue crabs may be directly related to trap confinement time (Guillory, 2001). Van Engel (1958) suggested that injuries to blue crabs might reduce the growth increment at molting from 25%-33% to less than 10%. Limb loss and other injuries or physiological stress may reduce the ability of blue crabs to evade predators because of slowed escape behavior and altered random directional movement (Smith, 1990).

Mortality of Bycatch

At least 23 species of fish and five species of invertebrates have been observed in blue crab traps (Davis, 1942; Whitaker, 1979; Guillory, 1993). Important recreational fish species included spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), black drum (*Pogonis cromis*), and southern flounder (*Paralichthys lethostigma*). Higher vertebrates such as diamondback terrapin (*Malaclemys terrapin*), river otter (*Lutra canadensis*), and raccoon (*Procyon lotor*) have also been observed in ghost traps. Seigel and Gibbons (1995) concluded that drowning in crab traps is a major threat to diamondback terrapin populations.

Derelict traps may also present additional hazards to wildlife through entanglement with buoy lines or trap wire. Possible effects of entanglement include impeded movement, drowning, starvation, reduced growth or fitness, and wounds (Ryan, 1990). Although difficult to document (Laist, 1997), several species of marine reptiles and mammals have been observed entangled in crab traps or buoy lines (Plotkin and Amos, 1990; Beck and Barrios, 1991; Federal Register, 2001; Guillory et al., 2001). Seven specimens of bottlenose dolphins (*Tursiops truncatus*) recovered in the Gulf of Mexico had rope marks or rope or traps attached; one dolphin was released alive after becoming entangled in a blue crab trap. Manatees (*Trichechus manatus*) in Florida have drowned after becoming entangled in crab trap buoy lines.

User Group Conflicts

User group conflicts have escalated as the number of derelict traps and other water-related activities have increased. Derelict traps can pose navigation hazards to waterfowl hunters, recreational anglers, pleasure boat operators, and shrimp fishermen and may entangle hooks of recreational anglers. Economic costs may also be incurred when vessels or shrimp fishing gear come into contact with crab traps or buoy lines. There may be two kinds of costs, the repair and replacement cost of the damaged gear or equipment and the opportunity cost of the vessel and gear when it is not in productive service (Meade et al., 1990). Traps that lodge in shrimp trawl TEDs (turtle excluder devices) may reduce shrimp catch and prevent escapement of sea turtles.

Conflicts between shrimp fishermen and blue crab fishermen have become very volatile in some areas. Concentrations of derelict and actively fished traps in localized areas may spatially displace shrimp fishermen. Several area closures or trap restrictions in the Gulf were based in part on these user group conflicts.

Visual Pollution

Marine debris such as derelict crab traps is unattractive and may have indirect financial costs. Exposed ghost traps in the water or along shorelines may be aesthetically degrading to other user groups and may devalue affected shoreline property. Fishing gear such as traps, foam buoys, and lines were not uncommon during beach cleanups across the United States (Hara, 1990).

Habitat

In general, passively-fished crab traps have a lesser impact on habitat than mobile fishing gear such as trawls and dredges (Rogers et al., 1998; Hamilton, 2000; Barnette, 2001). Additionally, the area impacted per unit effort is smaller for fixed gear than for mobile fishing gear. The potential physical impacts of ghost traps depend upon the type of habitat and the occurrence of these habitats relative to the distribution of blue crab traps. In general, sand- and mud-bottom habitats are less affected by crab and lobster traps than sensitive bottom habitats such as submergent aquatic vegetation (SAV) beds or non-vegetated live bottom (stony corals, gorgonians, sponges) (Barnette, 2001). In the Gulf of Mexico, SAV occurs from subtidal areas in protected estuaries to depths of 20 meters offshore and comprises an estimated 1,475,000 ha in the Gulf of Mexico (Holt et al., 1983). The blue crab fishery and areas of SAV may overlap within some estuaries or around barrier islands whereas most live bottoms in the Gulf of Mexico occur off west Florida and Texas (Parker et al., 1983) and do not overlap the blue crab fishery.

The physical impacts of ghost blue crab traps on SAV in the Gulf of Mexico have not been quantified, although some generalizations have been made concerning potential impacts of traps. Barnette (2001) concluded that crab and lobster traps have a low impact on SAV habitat. Stephan et al. (2000) concluded that although each individual trap has a relatively small footprint, Atlantic Coast SAV habitat could be impacted because of the large number of crab traps. Crab traps were not included as an anthropogenic disturbance to SAV beds in Texas (Texas Parks & Wildlife Department, 1999).

The impact of derelict traps on sensitive habitats differs from that of actively-fished traps. The effects of trap deployment and recovery would be less in derelict traps than in actively-fished traps while the opposite would be true for the effects of smothering. Jennings and Kaiser (1998) suggested that the frequency and intensity of physical contact are important variables when evaluating the effects of fishing gear on the biota. In conclusion, derelict traps, while individually occupying a small area, may impact SAV because of their large number and potential smothering effect.

Legal Concerns

In addition to biological, aesthetic, and socio-economic concerns, there may be local, state, and federal regulations that pertain to disposal of fishing gear. MARPOL Annex V, an international agreement signed by more than 65 nations, was implemented in the United States through the federal Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987. MARPOL V regulates vessels at sea and governs the discharge of garbage during normal operations of ships at sea, including a prohibition of any plastics (Breen, 1990). The MPPRCA, however, also applies to vessels in inland waters. The intentional disposal of old gear at sea is prohibited because most fishing gear has plastic components (Laist, 1996). The accidental loss of fishing gear is excluded. Local and state litter laws may also apply to the disposal of fishing gear in the water or along the shoreline.

REVIEW OF DERELICT TRAP REMOVAL PROGRAMS

Numerous local, state, regional, and national programs exist to target marine debris cleanups which incidentally encounter derelict traps that occur along shorelines. However, due to legal issues surrounding trap ownership rights and anti-tampering legislation, very few programs exist which specifically target derelict traps. Traps discarded onto shore have fewer removal issues than traps that remain in the water, either buoyed and abandoned or unbuoyed and lost. Listed below are the state programs targeting derelict crab traps and the annual Coastal Cleanup Program targeting general debris.

Gulf of Mexico

Mississippi

In 1999, the Mississippi Department of Marine Resources (MDMR), in conjunction with the Gulf Coast Research Laboratory, initiated a Derelict Trap Program that was funded by a grant from the Mississippi Tidelands Trust Program (Perry, 2000). The objectives of the project were to identify the scope of the problem in Mississippi and to educate the public. Coastal waters were surveyed, problem areas identified, and a trap retrieval program was initiated. Following completion of the initial project, the MDMR adopted a limited plan to retrieve and recycle traps within existing programmatic activities. To date, 1,575 derelict crab traps have been collected and recycled. Most were obtained from marsh areas around Bayou Caddy, Graveline Bayou, and Bayou Cumbest during winter low tides. Commercial and recreational fishermen in Mississippi have been instrumental in locating high concentrations of lost or abandoned traps and continue to work with the MDMR Crab Task Force to address the problem in local waters.

Texas

Although there are no organized programs to remove derelict traps, Texas Parks and Wildlife Department enforcement personnel occasionally remove illegal or abandoned traps as their schedules allow. These efforts are usually in response to complaints received from the public or other commercial fishermen. Agents may also confiscate illegal (missing or improper gear tag, escape rings, degradable panels, or float) traps that they observe. Over the past several years, approximately 2,000 abandoned or derelict traps have been removed from coastal waters (Tom Wagner, personal communication). Confiscated traps are either disposed of at area landfills or sold back to the identified trap owner following a guilty plea to the citation.

Atlantic Coast

A pilot fishing gear recycling program, supported through the NMFS Marine Entanglement Research Program, was proposed during the mid-1990s for the south Atlantic states of North Carolina, South Carolina, and Georgia (Spence, 1995). After preliminary focus meetings were held in 1994 to determine whether commercial fishing gear was a solid waste issue and if collection and recycling efforts were feasible, the program was implemented in 1995 in South Carolina and North Carolina. An independent directed derelict fishing gear cleanup took place in Georgia.

North Carolina

A comprehensive and coordinated commercial fishing gear recycling program was implemented in North Carolina in early 1995 (Burgess, 1995). An extensive media campaign was conducted to educate all concerned parties and the general public. The positive aspects of trap removal were emphasized rather than the negative effects of derelict traps. Dumpsters were placed at convenient sites identified with special blue highway signs. Traps were collected during a two-week seasonal closure (late January to early February) when fishermen were required to remove all traps from the water. Approximately 4,600 traps (22 tons) were collected; these traps represented less than 2% of the 250,000 traps reportedly replaced annually. The collection program was later discontinued, although the two-week seasonal closure to allow the removal of abandoned or lost traps is still in effect.

South Carolina

Dumpsters were placed in three locations in Beaufort County, South Carolina in 1995. No data are available on the number of recycled traps. The project was later terminated.

Georgia

The Georgia Department of Natural Resources, the NMFS, Georgia Sea Grant, representatives of the crabbing industry, private recyclers, and waste haulers cooperated to establish a pilot crab trap recycling program. Crab fishermen disposed of traps in receptacles located in each coastal county. The receptacles were made available during the spring and fall for a total of four months in 1996. Fishermen were instructed to remove the bait, weight, rope, and float and flatten the trap before placing it in a receptacle. The project was not continued.

General Marine Debris Cleanups

Several recent general marine debris clean-up programs were completed in Alabama (Leslie Hartman, personal communication). In 1998 and 1999, 356 derelict traps were removed during the annual Coastal Clean-ups.

The Center for Marine Conservation coordinated a nationwide volunteer effort to gather and categorize marine debris found on beaches in each coastal state (Hara, 1990). In 1988, fishing or boating gear comprised 6.1% of the total by number; included were 1,281 metal crab or fish traps.

RECOMMENDATIONS

Rates of Trap Loss and Abandonment

Intentional and inadvertent loss of actively-fished traps can be reduced with management measures that mandate the removal of unfished or unfishable traps from the water, decrease the probability of buoy or line contact with vessels, and minimize buoy or line deterioration.

1. Require crab fishermen to retrieve and to properly dispose of unfishable traps. Economic measures may be implemented that discourage illegal abandonment and encourage proper disposal of traps.
2. Adopt buoy and line specifications to minimize the number and impact of vessel encounters with crab gear. Large solid buoys, nonfloating buoy lines, and minimum buoy line size should be required; plastic jug buoys, which are prone to cracking and sinking, should be prohibited.
3. Mandate trap tags or buoy markings to facilitate enforcement of trap abandonment regulations.
4. Encourage fishermen to maintain buoys and lines as traps age.
5. Encourage communication and positive interaction between user groups in areas where fisheries or other activities overlap.
6. Consider programs that reduce the number of traps in the fishery (trap limits, limited entry).
7. Develop educational programs to inform crab fishermen and other user groups about problems associated with derelict traps and ways to reduce trap loss. Informed fishermen may be more likely to comply with regulations and to exercise better maintenance of fishing gear. With education, other user groups may exercise more caution around traps to reduce the inadvertent severing of buoy lines.

Derelict Trap Removal Programs

Derelict trap removal programs have been initiated in several states. Any trap removal program must:

1. Derive an inclusive definition for a derelict trap that addresses the variety of trap conditions which range from new to degraded, buoyed or unbuoyed, fishable or unfishable.
2. Modify existing regulations concerning crab trap possession to allow the removal and transportation of derelict traps by individuals other than the trap owner.
3. Develop specific guidelines for removal of derelict traps and options for disposal that are environmentally sound.
4. Publicize and promote programs that address derelict trap removal.
5. Encourage cooperative efforts among individuals, groups, organizations, and agencies to promote the removal of derelict traps.

Ghost Fishing Mortality

Ghost fishing mortality of blue crabs and bycatch can be reduced by adoption of several measures.

1. Equip traps with escape rings.
2. Install degradable wall panels or tie-down straps in traps to reduce the length of the ghost fishing period.
3. Install terrapin excluder devices in trap entrance funnels to reduce catch of diamondback terrapins and possibly other bycatch.

SUMMARY OF EXISTING STATE REGULATIONS

The status of selected measures to facilitate derelict trap removal programs or to reduce trap loss or ghost fishing mortality rates is summarized as follows:

Rate of Trap Loss

Removal of unfished traps: AL, LA, TX (after 30 days)
Removal of old, unfishable traps: LA, TX (after 30 days)
Minimum buoy size: FL, AL, MS, LA, TX
Solid buoys: FL, LA
Prohibition of plastic bottle buoys: FL, AL, LA, TX
Nonfloating buoy line: LA
Area closures: AL, MS, LA, TX
Trap limits: TX
Limited entry: TX
Trap tags/buoy marks: FL, AL, MS, LA, TX

Ghost Fishing Mortality

Escape rings: FL, LA, TX

Minimum mesh size: FL
Degradable panels: FL, TX

Derelict Trap Removal Efforts

Allowing nonowners to transport traps: LA (shrimp fishermen only)

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