Using Dual-Frequency Sonar to Detect Juvenile Goliath Grouper, *Epinephelus itajara*, in Mangrove Habitats.

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Introduction

Underwater visual surveys are a minimally-invasive means of studying the distribution and abundance of juvenile (< 1 m total length) goliath grouper, *Epinephelus itajara*. This is critical to evaluate population recovery from commercial extinction and to delineate essential fish habitat. However, low visibility, especially along red mangrove (*Rhizophora mangle)* shorelines, is often limiting.

The high-resolution dual-frequency sonar (DIDSON) system is a new technology that has the potential to improve field surveys. DIDSON systems use multiple narrow hydroacoustic beams (96 at 1.8 MHz and 48 at 1.0 MHz) to produce high-resolution, nearfield image streams. They can record the shape, size and movement of targets (i.e. fish), and function under low visibility conditions (turbid water and/or night surveys). A paired DIDSON – digital underwater camera system was used to survey the mangrove shorelines of the Florida Keys, USA and evaluate the feasibility of using DIDSON to quantify juvenile *E. itajara* abundance in mangrove habitats.

Methods

This study was conducted in a section of Niles Channel (Lower Florida Keys) that was surveyed previously (Frias-Torres 2006). Undercuts (eroded mangrove shorelines) and submerged dead trees were surveyed. System calibration was conducted by recording juvenile *E. itajara* both with DIDSON and with video under high visibility conditions. The specific profile obtained during calibration and in a previous visual census study (Frias-Torres 2006) was used to detect juveniles with DIDSON in turbid water. The paired DIDSON-video system recorded 2 h 40 min of underwater footage of which 1h and 42 min were used for data analysis. Following standard methods of video analysis in animal behavior (Lehner 1998), the number of juveniles was counted per 5 minutes of DIDSON and video time. The total length (TL) of each fish was measured using the DIDSON software measuring tool.

Study Area

Habitats Examined

Submersed Dead Trees

Undercuts
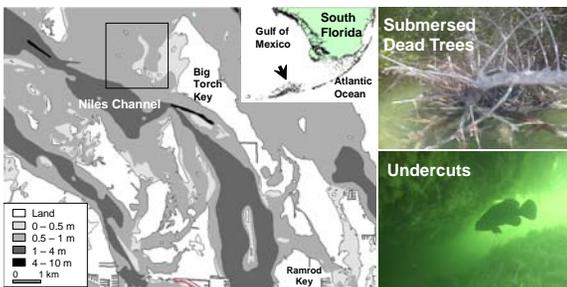
Coupled DIDSON and video camera setup

Video
DIDSON

Diver moving setup for placement at a fixed point



Results and Discussion

DIDSON detected the distinct profile and behavior of juvenile *E. itajara*
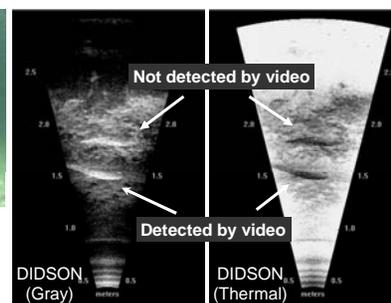

Video

DIDSON

1. Big head
2. Rounded pectoral fins
3. Characteristic head-down position
4. Compare with more slender profile of gray snappers, *Lutjanus griseus*

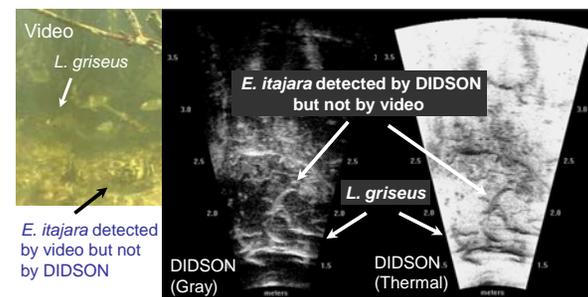[Video and DIDSON in the same time segment but different seconds]

Under turbid conditions, video observations resulted in underestimates of abundance relative to DIDSON

Pec. fin
Head
Video

Not detected by video
Detected by video
DIDSON (Gray)
DIDSON (Thermal)
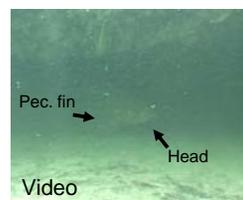
Juvenile *E. itajara* at the entrance of an undercut in turbid water [Identical Video-DIDSON time frame]

Under clear conditions, DIDSON could not detect individuals within 1 m from the setup, but video could.

Video
L. griseus
E. itajara detected by DIDSON but not by video
L. griseus
E. itajara detected by video but not by DIDSON
DIDSON (Gray)
DIDSON (Thermal)

[Video and DIDSON in the same time segment but different seconds]

E. itajara detected per 5 minutes

… But under both clear and turbid conditions, DIDSON could detect individuals that were hiding from the observer deep in undercuts or in a tangle of roots.
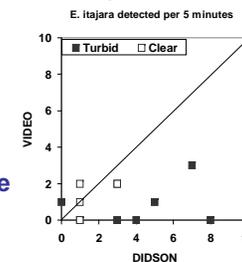
Conclusions

Under both clear and turbid conditions DIDSON enabled the quantification and measurement of juvenile *E. itajara* in mangrove undercuts and among the branches of submerged trees that were not visible or detected with video or by a diver. DIDSON could not detect immobile juveniles, unable to discern them from the substrate or the underwater structures where they were resting.

Recommendation: Combined surveys using DIDSON, video camera and diver to maximize knowledge of juvenile *E. itajara* mangrove habitat use.

Acknowledgements

Literature Cited

Frias-Torres S. 2006. Habitat use of juvenile goliath grouper, Epinephelus itajara in the Florida Keys, USA. Endangered Species Research 1: 1-6.
Lehner P. 1998. Handbook of ethological methods. Cambridge University Press, New York, 616 p.