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Short communication

A cage release method to improve fish tagging studies

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ABSTRACT

The return and survival of tagged fish to their depth of capture has proved difficult due to barotrauma and predation in previous telemetry studies. Tagging stress can slow and disorient the fish upon release, and reduce the ability to return to depth, relocate their home habitat site, and evade predators. To reduce these initial tag and release artifacts we designed and tested a remotely opening cage for use with reef fish in the northern Gulf of Mexico. Our objectives were to quickly return transmitter tagged fish to depth (20–30 m) in close proximity (<10 m) to their capture site, and to increase survival by providing predator protection during an initial recovery period. This cage release method proved successful for both red snapper (*Lutjanus campechanus*; $n = 62$ out of 71, 87%) and all gray triggerfish (*Balistes capriscus*; $n = 24$) that were tagged and released on artificial reefs. All tagged fish were released from November 2012 to September 2014, no initial tag induced mortalities were observed, and after tagging fish were successfully tracked for extended periods (for the entire 2 year study period).

1. Introduction

In both conventional and acoustic tagging studies, increased stress, emigration, and mortality of fish after tag and release has been reported for several different release methods (Szedlmayer, 1997; Starr et al., 2000; Humston et al., 2005; Szedlmayer and Schroepfer, 2005; McDonough and Cowan, 2007; Westmeyer et al., 2007; Topping and Szedlmayer, 2011b, 2013; Piraino and Szedlmayer, 2014). Immediate and prolonged tagging mortalities due to barotrauma and stress from the tagging procedure have been examined in multiple species (Parrish and Moffitt, 1992; Davis, 2002; McGovern et al., 2005; Jarvis and Lowe, 2008; Diamond and Campbell, 2009; Pribyl et al., 2009; Campbell et al., 2010; Sumpton et al., 2010; Hannah and Rankin, 2011; Hannah et al., 2012; Pribyl et al., 2011). These studies showed increased stress due to the rapid change in pressure, substantial changes in water and air temperature, fish handling, and time spent on the surface (Parrish and Moffitt, 1992; Davis, 2002; Jarvis and Lowe, 2008; Diamond and Campbell, 2009; Campbell et al., 2010).

While the effects of barotrauma stress have been examined, the effects of different release methods on tagged fish were rarely reported. Methods of release include surface release (Fable, 1980; Szedlmayer and Shipp, 1994; Gitschlag and Renaud, 1994; Patterson et al., 2001; McDonough and Cowan, 2007; Hannah and Rankin, 2011), drop weights (Szedlmayer and Schroepfer, 2005; Topping and Szedlmayer, 2011a, 2011b; Piraino and Szedlmayer, 2014), underwater tagging and release by SCUBA divers (Tong, 1978; Gitschlag, 1986; Parrish and Moffett, 1992; Szedlmayer, 1997; Starr et al., 2000; Sigurdsson et al., 2006), surface tagging and underwater release by divers (Szedlmayer, 1997; Nemeth et al., 2007), and surface tagging, caging, and delayed release by divers (Piraino and Szedlmayer, 2014).

In most cases, studies of release methods have not considered predator protection, but have focused on cost, time, training, and fish condition (*e.g.*, surface release, drop weights, underwater tagging). For example, the drop weight release method was quick, inexpensive, and returned fish to their depth of capture (Szedlmayer and Schroepfer, 2005; Topping and Szedlmayer, 2011a, 2011b; Piraino and Szedlmayer, 2014). However, during descent tagged fish were not protected against predators. This protection may be extremely important following tagging, because even fish with little sign of barotrauma can still have loss of equilibrium and reduced mobility (Tytler and Blaxter, 1977; Gitschlag and Renaud, 1994; Cooke and Philipp, 2004; Danylchuk et al., 2007; Jarvis and Lowe, 2008; Campbell et al., 2010; Raby et al., 2013). The early escape of disoriented fish during decent at mid-depths can substantially increase emigration and predation. In an effort to reduce predation effects, cage release methods were tested for transmitter tagged red snapper (*Lutjanus campechanus*; Piraino and Szedlmayer, 2014). The cages were lowered to the bottom near the capture reef site, and after ~2 h, SCUBA divers opened the cage

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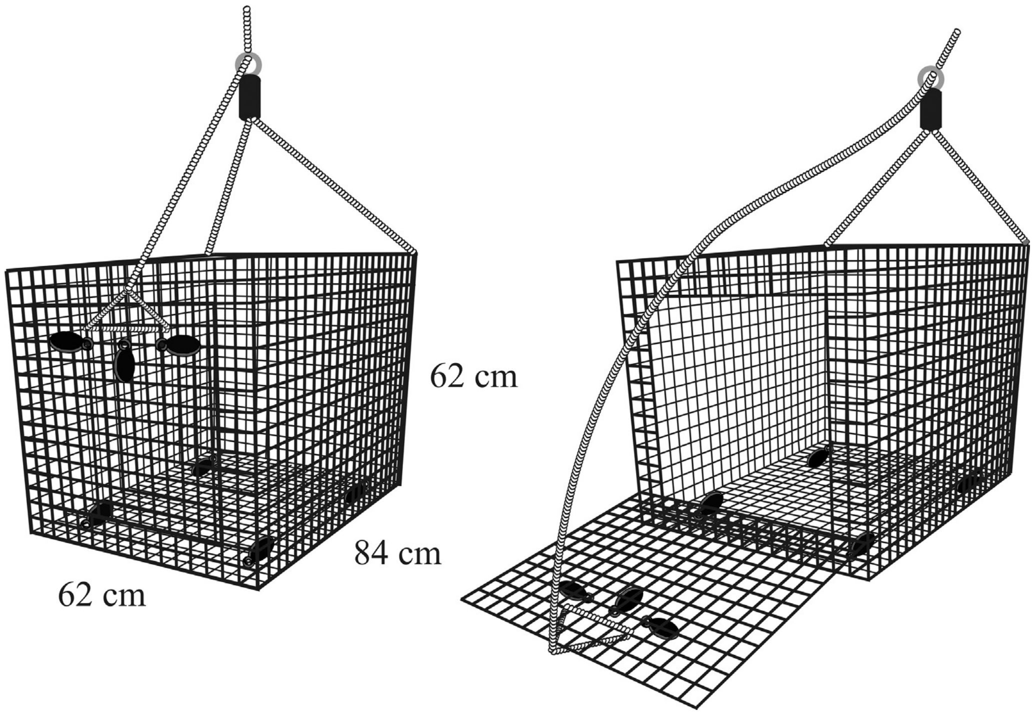

Fig. 1. Vinyl coated wire mesh cage (16 gauge wire, 3.8 cm mesh size) with individual 0.25 kg weights fastened to the bottom of the cage and to the outside of the cage door. A nylon rope (1.5 cm diameter) is attached to the inside of the door and runs through a stainless steel ring over the top of the cage. This ring is attached to a small buoy (black; 10 cm) to keep the rope suspended above the cage.

doors on the bottom and released the fish close (2–3 m) to the reef. This cage release method required more time and training, but successfully reduced tag induced emigrations and predation mortality of tagged red snapper from 85% to 8%.

A release method that provides protection from predators is especially important in regions with a high abundance of predators. In recent years shark abundances have apparently increased based on SCUBA diver encounters 20–50 km south of Dauphin Island, AL. For example in 2014, SCUBA diver fish surveys on artificial reefs had frequent encounters (~45%) with large (>2 m) Carcharhinid sharks, while past diver surveys (>1000) over 20 years prior to 2010 only had rare (<10) shark encounters (unpublished data Szedlmayer, S.T). These larger sharks include many species that commonly occur in our study area (10–40 m), for example, blacktip shark (*Carcharhinus limbatus*), bull shark (*C. leucas*), sandbar shark (*C. plumbeus*), spinner shark (*C. brevipinna*), nurse shark (*Ginglymostoma cirratum*), scalloped hammerhead (*Sphyrna lewini*), and tiger shark (*Galeocerdo cuvier*; Drymon et al., 2010). Thus, in our study area with substantial shark populations, the use of SCUBA divers to release tagged fish from submerged cages became difficult due to safety considerations.

In the present study, we further examined cage release methods to reduce predation and tag induced early emigrations with an untested species, gray triggerfish (*Balistes capriscus*) as well as continued studies with red snapper. Importantly, we developed a remote release method that eliminates the use of SCUBA divers and the risk of shark encounters.

2. Methods

The cage and release method was tested from November 2012 to 2014 on transmitter tagged red snapper and gray triggerfish 20–50 km south of Dauphin Island, AL in the northern Gulf of Mexico. Tagging methods followed Topping and Szedlmayer (2011a,b). Temperature and dissolved oxygen levels were measured at depth prior to tagging. If the dissolved oxygen values were lower than 2.5 mg/L fish were not tagged. If surface temperatures were higher than temperatures at depth of capture we chilled both the anesthesia container and the recovery container with ice. Fish were captured by hook and line, weighed, measured, and anesthetized on the research vessel in a 70-L container of seawater and tricaine methanesulfonate (150 mg tricaine methanesulfonate/L seawater for 2.5 min). Fish were tagged internally with an acoustic transmitter and externally with an anchor tag. During the tagging procedure the swim bladder was punctured for easy insertion of the transmitter. After tagging, fish were held until they showed signs of recovery (active fin and gill movements) and then placed in the release cage. The tagging procedure was complete in <10 min.

The release cage ($84 \times 62 \times 62$ cm) was constructed of vinyl coated wire mesh (16 gauge, 3.8 cm mesh), and fastened with stainless steel connectors (Fig. 1). Four 0.25 kg lead weights were attached to the bottom corners of the cage and three weights to the cage door. A nylon rope (1.5 cm diameter) was attached to the inside of the door and passed through a stainless steel ring over the top of the cage, which allowed opening and closing of the cage door. This ring was attached to a 10 cm buoy to keep the rope suspended above the cage (Fig. 1). Initial testing without fish was observed by SCUBA divers and confirmed that the cage descended to the seafloor and opened correctly.

Once a tagged fish recovered from anesthesia it was placed into the release cage and held at the surface (1 m depth), and observed for about 10–20 s to confirm that the fish was upright and actively swimming. After confirming normal swimming behavior, the caged fish was lowered to the bottom (20–30 m). As the cage was lowered to the bottom the tension was maintained on the line to keep the release door closed. Once the cage reached the seafloor the line was released which allowed the cage door to open. The weights on the cage door passively caused the door to fall open. The cage door weights continued to keep the door open until retrieval and allowed the tagged fish to leave on its own initiative (Fig. 2). Cages