Preliminary Release Mortality of Gulf of Mexico Greater Amberjack from Commercial and Recreational Hand-line Fisheries: Integration of Fishing Practices, Environmental Parameters, and Fish Physiological Attributes

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Preliminary Report on the Release Mortality of Gulf of Mexico Greater Amberjack from Commercial and Recreational Hand-line Fisheries: Integration of Fishing Practices, Environmental Parameters, and Fish Physiological Attributes

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Introduction

Two main factors that contribute to fishing mortality of a species are the direct mortality associated with retaining a portion of the catch, as well as the mortality associated with capture and release of target or bycatch species. Catch and release mortality can be a significant source of mortality for fisheries with regulatory size limits (for reviews see Davis 2002, Bartholomew and Bohnsack 2005). This is a preliminary report based on a study that addresses release mortality of greater amberjack (*Seriola dumerili*) in the Gulf of Mexico, which is funded by a Marine Fisheries Initiative (MARFIN) grant (#NA09NMF4330147). This on-going study seeks to address gaps in our knowledge concerning relative release mortality of greater amberjack as it relates to capture depth, temperature, and other environmental and physiological factors. This preliminary report focuses on acute and longer term release mortality estimates for greater amberjack.

Methods

Greater amberjack were captured by hook and line in the Gulf of Mexico and the Florida Keys from Little Torch Key, FL, to Port Fourchon, LA. Fish were captured using both bait (pinfish, blue runner, big eye scad, shrimp, squid) or various artificial lures including diamond jigs, butterfly jigs with assist hooks, bullethead jigs, and plugs. Baited hooks and lures had either circle hooks (Owner 7/0 and 8/0, Mustad 13/0), J-hooks (4/0-9/0), or treble hooks (2/0-4/0). Various sizes of hooks were used in the study due to the differing sizes of fish being caught as well as bait or lure size. Typical bandit gear consisted of 200 lb test monofilament, with a 10 lb weight, swivel and a single 13/0 Mustad circle hook. Typical rod and reel gear consisted of a

Penn 6/0 reel with 60-80 lb monofilament, 6-16 oz of lead and an 80 lb fluorocarbon and a 7/0 – 9/0 Owner or Gamakatsu circle hook. Butterfly jigs and bullethead jigs were also used.

Research sampling of morphological and physiological correlates of release mortality:

Fishing profiles, including depth of capture, water temperature, hook-up time, ascent rate, and fight time, are currently being recorded using Sensus Ultra Data Loggers (Reefnet, Mississauga, Ontario) attached to the fishing lines for each fish captured and tagged/released. Ascent profile (depth ± 1cm), temperature (± 0.1 C), and fight time are being related to indices of health assessed at the surface (e.g., activity levels, and blood and muscle lactate), as well as subsequent survival rate, as determined by recapture of tagged and released fish. Fish are assessed for hooking site and type, depth of capture, and activity on the deck at surfacing and release. A subset of fish are sampled, when possible for fight times, handling time on deck, and blood l-lactate (Lactate Pro) and muscle l-lactate levels (Eton Bioscience). The final report for this project will include an analysis of the relative tag recapture rates based on these variables using a multivariate approach to determine the primary factors related to release survival of greater amberjack.

All fish caught were tagged with a heavy-duty dart tag (Hallprint PDA) using a stainless steel tag applicator. The tag was applied through the dorsal musculature between the pterygiophores of the second dorsal fin (Williams 1992) (www.dnr.sc.gov/marine/pub/ seascience/tagfish.html). Approximately 5% of the fish were double tagged to estimate tag loss (Gulland 1963; Seber and Felton 1981; Xiao 1999; Cadigan and Brattey 2003).

In addition to dart tagged fish, five satellite tags were deployed on greater amberjack as part of another research study (SEDAR33-DW12) and were used here to estimate longer-term release mortality. Five PSATs (x-tag, Microwave Telemetry) were attached to amberjack behind the first dorsal fin through the epaxial musculature and between the pterygiophores of the second dorsal fin and the adjacent neural spines using intramuscular tags (Floy). Large mature fish were tagged in March of 2010 off the coast of Louisiana in the NW-GULF and their tags were programmed to release on 1 April 2010. All five fish were non-lethally sexed (SEDAR33-27), as well as vented prior to release because they were captured in relatively deeper water (150-350 ft) and had turgid swim bladders.

Results

Preliminary discard/release rates and relative mortality rates:

To date, 1,550 amberjack have been captured, assessed for acute mortality, and then tagged and released. Fish ranged from 22.6 to 141.2 cm fork length (Figure 1). A total of 4 out of 1,550 (0.26%) greater amberjack suffered acute mortality (i.e., dead on deck). Three of the four dead on the deck fish were caught on “J” hooks at depths of 115-210 ft, while the forth was caught on a baited “J” at 54 ft. Additionally, 1 out of 1,550 released fish was observed to be consumed by a mako shark *(Isurus oxyrinchus)* and 3 fish were eaten by barracuda (*Sphyraena barracuda*) on release. In addition to fish observed to be lost to barracuda, an additional 2 fish were severely injured by barracuda near the boat. One fish initially caught had a healed injury consistent with a barracuda attack in which most of the epiaxial musculature behind the first dorsal fin was missing. Skin had regrown over most of the wound. To date, three greater amberjack were eaten at the surface by goliath grouper prior to our being able to remove the fish from the water for tagging purposes. On an additional occasion, three goliath grouper in excess of 1 m in length simultaneously chased one amberjack to the surface from 55 ft depth in an unsuccessful attempt to capture it. This meant that these fish volitionally followed the amberjack from the bottom to the surface.

A total of 198 of 1,550 fish have been recaptured to date (12.8% recapture rate overall) (Table 1). Eight doubled tagged fish have been recovered and all had both tags still present, indicating that tag shedding is negligible. Recapture rate varied greatly between sampling regions and was highest in the Florida Keys (South Florida) and Louisiana (Table 1). Specifics of the recapture locations and movement rates are detailed in SEDAR33-12.

Including the five reproductively mature fish that were tagged with miniature pop-up satellite tags increased the recapture rate to 13.05% (203 out of 1,555 fish in total). These large fish suffered no mortality during the month they were at large (i.e., they were "recaptured" after a month by virtue of their pop-up tags). These fish were captured in water between 150 and 350 ft depths and were vented to ensure that the fish did not remain at the surface following release, indicating 100% survival.

The length frequency of fish tagged and released was slightly skewed towards smaller fish compared to the length frequency of fish released and later recaptured (Figure 2). When the length frequency for released fish was truncated based on the minimum size limit for the majority of the releases (approx >72 cm FL), there was still a slight skewing towards recapturing the larger amberjack that were initially released and the recapture rate was lower for smaller amberjack that had been released (Figure 3). We will be exploring this relationship further through multivariate analysis by including depth of capture as well, since it may be a confounding factor in this relationship.

Effects of Capture

Only 4 of 1,555 fish captured (0.25%) had everted stomachs. One of these fish was caught at 54 ft, one at 100 ft, and two at 312 ft. The latter two fish were caught on commercial bandit gear (2 of 285 fish caught on bandit gear, or 0.7%). Eye damage was also observed in 2 of 1,555 fish (0.13%), a result of being hooked in the eye. Separation of the cornea from the overlaying dermal layer giving the eye a crystalline appearance or popeye was not observed at all during this study. This is of interest because like many fish possessing a pseudobranch, choroid rete and the Root effect in the blood haemoglobin, it is likely that oxygen levels are maintained near saturation in the tissues of the eye and should thus be subject to rapid decompression (due to ascent) and barotrauma. However, pathologies of the eye due to rapid decompression of greater amberjack were not observed in the study. This is in stark contrast to red snapper (*Lutjanus campechanus*) where pathology of the eye was a primary correlate with hook and release mortality for a recent study on red snapper (Diamond and Campbell 2009).

One factor that appears to contribute to the lack of problems with barotrauma for greater amberjack appears to be buttressing of the swimbladder by the ribs, which are substantial and in direct contact with the swimbladder, thus providing support. Like all perciform fishes, carangid fishes such as *Seriola dumerili* display a physoclistous condition of the swimbladder. Thus, connection of the esophagous to the swimbladder via a *ductus pneumaticus* is present only in the larval stage. One feature of the greater amberjack and the Samsonfish (*Seriola hippos*) of the southern hemisphere is that they are capable of self-ventilation. Ascending greater amberjack were observed extruding bubbles of air from their gill chambers. We observed in greater amberjack that the swimbladder is in close contact to the supracleithral/post-temporal bones and only a thin layer of skin is present in this region. From the inside of the swimbladder, a single small tear of 2 – 5 mm was observed in fish that extruded bubbles on ascent (Figure 4). Fish that did not extrude bubbles had an intact swimbladder that could be excised intact (and still inflated) from fish *post-mortem,* indicating that the swimbladder had not ruptured during ascent. The observation of the tear at the supracleithral/post-temporal bones, and the intact and inflated swimbladders, supported the hypothesis that amberjack were not venting excess gas via a persistent *ductus pneumaticus,* which should not exist for an adult perciform. Therefore, greater amberjack appear to have a self-venting mechanism whereby they are able to "off-gas" or "blow bubbles" when ascending, on their own accord. The percentage of fish blowing bubbles on ascent increased significantly with capture depths >50 ft ($\chi^2 = 192.09$, P = 0.0001, 4 df), with almost all fish self-venting when captured in >200 ft of water (Figure 5).

Depth of initial capture versus recapture rate of greater amberjack (Figure 6) showed that the recapture rate differences were significant based on 50-ft depth categories ($\chi^2 = 29.7499$, P = 0.001). The greatest chi-square deviations were due to the 50-100 ft and the >200 ft depth categories and removal of these depth categories from the contingency table indicated that the remaining depth categories had similar proportions of tagged fish recovered ($\chi^2 = 3.2266$, P = 0.5206). However, the difference in the tagged versus recovered fish from >200 ft was due to percent recaptured being <u>greater than</u> the percent of amberjack initially tagged from depths >200 ft. This indicated that greater amberjack were not suffering increased release mortality with increasing depth of capture. However, fish captured and released at depth had turgid swimbladders (Figure 7) and were therefore vented (Figure 8) prior to their release. The proportion of fish requiring venting increased appreciably with depth with the majority of fish in depths greater than 250 ft requiring venting. Therefore, the caveat of this analysis currently is that the absence or presence of venting the fish may be confounding the interpretation and we are now working on a multivariate approach to the analysis. This is of concern because, overall, 17.2% of vented fish have been recaptured versus 9.9% of unvented fish. Fish released without venting are typically captured in shallower water and do not appear to have any external barotrauma injuries and have no difficulty re-submerging. There is therefore likely a depth threshold with the self-venting mechanism where after a certain depth, fish benefit by venting.

The occurrence of self-venting in the majority of greater amberjack caught in water >50 ft, in combination with the survival of large fish captured at relatively deep depths when vented, indicates that a slot-size limit may be a possibility for this reef fish. This could be considered as an alternative management strategy given that the sex ratio is skewed towards females for fish >1 m (SEDAR33-27).

References

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Table 1. Total number of greater amberjack (*Seriola dumerili*) tagged by sampling region and the percentage that were recaptured (n = 198)

	Sampling Region			
	South Florida	West Florida	North Florida	Louisiana
# Tagged	259	549	457	285
% Recaptured	25.10	7.65	7.66	19.65

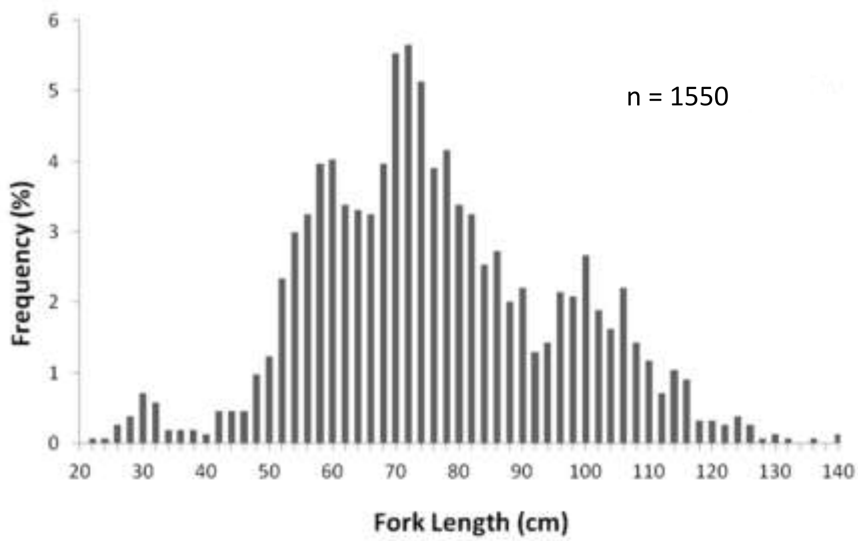

Figure 1. Length frequency distribution for greater amberjack tagged and released.

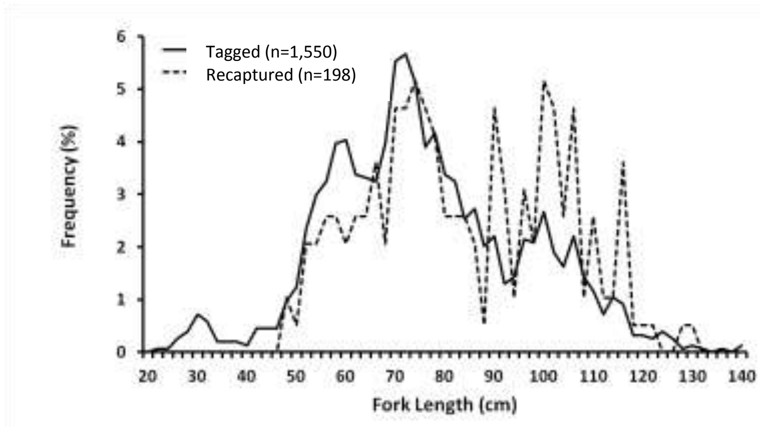

Figure 2. Length frequency distribution for greater amberjack tagged and released (solid line) and later recaptured (dashed line).

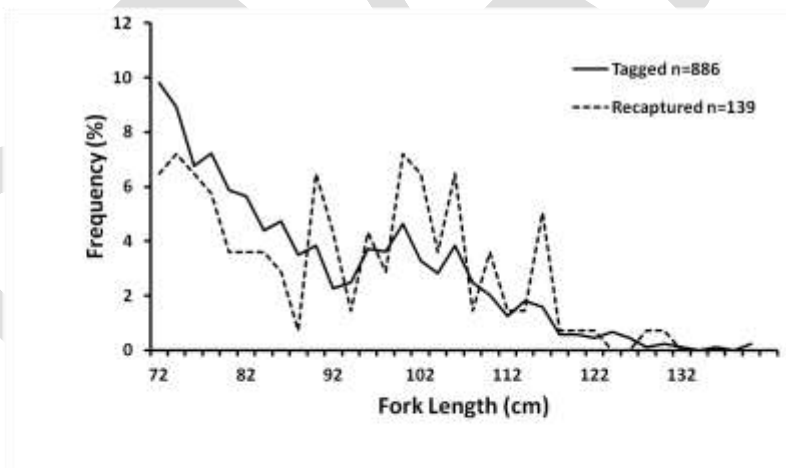

Figure 3. Length frequency distribution for greater amberjack tagged and released (solid line) and later recaptured (dashed line) for fish released that were ≥72 cm FL.

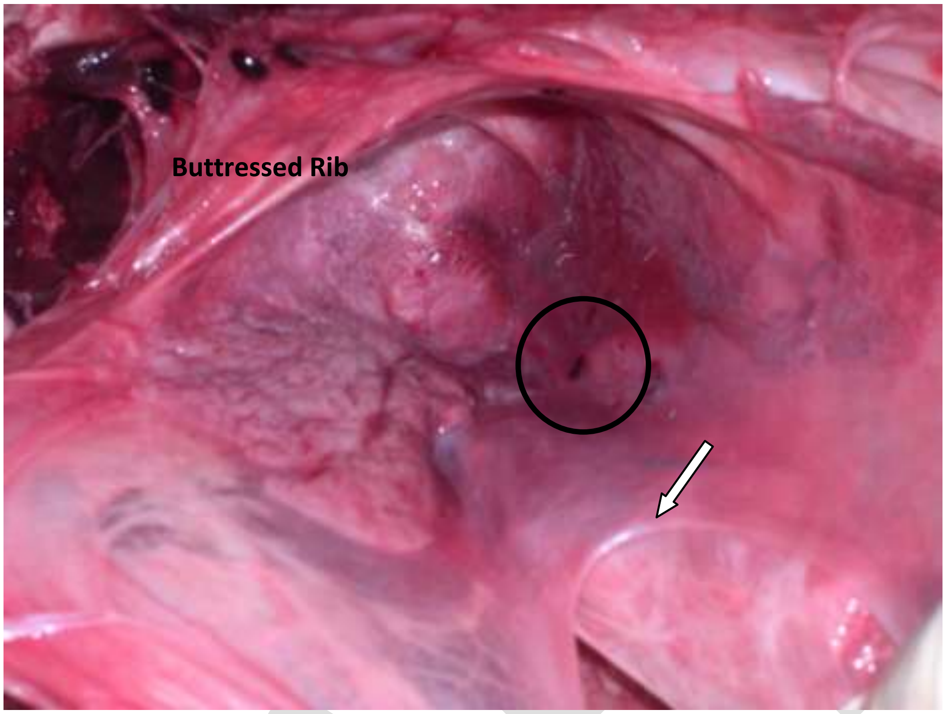

Figure 4. Inside view of the anterio-dorsal portion of a swimbladder from greater amberjack that self-vented on ascent, showing the tear in the tissue in anterior portion of the swimbladder at the supracleithral bone (enclosed by the circle). This is the source of gas bubbles coming out of the operculum of fish being brought to the surface. The relaxed edge of the sphincter muscle of the ovale is indicated by the white arrow. In physoclistic fish, this sphincter is typically contracted in a neutrally buoyant animal to prevent oxygen from being resorbed into the bloodstream from the gas bladder. One of the strong buttressing ribs of the thoracic region is labelled. Photo by D. Parkyn.

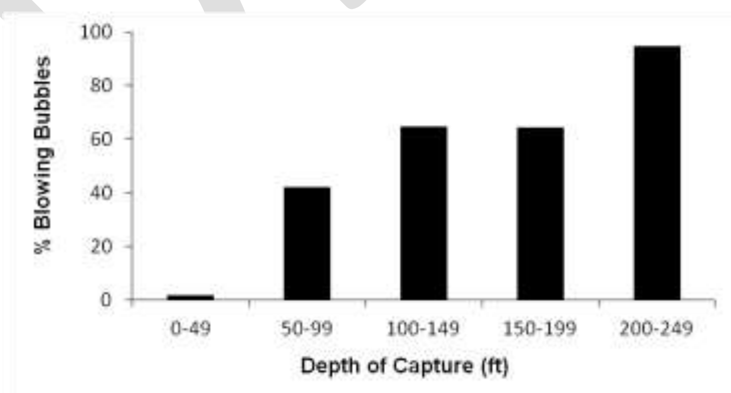

Figure 5. Percentage of greater amberjack self-venting by "blowing bubbles" as a function of capture depth (n=419 fish).

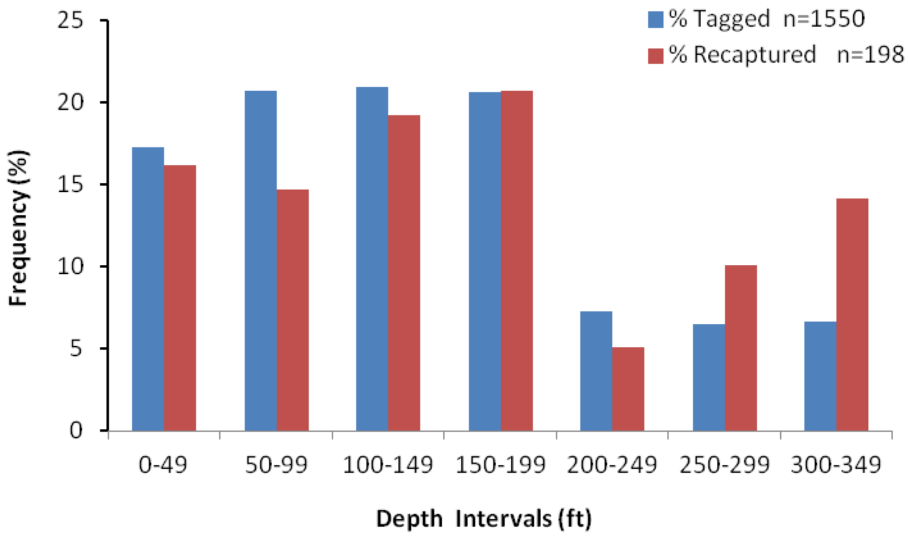

Figure 6. Frequency of tagged-and-released versus recaptured greater amberjack based on depth of initial capture.

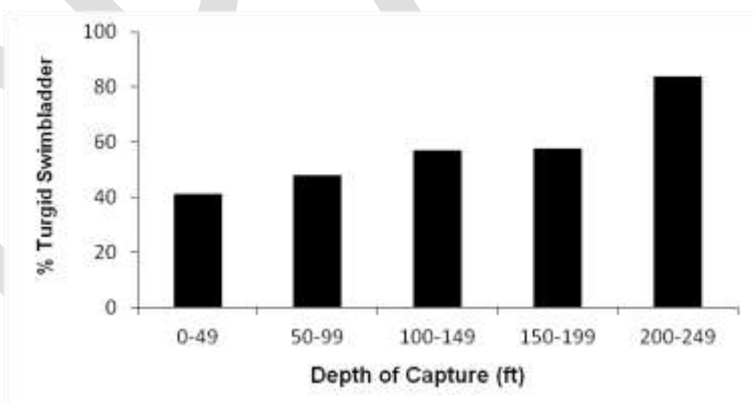

Figure 7. The percentage of greater amberjack landed with turgid swimbladders.

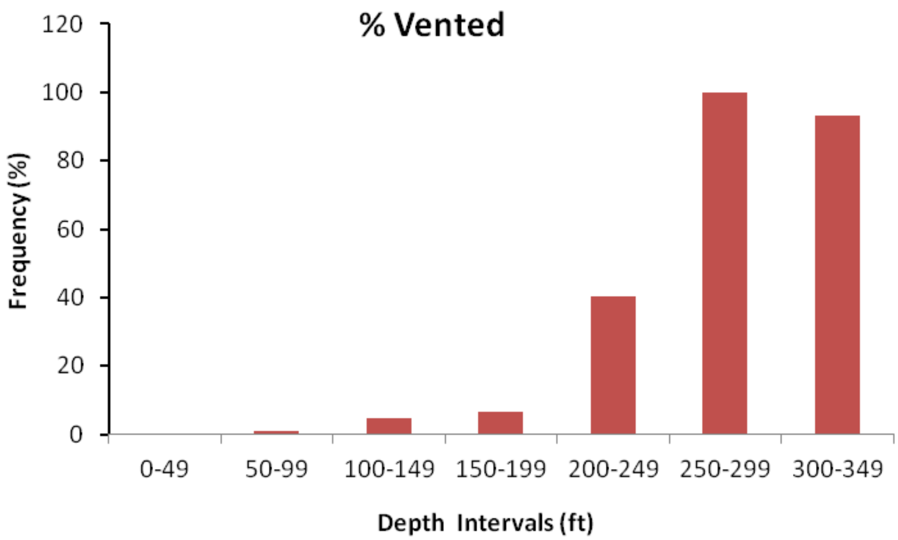

Figure 8. Frequency of captured greater amberjack that were vented during the study by 50-ft depth interval. This indicates almost all fish caught over 250 ft required venting.