Fishery Independent Estimates of Red Snapper, *Lutjanus campechanus*, Mortality Using Ultrasonic Telemetry in the Northern Gulf Of Mexico

Pesqueros Estimaciones Independientes de Red Snapper, *Lutjanus campechanus*, Mortalidad Usando Ultrasónico de Telemetría en el Norte Del Golfo de México

Pêche des Estimations Indépendantes de Red Snapper, *Lutjanus campechanus*, la Mortalité par Télémétrie à Ultrasons dans le Nord du Golfe du Mexique

LAURA JAY WILLIAMS* and STEPHEN SZEDLMAYER
*Auburn University, 8300 State Highway 104, Fairhope, Alabama 36532 USA. *lzw0017@tigermail.auburn.edu.*

EXTENDED ABSTRACT

Introduction

The red snapper, *Lutjanus campechanus,* fishery in the northern Gulf of Mexico is a commercially and recreationally important fishery that is considered overfished (SEDAR 31 2013). To meet the desired red snapper management goals in the United States federal waters the Gulf of Mexico Fishery Management Council has increased the minimum size limit and decreased the number of fishing days and daily bag limit since the onset of management in 1990 (Table 1, SEDAR 31 2013).

Critical to this management plan is accurate measures of mortality and perhaps more important is the separation of total mortality (*Z*) into its component parts of fishing (*F*) mortality and natural (*M*) mortality (SEDAR 31 2013). In earlier mark-recapture and telemetry studies *F* estimates were fishery dependent, relying on fisher returns of tagged fish. Natural mortality was generated by subtracting *F* from *Z* or was derived theoretically from a combination of water temperature and life history parameters including growth (*e.g.* Von Bertalanffy growth coefficient *K*) and maximum age (53 years, Goodyear 1995). New technology in telemetry systems has recently allowed the direct estimate of *M* in both freshwater and marine fish species (Hightower et al. 2001, Topping and Szedlmayer 2013).

In the present study, we estimate natural, fishing, and total red snapper mortality independent of the fishery using the newest VR2W Positioning System (VPS, Vemco Ltd., Nova Scotia) telemetry technology. The VPS technology offers advantages over traditional receiver arrays by recording the presence of a fish and using triangulation among receivers to provide the precise location (~1 m accuracy) of transmitter tagged fish (Piraino and Szedlmayer 2014).

Methods

The VPS study sites (n = 4) are artificial reefs deployed in an artificial reef building zone. The sites are located in 20–35m water depth approximately 20 - 50 km south of Dauphin Island, Alabama, USA, in the northern Gulf of Mexico.

Fish tagging procedures follow the protocol outlined by Piraino and Szedlmayer (2014). All transmitter tagged red snapper are larger than the present federal recreational minimum length limit (> 406 mm TL; Table 1). For identification, all fish are internally tagged with a uniquely identifiable acoustic transmitter (standard tag, Vemco V16-6x-R64k or depth tag, Vemco V16P-6x-R64k; 69kHz and transmission delay: 20–69 sec) and an externally visible internal anchor tag (Floy®). Following the tagging procedure, red snapper are placed into a predator protection cage that remotely releases the tagged fish at depth near (< 10 m) the reef site.

The fates of the tagged fish are identified using the VPS technology and classified as active (detections show regular movements around the reef), emigration (sequential detections away from the reef), fishing mortality (abrupt disappearance of detections around the reef), and natural mortality (detections show no movement). A known fate model was applied using monthly time intervals to estimate annual survivals and *M*, *F*, and *Z* mortalities ("MARK" program http://www.phidot.org/software/mark/docs/book, Topping and Szedlmayer 2013). Annual estimates were made for 2012, 2013, and 2014, and based on time intervals from August to July of the following year.

Results & Discussion

We used VPS telemetry detection data to independently estimate fishing mortality rates of red snapper in 2012, 2013, and 2014. In 2012, fishing mortality was high ($F = 0.76$), based on 8 transmitter tagged fish caught out of 16 transmitter tagged released fish (5 fisher captures and 3 captures based on telemetry data). No natural mortalities were observed ($M = 0$), thus total mortality ($Z = 0.76$) was equal to fishing mortality.

In 2013, we tagged additional red snapper (n = 40) and observed lower fishing mortality ($F = 0.26$). Again, no natural mortalities were observed ($M = 0$), and total mortality ($Z = 0.26$) was equal to fishing mortality. Fishers reported 3 captures and 3 fish were identified as caught using the VPS data.

The federal recreational red snapper season was only nine days in 2014 (Table 1). During this short sport season we had 37 red snapper tagged with transmitters and susceptible to fishing mortality. Fishing mortality increased in 2014 ($F = 0.34$) where sport fishers captured seven fish and two fish were caught based on VPS data. Similar to 2012 and 2013, no natural mortality was observed ($M = 0$) and total mortality ($Z = 0.34$) was equal to fishing mortality

Table 1. Red snapper, *Lutjanus campechanus*, recreational fishing regulations in the federal waters of the Gulf of Mexico from 1990 to 2014.

Year(s)	Number of Fishing Days	Minimum Size Limit (mm)	Daily Bag Limit (per person)
Pre-1990	365	330	none
1990 – 1994	365	330	7
1995 – 1996	365	381	5
1997	330	381	5
1998	272	381	4
1999	240	381	4
2000 – 2006	194	406	4
2007	194	406	2
2008	65	406	2
2009	75	406	2
2010	53	406	2
2011	49	406	2
2012	46	406	2
2013	42	406	2
2014	9	406	2

In the present study, sport fishers reported 65% (15 of 23) of the total fishing mortality that was estimated from the VPS data. The non-reporting rate showed no pattern among years and could be attributed to many factors including tag shedding or non-compliance.

The open sport fishing seasons decreased from 46 days in 2012, to 42 days in 2013, to 9 days in 2014. In 2012, the highest mortality (Z = 0.76) occurred during the longest season length. However, sample size susceptible to fishing mortality was low (n = 16) in 2012 compared to subsequent seasons. Sample sizes were increased in 2013 (n = 40) and 2014 (n = 37), and probably showed more accurate estimates. During these years, F unexpectedly increased from 0.26 to 0.34 even though the sport season time period was reduced by 78%, suggesting that fishers may be extremely efficient even with a severe reduction in season. Natural mortality was not observed throughout the course of this study. This could be due to the smaller sample sizes typical of telemetry studies or potentially as a result of higher fishing mortality. This study is ongoing, and additional VPS data will continue to be analyzed through 2015.

KEY WORDS: red snapper, *Lutjanus campechanus,* mortality, fishery independent assessment

LITERATURE CITED

Goodyear, C. P. 1995. Red Snapper in U.S. waters of the Gulf of Mexico. National Marine Fisheries Service, Southeast Fisheries Science Center, Contribution MIA-94/94-63, Miami, Florida USA.

Hightower, J.E., J.R. Jackson, and K.H. Pollock. 2001. Use of telemetry methods to estimate natural and fishing mortality of striped bass in Lake Gaston, North Carolina. *Transactions of the American Fisheries Society* **130**(4):557-567.

Piraino, M.N. and S.T. Szedlmayer. 2014. Fine-scale Movements and Home Ranges of Red Snapper *Lutjanus campechanus* Around Artificial Reefs in the Northern Gulf of Mexico. *Transactions of the American Fisheries Society* **143**:988-998.

SEDAR 31 (Southeast Data, Assessment, and Review). 2013. Gulf of Mexico Red Snapper Stock Assessment Report, 4055 Faber Place Drive, Suite 201 North Charleston, South Carolina USA.

Topping, D. T., and S. T. Szedlmayer. 2013. Use of Ultrasonic Telemetry to Estimate Natural and Fishing Mortality of Red Snapper. *Transactions of the American Fisheries Society* **142**(4):1090-1100.