Physiological Recovery of Bonefish (*Albula vulpes*) to Multiple Catch and Release Angling Events

Robert Zintl, Alex Ulm, Jon Charette, Sam Palmisano and Cam Risinger

Advisors: Georgie Burruss, Dr. Aaron Shultz

Introduction

Bonefish (*Albula vulpes*), a species of marine fish, inhabit the shallow flats and mangrove creeks of the Bahamian Archipelago (Danylchuk et al. 2007). Commonly predated on by great barracuda and lemon sharks, bonefish are an important mesopredator and benthic feeder, stirring settled nutrients back into the water column and regulating small invertebrate populations. Economically, bonefish are a commonly targeted sportfish due to their wariness and powerful swimming abilities when hooked. As of 2009, the recreational catch-and-release bonefish industry generates more than $141 million dollars annually in the Bahamas (Fedler 2010). Anecdotal evidence provided by local guides suggests there is increased fishing pressure on the creeks of Eleuthera. This may result in changes in the susceptibility of bonefish to being caught multiple times, an experience which could potentially be physiologically harmful to the fish and impact its recovery. Previous studies have shown that capture is physiologically harmful to fish, particularly in conjunction with poor handling practices (Suski et al. 2007). With increased fishing pressure, there is a possibility that fish are being caught more than once. This disturbance can be measured using static respirometry. Standard Metabolic Rate (SMR), the lowest metabolic rate that the fish requires to survive, can be used as a baseline for physiological disturbance. Excess Post-Exercise Oxygen Consumption (EPOC) can be used to quantify the physiological disturbance (Murchie et al. 2011). The outcomes of this study will provide data on the fishing pressure in Southern Eleuthera and indicate the physiological response of bonefish to multiple simulated angling events.

The purpose of this study was to investigate the behavioral and physiological responses of bonefish to multiple catch and release angling events, as well as to collect baseline data on fishing pressures on the flats and tidal creeks of South Eleuthera, The Bahamas.

Methods

Study Location, Fish Collection, Fishing Pressure

Bonefish are collected in tidal creeks and flats surrounding Cape Eleuthera by seining (Fig. 1). A large net is placed across a creek (Fig. 2), and the fish are ushered towards the net and captured using hand nets. Three to five fish are transported back to the wet lab at the Cape Eleuthera Institute. During fish collection and angling the total number of anglers are recorded along with angling hours and fish caught.

Fig 1: Seining locations (circles denote) on South Eleuthera

Fig 2: Seine net spanning Broad Creek

Chase to Exhaustion and Respirometry

Post capture, fish recover 48 hours, and after feeding, are fasted for 24 hours (Shultz et al. 2011), ensuring accurate metabolic rate readings. Fish are then moved into a Loligo Systems static respirometry system (Fig. 3), measuring oxygen consumption rates. Each fish is tested for a 16 hour period overnight to measure SMR. The 6 lowest values are averaged to quantify the SMR of each bonefish. The fish are then transferred to a chase tank for exercise (Fig. 4). To simulate an angling event, the tail of the fish is repeatedly grabbed, resulting in burst swimming (Fig. 5, Fig. 6). This continues until the fish no longer burst swims, at which point the fish is considered exhausted. The time and distance traveled are recorded during exercise. Post exercise, the fish re-enters the respirometry chamber and EPOC is measured over the next 6-hour period (Fig. 7). EPOC is used as a proxy for physiological disturbance during recovery. The highest values from the 6 hours are recorded as EPOC. The fish is rested for 36 hours and the process is repeated. A one-way repeated measures analysis of variance test is then used to test for statistical trends in data for each fish after all four trials. After data has been collected SMR and EPOC are compared and graphed.

Fig 3: Bonefish being placed in the static respirometry chamber for EPOC

Fig. 4: Bonefish being released into the chase tank

Fig. 5: Bonefish tail grabbing simulated angling event

Results

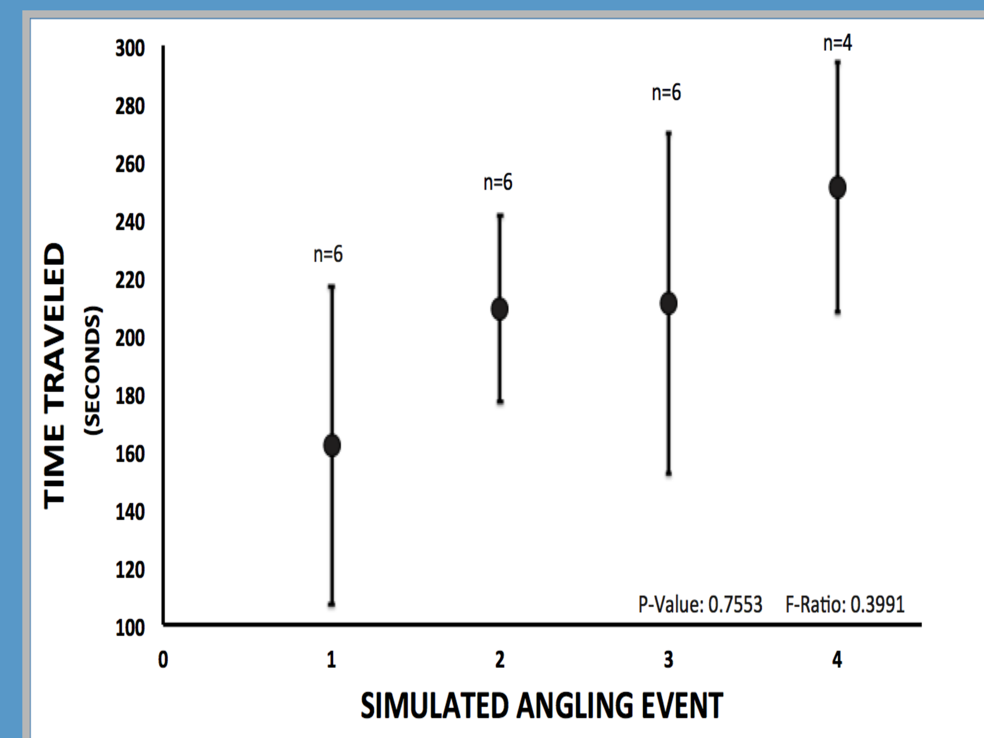

Fig. 8: Average speed maintained during chase to exhaustion trial. over a four consecutive simulated angling event with a 36 hour recovery period in-between trials (incorporation +/- standard error). The data does not show a statistically significant trend (one-way RMANOVA).

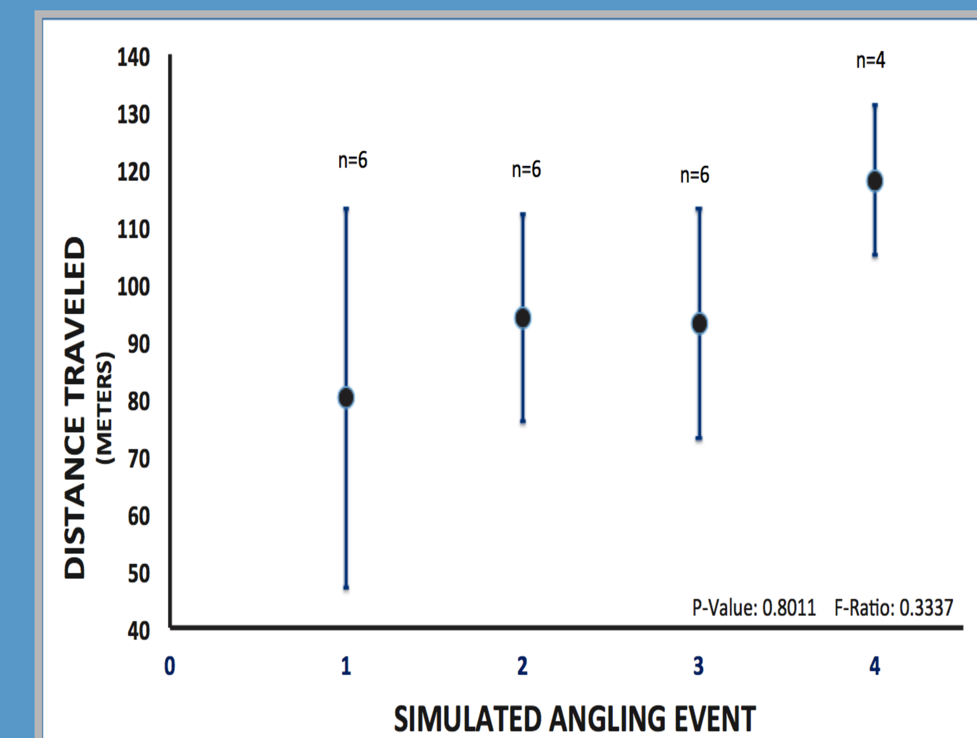

Fig. 9: Average distance traveled during chase to exhaustion protocol over a four consecutive simulated angling trials with a 36 hour recovery period in-between trials (incorporating +/- standard error). The data does not show a significant trend (one-way RMANOVA).

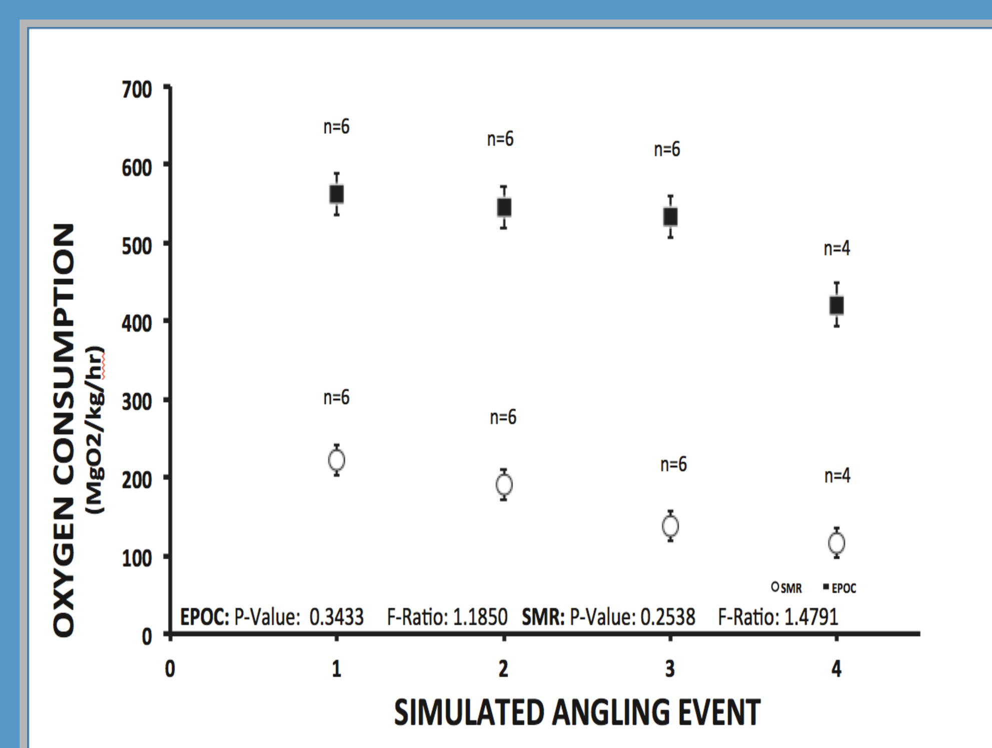

Fig. 10: EPOC represented by black squares and SMR represented by white circles over the four consecutive angling events with a 36 hour recovery period (standard error incorporated). This data does not show a statistically significant trend (one-way RMANOVA).

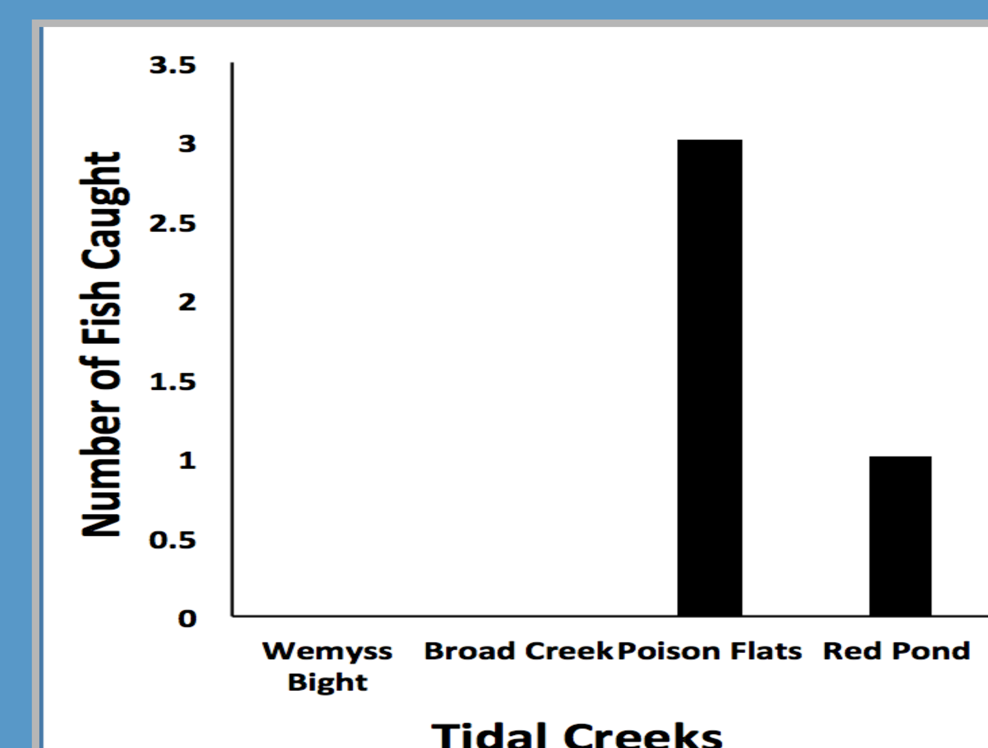

Fig. 11: Number of fish caught relating to catch per unit effort on the flats and tidal creeks of Southern Eleuthera.

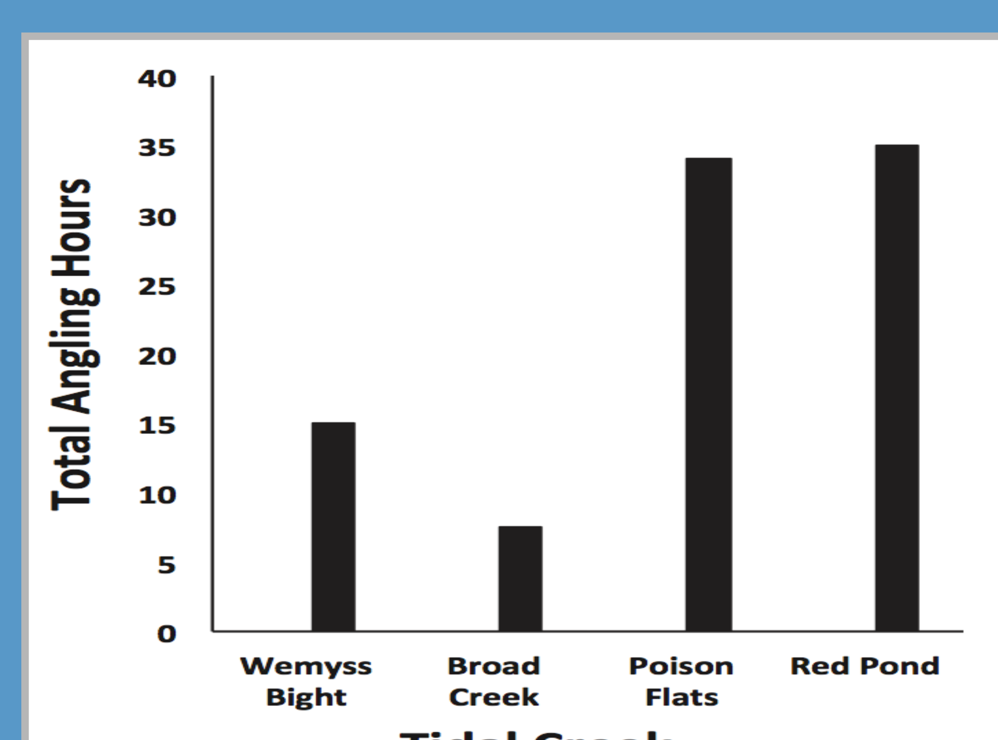

Fig. 12: Total angling hours relating to catch per unit effort on the flats and tidal creeks of Southern Eleuthera.

Fig. 13: Bonefish being hooked using a common fly pattern.

Discussion

The results of the repeated simulated angling events indicate no difference in time or distance traveled for fish during each subsequent event (Fig. 6). Standard Metabolic Rate (SMR) and Excess Post-Exercise Oxygen Consumption (EPOC) do not differ significantly after repeated simulated angling events. Four repeated simulated angling events do not have significantly different physiological effects on bonefish in the 12 day testing period. Best handling practices were adopted throughout this experiment and no fish were exposed to air or handled roughly during the testing period. Fish handled roughly or air exposed during each repeated simulated angling event could alter their physiological reaction and recovery from capture. However, the sample size of this study was quite low (n=6 for three simulated angling events, n=4 for four simulated angling events), and may have limited our ability to detect differences across the four simulated angling events.

Baseline data collected on fishing pressure demonstrates low fishing pressure on the flats and tidal creeks of South Eleuthera compared to anecdotal evidence of the fishing pressures Northern Eleuthera. The observed creeks have a CPUE (catch per unit effort) of 0.045 fish caught per angling hour, which is roughly one fish caught every 22 angling hours, associated with primarily novice anglers. Anecdotal evidence from local guides indicates there is higher pressure in different areas of Eleuthera. Specifically guides observed high pressure at Savannah Sound, with at least one angler per day during peak angling season. Fishing pressures should be quantified for each flat throughout the Bahamas to provide important information to local guides and regulators as to protection of the catch-and-release sportfishing industry. Increased fishing pressure leads to fish being exposed to similar common fly patterns that may result in the decreased catchability of bonefish similar to rainbow trout during peak angling season (Askey et al. 2006). Further research is needed to determine the ability of bonefish to recognize lures and, in turn, avoid hooks, which would result in a decreasing CPUE throughout peak angling season. In addition a more comprehensive collection of fishing pressures throughout The Bahamas would aid in recommendations to local anglers as well as regulators for protection of the species as a whole.

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