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# Ghost fishing activity in derelict blue crab traps in Louisiana

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ABSTRACT

Derelict crab traps impact the coastal ecosystem through continued catch of target species and species of conservation, economic, or recreational importance. During volunteer-supported crab trap cleanups in 2012 and 2013, we quantified ghost fishing activity in derelict crab traps in coastal Louisiana through a citizen scientist program. Volunteers removed 3607 derelict traps during these events, and over 65% of traps analyzed by citizen scientists were actively ghost fishing. Additionally, volunteers identified 19 species enmeshed in derelict traps, including a combination of fresh and saltwater species. We also detected a significant difference in the number of blue crab in actively ghost fishing derelict traps across removal locations with estimated catches varying between 2.4 and 3.5 crabs/trap. Our instantaneous estimates of ghost fishing activity are greater than those previously thought in Louisiana, further justifying current derelict crab trap prevention and removal extension and outreach programs in Louisiana and throughout the Gulf of Mexico.



## 1. Introduction

The introduction of wire traps in the mid-20th century greatly increased the commercial and recreational harvest of blue crab (*Callinectes sapidus*, Rathbun, 1896) in the Gulf of Mexico (Guillory, 1993; Guillory et al., 2001b). However the increased use of new gear has resulted in derelict (i.e., no longer tended to by fishermen) gear such as traps, lines, and buoys contributing to the problem of marine debris (Coe and Rogers, 1997; Good et al., 2010; Havens et al., 2008). Blue crab traps become derelict through a variety of means: storm activity, use of inferior rope and floats, vandalism, improper disposal, and vessel propellers severing buoy lines (Havens et al., 2008). The derelict gear can pose a variety of harms to the coastal ecosystem through continued catch of the target species (Breen, 1987; Havens et al., 2011), bycatch of species of conservation, economic, or recreational importance (Udyawer et al., 2013), and user group conflicts (Havens et al., 2011).

For many crustacean species including blue crab, capture in derelict trap can result in increased predation, cannibalism, starvation, loss of appendage, and a general decline in health (see review in Maselko et al. (2013)). Whereas derelict crab traps are no longer baited by fishermen, continual mortality of organisms within these traps causes an increase in fishing mortality through the phenomenon of ghost fishing with dead organisms then serving to attract more individuals (Breen, 1987). Additionally, if empty, organism may seek shelter in a trap and may become entrapped resulting in ghost fishing. In Louisiana, estimates of ghost fishing provided by Guillory (1993) suggested that each derelict trap contributed to the mortality of 26 blue crabs annually. When these mortality estimates are extrapolated to the number of traps lost annually in Louisiana coastal waters (e.g., 257 per fisherman; Guillory et al., 2001a), a significant effect on the blue crab fishery is realized with approximately 1816 active commercial crab fishermen, (Louisiana Department of Wildlife and Fisheries, 2011; West et al., 2011). Consequently, 12 million crabs or 2 million kilograms of potential harvest may be lost to ghost fishing mortality representing 10% of the annual landings reported in Louisiana in 2012 or about US$4 million (Louisiana Department of Wildlife and Fisheries, 2013). Additionally, in 2012, approximately 6000 recreational crab trap licenses were sold to Louisiana residents, and no estimates exist on loss rate or potential ghost fishing impact related to recreational trapping (Louisiana Department of Wildlife and Fisheries, 2012).

While the effect has not been quantified in Louisiana, other marine species of recreational, commercial, and conservation importance also endure problems associated with derelict traps. Fish and invertebrate species such as spotted sea trout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), and stone crab (*Menippe adina*) have been observed in derelict crab traps as well as diamond back terrapins (*Malaclemys terrapin*) and river otter (*Lontra canadensis*) (Guillory et al., 2001b; Harden and Williard, 2012; Havens et al., 2008; Radzio et al., 2013).

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Traps caught in shrimp fishing gear can clog turtle excluder devices preventing catch of shrimp and escape of turtles, and this furthers conflicts between shrimp and crab fishermen (recreational and commercial) (Guillory et al., 2001a,b). Additionally, derelict traps serve as an underwater hazard for boaters especially if the buoy line has been severed leading to additional economic losses (McIlgorm et al., 2011).

Although design modifications (e.g., biodegradable panels; Bilkovic et al., 2012) and best management practices related to gear maintenance have been suggested to reduce the impact of derelict traps on marine ecosystems, removal of derelict traps is the only absolute solution. Since 2004, the Louisiana Department of Wildlife and Fisheries (LDWF) has directed largely volunteer-supported derelict trap removal efforts through the authority granted by Louisiana R.S. 56:322 (N). In Louisiana, derelict trap removal by anyone other than the owner can only occur during a specified 10 day fishery closures between February 1 and March 31. During these closures, designated areas are legally closed to crab fishing, and all traps remaining in these zones are considered derelict and subject to removal. However, volunteer support and therefore effective derelict trap removal efforts declined by 2009, and as such LDWF partnered with the Louisiana Sea Grant College Program (LSG) in 2012 to create a new cleanup event to encourage greater volunteer participation called the 'Crab Trap Rodeo.' In addition to augmenting the removal of derelict crab traps, the increased volunteer support at these Rodeos created a unique opportunity to have citizen scientists collect ghost fishing data from derelict crab traps in 2012 and 2013.

Citizen scientists have participated in other marine debris projects quantifying types, impacts, and other aspects of marine debris (Hidalgo-Ruz and Thiel, 2013; Ribic et al., 2012). Utilizing volunteers to act as citizen scientists is beneficial in many respects. Primarily, using volunteers as citizen scientists allows for much more information to be collected when resources are limited (Bonney et al., 2009; Hidalgo-Ruz and Thiel, 2013; Silvertown, 2009). Because derelict traps can only be removed during the closures, time is a limiting factor with respect to data collection. However, because the overall purpose of the closures, and therefore, the volunteer supported cleanup events is to remove as many traps from Louisiana's waterways as possible, the opportunity exists to collect a large amount of data related to derelict crab trap prevalence and ghost fishing activity. Additionally, the incorporation of citizen scientists in the derelict crab trap removal events engages concerned volunteers and encourages environmental stewardship. Therefore, our goal was to quantify ghost fishing in derelict crab traps during trap removal events (i.e., Rodeos) using citizen scientists and scientist volunteers. The information collected will help guide blue crab fishery management decisions in Louisiana. Our objectives were to (1) describe the condition of derelict traps in Louisiana, (2) provide baseline data regarding the species captured by derelict traps, (3) provide estimates of the ghost fishing rates of derelict traps, and (4) provide recommendations for locations of future derelict crab trap removal events given specific management or conservation goals.

## 2. Methods

### 2.1. Study location and design

The locations of the 2012 and 2013 blue crab fishery closures were predetermined by LDWF personnel during a pre-assessment of areas based on need and feasibility (e.g., access and shallow water allowing removal of visible traps). Closures had clear GPS boundaries, and maps were provided to all volunteers. Blue crab fishery closure areas encompassed 2291 $km^2$ of typical cord grass (*Spartina* spp.) dominated salt marsh habitats in southeastern Louisiana (Table 1). Specifically, closures in 2012 covered the marshes north of Breton Sound (Delacroix closure; Fig. 1) and Terrebonne Bay (Cocodrie closure) while closures in 2013 covered Breton Sound (Pointe a la Hache closure) and the marshes south of Lake Borgne (Hopedale closure). Rodeo dates were selected by LSG based on feasibility within the February 1–March 31 allowable timeframe and low tides making many trap visible. Rodeos were held on 25 February, 3 March, and 17 March 2012 and 16 February, 23 February, and 9 March 2013 from 0830 h. to 1600 h. Volunteers were recruited through regional outreach events and radio and print advertisements. Although Rodeos were held on Saturdays to encourage greater volunteer participation rates, removal of derelict traps continued throughout the closure periods and was primarily facilitated by LDWF personnel and anonymous citizens. Volunteers were instructed to remove all visible derelict traps and to occasionally dredge the seafloor when possible. All traps returned to the collection sites were crushed with a hydraulic press and sent to appropriate disposal and recycling facilities per Louisiana R.S. 56:322 (N).

### 2.2. Sampling protocol

According to Bonney et al. (2009), obtaining practical citizen scientist data requires providing a clear protocol, simple and easy to understand data collection forms, and support. The protocol we provided to citizen scientists was designed with consultation from other state agencies that have conducted derelict crab trap removal programs and various participants. We reduced the extensive list of potential variables related to derelict trap condition and ghost fishing activity such that citizen scientists only had to complete one simple data collection form per trap (Cohn, 2008). One form per trap was determined to be the best for volunteers based on pilot trials with undergraduate students and prioritized the collection of the most relevant data. Quality control is also an important aspect of citizen scientist programs (Hidalgo-Ruz and Thiel, 2013). Because volunteers were aboard watercraft far from shore during data collection and all live animals recorded as enmeshed in traps were released when derelict traps were removed from the marsh, we initially asked volunteers to also take photos of each trap in anticipation that we would use these photos as a quality control check. Additionally, in both years volunteers brought back some species to the dock for assistance in species identification.

As feasible, we recruited one volunteer on each boat to record data from derelict traps that were removed by the team of volunteers on the boat. Every cleanup team did not collect data as the overall goal of the event was to remove traps. For willing volunteers, we provided a binder containing data collection forms and a species identification chart. We instructed volunteers how to record trap integrity (e.g., intact or collapsed), mesh type (square or hexagonal), and number of individuals (live or dead) of each species encountered in each derelict trap. If clear identification of dead individuals was not possible, volunteers were instructed to identify the carcasses to the lowest taxonomic level possible (e.g., bird, mammal). We instructed volunteers to release all live organisms immediately after data collection from each derelict trap. We collected datasheets as boats returned to the trap collection site. Onshore, we recruited a volunteer to count all traps that came off boats.

### 2.3. Data analysis

We summarized data collected from derelict traps for each Rodeo. If the trap had at least one live or dead enmeshed organism, we designated a trap as ghost fishing. We evaluated the differences in the proportion of ghost fishing traps across locations and mesh