OCS Study
BOEM 2020-038

Explosive Removal of Structures: Fisheries Impacts Assessment

U.S. Department of the Interior
Bureau of Ocean Energy Management
New Orleans Office

OCS Study
BOEM 2020-038

Explosive Removal of Structures: Fisheries Impact Assessment

Authors

Benny J. Gallaway, PhD
Scott Raborn
Kyle McCain
Taylor Beyea
Susan Dufault
Will Heyman, PhD

and Greeneridge Sciences, Inc.:
Katharine Kim
Alexander Conrad

Prepared under BOEM Contract
M16PC00005
by
LGL Ecological Research Associates, Inc.
4103 S. Texas Ave
Suite 211
Bryan, TX 77802-4043

Published by

U.S. Department of the Interior
Bureau of Ocean Energy Management
New Orleans Office

New Orleans, LA
June 2020

DISCLAIMER

Study concept, oversight, and funding were provided by the US Department of the Interior, Bureau of Ocean Energy Management (BOEM), Environmental Studies Program, Washington, DC, under Contract Number M16PC00005. This report has been technically reviewed by BOEM, and it has been approved for publication. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of BOEM, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

REPORT AVAILABILITY

To download a PDF file of this report, go to the US Department of the Interior, Bureau of Ocean Energy Management Data and Information Systems webpage (http://www.boem.gov/Environmental-Studies-EnvData/), click on the link for the Environmental Studies Program Information System (ESPIS), and search on 2020-038. The report is also available at the National Technical Reports Library at https://ntrl.ntis.gov/NTRL/.

CITATION

Gallaway BJ, Raborn S, McCain K, Beyea T, Default S, Conrad A, Kim K. 2020. Explosive removal of structures: fisheries impact assessment. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. Contract No.: M16PC00005. Report No.: OCS Study BOEM 2020-038. 149 p.

ABOUT THE COVER

ACKNOWLEDGMENTS

We particularly thank Mark Belter, the Contracting Officer's Representative for clear and helpful guidance throughout the program. Key to the success of the field work were representatives of the Charter Fishing Association, Inc., (especially captains S. Hickman, Buddy Guindon, Mike Jennings, Shane Cantrell, Steve Tomney) who provided research support and field sampling surveys. Dr. Steven Szedlmeyer (Auburn University) and Dr. Brad Erisman (University of Texas) led the telemetry and hydroacoustic studies, respectively. Their reports were incorporated in the annual platform assemblage reports, the results of which are summarized herein. We especially thank Connie Fields of LGL for formatting and producing the reports associated with this study.

Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

Short Form	Long Form
ACL	allowable catch limit
APE	average percent error
ARA	Applied Research Associates, Inc.
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
cm	centimeters
Comp B	Composition B (explosive material)
C4	Composition C-4 (explosive material)
dB	decibel
DO	dissolved oxygen
DOI	US Department of the Interior
ESPIS	Environmental Studies Program Information System
ESRI	Environmental Systems Research Institute
F	instantaneous fishing mortality rate
FL	fork length
fm	fathom
GA	Galveston BOEM Lease Area
GMFMC	Gulf of Mexico Fishery Management Council
GNLMM	generalized non-linear mixed model
GOM	Gulf of Mexico
GLM	generalized linear model
GLMM	generalized linear mixed model
HBX-1	high blast explosive composition 1
HL	hook-and-line
in	inches
ISO	International Organization for Standardization
KDE	kernel density estimate
kg	kilograms
Knts	nautical miles per hour
LD5O	lethal dose resulting in 50% mortality
LGL	LGL Ecological Researcher Associates, Inc.
LOA	letter of authorization
LSM	leased square mean
m	meter
mm	millimeter
ML	mudline
MS-222	tricaine methanesulfonate

Short Form	Long Form
NMFS	National Marine Fisheries Service
MMS	Minerals Management Service (now BOEM)
NE	northeast
NW	northwest
NMFS	National Marine Fishery Service
NOAA	US National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
ODO % sat	optical dissolved oxygen percent saturation
ODO mg/L	optical dissolved oxygen milligrams/liter
OTC	oxytetracycline dehydrate
ROV	remotely operated vehicle
SAIC	Science Applications International Corporation
SEDAR	Southeast Data, Assessment, and Review
SPL	sound pressure level
SPL_{peak}	peak sound pressure level
SRV	submerged rotating video
SW	southwest
TFA	total fish abundance
TL	total length
UWC	underwater calculator by Applied Research Associates, Inc.
VPS	VEMCO Positioning System
W	west
W-NW	west-northwest

1 Introduction

The US Department of the Interior's Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) perceived the need for updated estimates of the impacts from explosive severance decommissioning activities on fish and fisheries. This study was funded with the overarching goal to estimate potential impacts on federally-managed commercial and recreational fish and fisheries resulting from explosive severance decommissioning activities on the Outer Continental Shelf (OCS). The study area includes the federal waters in the Western and Central Planning Areas from the limit of state waters to a water depth of 300 m. The results from this report will be used to guide BOEM and BSEE in authorizing appropriate decommissioning activities that will minimize impacts to fish and fisheries.

1.1 Study Approach

We implemented a phased approach described as follows. Our first step was to compile a comprehensive literature synthesis describing the history of offshore oil and gas development in the Gulf of Mexico (Gulf), the sampling approaches that have been used to sample platform habitat, results of previous studies describing the fish assemblages associated with offshore oil and gas structures, and the perceived impacts of offshore platform removal (LGL 2017a). The results of the literature synthesis guided the selection of the sampling methodologies (e.g., active hydroacoustics, acoustic telemetry, biological sampling and underwater video) and the overall sampling design (stratified random design using region and depth as the basis for strata). Once the approach and design were established, a Field Season 1, "proof of concept" reconnaissance study was conducted in the late 2016 and early 2017 (LGL 2017b). During this same period, GSI and LGL (2017) prepared an acoustics synthesis report that: 1) reviewed the effects on fish of explosive removal of offshore platforms in the Gulf ; 2) reviewed sound characteristics of underwater explosive events; and 3) identified widely accepted models used to predict lethal effects; and 4) provided a detailed description of the explosive propagation model we used to estimate effects of explosive platform removal on federally managed fish and fisheries based on the results of our studies.

The first comprehensive field survey (Field Season 2) was conducted during April–August 2017 (LGL 2017c). A total of 30 sites were sampled in 2017, each of which was randomly selected from the total pool of 1260 offshore platforms and well protectors (but not caissons) that were in place at the time. The study team (LGL, Auburn University, and University of Texas) obtained 100% of the planned samples as described by LGL (2017c). LGL et al. (2018) provided a description of the results obtained during the summer of 2017, including overall fish abundance and diversity by platform site and depth layer, and the distribution and abundance of selected federally managed species. Red snapper (*Lutjanus campechanus*) was the most abundant of the federally managed species. For this species, we not only described distribution and abundance, but also obtained site fidelity estimates based on telemetry, and estimated population sizes at some platforms based upon mark-recapture estimates. Red snapper sampling also enabled estimation of their catch rates, age composition, growth and condition at platforms.

Field Season 3 sampling was conducted during May–August, 2018 (LGL 2018). Once more, 100% of the planned samples were obtained. In 2018, 32 platforms were randomly selected for sampling from the overall pool of 1,171 platforms and well protectors. In total we sampled 62 platforms (30 in 2017; 32 in 2018). Of these 3 were sampled during both years. A total of 89 structures had been removed between field seasons. LGL et al. (2018b) characterized the results obtained during Field Season 3, essentially as described above for Field Season 2.

Based mainly on LGL et al. (2018a) and LGL et al. (2018b), a final assemblage characterization report was developed LGL (2019). This report described the species assemblages and abundance of each fish species present at an average platform within each of four depth zones, 10 to 17 m, 18 to 30 m, 31 to 90 m, and the 91 to 300 m deep. As will be described below, hydroacoustic surveys were used to estimate total fish abundance at each platform sampled and submerged rotating video (SRV) surveys were used to estimate assemblage composition at each platform. The SRV data were used to apportion the total abundance into species abundances. For red snapper, we also conducted mark recapture estimates at a subset of sites, acoustic-telemetry studies to determine the proportion of time this species was in the lethal blast radius and age, growth, and condition studies (LGL et al. 2018a, 2018b, and LGL 2019).

Conrad et al. (2019) used the distribution and abundance data for the selected federally-managed species in conjunction with the selected acoustic model to estimate mortality of these species due to the explosive severance of the offshore structures removed in 2017 and 2018. These were supplemented with the projected mortality that would be estimated if all structures were explosively removed in a single year, and the mortality that would be estimated if all platforms within a 100 mi radius of a major port were all removed in a single year.

1.2 Report Organization

Below we first describe the study area, methods, and results of the assemblage characterization studies (Section 2.0), followed by an assessment of effects based on acoustic modeling (Section 3.0). We then provide an evaluation of the significance of the estimated efforts (Section 4.0).

2 Assemblage Characterization Studies

Assemblage characterizations were based on a comprehensive database review (LGL 2017a) and three field studies (LGL 2017a, LGL 2017c, LGL 2018). It should be noted that the literature syntheses of Gulf of Mexico (Gulf) platform studies was compiled using Thomson Reuters EndNote ™ version X7.7 bibliographic software which allows searching of any/all database fields as well as searching of the text of attached PDFs. All of the major reports produced by this study are also included in the EndNote ™ database.

The initial literature synthesis methodology was summarized in LGL (2017). Briefly, various online sources were searched using key words related to platforms, acoustic impacts, fish habitat, and artificial reefs as well as the common and species names of the selected federally managed fish species. Additional references related to oil and gas platform ecology were identified by the Project Manager based on his professional experience, and all papers related to the relevant SEDAR stock assessment reports were also included. This resulted in 668 references that we grouped into eight categories based on those used in Versar (2008) (see Table 2.1 in LGL 2017) and compiled into an Endnote™ database. Throughout the study additional references were added to the EndNote™ database where relevant to the project work or as new references were published. The current version of the database (version 6.0) contains 895 references, which are provided as a bibliography at the end of this report (Appendix 1). We next describe the field studies.

2.1 Study Area

The study area included federal waters in the Central and Western planning areas from the limit of state waters to a water depth of 300 m (Figures 1 and 2). The distribution of total platforms and well protectors by depth zone during 2017 and 2018 is shown in Figure 1, while those selected for our surveys are given in Figure 2. The number of platforms by year, State management area and depth zone can be found in Table 1.

In Figures 1 and 2, we show the recently established State Management boundaries for red snapper. In April 2019, the Gulf of Mexico Fishery Management Council (GMFMC) delegated management authority of the private angling component for recreational red snapper fishing to each Gulf state; that is, each state now manages both federal and state waters for red snapper (GMFMC 2019). The GMFMC also delegated to each state the authority to establish or modify the bag limit, a minimum size limit within 14-18 inches total length, and to establish a maximum size limit.

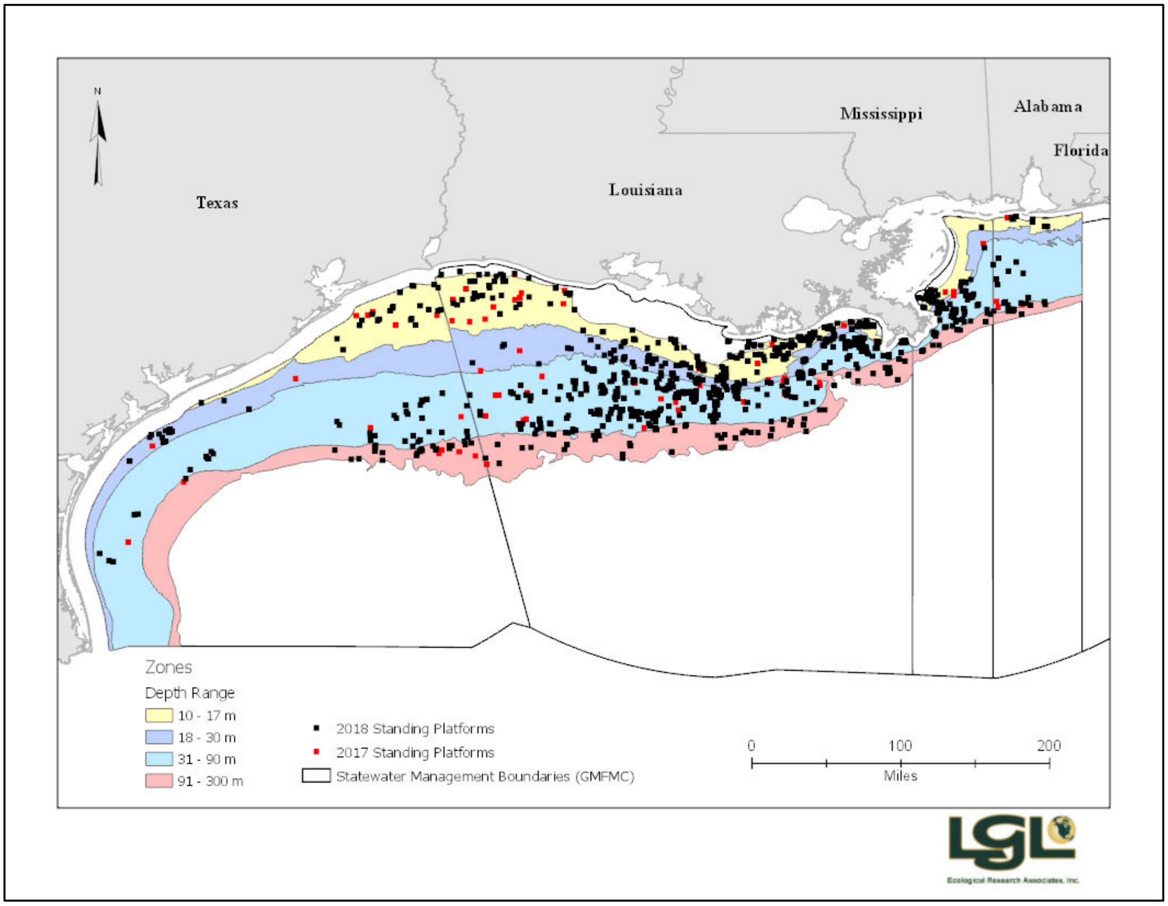

Figure 1. The distribution of standing platforms by year, private recreational red snapper state management area and depth zone.

All marked platforms were in place when the study commenced in 2017 and those marked in red were removed by 2018.

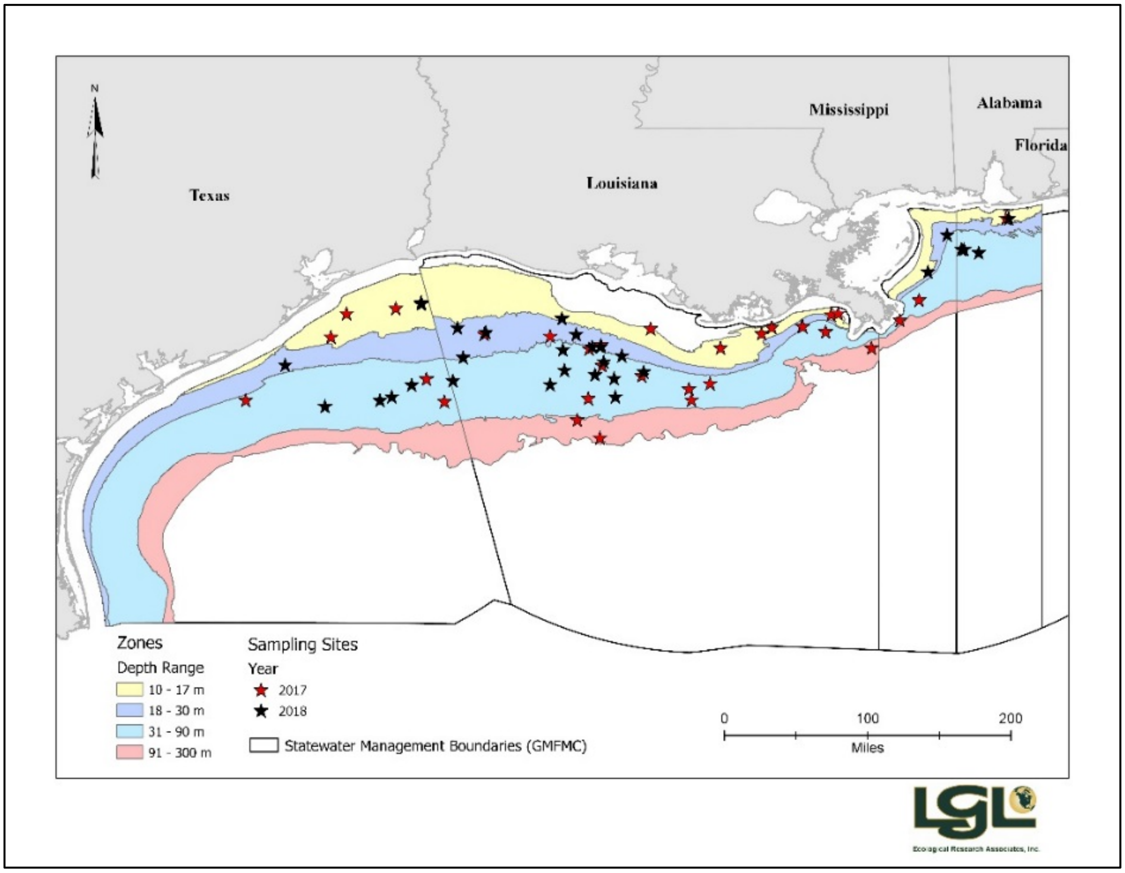

Figure 2. The distribution of randomly selected study platforms by year, private recreational red snapper state management area, and depth zone.

Table 1. Number of standing platforms in the study area by state and depth zone, 2017 and 2018

The data were obtained from the 2019 BOEM database.

2017									
Depth Zone (m)	**Total**		**TX**		**LA**		**MS**		**AL**
10–17	374		30		297		39		8
18–30	247		26		198		20		3
31–90	520		50		386		67		17
91–300	119		31		66		13		9
	1,260		**137**		**947**		**139**		**37**
2018									
Depth Zone (m)	**Total**		**TX**		**LA**		**MS**		**AL**
10–17	346		26		275		39		6
18–30	229		23		186		17		3
31–90	484		47		356		66		15
91–300	112		26		65		13		8
	1,171		**122**		**882**		**135**		**32**

2.2 Methods

Below we describe the basis for selecting key species, our analytical methods for modeling assemblage structure, and methods used to estimate age, growth, and condition of red snapper.

2.2.1 Key Species Selection

246 species of fish have been documented on petroleum platforms in the Gulf (Versar 2008). Assessing the impacts on all species is beyond the scope of this study. As specified in the contract, our focus is restricted to federally-managed species (Table 2) that are commercially and recreationally important, relatively abundant throughout the range of the study, known to be associated with platforms, and for which stock assessments are available for modeling purposes.

There are 39 federally managed fish species in the Gulf (GMFMC 2015). Only 25 of the federally managed species are known to occur on platforms in the Gulf , and, of those, stock assessments from SEDAR are available for only nine fish species (see Table 2). Since our study period corresponds to the May to October season, during which nearly all decommissioning activity takes place, we eliminated king mackerel (*Scomberomorus cavalla*), and Spanish mackerel (*Scomberomorus maculatus*) because they have only short-duration residence times during the summer months (Gallaway 1981). The yellowtail snapper (*Ocyurus chrysurus*) is not common in the Western Gulf, and the SEDAR stock assessment for this species is more than a decade old (SEDAR 3 2003). Very few groupers were observed in our study and they were not included as key species. Hence, we selected five key species for consideration: red snapper, gray triggerfish, vermilion snapper, greater amberjack, and cobia.

Stock assessments for the five focal species have been completed within the last 8 years and the total numbers at age 2+ for each species in the most recent year available (Table 3) serve as the basis for the comparative analyses presented later in this report. Numbers at each age across all ages for each species are provided in Appendix 1 of LGL 2019. All 5 of the focal stocks were overfished at some point in the past and are therefore under rebuilding plans. These measures have helped all of the focal stocks to rebound. Four of the five focal species' stocks (red snapper, gray triggerfish, vermilion snapper and cobia), have recovered to the point that the most recent assessment concluded that the stocks were not overfished nor was overfishing occurring (Table 4). By contrast, greater amberjack was still considered overfished and undergoing overfishing at the time of the most recent assessment (SEDAR 33 Update 2016; Table 4).

Table 2. Federally-managed fish showing species observed on platforms, those with stock assessments and species initially chosen for study

Common name	Scientific name	Observed on Platforms	With Stock Assessments	Chosen for Impact Analysis
Almaco jack	*Seriola rivoliana*	Yes		
Banded rudderfish	*Seriola zonata*	Yes		
Black grouper	*Mycteroperca bonaci*			
Blackfin snapper	*Lutjanus buccanella*			
Bluefish	*Pomatomus saltatrix*	Yes		
Blueline tilefish	*Caulolatilus microps*			
Cero	*Scomberomorus regalis*			
Cobia	*Rachycentron canadum*	Yes	Yes	Yes
Cubera snapper	*Lutjanus cyanopterus*			
Dolphinfish	*Coryphaena hippurus*	Yes		
Gag	*Mycteroperca microlepis*	Yes	Yes	
Goldface tilefish	*Caulolatilus chrysops*			
Goliath grouper	*Epinephelus itajara*	Yes		
Gray snapper	*Lutjanus griseus*	Yes		
Gray triggerfish	*Balistes capriscus*	Yes	Yes	Yes
Greater amberjack	*Seriola dumerili*	Yes	Yes	Yes
Hogfish	*Lachnolaimus maximus*	Yes		
King mackerel	*Scomberomorus cavalla*	Yes	Yes	
Lane snapper	*Lutjanus synagris*	Yes		
Lesser amberjack	*Seriola fasciata*	Yes		
Little tunny	*Euthynnus alletteratus*	Yes		

Common name	**Scientific name**	**Observed on Platforms**	**With Stock Assessments**	**Chosen for Impact Analysis**
Mutton snapper	*Lutjanus analis*			
Queen snapper	*Etelis oculatus*			
Red drum	*Sciaenops ocellatus*	Yes		
Red grouper	*Epinephelus morio*	Yes		
Red snapper	*Lutjanus campechanus*	Yes	Yes	Yes
Scamp	*Mycteroperca phenax*	Yes		
Silk snapper	*Lutjanus vivanus*	Yes		
Snowy grouper	*Hyporthodus niveatus*			
Spanish mackerel	*Scomberomorus maculatus*	Yes	Yes	
Speckled hind	*Epinephelus drummondhayi*			
Tilefish	*Lopholatilus chamaeleonticeps*			
vermilion snapper	*Rhomboplites aurorubens*	Yes	Yes	Yes
Warsaw grouper	*Hyporthodus nigritus*			
Wenchman	*Pristipomoides aquilonaris*	Yes		
Yellowedge grouper	*Hyporthodus flavolimbatus*			
Yellowfin grouper	*Mycteroperca venenosa*	Yes		
Yellowmouth grouper	*Mycteroperca interstitialis*			
Yellowtail snapper	*Ocyurus chrysurus*	Yes	Yes	
n = 39	n = 39	n = 25	n = 9	n = 5

Table 3. Gulf-wide numbers at age (0+ and 2+) for five focal species at the most recently assessed year

Eastern and Western Gulf data are also provided for red snapper

Species	Area	Total number of Age 2+	Total number of Age 0+	Year Estimated	Reference
Red snapper	Gulf-wide	36,738,000	256,277,000	2016	SEDAR 52, 2018
Red snapper	Eastern Gulf	13,095,000	72,231,000	2016	SEDAR 52, 2018
Red snapper	Western Gulf	23,643,000	184,046,000	2016	SEDAR 52, 2018
Vermilion snapper	Gulf-wide	30,184,024	63,736,924	2014	SEDAR 45, 2014
Gray triggerfish	Gulf-wide	2,822,750	10,872,330	2013	SEDAR 43, 2015
Greater amberjack	Gulf-wide	695,549	2,674,016	2015	SEDAR 33 Update, 2016
Cobia	Gulf-wide	423,955	2,054,265	2011	SEDAR 28 2013

Table 4. Stock status for the five focal species as reported in their most recent assessments

Species	Undergoing Overfishing (Y/N)	Overfished (Y/N)	Year Estimated	Reference
Red snapper	N	N	2016	SEDAR 52, 2018
Vermilion snapper	N	N	2014	SEDAR 45, 2014
Gray triggerfish	N	N	2013	SEDAR 43, 2015
Greater amberjack	Y	Y	2015	SEDAR 33 Update, 2016
Cobia	N	N	2011	SEDAR 28 2013

2.2.2 Species Abundances

Species abundances were estimated using hydroacoustic surveys coupled with submerged rotating video (SRV) camera surveys and measurement of physical properties of the water column. Additionally, weather conditions (wind strength, wind direction, wave height, current strength and direction) were recorded for each site. The detailed protocols for these surveys are described in LGL et al. (2018a, 2018b). At each site, hydroacoustic surveys were conducted first, followed by measurement of water column properties and SRV surveys. For convenience, a summary of these methods is provided in Appendix 2 of LGL (2019).

The abundance estimation approach using hydroacoustic and SRV data had to be carefully evaluated. For example, at a given site the estimation of red snapper abundance could be accomplished by combining total fish abundance estimated from the hydroacoustic survey with species relative abundances estimated concurrently with an SRV (Koenig and Stallings 2015). At some sites, bias was obvious when there was misalignment of the species being enumerated with each type of equipment. For instance, the hydroacoustic density estimate may have been 2,000 and was unknowingly comprised of 1,000 Atlantic bumper (*Chloroscombrus chrysurus*) and 1,000 red snapper. However, if the SRV sample videoed only ten fish because of poor visibility, nine of which were Atlantic bumper and only one was a red snapper, then the red snapper abundance estimate would be biased low (i.e., 200 instead of 1,000). For this reason, site-specific estimates were not reported. Instead, we modeled the average assemblage structure for a given depth zone and vertical depth layer given average environmental variables and used this output to apportion the corresponding model output of average total fish abundance.

Variables quantifying the number of legs descending from the surface and categorizing a given platform as occupied or unoccupied were considered but were not used in the final model. The number of legs did not capture the number of total pipes descending to the ocean floor nor the complexity of cross structures beneath the surface. We reasoned that the fish assemblage on a occupied platform would be exposed more to fishing pressure. However, we observed instances where crew boats were tied to and actively fishing platforms designated as “unoccupied” in the BOEM database. For these reasons, these variables were considered poor descriptors and were ultimately dismissed as misleading.

Below we describe how assemblage structure and total fish abundance were modeled separately. For each depth zone-layer combination, predictions from both models were combined to provide species abundance estimates with confidence intervals. Species abundances are predicted for what we term an “average platform” within each depth zone. One could argue that given the variabilities in substrate type, physicochemical variables, bottom depth, platform complexity, distance from fishing ports, etc., that an average platform does not exist. Though our estimates may not apply to any single platform within a depth zone, we argue that our average platform estimates yield unbiased expanded abundances when multiplied by the total number of platforms within a given depth zone because they were based on random samples spanning the ranges of the variabilities just mentioned.

2.2.2.1 Assemblage Structure from Submerged Rotating Video (SRV) Surveys

At each site, a survey of assemblage structure was available from the SRV max count observations for each vertical depth layer. That is, the relative abundance of a given species was estimated as its max count divided by the sum of the max counts for all species. In essence, this response, Assemblage Structure, can be characterized as a nominal multinomial distribution, which we modeled using a generalized logit link function:

$$log_e \left[\frac{Pr(y=j|x_i)}{Pr(y=k|x_i)}\right] = \alpha_{jk} + x_i\beta_{jk} \tag{1}$$

where, all jth nominal species categories were referenced to a particular species category k (we used the most numerically dominant species for k), xi=the vector of fixed effects explanatory variables for the ith sample, and αjk and βjk were parameters specific to the jth category and referenced to k. Hence, we modeled the log odds of a fish in the Assemblage Structure being in the jth category rather than being in the reference category, k, and allowed this relationship to change with the explanatory variables. The likelihood (li) for each ith observation was given as:

$$l_i = \sum_{j=1}^{J} y_{ij}\, log_e(\lambda_{ij}) \tag{2}$$

where, J=total number of species in the analysis, yij=observed number of individuals in the jth species and ith sample, and λij=the predicted number of individuals in the jth species and ith sample. Fixed effect variables included the categorical variable DepthZone (10–17 m, 18–30 m, 31–90 m, or 91–300 m), and the covariates Layer (vertical depth bands 3–12 m [labeled as 1], 13–22 m [labeled as 2], etc.), temperature and dissolved oxygen (DO). These last two covariates were included as extraneous/nuisance variables to reduce noise and confounding influences; furthermore, they were converted to standard normal deviates (z-scores) within each DepthZone-Layer combination before analysis. Layer was entered as a covariate to allow change in Assemblage Structure along the vertical depth gradient. Ignoring subscripts and parameters for the right side of the equation, fixed effects for the final model were specified as follows:

$$\lambda_{ij} = DepthZone|Layer + Temperature + DissolvedOxygen \quad (3)$$

where the operator "|" indicates an interaction of two or more terms and all of the corresponding main effects. We attempted to let the intercept and covariates Temperature and DO vary randomly across subjects defined with the categorical variable Site nested within each Year-DepthZone combination. Model convergence could not be achieved with this specification so Site could not be modelled as a random variable. Thus all effects remained fixed. This specification formed a generalized linear model (GLM) for which we estimated parameters with the GLIMMIX procedure in the statistical software SAS 9.4 TS Level 1M5 (SAS Institute, Inc. 2016).

2.2.2.2 Total Fish Abundance from Hydroacoustic Surveys

The hydroacoustic surveys provided observations of total fish abundance (TFA) for each Site-Layer combination. This response was assumed to be from a lognormal distribution, which we modeled with the log link function:

$$log_e(TFA_i) = \alpha + x_i\beta + z_i b \quad (4)$$

where, TFAi=predicted total fish abundance for the ith sample, α = the intercept, xi=the vector of fixed effects explanatory variables for the ith sample, β= their corresponding vector of coefficients, and Zi and b = the random effects and coefficients. The likelihood (li) for each ith observation was given as:

$$l_i = -\frac{1}{2}\left[\frac{log\{y_i\}-\mu_i}{{\sigma_i}^2} + log\{{\sigma_i}^2\} + log\{2\pi\}\right] \quad (5)$$

where yi = observed total fish abundance for the ith sample, μi and σi2 are the respective predicted mean and variance parameters for the loge transformed observations, and π=the constant pi. The same fixed effects variables were used as was described above for modeling Assemblage Structure. However, as the pattern of fish abundance throughout the water column did not appear to be linear, the term Layer was fit using a cubic B-spline (splLAYER) with three equally spaced knots positioned between the minimum and maximum values. Ignoring subscripts and parameters for the right side of the equation, fixed effects for the final model were specified as follows:

$$\mu_i = DepthZone|splLAYER + Temperature + DissolvedOxygen \quad (6)$$

The intercept and covariates Temperature and DO were allowed to vary randomly across subjects defined with the categorical variable Site nested within each Year-DepthZone combination. This specification formed a generalized nonlinear mixed model (GNLMM) whose parameters were also estimated with the GLIMMIX Procedure in SAS.

2.2.2.3 Species Abundance and Associated Variance Propagation

Abundance of each species was predicted by Layer for an average platform within each Depth Zone as the product of their predicted proportions from the Assemblage Structure model output and the predicted total fish abundance from the TFA model output. The arithmetic variance of TFA was given by the method of moments estimator:

$$Var[TFA] = e^{2\mu+\sigma^2}\left(e^{\sigma^2} - 1\right) \quad (7)$$

Variances from TFA and Assemblage Structure were then combined using Goodman's (1960) variance of products estimator:

$$Var[\lambda * TFA] = \lambda^2 Var[TFA] + TFA^2 Var[\lambda] - Var[TFA] * Var[\lambda] \quad (8)$$

2.2.3 Red Snapper Studies

Red snapper were collected for age, growth and condition evaluations by means of hook-and-line fishing. Gear and bait were standardized across all sampling sites. We used two hook sizes: a 6/0 Mustad demon perfect circle hook (model 39948NP-BN) baited with squid (order Teuthida), and an 11/0 Mustad circle hook (model 39960-DT) baited with Gulf menhaden (*Brevoortia patronus*). Each hook size and bait combination was deployed on independent poles at the same time during sampling and no more than one of each hook size was deployed while sampling. Red snapper were marked according to which hook size they had been caught on. Morphometric measurements (total length [TL], fork length [FL] in mm, individual weight in kilograms) were recorded, sex was determined by macroscopic examination of gonads, and sagittal otoliths were extracted, rinsed and cleaned, dried, and stored in coin envelopes.

Additionally telemetry studies of red snapper were conducted at three selected sites to estimate site fidelity, and mark and/or recapture studies were attempted at 10 sites as described below to obtain independent population estimates for comparison to the hydroacoustic and/or SRV estimates obtained independently.

2.2.3.1 Age and Growth

Otoliths provided from field sampling were mounted and thin sectioned in a transverse plane with a Pace Technologies, Pico 155 sectioning machine outfitted with 2, 4" diamond embedded waffering blades with a 0.75 mm spacer between the blades. Sections were polished on 2000 grit wet-dry sandpaper. Otoliths sections were submerged in water on a black background read under reflected light using a dissecting microscope outfitted with a Tucsen Bioimager camera. This method allowed us to read the annuli along the dorsal margin of the sulcus acousticus from the core to the proximal edge (Allman et al. 2005).

We obtained the reference otolith dataset used in Allman et al. 2005 to gauge the ability of our reader to obtain an Average Percent Error (APE) of 5% or better. An APE of 5% is the benchmark for moderately long-lived species with relatively difficult to read otoliths (Morison et al. 1998; Campana, 2001). Our readers obtained an APE of 5% on the reference dataset. A second reader read our sectioned otoliths at a later date.

Age structure was modeled as a nominal multinomial distribution using a generalized logit link as described above for Assemblage Structure. Fixed effects for the final model were all categorical and specified as follows:

$$\lambda_{ij} = DepthZone + Year + Hook\ size + Sex \quad (9)$$

where, λij is now the predicted number of individuals in the jth Age and ith sample (i.e., platform), Year was either 2017 or 2018, Hook size was either 6/0 or 11/0, and Sex was male or female.

Growth was modeled for observed TL with the three parameter Von Bertalanffy growth equation following the SEDAR stock assessments:

$$TL_t = L\infty(1 - e^{-K(t-t_0)}) \quad (10)$$

where, TLt = TL at age t, L∞ = TL asymptote, K = growth coefficient, t = age in years, and t0 = age at length 0. The growth performance index,φ, developed by Munro and Pauly (1983) is reported, but not used for comparisons:

$$\varphi = \log_{10}K + 2*\log_{10}L_\infty \quad (11)$$

2.2.3.2 Condition

Individual weight (Wt in kg) for red snapper was related to total length (TL in mm) as per Anderson and Neumann (1996) using the power function (Wt=aTLb), where Ln (TL) was interacted with three categorical variables. Ignoring subscripts and parameters, fixed effects for the final model were specified as follows:

$$Wt = TL|Sex + TL|DepthZone + TL|Age + e \quad (12)$$

where, sex was either male or female, DepthZone (defined above), and age ranged from 1 to 13 (ages 9-13 were grouped due to low sample sizes for each of these ages). Error (e) was assumed to be lognormally distributed. The intercept was allowed to vary randomly across subjects defined with the categorical variable Site nested within each Year-DepthZone combination. Likewise, we attempted to let the covariate TL vary randomly as well, but its covariance parameter was essentially estimated to be zero. This specification formed a generalized linear mixed model (GLMM) for which we estimated parameters with the GLIMMIX procedure. All effects were tested at $\alpha = 0.05$.

2.2.3.3 Site Fidelity (Telemetry)

Four VPS telemetry arrays were deployed on platforms off the coast of Alabama and Louisiana (Figure 3, Panel A). The East site (Site 30) was located 25 km (13 nautical miles) southeast of Dauphin Island, Alabama and was deployed on 28 March 2017. The Center site (Site 9) and West site (Site 6) were located south of coastal Louisiana. The Center site was deployed on 3–4 July 2017. The West site was deployed 7–8 July 2017. The fourth site (Site 59) was placed 2 km east of Site 30 on 23 May 2018. The first data set from Site 59 was downloaded 30 Oct 2018 and has not yet been analyzed. Each array includes six VEMCO VR2Tx receivers. A center receiver (C) was placed 20 m north of each platform. Surrounding receivers were placed 300 m to the northeast (NE), northwest (NW), southeast (SE) and southwest (SW) of the C receiver. A south receiver (S) was placed 415 m south of the C receiver. Environmental meters (DO, temperature, and salinity) were attached to the center receiver line at each site. Receivers were collected and replaced at the East site on 11 August 2017, 30 November 2017, 4 May 2018, and 30 October 2018. Receivers were collected and replaced at the Center and West sites on 30–31 October 2017 and 24–25 April 2018. The Center and West sites were permanently removed on 27 July 2018.

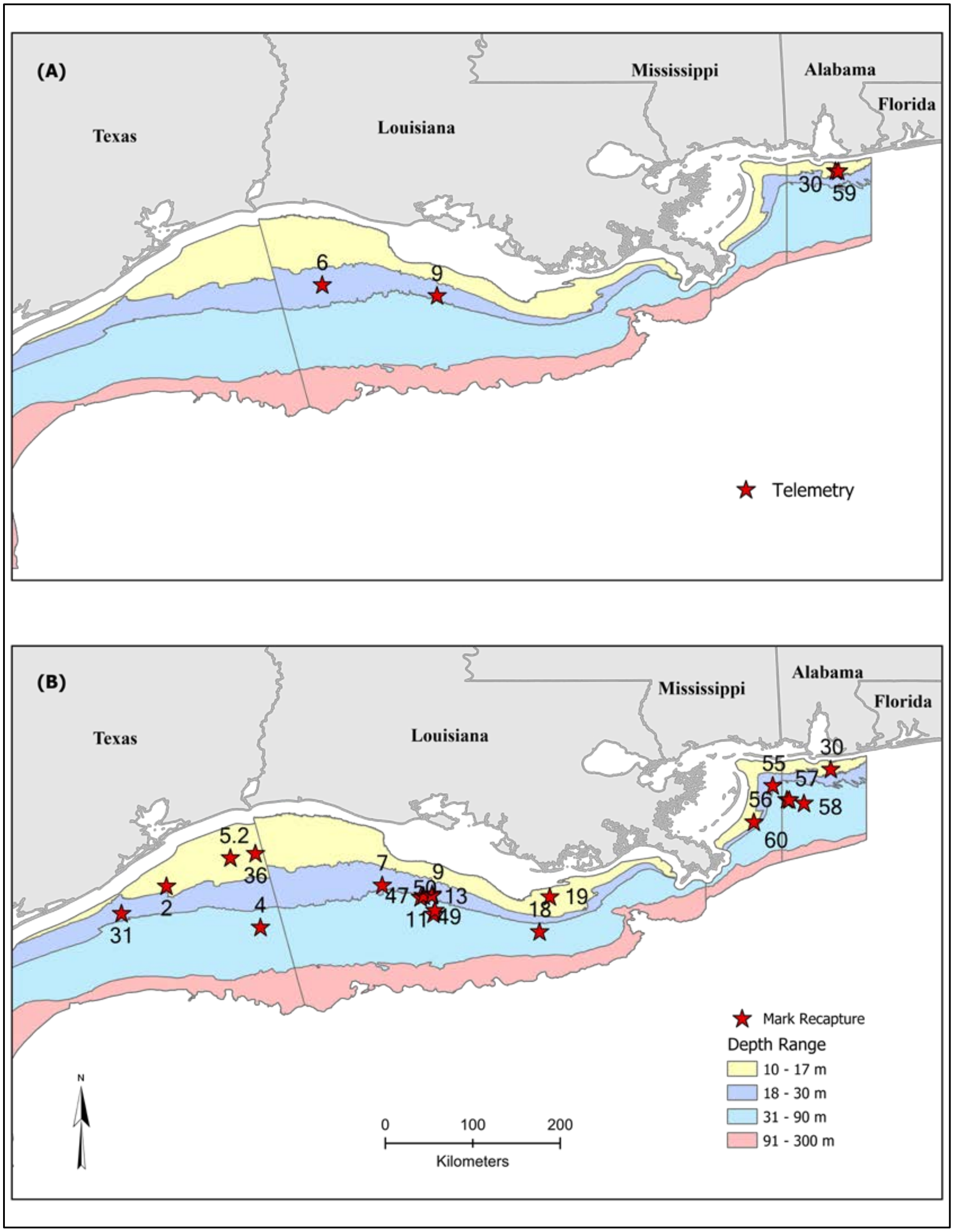

Figure 3. Location of telemetry and mark-recapture study sites, 2017 and 2018.

Red snapper were tagged following previous protocols (Piraino and Szedlmayer 2014; Williams-Grove and Szedlmayer 2016a, 2016b). As of October 2018, 81 red snapper (>406 mm total length TL) were tagged with acoustic V16-6x transmitters (69 kHz, 20–69 s signal interval, five year battery life) and internal anchor tags (Floy® FM-95W) over all VPS platform sites. Fish were captured using hook and line, anesthetized in 150 mg/L MS-222 (tricaine methanesulfonate) for 90 s, weighed (0.1 kg), measured (mm) and injected with 0.4 ml/kg oxytetracycline dehydrate (OTC). Fish were released with remotely opening predator protection cages at depth (Piraino and Szedlmayer 2014; Williams-Grove et al. 2015; Williams-Grove and Szedlmayer 2016a, 2016b).

A monetary reward ($150) was offered for red snapper tag returns to increase fisher reporting rate and increase the accuracy of fishing mortality estimates. Also, to increase tag reporting, reward posters were displayed at local marinas, tackle stores and bait shops, and identification numbers, contact information and reward notice were placed on external floy tags that were used to tag red snapper.

Fish positions for 54 red snapper were analyzed with the R program for home range area estimates (95% KDE) and compared over diel and seasonal time periods with repeated measures (GLMM and Tukey-Kramer, SAS 9.4; Venables and Ripley 2002; Venables and Dichmont 2004; Seavy et al. 2005; Bolker et al. 2008; Piraino and Szedlmayer 2014; Williams-Grove and Szedlmayer 2016a, 2016b). Fish size (TL) was compared to area use by linear regression in SAS software. Mean environmental measures of DO, salinity and temperature were calculated by date for each VPS site and compared to home range with linear regression.

Distances (m) of fish positions from platform structure were measured with ArcMap 10.4.1 proximity analysis tools (Environmental Systems Research Institute [ESRI]; McKinzie et al. 2014). Percent frequencies of positions located inside (0 m), near (< 95 m) or away (≥ 95 m) from platform structure were calculated.

A known fate model in the "MARK" program (White 2014) was used to estimate residence time, site fidelity and mortalities for tagged red snapper (Edwards 1992; Kaplan and Meier 1958; Schroepfer and Szedlmayer 2006; Topping and Szedlmayer 2011; Topping and Szedlmayer 2013; Williams-Grove and Szedlmayer 2016a, 2016b).

2.2.3.4 Mark and/or Recapture

Mark and/or recapture studies were attempted at 21 sites; 10 sites in 2017 and 11 sites in 2018 (Panel B of Figure 3). Fish were captured using hook and line, tagged with internal anchor tags (Floy ® FM-95W) and released with remotely opening predator protection cages at depth. A remote YSIEX02 was used to record oceanographic conditions at each site. As noted above, a high monetary tag reward was offered for red snapper tag returns and reward posters were placed at key facilities as described above.

A minimum of 10 days was allowed to pass between marking and recapture attempts to allow full recovery and mixing of tagged and untagged fish. All recapture events coincided with trips made to obtain samples for age, growth and condition analyses so all recaptured fish were kept for age determination. Population estimated were made using the historical Peterson estimate as well as a Bayesian approach following Gazey and Staley (1986).

2.3 Results

2.3.1 Assemblage Structure

A total of 36 taxa were included in our GLM and it provides an estimate of abundance for each of these species at each "average platform", even if a species was not actively observed at platforms within that depth zone (Table 5). We actually observed 7, 26, 32, and 13 species at study platforms within the depth zones 10 to 17 m, 18 to 30 m, 31 to 90 m, and 91 to 300 m, respectively. The abundance estimates for the species actually observed at platforms within a depth zone constituted from 97 to 99% of the total estimated abundance for all 36 species. Some of the species not documented to have been present during sampling would be expected to occur given a larger sample size; others would not be expected to be present or they would only rarely occur. Nevertheless, the overall abundance of such species would be expected to be low, as suggested by the model.

Model diagnostics for the hydroacoustic predictions of TFA indicated no pattern in the residuals, and the average predicted values agreed well with those observed (Appendix 4 in LGL 2019; Figures A4-1 and A4-2). Likewise, the predicted values for the SRV counts were similar to those observed (Figure A4-3); however, residuals are not available for multinomial responses. The interaction of Depth Zone and Layer (modeled as spline) was significant for the hydroacoustic model of TFA as was the random covariate effect of DO, while Temperature was not statistically significant (Tables A4-1 and A4-2 of Appendix 4, LGL 2019). All fixed effect terms were statistically significant (at α=0.05) for the SRV model (Table A4-3).

The dominant species at the average platforms within the 10- to17- m deep shallow Coastal Zone were, in order of abundance, Atlantic bumper (4,362), Atlantic spadefish (1,815), blue runner (622), and red snapper (359). These four species comprised 92% of the total number of individuals at the average shallow coastal platform. Numerically dominant species at an average platform in the deeper Coastal Zone (18- to 30- m deep) included Atlantic bumper (6,227), Gulf menhaden (2,876), blue runner (1,712), red snapper (1,015), Atlantic spadefish (926), Atlantic moonfish (514) and gray snapper (400). Collectively, these species comprised about 91% of the fish present (13,670 of 15,014, Table 5). The dominant species predicted to be associated with the average platform within each of the Coastal Zones (10- to 17- m deep and 18- to 30- m deep) were remarkably consistent with the historical findings (LGL 2017a), albeit there was one major exception.

For example, the similarity of our assemblages with the only literature included common dominant species for both the early studies (see Gallaway and Lewbel 1982) and our study conducted in 2017 and 2018. Namely, these included Atlantic spadefish, bluefish, blue runner, lookdown, Atlantic moonfish, and red snapper. The exception was Atlantic bumper. This species was observed in our study to be the most abundant species at coastal platforms in the 10- to 30- m depth range (Table 5). It was not listed by Gallaway and Lewbel (1982) as even being present on Gulf platforms, nor was it listed as being seen at coastal platforms in the Northern Gulf by Stanley and Wilson (1997, 2003) or by Stunz and Ajemian (2016) for platforms offshore south Texas. In contrast, Reeves (2015), Munally (2016) and Reeves et. al. (2017) observed Atlantic bumper were abundant at platforms offshore Louisiana by the mid 2000s.

Chesney et al. (2000) noted that Gunter (1936) reported that Atlantic bumper ranked 22nd in abundance in shrimp trawl bycatch in the 1930s but, by the mid 1990s, Atlantic bumper ranked 7th in abundance in the shrimp trawl bycatch (Adkins 1993). Many possible factors may have contributed to this and other changes in faunal assemblages. Chesney et al. (2000) focused on eutrophication and hypoxia as being possible factors accounting for Atlantic bumper increases over time, but also suggested that installation of offshore oil and gas platforms may have also been a contributing factor. Whatever the reason, the Atlantic bumper, a forage species, has become the dominant species on coastal platforms in the Northern Gulf in recent years (since about 2015). Apparently, it was not abundant or even present on platforms from the 1970s to the early 2000s.

At the average Offshore and/or Bluewater Platform (31- to 90- m deep), 10 species comprised 93% of the numerical abundance and adding the unidentified component raised the total percent to 95% (Table 5). The 10 dominant species were blue runner (3,971), red snapper (2,980), vermilion snapper (3,506), Bermuda chub (838), gray snapper (491), leatherjack (706), Atlantic cumper (841), greater amberjack

(487), Atlantic spadefish (481), and Crevalle jack (326). Again the results are consistent with historical knowledge (LGL 2017a) with the exception of Atlantic bumper, as noted above.

We documented 13 species to occur at Shelf-Edge Platforms (91- to 300- m deep) based on SRV surveys (Table 5). Unidentified baitfish dominated the estimates of total abundance (13,090 of 20,284 total fish) but the deep platforms, on average, were characterized by Crevalle jack (2,074) and Bermuda chub (1,405). Other notable species present included great barracuda (478), horse-eye jack (416), greater amberjack (587), rainbow runner (405) and red snapper (133). The 13 documented species comprised 97% of the total abundance.

Abundance-by-vertical depth estimates for all 36 species for each of the four bottom depth zones are shown in Appendix 3 of LGL 2019. Vertical abundance patterns for key federally managed species will be discussed below. Vertical abundance and distance from platform will be key factors in the model used to predict mortality from explosive decommissioning activities.

Though the focus of the project was specific numbers of individual fish species, the "raw" hydroacoustic information was also highly useful in providing information concerning the general abundance of fish around platforms. Hydroacoustic data of fish density in number of fish/m3 is plotted with increasing distance from the platforms as a boxplot in Figure 4. This shows how the overall fish density declines with increasing distance from the center of each platform at the seafloor and provides reassurance that we are capturing the platform associated fish. In 2017, differences between distance zones were statistically significant ($F = 38.511$, $p < 0.001$) with the greatest difference between the 0-25m and 75-100m zones ($Z=16.29$, $p < 0.001$), and similarly in 2018 significant differences were seen ($F = 57.33$, $p < 0.001$) with the greatest difference being between the 0-25m and >100m zones, unsurprisingly ($Z=26.136$, $p < 0.001$).

Table 5. Model estimates of the abundance of fish at the “average platform” in the four depth zones defined in this study

(For additional detail see Appendix Table 2.1)

	Depth zone (m)			
Common Name	**10–17**	**18–30**	**31–90**	**91–300**
Amaco jack	5	16	129	111
Angelfish sp.	0.4	2	47	0.7
Atlantic bumper	4,362	6,227	841	324
Atlantic moonfish	19	514	97	23
Atlantic spadefish	1,815	926	481	60
Bar jack	1	4	13	178
Bermuda chub	39	162	838	1,405
Black jack	0.1	0.2	0.1	23
Blue runner	622	1,712	3,971	691
Bluefish	2	4	0.6	0.6
Butterflyfish sp.	0.1	0.4	8	0.2
Cobia	57	13	24	1.4
Crevalle jack	16	148	326	2,074
Dog snapper	0.2	0.1	0.5	0.05
Filefish sp.	-	-	0.2	-
Gray snapper	137	400	491	37
Gray triggerfish	1.3	13	63	2
Great barracuda	4	27	75	478
Greater amberjack	14	32	487	587
Grouper sp.	0.2	0.7	16	0.3
Guaguanche	3	32	22	2
Gulf menhaden	67	2,876	169	105
Horse-eye jack	3	19	86	416
kKng mackerel	4	81	38	5
Leatherjack	26	105	706	45
Lookdown	3	26	107	8
Ocean triggerfish	0.6	1	10	20
Rainbow runner	13	266	53	405
Red drum	0.1	4	0.2	0.2
Red snapper	359	1,015	2,980	133
Sheepshead	0.3	19	6	1
Spanish hogfish	0.1	0.3	2	0.1
Spanish mackerel	0.2	-	0.1	-
Unidentified fish	142	250	276	13,090

	Depth zone (m)			
Common Name	**10–17**	**18–30**	**31–90**	**91–300**
Vermilion snapper	45	118	3,506	57
Yellow jack	0.8	0.9	7	0.5
Total	**7,764**	15,014	15,877	20,284
Confidence Intervals	(1975-30517)	(8593-26234)	(6349-39700)	(10169-40459)

7	26	32	13
7,494	14,784	15,707	19,611
96.5	98.5	98.9	96.7

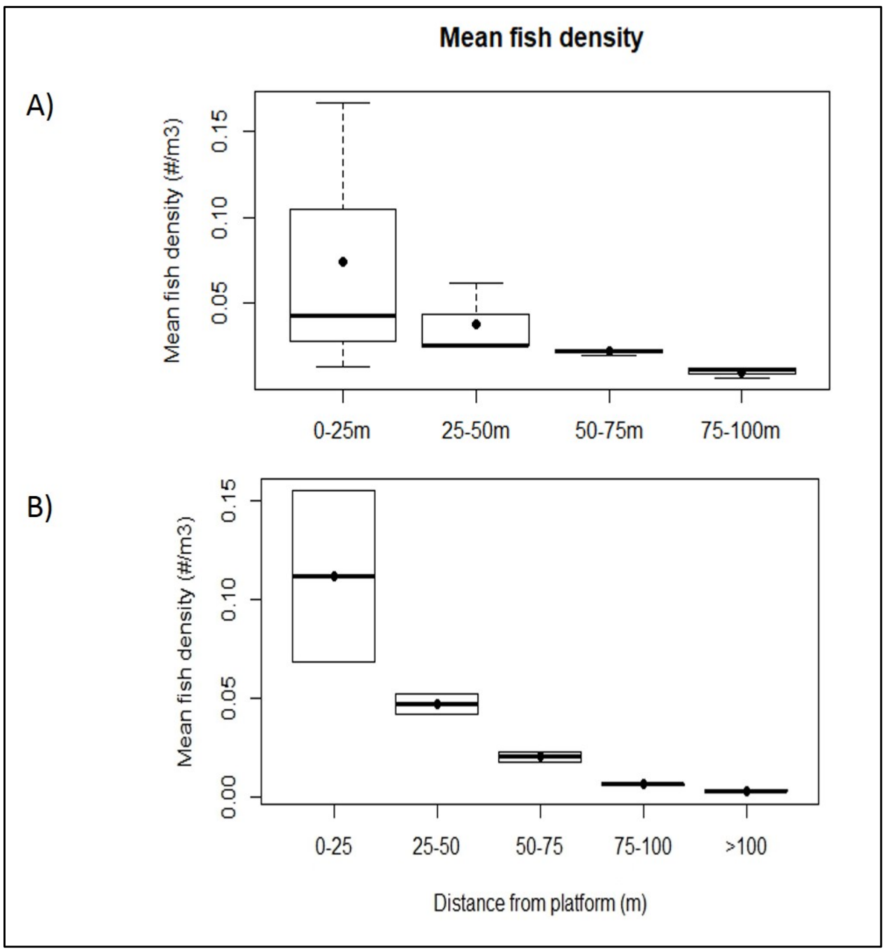

Figure 4. Acoustic fish density in number of fish/m3 with increasing distance from platform across all a) 2017 survey sites and b) 2018 survey sites.

Box plots show median values (solid horizontal line) and means (black dot). The lower and upper ends of the box are the 25% and 75% quartiles, respectively.

2.3.2 Species Accounts

We discuss each of the five selected species in order of their overall stock size estimate. Red snapper has the largest stock of our selected species (36.8 million fish), followed by vermilion snapper (30.1 million fish), gray triggerfish (2.8 million fish), greater amberjack (696 thousand fish), and cobia (424 thousand fish).

2.3.2.1 Red Snapper

The red snapper is one of, if not the, most valuable finfish in the Gulf recreational and commercial fisheries (SEDAR 2018). It occurs throughout the Gulf and is considered to be represented by two stocks, divided at the mouth of the Mississippi River. The Gulf-wide stock of age 2+ fish is estimated to consist of nearly 37 million individuals; 13 million fish in the East and 24 million fish in the West (see Table 3 above). In our study, red snapper ranked 4th in overall abundance (Table 5).

2.3.2.1.1 Distribution and Abundance

Red snapper were most abundant at offshore platforms within the 31- to 90- m bottom depth range (2,980 fish typically present with a 95% confidence interval of 875 to 10,152, Table 5), followed by abundance at platforms in the 18- to 30- m bottom depth range where 1,015 fish (confidence interval: 541 to 1904) were typically present. About 359 red snapper were estimated at shallow platforms (10- to 17- m bottom depth). At deeper (91- to 300- m bottom depth) platforms, on the order of 133 fish were seen. Using the abundance levels from Table 5 and the number of platforms present by bottom depth and State Management Zone in 2017 and 2018 (Table 1), we estimate that about 5.3% of the total age 2+ red snapper stock resided on platforms in 2017 and 4.9% in 2018 following the removal of 89 platforms (Table 6). Approximately 75% of the age 2+ red snapper estimated to occur on offshore platforms in the Gulf occurred in the Louisiana Management Zone.

Vertical distribution patterns for age 2+ red snapper determined from the hydroacoustic/SRV surveys (Appendix 3 of LGL 2019) show that, for the average platform within the 18- to 30- m bottom depth zone, this species was present throughout the water column, but was more abundant at depths of 13 to 22 m (490 fish) and 22 to 30 m (315 fish) than in the upper water column (210 fish between 3 to 12 m in depth) (see Appendix 3 of LGL 2019). Similarly, red snapper occurred throughout the water column at platforms in the 31- to 90- m depth zone but were least abundant in the surface layer. Abundance by depth at these sites ranged from 575 to 768 fish at depths between 13 and 32 m, and from 282 to 487 fish were present at depths of 33m to the bottom. As will be shown below, red snapper remained close to the platform with 98% of all positions measured in the telemetry study being either within or adjacent to the platform.

Before Williams-Grove and Szedlmayer (2017), the common view was that the red snapper was a demersal fish species exhibiting a high association with low relief bottom standing throughout their life span. However, in recent years, anecdotal accounts from fishers began to suggest upper water column use by this species. Williams-Grove and Szedlmayer (2017) documented red snapper tended to stay at deeper depths during colder months (<3m from the seafloor) but moved up in the water column more frequently during spring and summer months. Their results were consistent with our findings.

2.3.2.1.2 Site Fidelity

A total of 764,515 red snapper positions from 54 individuals (from the total of 81 red snapper tagged with acoustic telemetry tags) were recorded. These data were analyzed from the three primary sites (Sites 6, 9, 30) from March 2017 to May 2018. Red snapper remained close to platform structure with 98% of all positions either within or near the structures (LGL et al. 2018b). Over all sites, red snapper were, on average, located 28.2 ± 33.9M from the platforms (Everett et al. in prep). Observed home range estimates (95% KDE) for an individual fish at each of the three sites are shown by Figure 5. Overall, least square mean (LSM) home range estimates based on all red snapper at each site ranged from a high of 35,026 m2 at the West site to a low of 15,199 m2 at the East site. The home range estimate for the Central site was 22,749 m2. red snapper at the East and Central sites showed no significant differences in area used between diel periods, but fish at the West site showed significantly increased area used during the midday as compared to night, dawn and dusk. Area use was largest in summer and fall and smallest during winter (LGL et al. 2018b).

Site fidelity on platforms was 30% per year; i.e., 30% of the fish remained at the site marked for an entire year. Of the 22 fish that emigrated from the marking sites, 9 showed homing behavior and returned to their original release site. Residence time (50% of the fish still present) was 11 months. Fishing mortality (F) for red snapper at all sites was high (F=0.75, LGL et al. 2018b). Whereas, the estimate of natural mortality was low (M=0.06; 95% Confidence Limits 0.01 to 0.22).

Table 6. Estimated abundance of Age 2+ red snapper at platforms within each of our four bottom depth zones, 2017 and 2018

A) Age 2+ Red Snapper by Year and Depth Zone (Median Estimates with Confidence Limits)

	2017			**2018**		
Depth Zone (m)	**LCL**	**Median**	**UCL**	**LCL**	**Median**	**UCL**
10–17	35,156	134,247	511,258	32,524	124,197	472,982
18–30	133,627	250,774	470,288	123,889	232,499	436,016
31–90	455,000	1,549,523	5,279,040	423,500	1,442,249	4,913,568
91–300	29,274	8,568	24,570	27,552	8,064	23,125
Total		**1,943,113**			**1,807,008**	

B) Age 2+ Red Snapper by State and Depth Zone, 2017 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	10,769	26,397	148,993	2,232	188,390
LA	106,608	201,025	1,150,223	4,752	1,462,609
MS	13,999	20,306	199,650	936	234,891
AL	2,872	3,046	50,657	648	57,223
				2017 Platform Total	**1,943,113**
				GOM Stock Size	36,738,000
				Percent of Stock on Platforms	5.3

C) Age 2+ Red Snapper by State and Depth Zone, 2018 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	9,333	23,351	140,053	1,872	174,609
LA	98,711	188,842	1,060,827	4,680	1,353,061

MS	13,999	17,260	196,670	936	228,865
AL	2,154	3,046	44,698	576	50,473
				2018 Platform Total	**1,807,008**
				GOM Stock Size	36,738,000
				Percent of Stock on Platforms	4.9

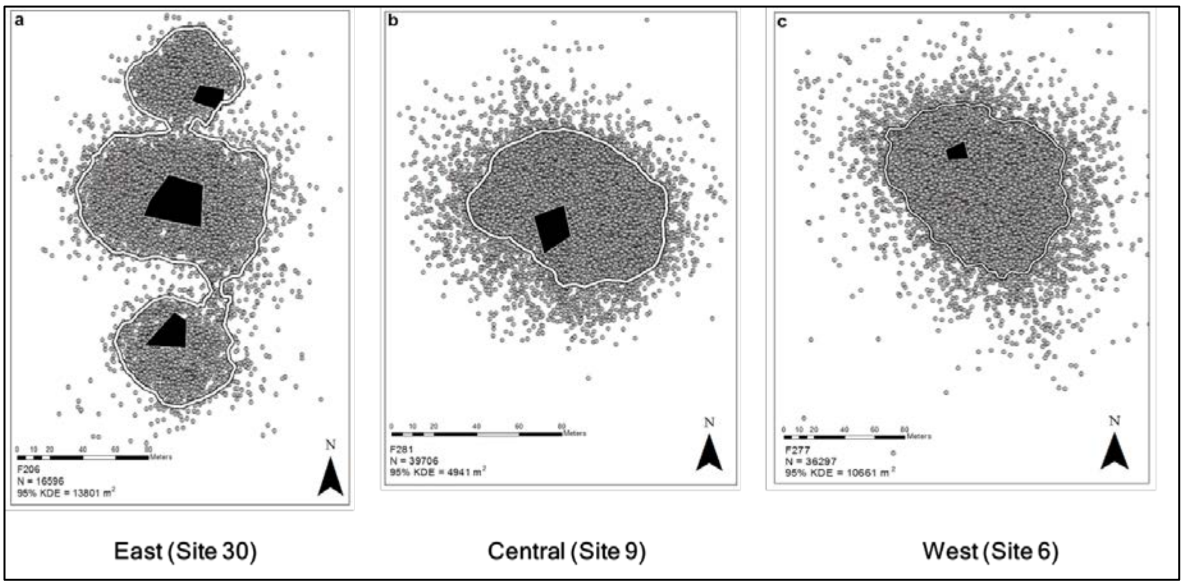

Figure 5. Home range (95% kernal density estimate) of an individual red snapper at each of the three sites is illustrated with a white line.

Two previous telemetry studies of red snapper on Louisiana offshore platforms (Peabody 2004, McDonough and Cowan 2007) reported lower site fidelity than we observed. Peabody (2004) observed high site fidelity in the first five months of a 202-d long study followed by low site fidelity in later months. The low site fidelity observed after the first few months may have been related to red snapper movements or a number of other factors. Peabody (2004) reported three possible difficulties that may have reduced site fidelity: variable transmitter detection range, thermoclines causing reduced detections, and transmitter battery failures. The transmitter detection range was greatly reduced (ranging from 30 to 180 m) compared with previous studies that indicated a high detection rate (~50%) out to 800 m with a maximum detection of 1600 m (Szedlmayer and Schroepfer 2005; Topping and Szedlmayer 2011b).

McDonough and Cowan (2007) tracked red snapper on a single platform with the Vemco Radio-linked Acoustic Positioning system (VRAP, Vemco, Bedford, Nova Scotia) that had a hard wire link between all receivers allowing fine-scale movement estimates. This system was the predecessor of the VPS system and has been discontinued. red snapper of unspecified sized (N = 20) were caught from several platforms but all were released on the same platform. Movements from 15 fish were tracked for a limited time period (14 days), and low residency was reported, with only five fish remaining at their release site until the end of the study. This study also reported a short detection range (150 m), which was attributed to acoustic noise on the active production platforms. In both of these platform studies that reported low site fidelity, short study periods, structural interference, and equipment failure prevented long-term tracking of red snapper. All things considered, we believe the present study represents the best estimate of red snapper site fidelity at offshore petroleum platforms.

2.3.2.1.3 Mark and/or Recapture Population Estimates at Platforms

As a way of verifying our abundance estimates for red snapper based on the hydroacoustic and/or SRV approach, we obtained mark and/or recapture abundance estimates at selected sites (Figure 6). Ten mark/recapture estimates were available for the 18–30 m depth zone across site-year combinations and ranged from 447 to 5,347. The median value from these ten estimates was 1,166, which was remarkably close to our hydroacoustic/SRV median estimate of 1,015 for this depth zone. No mark and/or recapture estimates were obtained from the 10–17 m and 91–300 m depth zones, and only one estimate was available for 31–90 m. This one estimate, 534, was lower than the hydroacoustic/SRV median estimate of 2,980.

2.3.2.1.4 Age Distribution

In all, there were 2,155 red snapper aged from otolith cross sections; after filtering for missing independent variables, 1,900 remained for analysis. Only one red snapper was caught in the 91–300 m depth zone and was not reported. Because the sample sizes varied by combinations of the various factor levels, means are reported as marginal means across all factor combinations.

The age distribution for red snapper increased with depth zone (Figure 7; $p<0.0001$); modal ages were ages 2–3 for 10-17 m, age 3 for 18–30 m, and age 5 for 31–90 m. Year was also significant and modes at ages 3 and 5 in 2017 clearly translated into modes at ages 4 and 6 in 2018. Though the hook size was significant at $p=0.0343$, the biological significance appeared negligible. Age structure did not differ between sexes.

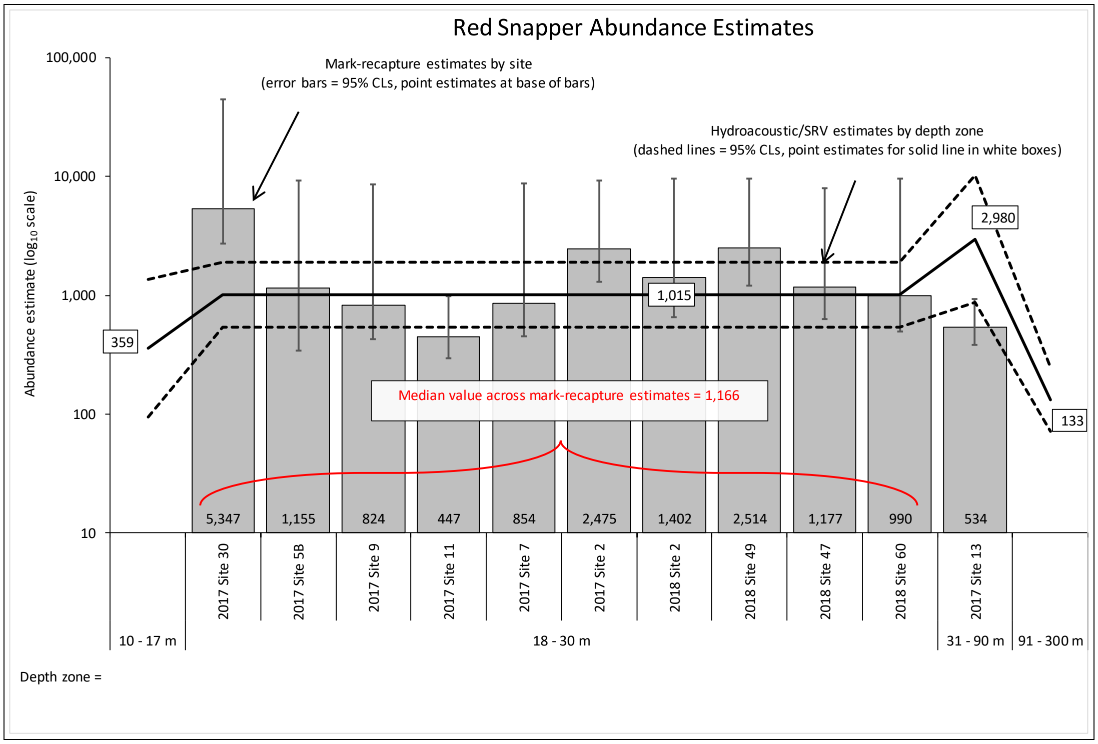

Figure 6. Comparison of abundance estimates made with the hydroacoustic and/or SRV approach and mark and/or recapture method for selected sites.

The hydroacoustic/SRV estimates represent median values; as such, the median value is reported for the mark/recapture estimates within the 18–30 m depth zone (point estimates for each site are given at the base of each bar).

2.3.2.1.5 Growth and Condition

Length at age was modeled for each depth zone with a three parameter Von Bertalanffy growth equation (Figure 8). Fitted curves were similar across all depth zones and to the curve reported in SEDAR 31 (Figure 9). Though no analyses were performed to test for statistical significance of differences, these plots indicate there was little if any biological significance.

Weight-length relationships were compared between males and females, depth zones, and ages (Figure 10) to assess condition. None of the comparisons demonstrated statistically or biologically significant differences.

2.3.2.2 Vermilion Snapper

The vermilion snapper population is centered in the Gulf but ranges north to North Carolina and south to Brazil (Grimes et al.1982). This species occurs in moderately deep (40–300 m) waters, most commonly over rock, gravel, or sand bottoms near the edge of the continental shelf. Vermilion snapper are generalist predators that are able to feed on benthic and pelagic fishes, shrimp, crabs, polychaetes, cephalopods, and other invertebrates (Sedberry and Cuellar 1993). Vermilion snapper share similar habitats and diets as red snapper, though red snapper are more voracious predators. In our study, the vermilion snapper ranked fifth in overall abundance of fishes present on offshore platforms area during 2017 and 2018. Vermilion snapper were present at all depth zones but were most abundant at platforms within the 31- to 90- m depth range. Within this depth range, the average platform harbored 3,506 vermilion snapper (95% CI: 428–28,743) as shown by Table 5 and/or Appendix Table 2.1. Using the abundance levels from Table 5 and the numbers of platforms present by bottom depth and State Management Zone in 2017 and 2018 (Table 1), we estimate that about 6.2% of the total age 2+ vermilion snapper resided on platforms in 2017 and a similar percentage, about 5.8% was estimated for 2018 (Table 7). Considering the numbers of platforms in each state management and depth zone, approximately 75% of the total vermilion snapper on platforms occurred offshore Louisiana. As shown in Appendix 3 of LGL (2019), this species was most abundant at depths between 13 and 72 m, as compared to shallower and deeper water layers. Few were observed within the 12- m deep layer in the 31- to 90- m bottom depth zone where vermilion snapper was most abundant.

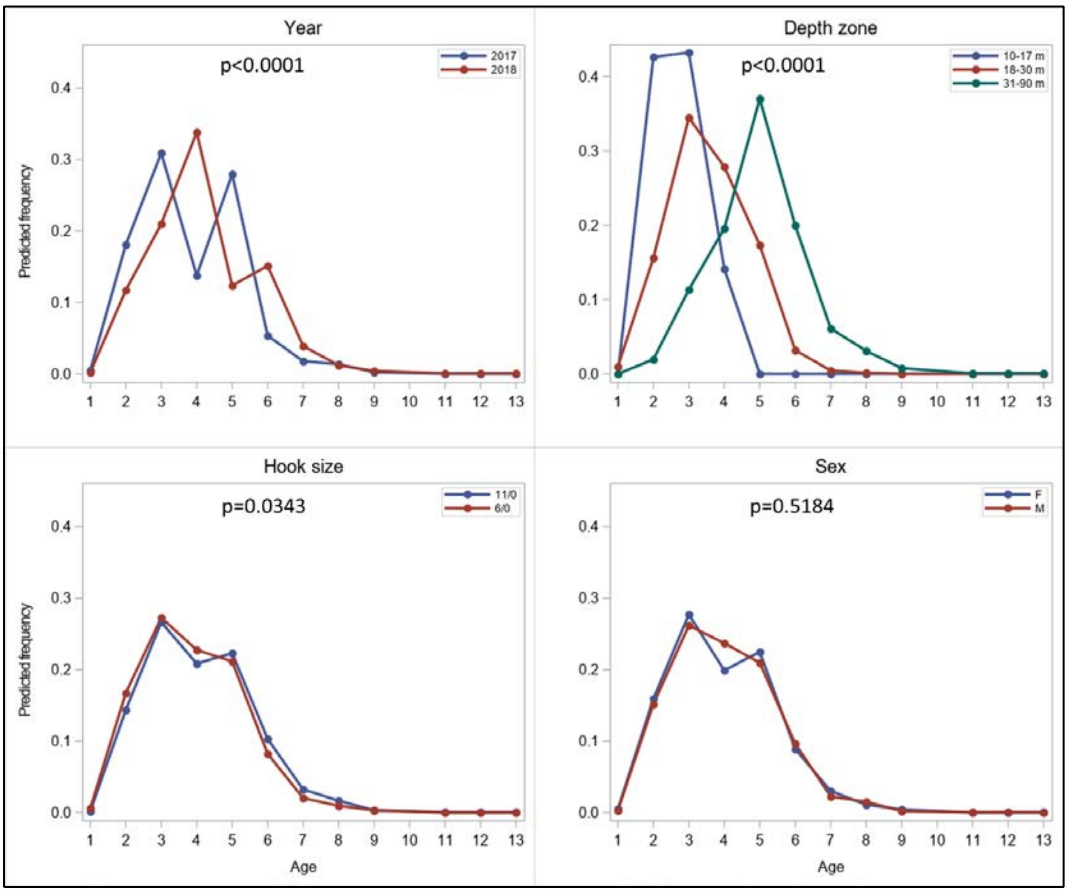

Figure 7. Comparison of age distributions for year, depth zones, and hook size.

Type III p-values are given for each comparison.

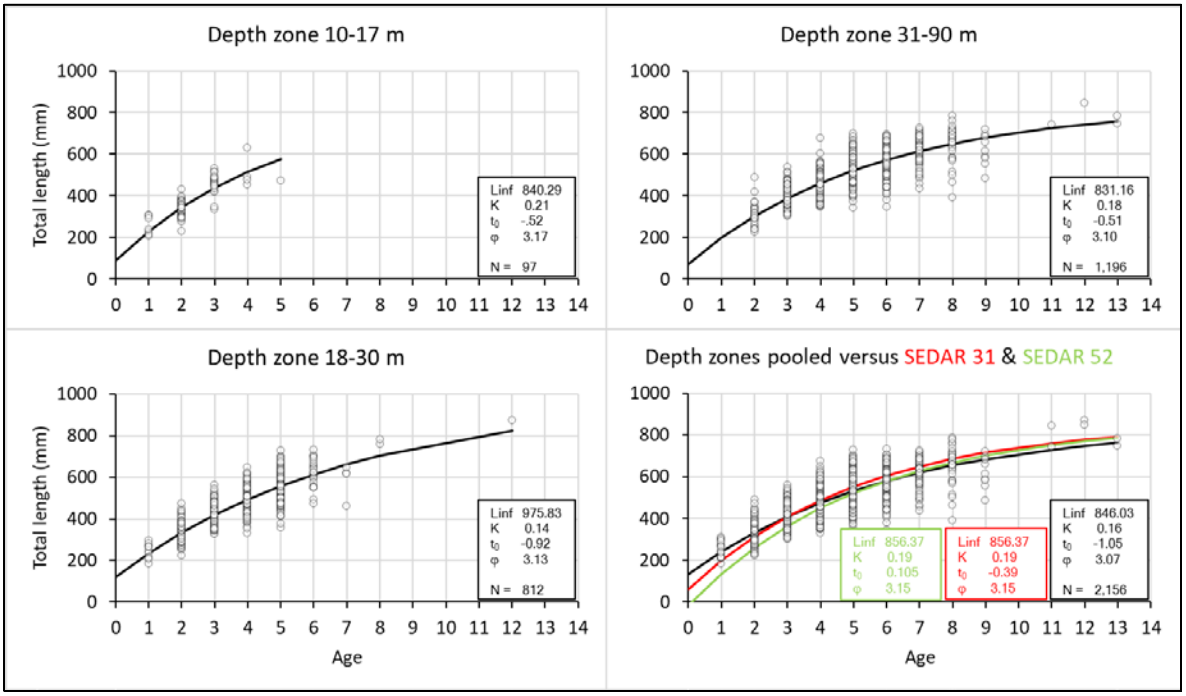

Figure 8. Von Bertalanffy curves by depth zone and pooled compared to SEDAR estimates.

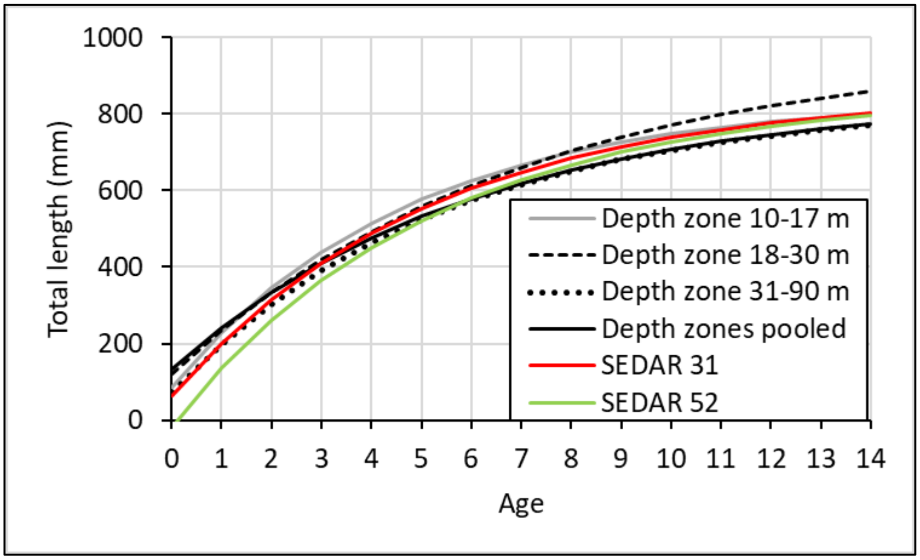

Figure 9. Comparison of Von Bertalanffy curves among depth zones and SEDAR estimates.

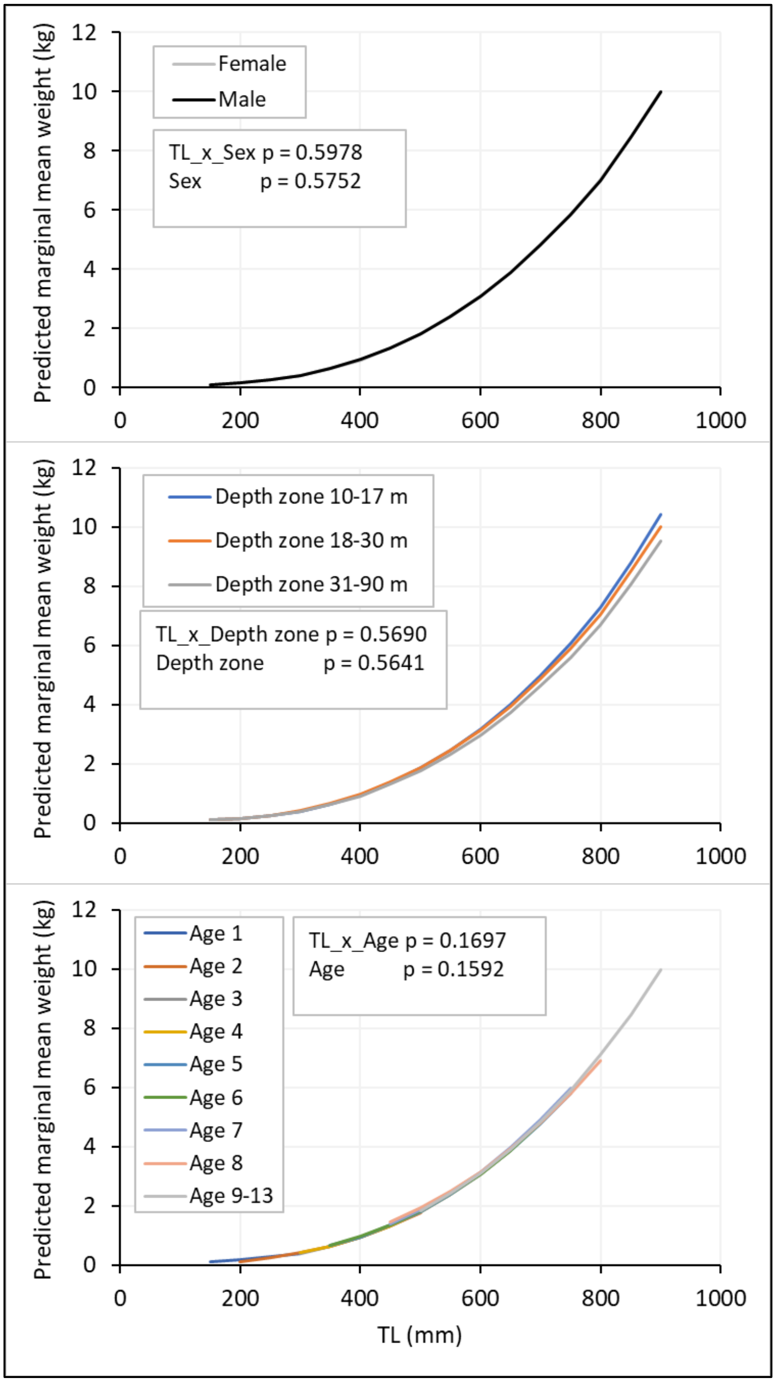

Figure 10. Comparison of weight compared to length relationships for gender, depth zones, and ages.

2.3.2.3 Gray Triggerfish

The gray triggerfish was reported by Gallaway (1981), Gallaway and Lewbel (1982), Stanley and Wilson (2003) and Gitschlag et al. (2000) as being one of the more abundant species associated with platforms at bottom depths greater than 20 m. In this study, gray triggerfish were not abundant (ranked 22nd in overall abundance), ranging from about only 1 to 63 fish at the "average platform" over all depths (Table 5). We suspect that this might reflect a sampling problem and that many more gray triggerfish were present at our study sites but were within the structure itself where they could not be counted. Based on our estimates, only about 1.0% of the age 2+ gray triggerfish stock occurred at platforms (Table 8).

2.3.2.4 Greater Amberjack

Greater amberjack ranked 10th in overall abundance in our study (Table 5). The "average platform" within the 31- to 90- m bottom depth zone was characterized by 487 (176-1,347) greater amberjack and similar numbers were estimated to occur on the average platform within the 91- to 300- m bottom depth zone (median estimate was 587 fish with a confidence interval of 313-1,095 specimens). Most of the greater amberjack collected at platforms were relatively large fish, averaging over 28 lbs. each. Considering only age 2+ fish, a total of 336,210 fish were at offshore platforms in 2017 and 313,602 fish were present at these habitats in 2018 (Table 9). The estimates, if accurate, would suggest that about 48% of the stock resided on platforms in 2017 and that number was reduced to 45% in 2018 due to the removal of 89 platforms. The vast majority of the greater amberjack occurred in the Louisiana Management zone where deep platforms are most abundant (Table 9).

Greater amberjack were most abundant in the water column at depths between 13 to 32 m (118 to 140 fish present, on average) based on the "average platform "within the 31- to 90- m depth zone. In the deep zone (91- to 300- m deep), the high abundance zone shifted to depths between 33 and 52 m (see Appendix 3 in LGL 2019).

2.3.2.5 Cobia

Cobia are usually thought of as being generally solitary but are also common in pairs and/or small groups ranging up to 8 or more fish. Cobia ranked 21st in total abundance in our study. The number of cobia present on an "average platform" in water 10- to 17- m deep, 18- to 30- m deep, 31- to 90- m deep and 91- to 300- m deep was 57 (14–230), 13 (6–26), 24 (16–36) and 1.4 (0–5) fish, respectively (Table 5). Collectively, these numbers, used in combination with the total number of platforms within each depth zone, suggest that 37,045 cobia were present on platforms in 2017 and 34,350 cobia were present in 2018 following the removal of 89 platforms between years (Table 10). On the order of 8 to 9% of the Gulf cobia stock occurs on platforms, mostly in Louisiana where platforms are the most numerous (SEDAR 2013). In general, cobia were typically more abundant in the upper 12 to 22 m of the water column (see Appendix 3 in LGL 2019).

3 Explosive Removal Impacts

The UnderWater Calculator version 1 (UWC), was the underwater acoustic shock propagation model used for this study. A description of the UWC and the motivation for its selection over other models are detailed elsewhere (Dzwilewski and Fenton 2003; GSI and LGL 2017). User input to the UWC includes detonation charge specifications (explosive type and weight), pile specifications (diameter and wall thickness), source (charge) depth, and receiver (e.g., fish) depth. In addition, the UWC offers three bottom boundary conditions to be specified by the user: water (free space), soft clay, and stiff clay. The UWC fixes the explosive coupling efficiency for these bottom types at 43.51%, 37.90%, and 34.37%, respectively.

Table 7. Estimated abundance of age 2+ vermilion snapper at platforms within each of our bottom depth zones, 2017 and 2018, by state and bottom depth zone 2017 and 2018

A) Age 2+ Vermilion Snapper by Year and Depth Zone (Median Estimate with Confidence Limits)

	2017			2018		
Depth Zone (m)	**LCL**	**Median**	**UCL**	**LCL**	**Median**	**UCL**
10–17	4,114	16,708	67,320	3,806	15,457	62,280
18–30	16,549	29,242	51,870	15,343	27,111	48,090
31–90	222,560	1,823,235	14,946,360	207,152	1,697,011	13,911,612
91–300	3,570	6,783	12,971	3,360	6,384	12,208
Total		**1,875,967**			**1,745,963**	

B) Age 2+ Vermilion Snapper by State and Depth Zone, 2017 (Median Estimate)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	1,340	3,078	175,311	1,767	181,496
LA	13,268	23,441	1,353,401	3,762	1,393,872
MS	1,742	2,368	234,917	741	239,768
AL	357	355	59,606	513	60,831
				2017 Platform Total	**1,875,967**
				GOM Stock Size	30,184,024
				Percent of Stock on Platforms	6.2

C) Age 2+ Vermilion Snapper by State and Depth Zone, 2018 (Median Estimate)

State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	1,161	2,723	164,792	1,482	170,159
LA	12,285	22,020	1,248,214	3,705	1,286,225
MS	1,742	2,013	231,411	741	235,906
AL	268	355	52,593	456	53,673
				2018 Platform Total	**1,745,963**
				GOM Stock Size	30,184,024
				Percent of Stock on Platforms	5.8

Table 8. Estimated abundance of age 2+ gray triggerfish at platforms within each of our bottom depth zones, 2017 and 2018, by state and bottom depth zone 2017 and 2018

A) Age 2+ Gray Triggerfish by Year and Depth Zone (Median Estimates with Confidence Limits)

	2017			**2018**		
Depth Zone (m)	**LCL**	**Median**	**UCL**	**LCL**	**Median**	**UCL**
10–17	42	485	4,114	39	449	3,806
18–30	1,482	3,174	6,311	1,374	2,943	5,851
31–90	20,800	32,973	52,520	19,360	30,690	48,884
91–300	119	251	714	112	236	672
Total		**36,883**			**34,318**	

B) Age 2+ Gray Triggerfish by State and Depth Zone, 2017 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	39	334	3,170	65	3,609
LA	385	2,544	24,476	139	27,545
MS	51	257	4,248	27	4,583
AL	10	39	1,078	19	1,146
				2017 Platform Total	**36,883**
				GOM Stock Size	2,822,750
				Percent of Stock on Platforms	1.3

C) Age 2+ Gray Triggerfish by State and Depth Zone, 2018 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	34	296	2,980	55	3,364
LA	357	2,390	22,574	137	25,458
MS	51	218	4,185	27	4,481
AL	8	39	951	17	1,014
				2018 Platform Total	**34,318**
				GOM Stock Size	2,822,750
				Percent of Stock on Platforms	1.2

Table 9. Estimated abundance of age 2+ greater amberjack at platforms within each of our bottom depth zones, 2017 and 2018, by state and bottom depth zone 2017 and 2018

A) Age 2+ Greater Amberjack by Year and Depth Zone (Median Estimates with Confidence Limits)

Year:	**2017**			**2018**		
Depth Zone (m)	**LCL**	**Median**	**UCL**	**LCL**	**Median**	**UCL**
10 - 17	1,122	5,226	22,440	1,038	4,835	20,760
18 - 30	4,199	7,910	14,573	3,893	7,334	13,511
31 - 90	91,520	253,279	700,440	85,184	235,744	651,948
91 - 300	37,247	69,795	130,781	35,056	65,689	123,088
Total		**336,210**			**313,602**	

B) Age 2+ Greater Amberjack by State and Depth Zone, 2017 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**31–300**	**Total**
TX	419	833	24,354	18,182	43,787
LA	4,150	6,341	188,011	38,710	237,212
MS	545	640	32,634	7,625	41,444
AL	112	96	8,280	5,279	13,767
				2017 Platform Total	**336,210**
				GOM Stock Size	695,549
				Percent of Stock on Platforms	48.3

C) Age 2+ Greater Amberjack by State and Depth Zone, 2018 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	363	737	22,893	15,249	39,242
LA	3,843	5,956	173,399	38,123	221,321
MS	545	544	32,147	7,625	40,861
AL	84	96	7,306	4,692	12,178
				2018 Platform Total	**313,602**
				GOM Stock Size	695,549
				Percent of Stock on Platforms	45.1

Table 10. Estimated abundance of age 2+ cobia on the platforms within each of our bottom depth zones, 2017 and 2018, by state and depth zone 2017 and 2018

A) Age 2+ Cobia by Year and Depth Zone (Median Estimates with Confidence Limits)

Year:	**2017**			**2018**		
Depth Zone (m)	**LCL**	**Median**	**UCL**	**LCL**	**Median**	**UCL**
10 - 17	5,236	21,365	86,020	4,844	19,765	79,580
18 - 30	1,598	3,216	6,391	1,482	2,981	5,925
31 - 90	8,320	12,303	18,720	7,744	11,451	17,424
91 - 300	21	162	595	20	152	560
Total		**37,045**			**34,350**	

B) Age 2+ Cobia by State and Depth Zone, 2017 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	1,714	338	1,183	42	3,277
LA	16,966	2,578	9,133	90	28,766
MS	2,228	260	1,585	18	4,091
AL	457	39	402	12	910
				2017 Platform Total	**37,045**
				GOM Stock Size	423,955
				Percent of Stock on Platforms	8.7

C) Age 2+ Cobia by State and Depth Zone, 2018 (Median Estimates)

	Depth zone (m)				
State	**10–17**	**18–30**	**31–90**	**91–300**	**Total**
TX	1,485	299	1,112	35	2,932
LA	15,709	2,421	8,423	88	26,642
MS	2,228	221	1,562	18	4,028
AL	343	39	355	11	748
				2018 Platform Total	**34,350**
				GOM Stock Size	423,955
				Percent of Stock on Platforms	8.1

The minimum slant range (distance) to a defined peak acoustic pressure is a function of said pressure, the explosive weight, and two Swisdak Similitude Coefficients specific to a given explosive (Dzwilewski and Fenton, 2003). The UWC includes four built-in types of explosive material (TNT, pentaerythritol tetranitrate, H6, and C-4) as well as allows user-defined Swisdak Similitude Coefficients for other explosives. For the four types of explosives included in the UWC, relevant Swisdak coefficients K and a range from 52.4–60.6 and 1.13–1.22, respectively. The explosive material utilized for platform removals during the hydroacoustic measurements of this report was Composition B (Comp-B). Unfortunately, Swisdak coefficients were unavailable for Comp-B. Such coefficients were available for mixtures HBX-1 and HBX-3 (Kaye, 1983), initially thought to be similar to Comp-B based upon their peak pressure equivalents in free air (Brown, 1986). However, when these coefficients were applied in the UWC, they predicted weaker explosions than TNT, yet TNT Equivalent Weight Factors were known for Comp-B to range from 1.11 (NATO, 2010) to 1.35 (Dahl, 2016). That is, a given Comp-B charge should yield the same impact as a TNT charge with 11–35% larger mass. Consequently, to accommodate Comp-B, rather than relying upon Comp-B-specific Swisdak coefficients which were unavailable, Swisdak coefficients for TNT were used as input, and a TNT Equivalent Weight Factor for peak pressure was added to the UWC. For this study, the aforementioned TNT Equivalent Weight Factors for Comp-B were used as bounding values to adjust the effective weight of the explosives. The additional user input of a TNT Equivalent Weight Factor to the UWC in and of itself does not affect the modeled impacts, although the increased effective weight of Comp-B relative to TNT certainly does.

This study analyzes the explosive severance of four types of pipes: piles, conductors, skirt piles, and caissons. The UWC was designed for piles and lacks a method for modeling other types of pipes. This study treated all pipe types the same except for the 11 sites that had conductors with internal concentric pipes. Although the thickness of the internal pipes was available, their diameters were not. The UWC is based upon parametric numerical simulations of “typical pile diameters” of 24, 36, 48, and 72 in (Dzwilewski and Fenton, 2003) and, thus, treats any pipes with diameters less than 24 in (61.0 cm) as having no effect on the efficiency of the transmitted shock wave. Therefore, for the results in this report, two pipe cases were considered. One case was Small Internal Pipes, in which the internal pipes were less than 24” in diameter and, thus, assumed to have no effect on acoustic energy. In this case, only outer pipe specifications were used in the UWC. The second case was Large Internal Pipes, which assumed the outer diameter of the internal pipe was as large as the inner diameter of the largest pipe. In this case, the sum total of the wall thicknesses of all concentric pipes was entered into the UWC model as a single pipe wall thickness.

In its forward calculation, the UWC estimates underwater shock wave parameters such as the peak pressure, impulse, and energy flux density for a user-specified source-to-receiver slant range. In its backward or inverse calculation, the UWC estimates the slant range from the explosive charge to a user-specified energy flux density or peak pressure value. In this study, the range of received peak sound pressure level (SPL_{peak}) of 229–234 dB re 1µPa was adopted as the acoustic threshold for mortal and potential mortal injury to fish (Popper et al., 2015), and the inverse calculation was performed to determine the ranges to that threshold.

For each pipe explosion, the inverse calculation was performed twice: once to calculate a narrow range of mortal injury using the most conservative model input values and a second time for a wider range of potential mortal injury using the least conservative values (Table 11).

Table 11. Bounding model cases

Variable	Narrow Range (Less Conservative)	Wide Range (More Conservative)
Sediment type	Stiff clay	Soft clay
Pipe option	Large internal pipes	Small internal pipes
SPL_{peak}	234 dB re 1 µPa	229 dB re 1 µPa

One set of estimates is based on the less conductive stiff clay, the large internal pipe option (i.e., all internal concentric pipes are large enough to consider in the thickness of the outer pipe), and the higher peak pressure mortality threshold. The second set of estimates are based on the more conductive soft clay, small internal pipe option (i.e., all internal pipes are smaller than 24 in (0.61 m) and, thus, do not affect calculations), and the lower peak pressure mortality threshold.

The range of each randomly placed fish to each explosion was calculated and the count of lethal exposures tallied. Minimum and maximum exposure levels, as well as the total number of exposures (most sites involved multiple explosions), were recorded for any fish located farther than the defined lethal range based on the UWC forward calculation.

Below, we first describe methods and results obtained from modeling the effects of the explosive removal activities on the mortality of the resident fish based upon three scenarios: 1) the actual explosive removals of 24 platforms in 2017 and 23 platforms in 2018; 2) the effects that would occur if all the remaining platforms in the study area were removed in a single year; and 3) the effects of removing all the remaining platforms within a 100 mile radius of major fishing ports. The last section of the report provides an assessment of the predicted effects using existing stock assessment models for each of the five selected species.

3.1 Estimation of Effects

As described above, we organized our effects description around three scenarios: the actual removals that occurred in 2017 and 2018 (the years of our study), the removal of all the remaining platforms in federal waters in a single year and the removal of all platforms within 100-miles of major ports.

3.1.1 2017 and 2018 Removals

3.1.1.1 Model Results

In 2017 and 2018, 329 explosions were used to sever 319 pipes at 47 platforms in water depths ranging from 10 m to 93 m. These 47 platforms were divided into four depth zone categories as follows:

Depth Zone	Water Depth	2017	2018	Number of Platforms
A	10–17 m	3	11	14
B	18–30 m	12	1	13
C	31–90 m	8	10	18
D	91–300 m	1	1	2

A listing of each platform and its attributes used in the assessment is provided as Appendix 1 in Conrad et al. (2019). Detailed structural plans were available for only a subset of the platforms. For those platforms with very limited or no available structural information other than depth, the depth zones were used, in part, to estimate platform size and pipe orientation.

The explosive material used in the 2017–2018 removals was Comp B, a mixture of the explosives RDX and TNT along with paraffin wax (see Appendix 2 in Conrad et al. 2019). The standard proportions are 59.5% RDX, 39.4% TNT, and 1% wax. The explosions generally used 36.3–90.7 kg (80–200 lbs) of explosive material. At platform B1_2018, three explosions were made using 36.3 kg (80 lbs) each of Comp B. In addition, two explosions were made using only 3.2 kg (7 lbs) of explosive material each, and one explosion was made using 15.0 kg (33 lbs) of Comp B. Using such small quantities of Comp B to sever pipes was atypical.

The explosions severed pipes having diameters 0.25–1.8 m (10–72 in) with wall thicknesses generally ranging between 1.0–6.35 cm (0.38–2.5 in). Platforms A8_2018 and A11_2018 had conductors with wall thicknesses of 29.2 cm (11.5 in) and 22.6 cm (8.88 in), respectively, but these were unusually thick. Data on abundance of fishes were binned with respect to horizontal distance from the platforms and vertical depth below the water surface (see Appendices 3 through 7 in Conrad et al. 2019). Four horizontal bins, shaped as rounded rectangular rings each of 25 m width, surrounded each platform. The depth bins were 10 m thick, starting 3 m below the surface. Depending on the water depth, the number of depth bins for the platforms ranged from 1 to 9.

For each platform and based on fish distances derived from the hydroacoustic data, simulated fish were randomly placed in a uniform distribution within each horizontal bin. First, the total number of fish in each bin was determined by randomly rounding the (non-integer) abundance estimate of that bin up or down depending on the decimal portion of the abundance estimate value. For example, if the abundance estimate in a bin was 104.2, then in 8 random simulations out of 10, 104 fish would be placed. For the other 2 simulations out of 10, 105 fish would be placed. Thus, the average over all simulations would be 104.2 fish placed.

For each platform site, fish in each horizontal and vertical bin were randomly placed based on the abundance distribution estimates for that site's depth category. The initial placements were done in circular rings, using polar coordinates. The bins were not circular, however; they were rounded rectangles (see Fig. 11 below) because they represented distances from a rectangular platform. Consequently, fish initially placed outside of bins were removed and then randomly placed again. This placement process was repeated until the correct number of fish had been placed in each bin.

Table 12 displays the number of fish of each federally-managed species that were estimated to occur at sites within each of the depth zones, A–D. These represent the total number of fish summed over all depth bins at each depth zone. Due to abundance estimates' binning into four depth zones "A" through "D", most platforms were actually in shallower water than the deepest bins for their prescribed depth zone. All fish in bins shallower than each platform's total water depth were placed, and the remaining fish were then placed in the deepest bin based on the depth at the platform. The number of fish and their locations were randomized 10,000 times to ensure representative fish distribution.

Table 12. Abundance estimates for each species for each depth zone

Depth Zone	Red Snapper	Vermilion Snapper	Gray Triggerfish	Greater Amberjack	Cobia	TOTAL
A	359	44.7	1.3	14	57.1	476
B	1015.3	118.4	12.8	32	13	1191.6
C	2979.9	3506.2	63.4	487.1	23.7	7060.2
D	133.1	57	2.1	586.5	1.4	780

An example of one iteration of fish placement of the five species in the 4 horizontal range bins at the deepest platform removed in 2017 or 2018 (see D1_2017 in Appendix 1 of Conrad et al. 2019) can be seen in Figure 11. Each rounded rectangle (blue, orange, purple and black) represents the line of constant range from the platform edge (red). Fish were randomly placed in each range bin based on abundance estimates described above. Densities of each species vary but are constant within each bin.

Mortality and potential mortal injury to fish were anticipated to occur at a received sound level of 229–234 dB re 1 µPa SPL_{peak} (Popper et al., 2015). For this report, over 100,000 simulated fish were placed around 47 platforms, and mortality ranges were calculated for 329 explosions. Using the most conservative inputs (229 dB, Small Inner Pipes and Soft Clay), every fish was exposed to a lethal peak pressure at all 47 sites. The exact number of fish and their positions were randomly selected 10,000 times as described above.

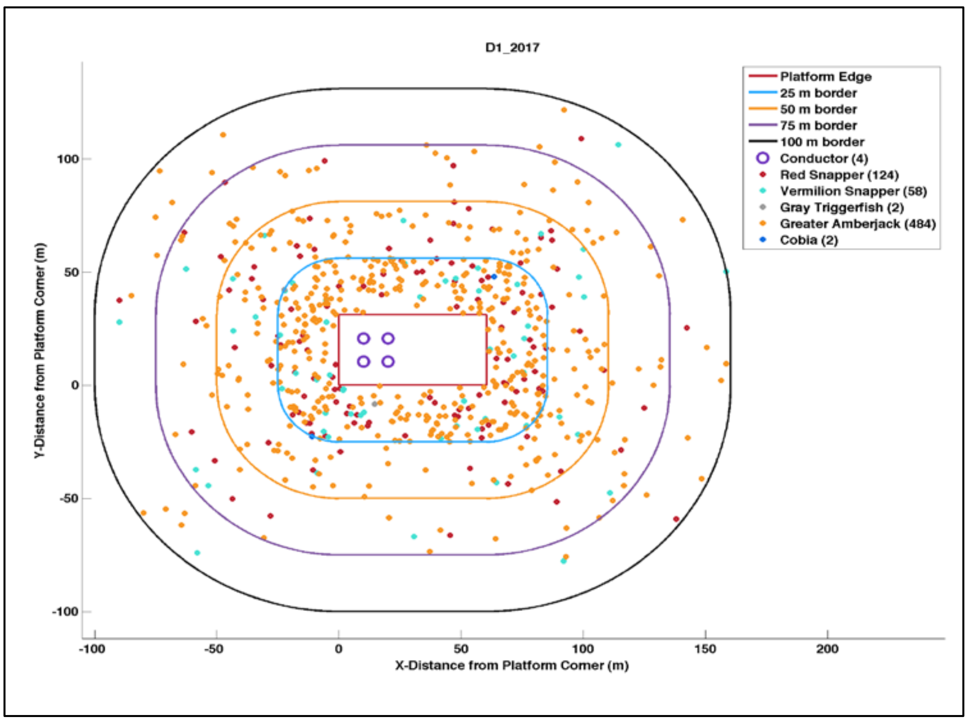

Figure 11. Random placement of 670 fish around platform D1_2017 in 91.44 m water depth, using hydroacoustic abundance estimates.

The five species included are red snapper (red dots), vermilion snapper (cyan dots), gray triggerfish (gray dots), greater amberjack (orange dots) and cobia (blue dots). Four conductors were exploded at this site on 3 July 2017. The estimated positions of the four conductors (based on schematics of other platforms) are shown as purple circles inside the red platform boundary. Edges of horizontal range bins are shown as rounded rectangles outside the platform boundary.

Based upon the simulated fish positions in Figure 11, all 670 fish representing federally-managed species present at platform D1_2017 were exposed to lethal doses using the most conservative inputs (229 dB re 1 µPa peak, Small Internal Pipes, Soft Clay). These fish are depicted in Figure 12 as red x's. When using the less conservative inputs (Large Internal Pipes, Stiff Clay), 665 fish were exposed to the lethal dose of 234 dB re 1 µPa peak. However, the remaining five fish were each exposed to at least 232.9 dB re 1 µPa peak, four times due to the four conductor explosions. In Figure 12, these potentially surviving five fish are denoted with green triangles.

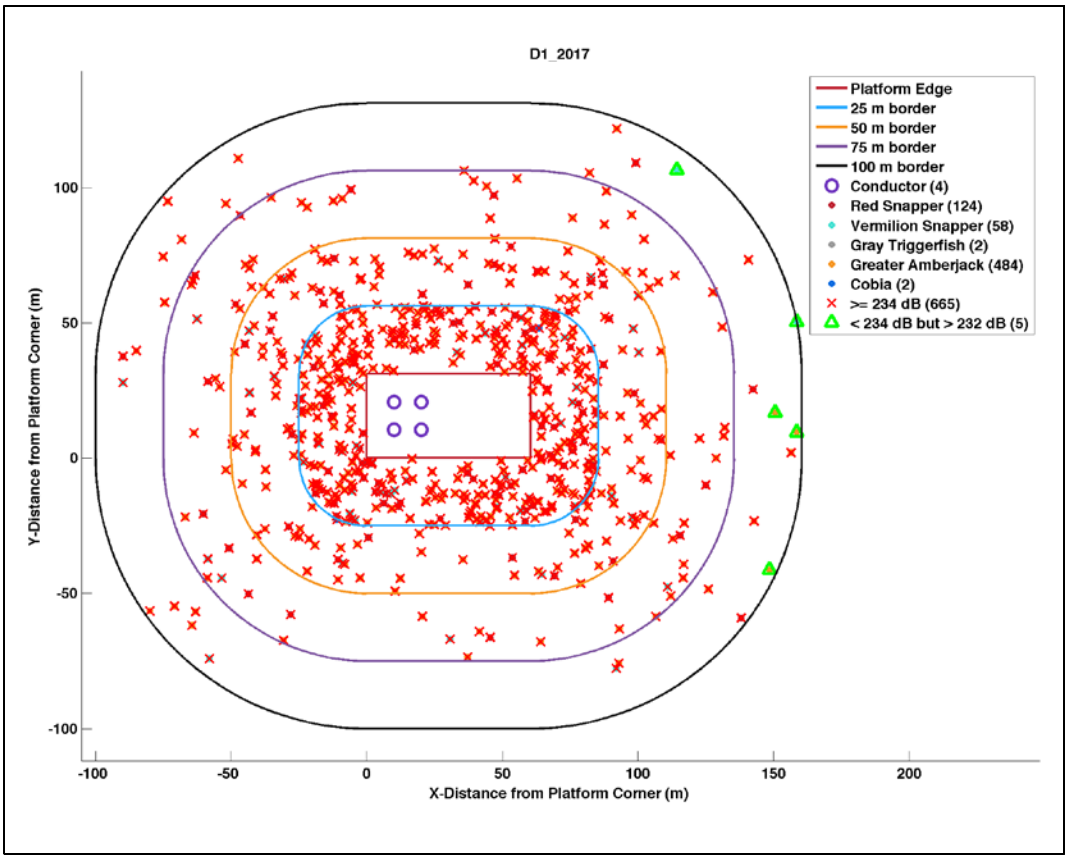

Figure 12. Fish exposed to lethal doses.

Red x = lethal dose. Based upon the simulated fish positions in Figure 1, all 670 fish were exposed to lethal doses using (229 dB re 1 µPa peak, Small Internal Pipes, Soft Clay). When using (234 dB re 1 µPa peak, large Internal Pipes, and stiff clay, 665 fish were exposed to lethal doses. The remaining five fish, exposed to greater than 229 dB re 1 µPa peak but less than 234 dB re 1 µPa peak, are denoted with green triangles.

As shown in Appendix Table 2.2, the least conservative range of survival for platform D1_2017 was 157 m. The explosions occurred 6.9 m below the 91.4 m deep mudline, so fish on the outer edge of the 100 m range opposite the conductors and near the sea surface were further than 157 m.

Using the less conservative inputs (234 dB re 1 µPa peak, Large Internal Pipes, and Stiff Clay), every fish was exposed to a lethal dose at 46 of the 47 sites (Appendix Table 2.2). At one site, platform D1_2017, depending on the random placement of fish, 0 or up to 5 of the 653–688 fish (0–0.8%) were exposed to less than the lethal threshold. However, each of those 0–5 fish were exposed to four separate explosions with peak pressures of more than 232.3 dB re 1µPa. Figure 12 shows positions based on one iteration in which 5 fish were exposed to less than the lethal threshold using the less conservative input parameters.

The UWC acoustic model was used to estimate fish mortality based on fish abundance estimates and explosive type and weight at a wide variety of platform sites. Using this model, fish at all of the sites were exposed to lethal blasts using the most conservative (i.e., yielding greatest mortality) model inputs, and nearly all fish were exposed to lethal blasts when using less conservative inputs. A few fish (0.1%) may have survived at one site, a platform located in the deepest water using some of the smaller explosive charges. Nearly all of the approximately 101,742 fish simulated in this study were exposed to lethal levels of peak pressure from the 329 explosions detonated to remove platforms in 2017 and 2018. Based on these results, we conclude that all the fish at a platform will be lost if explosives are used to remove platforms.

"More Conservative" exposure counts were the average number of fish that experienced at least 229 dB re 1 µPa peak pressure based on calculations with Small Internal Pipes in soft clay. "Less Conservative" exposure counts were estimated using a 234 dB re 1 µPa peak pressure threshold based on calculations with Large Internal Pipes in stiff clay. "Range for Survival" is the minimum distance for a fish to avoid lethal peak pressure at each site. Platform D1_2017 is highlighted because it is the only platform at which some fish simulated in this study were not exposed to a lethal dose of acoustic energy.

3.1.1.1.1 Red Snapper

The explosive removal of 24 platforms in 2017 and 23 platforms in 2018 likely resulted in the mortality of 69,506 red snapper, 37,233 in 2017 and 32,273 in 2018 (Table 13). In 2017, based on project-specific ageing studies, the ages of these fish ranged, from age 1 (0.5%) to age 13 (0.2%), with most being age 5 (40%). Based on average weight-at-age (SEDAR 52 2018), ~179,000 lbs. of red snapper were killed in association with platform removals in 2017, all from the western Gulf (Appendix Table 2.3). In 2018, the estimated 32,275 red snapper that were assumed to have been killed had a total biomass of ~152,000 lbs.

3.1.1.1.2 Vermilion Snapper

The 2017 platform removals were predicted to have resulted in an estimated kill of 29,662 vermilion snapper which compared to an estimated kill of 32,268 fish in 2018:

	2017			2018		
Depth Zone (m)	East GOM	West GOM	Total	East GOM	West GOM	Total
10–17	-	134	134	45	491	536
18–30	-	1,421	1,421	-	118	118
31–90	-	28,050	28,050	3,506	28,050	31,556
91–300	-	57	57	-	57	57

	2017			2018		
Depth Zone (m)	**East GOM**	**West GOM**	**Total**	**East GOM**	**West GOM**	**Total**
Total	**-**	**29,662**	**29,662**	**3,551**	**28,717**	**32,268**

Of these, the vast majority came from the 31- to 90- m depth zone and most were from the western Gulf.

Table 13. Estimates of red snapper killed by explosive removal of structures in 2017 and 2018.

(See Appendix Table 2.3 for detail)

Age	2017	2018	Total
1	161	358	519
2	2,673	3,765	6,438
3	7,510	4,762	12,272
4	4,727	8,368	13,095
5	14,876	5,167	20,043
6	4,144	7,004	11,148
7	1,781	1,941	3,722
8	1,134	596	1,730
9	130	219	349
11	0	31	31
12	32	31	63
13	65	31	96
	37,233	**32,273**	**69,506**

Based on the model results above, all fish present were assumed to have been killed. The red snapper stock is divided at the mouth of the Mississippi River into the Eastern and Western stocks following the SEDAR stock assessments for red snapper.

3.1.1.1.3 Greater Amberjack

A total of 10,079 greater amberjack were estimated to have been killed in association with platform removals over the study period, 4,909 in 2017 and 5,170 in 2018:

	2017			2018		
Depth Zone (m)	**EastGOM**	**WestGOM**	**Total**	**EastGOM**	**WestGOM**	**Total**
10–17	-	42	42	14	154	168
18–30	-	384	384	-	32	32
31–90	-	3,897	3,897	487	3,897	4,384
91–300	-	587	587	-	587	587
Total	**-**	**4,909**	**4,909**	**501**	**4,669**	**5,170**

Most of the platform removals occurred in the western Gulf and most of the estimated mortality occurred in the 31- to 90- m depth zone.

3.1.1.1.4 Gray Triggerfish

Gray triggerfish were not found to be abundant in our study. Explosive platform removals in 2017 were estimated to have killed 667 gray triggerfish, and 601 gray triggerfish were estimated to have been killed in 2018:

	2017			2018		
Depth Zone (m)	**East OM**	**WestGOM**	**Total**	**EastGOM**	**WestGOM**	**Total**
10–17	-	4	4	1	14	16
18–30	1,041	154	154	-	13	13
31–90	-	507	507	63	507	571
91–300	-	2	2	-	2	2
Total	**1,041**	**667**	**667**	**65**	**537**	**601**

Again, most of the mortality occurred in the 31- to 90- m depth zone.

3.1.1.1.5 Cobia

An estimated 518 cobia were assumed to have been killed in the western Gulf in 2017 in association with explosive platform removals and another 913 were estimated to have been killed in 2018:

	2017			2018		
Depth Zone (m)	**EastGOM**	**WestGOM**	**Total**	**EastGOM**	**WestGOM**	**Total**
10–17	-	171	171	57	628	685
18–30	-	156	156	-	13	13
31–90	-	189	189	24	189	213
91–300	-	1	1	-	1	1
Total	**-**	**518**	**518**	**81**	**832**	**913**

In 2018, 628 of the total estimated 913 Cobia mortalities occurred in the 10- to 17- m deep zone in the western Gulf.

3.1.2 Removal of all Platforms in a Single Year (2018)

In 2018, there were 1,171 standing platforms in the Gulf (Figure 13). If all of these had been explosively removed in 2018, we estimate that a total of 1,813,853 red snapper would have been killed having an estimated biomass of 8,595,496 lbs. (Table 14, Appendix Table 2.4). Tables 15-18 show the total numbers of vermilion snapper, greater amberjack, gray triggerfish and cobia that might have been killed had all the standing platforms in federal waters of the Gulf been explosively removed.

3.1.3 Removal of all Platforms within 100 miles of Fishing Ports

Figure 13 shows that of the 1,171 standing offshore platforms remaining in 2018, 1,115 were located within a 100-mile radius of a major fishing port. Thus the vast majority of these platforms were within range of recreational fisheries. Had all the accessible platforms been explosively removed in 2018, a total of 1,755,160 red snapper having a biomass of 8,284,260 lbs. would have been lost to the directed red snapper fishery (Table 19, Appendix Table 2.5). Further, 1,680,701 vermilion snapper, 282,548 greater amberjack, 33,097 gray triggerfish and 33,872 cobia would have been lost (Table 20). These results suggest significant local effects on fisheries.

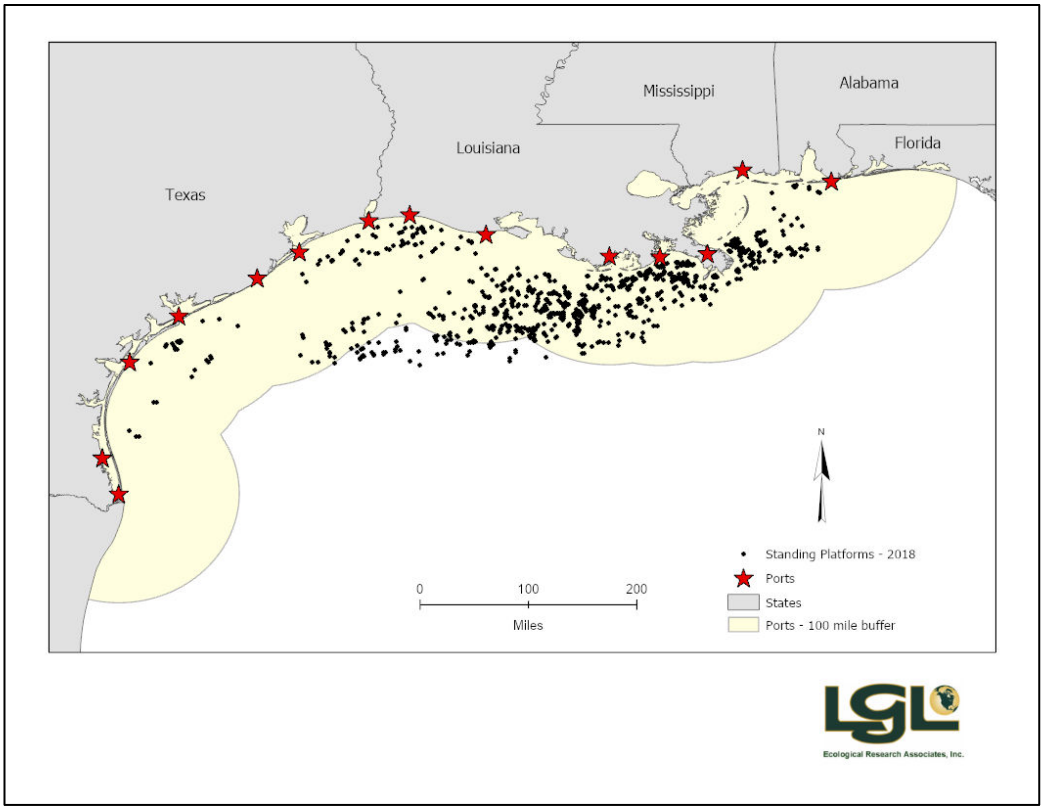

Figure 13. The location of the 1,171 standing platforms in the Gulf of Mexico in 2018.

The red stars represent major fishing ports and the yellow polygon represents a 100-mile radius from each major port. A total of 1,115 platforms were located within 100-m of each port.

Table 14. Median abundance of red snapper by age on the 1,171 standing platforms present in federal waters of the Gulf of Mexico in 2018

(For detail, see Appendix Table 2.4)

Age	Number	Biomass
1	12,599	3,611
2	173,942	184,069
3	281,742	645,980
4	519,163	1,980,083
5	287,269	1,570,630
6	384,266	2,744,803
7	105,329	921,872

Age	Number	Biomass
8	32,640	333,885
9	11,833	136,698
11	1,690	23,218
12	1,690	24,709
13	1,690	25,938
	1,813,853	**8,595,496**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 15. Median abundance of vermilion snapper on the 1,171 standing platforms in federal waters of the Gulf of Mexico in 2018

Depth Zone (m)	East GOM	West GOM	Total
10–17	2,010	13,446	15,457
18–30	2,368	24,743	27,111
31–90	284,007	1,413,022	1,697,029
91–300	1,197	5,187	6,384
Total	**289,582**	**1,456,398**	**1,745,980**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 16. Median abundance of greater amberjack on the 1,171 standing platforms in federal waters of the Gulf of Mexico in 2018

Depth Zone (m)	East GOM	West GOM	Total
10–17	629	4,206	4,835
18–30	640	6,693	7,333
31–90	39,453	196,292	235,745
91–300	12,317	53,373	65,690
Total	**53,039**	**260,564**	**313,603**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 17. Median abundance of gray triggerfish on the 1,171 standing platforms in federal waters of the Gulf of Mexico in 2018

Depth Zone (m)	East GOM	West GOM	Total
10–17	58	391	449
18–30	257	2,686	2,943
31–90	5,136	25,554	30,690

Depth Zone (m)	East GOM	West GOM	Total
91–300	44	192	236
Total	**5,496**	**28,822**	**34,318**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 18. Median abundance of cobia on the 1,171 standing platforms in federal waters of the Gulf of Mexico in 2018

Depth Zone (m)	East GOM	West GOM	Total
10–17	2,571	17,195	19,765
18–30	260	2,721	2,981
31–90	1,916	9,535	11,451
91–300	29	124	152
Total	**4,776**	**29,574**	**34,350**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 19. Median abundance of red snapper by age on the 1,115 standing platforms within 100 miles of major fishing ports in 2018

(For detail, see Appendix Table 2.5)

Age	Number	Biomass
1	12,599	3,611
2	172,036	182,051
3	274,388	629,119
4	502,140	1,915,159
5	276,238	1,510,320
6	369,082	2,636,343
7	101,107	884,923
8	31,346	320,651
9	11,356	131,192
11	1,622	22,283
12	1,622	23,713
13	1,622	24,894
Total	**1,755,160**	**8,284,260**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

Table 20. Median abundance of other federally-managed species on the 1,115 standing platforms within 100 miles of a major fishing ports

Depth Zone (m)	Vermilion Snapper	Greater Amberjack	Gray Triggerfish	Cobia
10–17	15,457	4,835	449	19,765
18–30	27,111	7,333	2,943	2,981
31–90	1,633,916	226,978	29,549	11,026
91–300	4,218	43,402	156	100
Total	**1,680,701**	**282,548**	**33,097**	**33,872**

Based on the model results above, all fish present would be assumed to be killed if all the platforms were explosively removed.

4 Assessment of Removal Impacts

Above we described the consequences of explosive platform removals on five federally-managed fish species that were documented to use these habitats. We addressed 1) the specific effects for the 2017 and 2018 platform removals; 2) the effects of removing all the remaining platforms in a single year; and 3) the effects of removing all the remaining platforms within a 100-mile radius of the major fishing ports. These effects data have been provided to the National Marine Fisheries Service (NMFS) for formal incorporation into upcoming stock assessments for each of the species in question. Three stock assessments have been initiated in 2019 (cobia, vermilion snapper, gray triggerfish) and a greater amberjack assessment is scheduled to be initiated in 2020. The date of the next red snapper assessment will follow in 2020 or 2021. For these assessments, NMFS will address the effects of platform removals and acknowledge the Bureau of Ocean Energy Management (BOEM) as the source of the data.

For the present, we base our assessment of the significance of the estimated impacts based upon the degree to which the platform-associated mortality increased fishing mortality rates and the consequences of these increases to the directed fisheries. Following the SEDAR stock assessments, we use exploitation rates (in our case, number killed/total age 2+ stock size) as a proxy for fishing mortality. We will be discussing the assessment on a State Management Area basis (see Figure 1 above).

4.1 2017 and 2018 Platform Removal Mortality

The number of key species killed as a consequence of the specific 2017 and 2018 platform removals had minimal effects on exploitation rates, at least on a total stock size basis (Table 21). The maximum impact was observed for greater amberjack which had an exploitation rate of 0.007. However, the biological effects of the annual removals appeared to be of some consequence on a local basis as described below for red snapper which has the most comprehensive assessment information.

For background, the GMFMC and National Oceanic and Atmospheric Administration (NOAA) Fisheries manages the red snapper fishery in the Gulf of Mexico (Gulf). NOAA Fisheries (2018) notes that fishery is first divided into commercial and recreational sectors. In 2018, the red snapper catch quota for both sectors combined was 13.74 million pounds whole weight. The recreational sector is allocated 49% of the total quota (6.73 mp) and the commercial sector is allocated 51% of the total quota (7.01 mp). The recreational quota is further split with 57.7% allocated to the private angling component and 42.3% to the for-hire component. An annual catch target is then set at 80% of the quota. This 20% buffer helps minimize the potential for a quota overage.

NOAA (2019) provides the Allowable Catch Limit (ACL) for red snapper for the private recreational sector for each Gulf state in 2018 and 2019. The state ACL's for 2018 were 1,778,515 lbs. for Florida; 984,291 lbs. for Alabama; 137,949 lbs. for Mississippi; 743,000 lbs. for Louisiana; and 241,245 lbs. for Texas (Table 22). Given these ACLs, the total allowable catch for the Eastern Gulf (Florida, Alabama, Mississippi) was 2,900,755 lbs.; and for the western Gulf, allowable catch totaled 984,245 lbs. In 2018, platform removals in the Eastern Gulf region killed 16,323 lbs. (0.6 of the red snapper total ACL); whereas in the western Gulf, platform removals killed 135,862 lbs. of red snapper (13.8% of the western Gulf ACL).

Table 21. Exploitation rates (number killed/total age 2+ stock size) associated with 2017 and 2018 platform removals based on estimated mortalities and stock size from SEDAR stock assessments

1) Red Snapper	**East**	**West**	**Total Removals**	**Exploitation Rate**
2017 number killed	0	37,232	37,232	0.001
2018 number killed	3,339	28,936	32,275	0.004
2016 TOTAL STOCK[1]	13,094,871	23,143,192	36,738,063	
2) Vermilion Snapper	**East**	**West**	**Total Removals**	**Exploitation Rate**
2017 number killed	0	29,662	29,662	0.001
2018 number killed	3,551	28,717	32,268	0.001
2014 TOTAL STOCK[2]			30,181,024	
3) Greater Amberjack	**East**	**West**	**Total Removals**	**Exploitation Rate**
2017 number killed	0	4,909	4,909	0.007
2018 number killed	501	4,669	5,170	0.007
2015 TOTAL STOCK[3]			695,548	
4) Gray Triggerfish	**East**	**West**	**Total Removals**	**Exploitation Rate**
2017 number killed	0	667	667	0.0002
2018 number killed	65	537	601	0.0002
2013 TOTAL STOCK[4]			2,822,749	
5) Cobia	**East**	**West**	**Total Removals**	**Exploitation Rate**
2017 number killed	0	518	518	0.001
2018 number killed	81	832	913	0.002
2011 TOTAL STOCK[5]			423,955	

1) SEDAR 52
2) SEDAR 45
3) SEDAR 33
4) SEDAR 43
5) SEDAR 28

Table 22. Allowable Catch Limit (ACL) for red snapper for each Gulf state in 2018, and comparative "takes" from platform removals

1)	**East Gulf**	**2018 ACL (lbs)**	**2018 Platform Take (lbs)**	**% of ACL**
	Florida	1,778,515	0	0.00%
	Alabama	984,291	16,323	1.66%
	Mississippi	137,949	0	0.00%
		2,900,755	**16323**	**0.56%**
2)	**West Gulf**	**2018 ACL (lbs)**	**2018 Platform Take (lbs)**	**% of ACL**

	Louisiana	743,000	118,311	15.92%
	Texas	241,245	17,551	7.28%
		984,245	**135,862**	**13.80%**
3)	**Total Gulf**	**3,885,000**	**152,185**	**3.92%**

For Louisiana, platform removal mortality was about 16% of the ACL allotted to the private recreational sector.

4.2 Removal of all Platforms in a Single Year

Our approach for evaluating the significance of the effects of removal of all the remaining platforms in a single year was based on data for red snapper. Subadult and adult red snapper are targeted by both the recreational (Private Sector, Charter boats, and Headboats) and commercial sectors of the Gulf of Mexico fishery. The catch in each sector includes landed catch and fish that were discarded, both alive and dead. We characterized the take in each sector in 2016 (the most recent year for which data are available) in terms of number of red snapper, and compared these takes to the "take" that would have occurred if all the platforms and associated fish present in the Gulf in 2018 had been removed in 2016. This is the worst case scenario assuming that explosive severance was the only method used to decommission the structure (mechanical removal is also a common decommissioning method).

Recreational fisheries catch in numbers of fish were obtained from the SEDAR 52 stock assessment. Table 2.12 provided landings and Tables 2.14 and 2.15 provided numbers of discards. In the commercial fisheries, catch was reported in kg of fish landed (e.g., Table 2.5, SEDAR 52) and in numbers of fish discarded (SEDAR 2018, Table 2.7). The number of fish caught by the commercial sector was determined by multiplying the total catch (in kg) by the age frequencies of the landings (SEDAR 52 Table 2.6), then dividing the total kg for each age group by an estimate of weight at age. We used a model-derived weight at age (kg whole weight) for Gulf red snapper calculated within the SEDAR 52 stock assessment model at the mid-point of the calendar year (personal communication, Matthew Smith).

Under this scenario, the "platform fleet" dead discards would have accounted for about 18% of the total landings in 2016 (1,813,955 fish of the total 10,150,249 fish hypothetically landed, Table 23). However, in the western Gulf, platform takes were on the order of 35% of the total (1,533,233 red snapper divided by the 4,337,717 total take, Table 23). This represented an increase in the western Gulf exploitation rate from 0.119 to 0.183, an increase of the base rate by a factor of 1.54.

Table 23. Recreational and commercial fleet landings of red snapper (numbers) in 2016, the terminal year of the SEDAR 52 red snapper stock assessment

A. Landings	East	West	Total
2016 Rec Landings	863,253	235,478	1,098,731
2016 Rec. Discards	3,267,883	545,671	3,813,554
2016 Comm Landings	1,278,813	1,985,921	3,264,734
2016 Comm Discards	121,861	37,414	159,275
	5,531,810	2,804,484	8,336,294
2018 Platform Discards	280,622	1,533,233	1,813,955
	5,812,432	4,337,717	10,150,249

2016 Stock Size	13,094,871	23,643,192	36,738,063
B) Exploitation rates (number age 2+ killed/total number age 2+ , a proxy for fishing mortality)			
Without Platforms	0.422	0.119	0.227
With Platforms	0.444	0.183	0.276

In 2018 the "platform fleet" removals are also assumed to be representative of actual platform mortalities in recent years.

The vast majority of the red snapper Gulf platform population occurs in the western as compared to the eastern Gulf, and the western Gulf totals are documented by the Louisiana platform populations (Table 24). The eastern Gulf totals are dominated by Mississippi.

Table 24. Numbers and biomass of red snapper associated with offshore platforms in the eastern and western Gulf of Mexico

East	Number	Biomass
Alabama	50,962	254,810
Mississippi	229,660	1,123,493
East Total	280,622	1,378,303
West	**Number**	**Biomass**
Texas	176,198	843,682
Louisiana	1,357,035	6,373,511
West Total	1,533,233	7,217,193
Total	**1,813,855**	**8,595,497**

The Florida shelf is characterized by a diversity of hard-substrate, natural habitat on its shelf but there are no offshore platform habitats. The natural habitats offshore Florida, especially in the Florida panhandle and the shelf north of the Tampa Bay area, hold large numbers of red snapper and many of these are lost as dead discards during closed seasons (Goethel and Smith 2018). The Alabama shelf has a high density of artificial reefs, as well as natural reefs (Karnauskas et al. 2017). Hard substrate within the small Mississippi State Management Area and the large Louisiana Management Areas is dominated by petroleum platform habitat and has relatively few natural reefs. Texas is characterized by a variety of natural and artificial reef habitats (Karnauskas et al. 2017).

We suggest that, at least for red snapper, petroleum platform habitats located over soft bottom habitats on the Louisiana and Mississippi shelves have served to increase productivity as opposed to simply aggregate fish. Carr and Hixon (1997) observed that artificial reefs could increase production under several scenarios. They observed if there were no natural reefs in a management area, then the addition of artificial reefs would enhance production of obligate reef species within the management area. We suggest that red snapper between age 2 and 7–10 years of age are essentially obligate reef species because of their demonstrated affinity for high-relief vertical structure (Gallaway et al. 2009 and many others). red snapper recruit to high-relief vertical structure as age-2 fish in late summer and fall. Before this age juveniles aggregate on low-relief habitats (shell, gravel, etc.). Natural high-relief habitat occurs as rock outcrops and ledges, and coral reefs. Figure 14 shows a major portion of the Louisiana Management area showing platforms, the distribution of soft sediments (mud and sand), gravel-sized substrate (an index to age 0–1 juvenile rearing habitat) and rock substrates (an index of natural high-relief habitat for age 2- to 10- yr. old fish). Our study sites are displayed as numbered green stars. All presently existing platforms are also shown. Substrate type and distribution are from the usSEABED database (Buczkowski et al. 2006).

Each of the 312 platforms within this polygon, on average, were populated by 1,220 age 2+ red snapper. The average weight of these fish was 2.02 kg. Thus a total of 768,893 kg (1,695,116 lbs.) of red snapper were present in this area that would otherwise not have been present in the absence of any platforms. There were no natural adult habitat areas within our soft bottom polygon or within 6 to 8 km of the polygon border. We suggest the red snapper in this area represent production that would not have occurred in the absence of platforms. The Louisiana total recreational harvest of red snapper in 2016 was estimated to have been 1,103,723 lbs. (Ava Lasseter, Gulf of Mexico Fishery Management Council, pers. comm.) which is about the same as the biomass of red snapper within our polygon.

This report is focused on five, selected federally-managed species. At sites located in the 31- to 90- m depth zones these species accounted for 42.6% of the total mortalities. The other 57.4% of the mortalities would be expected to be documented by species such as blue runner, Atlantic bumper, jacks and leatherjack. In contrast, the five federally-managed species constituted less than 10% of the total fish present in all other depth zones. All the two shallow sites, the Atlantic bumper was the dominant species along with blue runner. At the deep sites, jacks and Bermuda chub were among the dominants.

4.3 Removal of all Platforms within 100 Miles of Fishing Ports

As shown above, 95% (1115 of 1,171) of the offshore platforms remaining in 2018 were within a 100-mile radius of a major fishing port. Ultimately, the loss of these habitats will affect local directed reef fish fisheries, especially those in the Louisiana and Mississippi State Management areas. For example, hard substrate habitat within the Louisiana Management Area (not including pipelines and pipeline crossings) consists of 866 offshore platforms (platforms plus 161 caissons and 4 well protectors), 372 toppled oil platforms and bases located in 91 permitted artificial reef areas and, based on analysis of existing natural bank topography data, 448 km^2 of natural bank habitat. Though large in area, the natural banks consist of only 13 discrete or named banks, mostly located well offshore at the shelf edge. On a numerical basis, offshore platforms (including caissons and well protectors) thus constitute about 72% of the known, discrete reef habitats (1031 of 1363 sites). The loss of 72% of the known sites in the Louisiana Management Area would likely have significant impacts on the local fisheries. The same is likely true for Mississippi; Texas and Alabama fisheries would be less impacted.

However, there may be more natural reef habitat offshore Louisiana than has been characterized. The rock areas shown in Figure 15 generally correspond to natural banks and suggest that only a dozen or more sites may be present (Buczkowski et al. 2006). The soft bottom areas of the region constitute prime penaeid shrimp habitat, and the region is heavily trawled out to the 100 m depth contour. Areas of limited trawling (≤25 total 10-min tow intervals over the 13-yr. period of record mapped) result from prevalent hypoxia, offshore oil and gas structures, natural banks, artificial reefs and known obstructions (e.g. LOOP) (Figure 16). This leaves other areas, however, where it is unknown why no shrimping occurs. These areas may represent bottom obstructions constituting red snapper and other reef fish habitat. There may be more reef habitat in western Louisiana (and other areas of the Gulf) than is currently recognized.

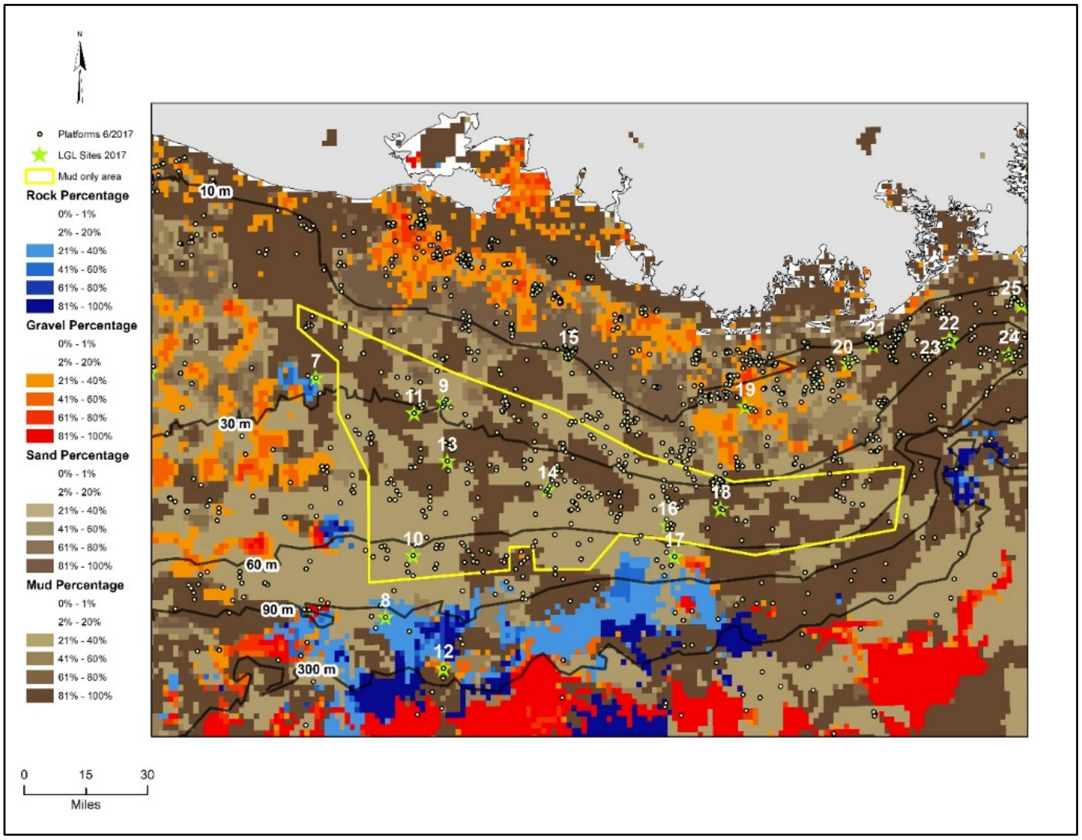

Figure 14. Distribution of platforms, and substrate types, in a selected area offshore western Louisiana.

The polygon depicts a large area of soft substrate.

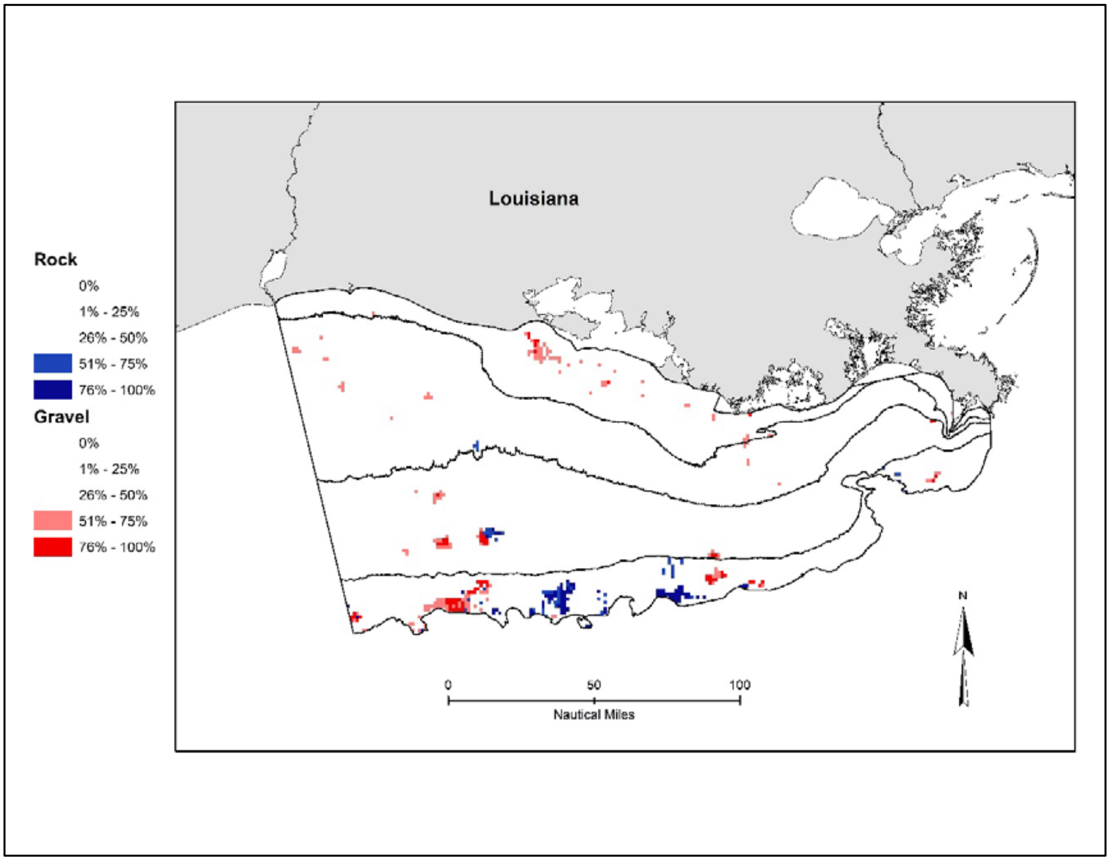

Figure 15. Rock and gravel bottom substrate distribution on the Louisiana Shelf corresponding to Region 2 of the Sea Grant Red Snapper abundance study.

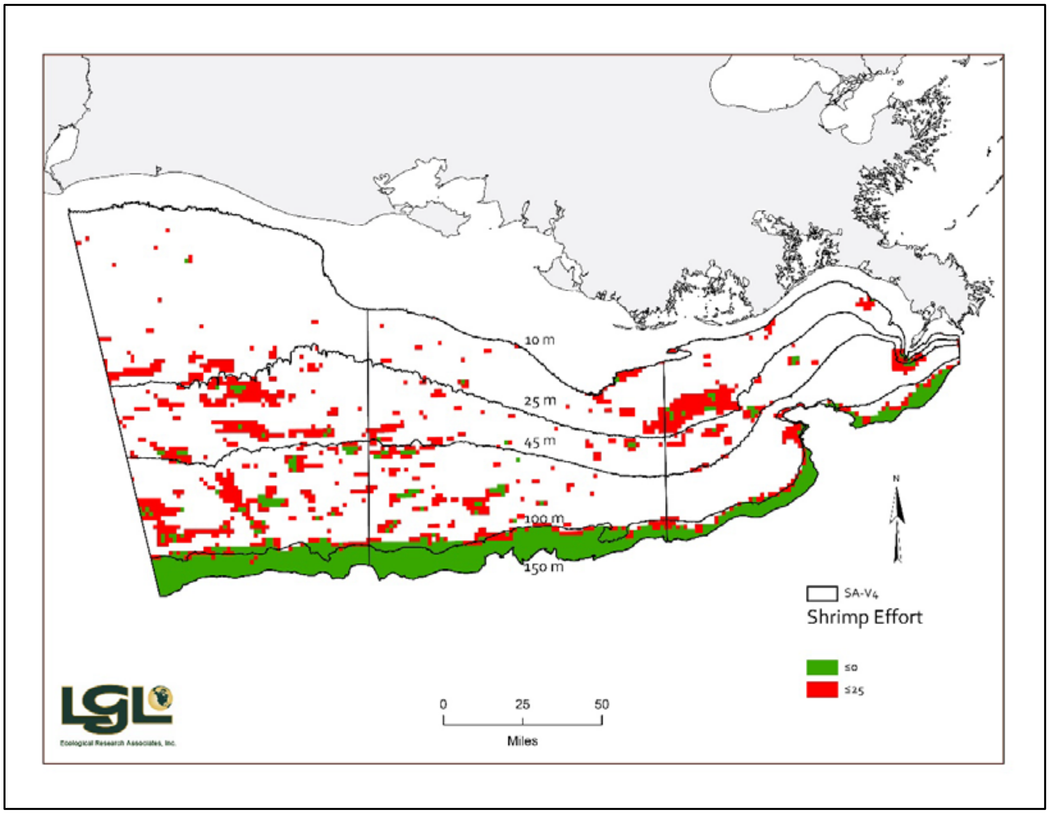

Figure 16. Distribution of limited shrimp trawling effort.

5 Summary and Conclusions

An Acoustic model-based approach combined with measurements of the relative abundance and distribution of commercially and/or recreationally valuable, federally-managed fish species was used to estimate the mortality of managed fish species due to the explosive severance of the offshore platforms.

5.1 The Model

The UnderWater Calculator version 1 (UWC), was the underwater acoustic shock propagation model used for this study.

User input to the UWC includes detonation charge specifications (explosive type and weight), pile specifications (diameter and wall thickness), source (charge) depth, and receiver (e.g., fish) depth. In addition, the UWC offers three bottom boundary conditions to be specified by the user: water (free space), soft clay, and stiff clay. The UWC fixes the explosive coupling efficiency for these bottom types at 43.51%, 37.90%, and 34.37% respectively. The UWC includes four built-in types of explosive material (TNT, pentaerythritol tetranitrate, H6, and C-4) and allows user-defined Swisdak Similitude Coefficients for a fifth type. The explosive material utilized for platform removals during the hydroacoustic measurements of this report was Composition B (Comp-B).

We analyze the explosive severance of four types of pipes: piles, conductors, skirt piles, and caissons. We treated all pipe types the same except for the 11 sites that had conductors with internal concentric pipes. These were treated as a special case. In this study, the range of received peak sound pressure level (SPL_{peak}) of 229-234 dB re 1µPa was adopted as the acoustic threshold for mortal and potential mortal injury to fish (Popper et al. 2015). For each pipe explosion, the inverse calculation was performed twice: once to calculate a narrow range of mortal injury using the most conservative model input values and a second time to determine a wider range of potential mortal injury using the least conservative values. The range of each randomly placed fish to each explosion was calculated and the count of lethal exposures tallied. Minimum and maximum exposure levels, as well as the total number of exposures (most sites involved multiple explosions), were recorded for any fish located farther than the defined lethal range based on the UWC forward calculation.

5.2 Estimation of Effects

Effects were based upon three scenarios; 1) the actual removals that occurred in 2017 and 2018 (the years of our study); 2) the removal of all the remaining structures in federal waters in a single year (2018); and 3) the removal of all platforms within 100 miles of major ports. A major finding of our study is that very few fish survive explosive removals.

5.2.1 2017 and 2018 Removals

The explosive removal of 24 platforms in 2017 and 23 platforms in 2018 likely resulted in the following mortalities of selected species:

- Red snapper: 69,505 fish (37,232 in 2017 and 32,275 in 2018)
- Vermilion snapper: 61,930 fish (29,662 in 2017 and 32,268 in 2018)
- Greater amberjack: 10,079 fish (4,909 in 2017 and 5,170 in 2018)
- Gray triggerfish: 1,268 fish (667 in 2017 and 601 in 2018)
- Cobia: 1,431 fish (518 in 2017 and 913 in 2018)

These annual mortalities typically constituted a small fraction of the total stock. Both red and vermilion snapper have stocks that exceed 30 million age 2+ fish; the gray triggerfish stock numbers approximately 3 million fish; the greater amberjack stock is estimated to contain about 700,000 fish; and the cobia stock contains an estimated 424,000 fish.

5.2.2 Removal of all Platforms in a Single Year (2018)

If all the remaining platforms had been removed in 2018 using the explosive severance method, the following mortalities would have been expected:

- Red snapper: 1,813,855 killed, (4.9% of total stock)
- Vermilion snapper: 1,745,980 killed (5.8% of total stock)
- Greater amberjack: 313,603 killed (45.1% of total stock)
- Gray triggerfish: 34,313 killed (1.2% of total stock)
- Cobia: 34,500 killed (8.1% of total stock)

Of these, greater amberjack losses appear problematic, but the stock size for Greater Amberjack is suspect.

5.2.3 Removal of all Platforms within 100 miles of Fishing Ports

As the vast majority of the offshore platforms are located within 100 miles of a major port, the results are similar to the effects associated with removing all the platforms in a single year using the explosive severance method.

- Red snapper: 1,755,161 killed
- Vermilion snapper: 1,680,701 killed
- Greater amberjack: 282,548 killed
- Gray triggerfish: 33,097 killed
- Cobia: 33,872 killed

Again, greater amberjack effects appear problematic.

5.3 Assessment of Effects

5.3.1 2017 and 2018 Platform Removal

As shown below, annual removals reflect low exploitation rates on a stock-wide basis:

Species	Year	Exploitation Rate
Red snapper	2017	0.001
	2018	0.004
Vermilion snapper	2017	0.001
	2018	0.001
Greater amberjack	2017	0.007
	2018	0.007
Gray triggerfish	2017	0.0002
	2018	0.0002

Species	Year	Exploitation Rate
Cobia	2017	0.001
	2018	0.002

However, on a state and biomass basis, these same removals may represent as much as 16% of the red snapper Allowable Catch Limits for the Private Recreational Sector. In 2018, platform mortalities represented the following percentages of the respective ACLs:

East Gulf	% ACL
Florida	0.00
Alabama	1.66
Mississippi	0
West Gulf (2018)	
Louisiana	15.92
Texas	7.28

If the Louisiana platform removal losses were subtracted from the private recreational sector ACL, fewer fish would be available and the allowable take would be reached sooner thereby shortening the season.

5.3.2 Removal of all Platforms in a Single Year

If all the remaining platforms were removed using only the explosive severance method in a single year (e.g., 2018), the platform removals would be equivalent to ~18% of the comparable total red snapper landings, Gulfwide. However, our assessment based on the SEDAR 52 stock size and the 2018 platform removals suggested red snapper losses in the Western Gulf would be on the order of 35% of the total landings if all the platforms were removed. Platform red snapper populations are especially important to the Louisiana and Mississippi Management Areas and may have increased red snapper productivity in these areas.

5.3.3 Removal of all Platforms within 100 miles of Fishing Ports

Most of the existing platforms are within a 100-mile range of a major fishing port. Loss of these platforms would likely have significant adverse impacts on local fisheries. In Louisiana, platforms may represent on the order of 72% of the accessible fishing sites.

5.4 Conclusions

An array of recreationally and commercially valuable, federally-managed reef fish species aggregate to varying degrees around offshore oil and gas platforms. On a Gulf-wide basis, these aggregations typically represent small fractions of the overall stocks. However, there appears to be at least one potential exception. On the order of 48% of the greater amberjack stock is associated with offshore oil and gas platforms, mainly platforms offshore Western Louisiana. Few, if any, fish that aggregate around platforms survive explosive platform removal.

Platform removals are likely having, and will likely have, significant adverse impacts on local fisheries, especially those offshore Louisiana and Mississippi. In these specific areas, a case can be made that platforms serve to increase reef fish productivity as opposed to merely aggregating the fish due to the apparent absence of other suitable habitats. However, evidence is presented that there may be more reef habitat in these areas than is currently recognized.

References

Allman RJ, Fitzhugh GR, Starzinger KJ, Farsky RA. 2005. Precision of age estimation in red snapper (*Lutjanus campechanus*). Fish Res. 73 (2005):123-133.

Anderson RO, RM Neumann. 1996. Length, weight, and associated structural indices. In: Murphy BR, Willis DW, editors. Fisheries techniques, 2nd ed. Bathesda (MD): American Fisheries Society. p. 447–482.

Adkins, G. 1993. A comprehensive assessment of bycatch in the Louisiana shrimp fishery. Baton Rouge (LA): Louisiana Department of Wildlife and Fisheries, Marine Fisheries Division. Technical Bulletin Number 42.

Bolker BM, Brooks ME, Clark CJ, Geange SW, Poulsen JR, et al. 2008. Generalized linear mixed models: a practical guide for ecology and evolution. Trends Ecol Evol. 24(3):127-135.

Brown SJ. 1986. Pressure systems energy release protection (gas pressurized systems). Hampton (VA): National Aeronautics and Space Administration. 434 p. NASA Contractor Report 178090.

Buczkowski BJ, Reid JA, Jenkins CJ, Reid JM, Williams SJ, et al. 2006. usSEABED: Gulf of Mexico and Caribbean (Puerto Rico and U.S. Virgin Islands) offshore surficial sediment data release: data series 146, version 1.0. Reston (VA): US Geological Survey. 50 p. [accessed 2014 February] http://pubs.usgs.gov/ds/2006/146/.

Campana SE. 2001. Accuracy, precision and quality control in age determination, including a review of the use and abuse of age validation methods. J Fish Biol. 59:197-242.

Carr HH, Hixson MA. 1997. Artificial reefs' the importance of comparisons with natural reefs. Fisheries. 22 (4): 28-33.

Chesney EJ, Baltz DM, Thomas RG. 2000. Louisiana estuarine and coastal fisheries and habitats: perspectives from a fish's eye view. Ecol Appl. 10(2):350-366.

Conrad AS, Kim KH, Gallaway BJ. 2019. Explosive removal of structures: acoustic model application. College Station (TX): LGL Ecological Research Associates, Inc. 47 p. Contract No.: M16PC00005.

Dahl PH. 2016. Center for Independent Experts (CIE) independent peer review report of underwater calculator for shocks, or UWCv2 (Vers. 2.0). Seattle (WA): Center for Independent Experts. 30 pp.

Dzwilewski PT, Fenton G (Applied Research Associates, Inc., Littleton, CO). 2003. Shock wave/sound propagation modeling results for calculating marine protected species impact zones during explosive removal of offshore structures. New Orleans (LA): Department of the Interior, Minerals Management Service. 39 p. Contract No.: 0302P057572. Report No.: OCS Study MMS 2003-059.

Edwards AW. 1992. Likelihood, expanded edition. Baltimore (MD): Johns Hopkins University Press. 246 p.

Everett AC, Szedlmeyer ST, Gallaway BJ. Fine scale movement patterns of red snapper (*lutjanus campechanus*) based on acoustic telemetry around oil and gas platforms in the Northern Gulf of Mexico. Bryan (TX): LGL Ecological Research Associates, Inc.

Gallaway BJ (LGL Ecological Research Associates, Bryan, TX). 1981. An ecosystem analysis of oil and gas development on the Texas-Louisiana continental shelf. Washington (DC): US Department of the Interior, Fish and Wildlife Service, Office of Biological Services. 89 p. Contract No.: 14-16-0009-80-058. Report No.: FWS/OBS-81/27.

Gallaway, B.J. and G.S. Lewbel. 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: a community profile. Slidell (LA); New Orleans (LA): US Fish and Wildlife Service; Bureau of Land Management, Minerals Management Service. 92 p. FWS/OBS-82/27. Open-File Report 82-03.

Gallaway BJ, Szedlmayer ST, Gazey WJ. 2009. A life history review for red snapper in the Gulf of Mexico with an evaluation of the importance of offshore petroleum platforms and other artificial reefs. Rev Fish Sci. 17(1):48-67.

Gazey W Staley MJ.1986. Population estimation from mark-recapture experiments using a sequential bayes algorithm. Ecology. 67(4): 941-951. doi:10.2307/1939816.

Gitschlag GR, Schirripa MJ, Powers JE (National Marine Fisheries Service, Miami FL). 2000. Estimation of fisheries impacts due to underwater explosives used to sever and salvage oil and gas platforms in the U.S. Gulf of Mexico: final report. New Orleans (LA): US Deptartment of the Interior, Minerals Management Service. 96 p. Interagency Agreement 17912. Report No.: OCS Study MMS 2000-087.

Goodman LA. 1960. On the exact variance of products. J Am Stat Assoc. 55:708-713.

Goethel DR, Smith MW. 2018. The impact of a reduction in shrimp effort thresholds on SEDAR 52 Gulf of Mexico red snapper catch limit provisions. Biscayne (FL): NOAA Southeast Fisheries Science Center. 10 p. http://gulfcouncil.org/wp-content/uploads/D-4b-SEFSC-report-on-bycatch-reduction-thresholds-for-the-shrimp-fishery.pdf

Grimes CB, Manooch CS, Huntsman GR. 1982. Reef and rock outcropping fishes of the Outer Continental Shelf of North Carolina and South Carolina, and ecological notes on the red porgy and vermilion snapper. Bull Mar Sci. 32(1):277-289.

Gulf of Mexico Fishery Management Council. 2015. Species listed in the fishery management plans of the Gulf of Mexico Fishery Management Council. Revised 7/21/15. 8 p. http://gulfcouncil.org/Beta/GMFMCWeb/downloads/species%20managed.pdf

Gulf of Mexico Fisheries Management Council (Tampa, FL). 2019. State management program for recreational red snapper final draft amendment 50a to the fishery management plan for the reef fish resources of the Gulf of Mexico including programmatic environmental impact assessment. 3/13/2019. St. Petersburg (FL): National Oceanic and Atmospheric Administration National Marine Fisheries Service Southeast Regional Office. 251 p. NOAA Award No.: NA15NMF441011. http://gulfcouncil.org/wp-content/uploads/B-6a-State-Management-Program-for-Red-Snapper-Final-Draft-3-13-2019.pdf

Gunter G. 1936. Studies of the destruction of marine fish by shrimp trawlers in Louisiana. Louisiana Conserv Rev. 5(4):18–24, 45–46.

Kaplan EL, Meier P. 1958. Nonparametric estimation from incomplete observations. J Am Stat Assoc. 53(282):457-481.

Karnauskas M, Walter III JF, Campbell MD, Pollack AG, Drymon JM, et al. 2017. Red snapper distribution on natural habitats and artificial structures in the northern Gulf of Mexico. Mar Coast Fish. 9(1): 50-67.

Kaye SM. 1983. Encyclopedia of explosives and related items PATR 2700, Volume 10. Pitcantinny (NJ): US Army Research and Development Command (ARDEC). 786 p.

Koenig CC, Stalling CD. 2015. A new compact rotating video system for rapid survey of reef fish populations. Bull Mar Sci. 91(3):365-373.

LGL (LGL Ecological Research Associates, Inc., Bryan, TX). 2017a. Explosive removal of structures: fisheries impact assessment. Assemblage characterization synthesis report. Final report to Bureau of Ocean Energy Management, New Orleans, LA. 112 p. http://dx.doi.org/10.13140/RG.2.2.15319.91043

LGL (LGL Ecological Research Associates, Inc., Bryan, TX). 2017b. Field season 1 sampling report. Report to Bureau of Oceanic Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 33 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.35872.00001

LGL (LGL Ecological Research Associates, Inc., Bryan, TX). 2017c. Field season 2 sampling report. Report to Bureau of Oceanic Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 87 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.25805.67049

LGL (LGL Ecological Research Associates, Inc., Bryan, TX) 2018. Field season 3 sampling report. Report to Bureau of Ocean Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 51 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.14900.48000

LGL (LGL Ecological Research Associates, Inc., Bryan, TX). 2019. Characterization of fish assemblages sssociated with oil and gas platforms in the Gulf of Mexico. Report to Bureau of Ocean Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 68 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.28322.25282

LGL (LGL Ecological Research Associates, Inc. (LGL), Auburn University (AU) and Marine Science Institute University of Texas (UT). 2018a. Field season 2 assemblage characterization report. Report to Bureau of Ocean Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 68 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.16578.20160

LGL (LGL Ecological Research Associates, Inc. (LGL), Auburn University (AU) and Marine Science Institute University of Texas (UT). 2018b. Field season 3 assemblage characterization report. Report to Bureau of Ocean Energy Management. College Station (TX): LGL Ecological Research Associates, Inc. 60 p. Contract No.: M16PC00005. http://dx.doi.org/10.13140/RG.2.2.23289.08806

McKinzie MK, Jarvis ET, Lowe CG. 2014. Fine-scale horizontal and vertical movement of barred sea bass, Paralabrax nebulifer, during spawning and non-spawning seasons. Fish Res. 150:66-75. doi:10.1016/j.fishres.2013.10.016.

Morison AK, Robertson SG, Smith DC. 1998. An integrated system for production fish aging: Image analysis and quality assurance. N Am J Fish Manage. 18, 587-598.

NATO [North Atlantic Treaty Organization]. 2010. Manual of NATO safety principles for the storage of military ammunition and explosives. Allied Ammunition Storage and Transport Publication AASTP-1, edition 1. Corrected version. Brussels (BE): NATO Headquarters. 588 p.

[NOAA] National Oceanic and Atmospheric Administration Fisheries. 2018. NOAA announces the 2018 Gulf of Mexico Red Snapper recreational seasons and clarifies permit regulations for vessels fishing in federal waters. FB18-026 Gulf of Mexico Fishery Bulletin. St Petersburg (FL): NOAA Fisheries Southeast Regional Office. [accessed 2020 Mar 23]. https://www.fisheries.noaa.gov/bulletin/noaa-announces-2018-gulf-mexico-red-snapper-recreational-seasons-and-clarifies-permit

[NOAA] National Oceanic and Atmospheric Administration Fisheries. 2019. State recreational red snapper management exempted fishing permits. St Petersburg (FL): NOAA Fisheries Southeast Regional Office; [updated 2020 Feb 5; accessed 2020 Mar 23]. https://www.fisheries.noaa.gov/southeast/state-recreational-red-snapper-management-exempted-fishing-permits.

Piraino MN, Szedlmayer ST. 2014. Fine-scale movements and home ranges of Red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico. Trans Am Fish Soc. 143:988-998.

Popper AN, Hawkins AD, Fay RR, Mann DA, Bartol TJ, et al. 2014. ASA S3/SC1.4 TR-2014 Sound exposure guidelines for fishes and sea turtles. Springer Briefs in Oceanography. Melville (NY): Acoustical Society of America. DOI 10.1007/978-3-319-06659-2_1. 73 p.

Reeves DB. 2015. Oil and gas platforms on Ship Shoal, Northern Gulf of Mexico as habitat for reef-associated organisms [thesis]. Baton Rouge (LA): Louisiana State University. 73 p. https://pdfs.semanticscholar.org/018d/37d53b8603f1ce72ea6d0acc6f39e5a0da4d.pdf

Reeves DB, Chesney EJ, Munnelly RT, Baltz DM, Marx BD. 2019. Abundance and distribution of reef-associated fishes around small oil and gas platforms in the Northern Gulf of Mexico's hypoxic zone. Estuar Coast. 41(2018):1835-1847.

SAS Institute, Inc. 2016. SAS Online Doc,Version SAS 9.4 TS Level 1M5. Cary (NC): SAS Institute.

Schroepfer RL, Szedlmayer ST. 2006. Estimates of residence and site fidelity for red snapper *Lutjanus campechanus* on artificial reefs in the northeastern Gulf of Mexico. Bull Mar Sci. 78(1):93-101.

Sedberry GR, Cuellar N. 1993 Planktonic and benthic feeding by the reef-associated vermilion snapper, Rhomblites aurorubens (*Teleostei*, *Lutjanidae*). Fish Bull. 91: 699-709p.

[SEDAR] SouthEast Data, Assessment, and Review. 2003. SEDAR 3 assessment report 1: complete stock assessment report of yellowtail snapper in the southeastern United States. North Charleston (SC):

SEDAR. 330 p. [accessed 2020 Mar 24]; http://sedarweb.org/docs/sar/SEDAR3_SAR1YTS_Final.pdf

[SEDAR] SouthEast Data, Assessment, and Review. 2016. SEDAR 33 stock assessment update report Gulf of Mexico greater amberjack (*Seriola dumerlili*). North Charleston (SC): SEDAR. 148 p. [accessed 2020 Mar 24]; http://sedarweb.org/docs/suar/GAJ_S33_2016%20Update_Final.pdf.

[SEDAR] SouthEast Data, Assessment, and Review. 2018. SEDAR 52 stock assessment report Gulf of Mexico red snapper stock assessment report. North Charleston (SC): SEDAR; [updated 9 May 2018; accessed 2020 Mar 24]; https://sedarweb.org/docs/sar/S52_Final_SAR_v2.pdf, South Carolina: 434p.

Seavy NE, Quader S, Alexander JD, Ralph CJ. 2005. Generalized linear models and point count data: statistical considerations for design and analysis of monitoring studies. In: Ralph CJ, Rich TD, editors. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partnership in Flight Conference. 2002 March 20–24; Asilomar, CA. Vol. 2. Albany (CA): USDA Forest Service, Pacific Southwest Research Station. Report No.: Gen. Tech. Rep. PSW-GTR-191. p. 744–753.

Stanley DR, Wilson CA. Wilson. 2003. Seasonal and spatial variation in the biomass and size frequency distribution of fish associated with oil and gas platforms in the northern Gulf of Mexico. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, Feefs, and Offshore Development: American Fisheries Society Symposium 36. Proceedings of the Gulf of Mexico Fish and Fisheries Meeting; 24–26 October 2003; New Orleans, LA. Bethesda (MD): American Fisheries Society. p. 123–153.

Topping DT, Szedlmayer ST. 2011. Home range and movement patterns of red snapper (*Lutjanus campechanus*) on artificial reefs. Fish Res. 112:77-84. doi:10.1016/j.fishres.2011.08.013.

Topping DT, Szedlmayer ST. 2013. Use of ultrasonic telemetry to estimate natural and fishing mortality of red snapper. Trans Am Fish Soc. 142:1090-1100. doi:10.1080/00028487.2013.790844.

Venables WN, Ripley BD. 2002. Random and mixed effects. In: Venables WN, Ripley BD, editors. Modern applied statistics with S. New York (NY): Springer Science+Business Media. p. 271–300.

Venables WN, Dichmont CM. 2004. GLMs, GAMs and GLMMs: an overview of theory for applications in fisheries research. Fish Res. 70:319-337. doi:10.1016/j.fishres.2004.08.011.

Versar, Inc. 2008. Literature search and data synthesis of biological information for use in management decisions concerning decommissioning of offshore oil and gas structures in the Gulf of Mexico (draft). Herndon (VA): US Department of the Interior, Minerals Management Service. Contract No.: 1435-01-05-39082. 129 p. [accessed 2020 Mar 24] http://sedarweb.org/docs/wsupp/SEDAR31-RD43-%20VERSAR%20Oil%20and%20Gas%20Platform%20Biological%20Assessment.pdf

White GC. 2014. Introduction to Program Mark. Werner College of Natural Resources, Colorado State University. http://www.phidot.org/software/mark/docs/book/

Williams-Grove LJ, Szedlmayer ST. 2015. Red snapper, *Lutjanus campechanus*, mortality, movements, and habitat use based on advanced telemetry methods [dissertation]. Auburn (AL): Auburn University.

Williams-Grove LJ, Szedlmayer ST. 2016a. Acoustic positioning and movement patterns of red snapper, *Lutjanus campechanus*, around artificial reefs in the northern Gulf of Mexico. Mar Ecol Pro Ser. 553:223-251. doi:10.3354/meps11778.

Williams-Grove LJ, Szedlmayer ST. 2016b. Mortality estimates of red snapper based on ultrasonic telemetry in the northern Gulf of Mexico. N Am J Fish Manage. 36(5):1036-1044. doi:10.1080/02755947.2016.1184197.

Williams-Grove LJ, Szedlmayer ST. 2017. Depth preferences and three-dimensional movements of red snapper, *Lutjanus campechanus*, on an artificial reef in the northern Gulf of Mexico. Fish Res. 190:61-70. doi: 10.1016/j.fishres.2017.01.003.

Appendix 1. Version 6 of the Endnote ™ Database

Abbott JK (Arizona State University, Tucson, AZ). 2016. Effects of the two-year exempted fishing permit for the Gulf of Mexico headboat collaborative. North Charleston (SC): SEDAR [Southeast Data, Assessment, & Review]. 82 p. Report No.: SEDAR52-RD-08.

Abbott JK, Willard D. 2017. Rights-based management for recreational for-hire fisheries: evidence from a policy trial. Fish Res. 196:106-116.

Abelson A, Shlesinger Y. 2002. Comparison of the development of coral and fish communities on rock-aggregated artificial reefs in Eilat, Red Sea. ICES J Mar Sci. 59:S122-S126.

Adams MS, Sagarese SR, Rios AB. 2016. Gulf of Mexico data-limited species life history compilation. North Charleston (SC): SEDAR. 36 p. Report No.: SEDAR49-DW-05.

Addis DT, Patterson WF III, Dance MA. 2007. Site fidelity and movement of reef fishes tagged at unreported artificial reef sites off NW Florida. In: Proceedings of the 60th Gulf and Caribbean Fisheries Institute. Punta Cana, Dominican Republic; November 5–9. 2007. Marathon (FL): Gulf and Caribbean Fisheries Institute. p. 297-304.

Addis DT, Patterson WF III, Dance MA. 2016. The potential for unreported artificial reefs to serve as refuges from fishing mortality for reef fishes. N Am J Fish Manage. 36(1):131-139.

Adriance JW, Sweda MT (Louisiana Wildlife and Fisheries Department, New Orleans and Grand Isle, LA). 2012. Spatial distribution and occurrence of red snapper, *Lutjanus campechanus*, sampled off the Louisiana coast during nearshore trawl sampling efforts. Tampa (FL): SEDAR. 11 p. Report No.: SEDAR31-WP-03.

Agassiz A. 1888. Three cruises of the United States coast and geodetic survey steamer “Blake” in the Gulf of Mexico, in the Caribbean Sea, and along the Atlantic coast of the United States, from 1877 to 1880. 2 volumes. Bull Mus Comp Zool Harv. (14 and 15):314 p. and 220 p.

Aglen A (Bergen, NO). 1989. Empirical results on precision-effort relationships for acoustic surveys. [Working paper.] CM 1989/B:30. Copenhagen (DK): International Council of Exploration of the Sea. 28 p. Report No.: C.M.1989/B:30. [accessed 2020 14 April]. http://www.ices.dk/sites/pub/CM%20Doccuments/1989/B/1989_B30.pdf

Ainslie MA. 2016. Center for Independent Experts (CIE) independent peer review report of the Underwater Calculator and associated documentation. [accessed 2020 April 14]. https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2016/2016_09_01%20Ainslie%20UWC%20review%20report.pdf

Ajemian MJ, Wetz JJ, Shipley-Lozano B, Shively JD, Stunz GW. 2015. An analysis of artificial reef fish community structure along the northwestern Gulf of Mexico shelf: potential impacts of “rigs-to-reefs” programs. PLoS One. 10(5):e0126354.

Ajemian MJ, Wetz JJ, Shipley-Lozano B, Stunz GW. 2015. Rapid assessment of fish communities on submerged oil and gas platform reefs using remotely operated vehicles. Fish Res. 167:143-155.

Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser. 367:233-238.

Alexander C, McKinney J. 2016. Assessment of fish assemblages on northern Gulf of Mexico manmade structures. New Orleans (LA): Louisiana Department of Wildlife and Fisheries. 11 p. Louisiana State Wildlife Grant T-91-R.

Allison PD. 1995. Survival analysis using the SAS® system: a practical guide. Cary (NC): SAS Institute.

Allman R, Barnett B, Trowbridge H, Goetz L, Evou N (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2012. Red snapper (*Lutjanus campechanus*) otolith ageing summary for collection years 2009-2011. North Charleston (SC): SEDAR. 26 p. Report No.: SEDAR31-DW05.

Allman R, Trowbridge H, Barnett B (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2013. Greater amberjack (*Seriola dumerili*) otolith ageing summary for Panama City laboratory (2009-2012). North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR33-DW21.

Allman RJ. 2007. Small-scale spatial variation in the population structure of vermilion snapper (*Rhomboplites aurorubens*) from the northeast Gulf of Mexico. Fish Res. 88(1-3):88-99.

Allman RJ, Fioramonti CL, Patterson WF III, Pacicco AE. 2015. Validation of annual growth zone formation in gray triggerfish (*Balistes capriscus*) dorsal spines, fin rays, and vertebrae. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR43-WP01.

Allman RJ, Fitzhugh GR, Starzinger KJ, Farsky RA. 2005. Precision of age estimation in red snapper (*Lutjanus campechanus*). Fish Res. 73(1):123-133.

Allman RJ, Goetz LA. 2009. Regional variation in the population structure of gray snapper, *Lutjanus griseus*, along the west Florida shelf. Bull Mar Sci. 84(3):315-330.

Allman RJ, Grimes CB. 2002. Temporal and spatial dynamics of spawning, settlement, and growth of gray snapper (*Lutjanus griseus*) from the west Florida shelf as determined from otolith microstructures. Fish Bull. 100:391-403.

Allman RJ, Tunnell JA, Barnett BK. 2005. Draft: vermilion snapper otolith aging: 2001-2004 data summary. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR9-DW2.

Andaloro F, Castriota L, Ferraro M, Romeo T, Sara G, et al. 2011. Evaluating fish assemblages associated with gas platforms: evidence from a visual census technique and experimental fishing surveys. Cien Mar. 37(1):1-9.

Andaloro F, Ferraro M, Mostarda E, Romeo T, Consoli P. 2013. Assessing the suitability of a remotely operated vehicle (ROV) to study the fish community associated with offshore gas platforms in the Ionian Sea: a comparative analysis with underwater visual censuses (UVCs). Helgol Mar Res. 67:241-250.

Anderson RO, Neumann RM. 1996. Length, weight, and assocatied structural indices. In: Murphy BR, Willis DW, editors. Fisheries techniques, 2nd ed. Bethesda (MD): American Fisheries Society. p. 447-482.

Anthony KM. 2009. Translocation, homing behavior and habitat utilization of oil platform-associated groundfishes in the east Santa Barbara Channel, California [thesis]. Long Beach (CA): California State University.

Anthony KM, Love MS, Lowe CG. 2012. Translocation, homing behavior and habitat use of groundfishes associated with oil platforms in the East Santa Barbara Channel, California. Bull S Calif Acad Sci. 111(2):1-27.

Antoine JW. 1972. Structure of the Gulf of Mexico. In: Rezak R, Henry VJ, editors. Contributions on the geological and geophysical oceanography of the Gulf of Mexico. Texas A&M University Oceanographic Studies. Volume 3. Houston (TX): Gulf Publishing. p. 1–34.

Antoni L, Emerick N, Saillant E. 2011. Genetic variation of gray triggerfish in U.S. waters of the Gulf of Mexico and western Atlantic Ocean as inferred from mitochondrial DNA sequences. N Am J Fish Manage. 31(4):714-721.

Arena PT, Jordan LKB, Spieler RE. 2007. Fish assemblages on sunken vessels and natural reefs in southeast Florida, USA. Hydrobiologia. 580:157-171.

Bacheler NM, Bartolino V, Reichert MJM. 2013. Influence of soak time and fish accumulation on catches of reef fishes in a multispecies trap survey. Fish Bull. 111(3):218-232.

Bacheler NM, Berrane DJ, Mitchell WA, Schobernd CM, Schobernd ZH, et al. 2014. Environmental conditions and habitat characteristics influence trap and video detection probabilities for reef fish species. Mar Ecol Prog Ser. 517:1-14.

Bacheler NM, Schobernd CM, Schobernd ZH, Mitchell WA, Berrane DJ, et al. 2013. Comparison of trap and underwater video gears for indexing reef fish presence and abundance in the southeast United States. Fish Res. 143:81-88.

Bacheler NM, Shertzer KW. 2014. Estimating relative abundance and species richness from video surveys of reef fishes. Fish Bull. 113(1):15-26.

Badalamenti F, Chemello R, D'Anna G, Henriquez Ramos P, Riggio S. 2002. Are artificial reefs comparable to neighbouring natural rocky areas? A mollusc case study in the Gulf of Castellammare (NW Sicily). ICES J Mar Sci. 59:S127-S131.

Baertlein N, McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Commercial vertical line vessel standardized catch rates of cobia in the US Gulf of Mexico, 1993-2010. [Revised 1 March 2012.] North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR28-DW16.

Baine M. 2002. The North Sea rigs-to-reefs debate. ICES J Mar Sci. 59:S277-S280.

Balk H, Lindem T. 2006. Sonar 4, Sonar 5, Sonar 6 e post-processing systems. Operator manual. Oslo (NO): Lindem Data Acquisition.

Barbieri LR, Colvocoresses JA (Florida Fish and Wildlife Conservation Commission Florida Marine Research Institute, Tallahassee, FL). 2016. Southeast Florida reef fish abundance and biology. Five year performance report to the US Department of the Interior Fish and Wildlife Service. 121 p. North Charleston (SC): SEDAR. Report No.: F0628-2221-97-02-F and SEDAR51-RD-20. Grant No.: F-73.

Barile PJ (Marine Research & Consulting, Inc.). 2013. Analysis of annual monthly and weekly king mackerel landings in the southeast Florida winter "mixing zone:" evidence for stock migrations and a resident population along the east coast of Florida. North Charleston (SC): SEDAR. 12 p. Report No.: SEDAR38-DW-08.

Barile PJ (Marine Research & Consulting, Inc.). 2013. Analysis of environmental factors affecting king mackerel landings along the east coast of Florida. North Charleston (SC): SEDAR. 14 p. Report No.: SEDAR38-DW-07.

Barile PJ (Marine Research & Consulting, Inc.). 2014. NMFS-Trip Intercept Program (TIP) data indicates significant Atlantic King Mackerel recruitment of new age classes into the East Florida commercial handline fishery in April 2014. North Charleston (SC): SEDAR. 5 p. Report No.: SEDAR38-RW-07.

Barile PJ (Marine Research & Consulting, Inc.). 2014. The NMFS-SEFSC must account for climate change and inter-annual environmental variability in all South Atlantic stock assessments. North Charleston (SC): SEDAR. 14 p. Report No.: SEDAR38-AW-03.

Barkaszi MJ, Frankel A, Martin JS, Poe W (CSA Ocean Sciences, Inc., Stuart, FL). 2016. Pressure wave and acoustic properties generated by the explosive removal of offshore structures in the Gulf of Mexico. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 72 p. Contract no.: M13PX00068. Report No.: OCS Study BOEM 2016-019. [accessed 2020 April 14]. https://marinecadastre.gov/espis/#/search/study/100045

Baxter L II, Hays EE, Hampson GR, Backus RH (Woods Hole Oceanographic Institution, Woods Hole, MA). 1982. Mortality of fish subjected to explosive shock as applied to oil well severance on Georges Bank. Washington (DC): US Department of the Interior, Minerals Management Service. 73 p. Contract No.: 14-08-0001-18920. Report No.: WHOI-82-54. DOI:10.1575/1912/2204

Beaumariage DS (Florida Department of Natural Resources, Division of Marine Resources, St. Petersburg, FL). 1969. Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. St. Petersburg (FL): State of Florida Department of Natural Resources. 46 p. Report No.: Technical Series No. 59; SEDAR24-RD62.

Beaumariage DS, Bullock LH. 1976. Biological research on snappers and groupers as related to fishery management requirements. In: Bullis HR Jr, Jones AC, editors. Proceedings: Colloquium on Snapper-Grouper Fishery Resources of the Western Central Atlantic Ocean; Pensacola Beach, FL. Gainesville (FL): University of Florida, Florida Sea Grant Program. Report No.: 17. p. 86-99.

Bedinger CA Jr, Childers RE, Kimball KT, Cooper JW, Kwok A (Southwest Research Institute, Houston, TX). 1981. Part 1—background, program organization and study plan. In: Bedinger CA Jr, editor. Ecological investigations of petroleum production platforms in the Central Gulf of Mexico Volume I—Pollutant fate and effects studies. SWRI Project 01-5245. New Orleans (LA): Bureau of Land Management. Contract No.: AA551-CT8-17. Report No.: 1981-14. p. 1-53.

Benoit-Bird KJ, Lawson GL. 2016. Ecological insights from pelagic habitats acquired using active acoustic techniques. Ann Rev Mar Sci. 8:463-490.

Beyer SG, Szedlmayer ST. 2010. The use of otolith shape analysis for ageing juvenile red snapper, *Lutjanus campechanus*. Environ Biol Fish. 89:333-340.

Black BA, Allman RJ, Schroeder ID, Schirripa MJ. 2011. Multidecadal otolith growth histories for red and gray snapper (*Lutjanus* spp.) in the northern Gulf of Mexico, USA. Fish Oceanogr. 20(5):347-356.

Bohnsack JA. 1989. Are high densities of fishes at artificial reef the result of habitat limitation or behavioral preference? Bull Mar Sci. 44(2):631-645.

Bohnsack JA, Bannerot SP. 1986. A stationary visual census technique for quantitatively assessing community structure of coral reef fishes. Washington (DC): National Marines Fisheries Service. 21 p. Report No.: NOAA Technical Report NMFS 41.

Bohnsack JA, Harper DE, McClellan DB, Hulsbeck M. 1994. Effects of reef size on colonization and assemblage structure of fishes at artificial reefs off southeastern Florida, U.S.A. Bull Mar Sci. 55(2-3):796-823.

Bohnsack JA, Sutherland DL. 1985. Artificial reef research: a review with recommendations for future priorities. Bull Mar Sci. 37(1):11-39.

Boland GS. 2000. Fish and epifaunal community observations at an artificial reef near a natural coral reef: nineteen years at platform High Island A389-A, from bare steel to coral habitat. In: McKay M, Nides J, Vigil D, editors. Proceedings: Gulf of Mexico Fish and Fisheries: Bringing Together New and Recent Research. New Orleans (LA): US Department of the Interior, Minerals Management Service. Contract No.: 1435-00-01-CA-31060. Report No.: OCS Study MMS 2002-004. p. 372–392. [accessed 2020 April 14]. https://marinecadastre.gov/espis/#/search/study/177

Boland GS, Gallaway BJ, Baker JS, Lewbel GS (LGL Ecological Research Associates, Inc., Bryan, TX). 1983. Ecological effects of energy development on reef fish of the Flower Garden Banks. Final report for work unit B1/B5.Galveston (TX): [NMFS-SEFSC] National Marine Fisheries Service, Southeast Fisheries Center. 499 p. Contract No.: NA80-GA-C-00057.

Bolker BM, Brooks ME, Clark CJ, Geange SW, Poulsen JR, et al. 2009. Generalized linear mixed models: a practical guide for ecology and evolution. Trends Ecol Evol. 24(3):127-135.

Bollinger MA, Kline RJ. 2017. Validating sidescan sonar as a fish survey tool over artificial reefs. J Coast Res. 33(6):1397-1407.

Bonney R, Cooper CB, Dickinson J, Kelling S, Phillips T, et al. 2009. Citizen science: a developing tool for expanding science knowledge and scientific literacy. BioSci. 59(11):977-984.

Bortone SA. 2020. Artificial reefs in the future management of Red Snapper, *Lutjanus campechanus*. In: Bortone SA, Szedlmayer ST, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 275-283.

Bortone SA, Hastings PA, Collard SB. 1977. The pelagic-*Sargassum* ichthyofauna of the eastern Gulf of Mexico. Northeast Gulf Sci. 1(2):60-67.

Bortone SA, Szedlmayer ST. 2020. Introduction. In: Szedlmayer ST, Bortone SA, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 1-4.

Borwn SJ (Quest Engineering Development Corp., Crosby, TX). 1986. Pressure systems energy release protection (gas pressurized systems). Hampton (VA): National Aeronautics and Space Administration [NASA], Langley Resarch Center.435 p. Contract No.: NASI-17278. Report No.: NASA Contractor Report 178090.

Boswell KM, Wells RJD, Cowan JH, Jr., Wilson CA. 2010. Biomass, density, and size distributions of fishes associated with a large-scale artificial reef complex in the Gulf of Mexico. Bull Mar Sci. 86(4):879-889.

Boswell KM, Wilson MP, Wilson CA. 2007. Hydroacoustics as a tool for assessing fish biomass and size distribution associated with discrete shallow water estuarine habitats in Louisiana. Estuar Coast. 30(4):607-617.

Brandt JR, Jackson DC. 2013. Influences of artificial reefs on juvenile red snapper along the Mississippi Gulf coast. Mar Coast Fish. 5(1):1-10.

Brandt SB, Mason DM, Patrick EV, Argyle RL, Wells L, et al. 1991. Acoustic measures of the abundance and size of pelagic planktivores in Lake Michigan. Can J Fish Aquat Sci. 48:894-908.

Brennan K, Fitzpatrick K (National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, NC). 2012. Estimates of historic recreational landings of Spanish mackerel in the South Atlantic using the FHWAR census method. Beaufort (NC): SEDAR. 11 p. Report No.: SEDAR31-RD25.

Brickhill MJ, Lee SY, Connolly RM. 2005. Fishes associated with artificial reefs: attributing changes to attraction or production using novel approaches. J Fish Biol. 67(Supplement B):53-71.

Bright TJ, Pequegnat LH. 1974. Biota of the West Flower Garden Bank. Houston (TX): Gulf Publishing Company. 435 p.

Bright TJ, Rezak R (Texas A&M University, College Station, TX). 1978. South Texas topographic features study. New Orleans (LA): US Department of the Interior, Bureau of Land Management. 824 p. Contract No.: AA550-CT6-18.

Britt JR, Eubanks RJ, Lumsden MG. 1991. Underwater shock wave reflection and refraction in deep and shallow water. Volume 1: a user’s manual for the REFMS code (version 4.0). St. Joseph (LA): Science Applications International Corporation. No. DNR-TR-91-15-VI.

Brown H, Benfield MC, Keenan SF, Powers SP. 2010. Movement patterns and home ranges of a pelagic carangid fish, *Caranx crysos*, around a petroleum platform complex. Mar Ecol Prog Ser. 403:205-218.

Brown-Peterson NJ, Overstreet RM, Lotz JM. 2001. Reproductive biology of cobia, *Rachycentron canadum*, from coastal waters of the southern United States. Fish Bull. 99:15-28.

Brucks JT. 1971. Currents of the Caribbean and adjacent regions as deduced from drift-bottle studies. Bull Mar Sci. 21(2):455-465.

Bryan M, Saul S (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Recreational indices for cobia and Spanish mackerel in the Gulf of Mexico.. North Charleston (SC): SEDAR. 42 p. Report No.: SEDAR28-DW22.

Buczkowski BJ, Reid JA, Jenkins CJ, Reid JM, Williams SJ, et al. 2006. usSEABED: Gulf of Mexico and Caribbean (Puerto Rico and U.S. Virgin Islands) offshore surficial sediment data release. US Geological Survey Data Series 146, 2006, version 1.0. Reston (VA): US Department of the Interior, US Geological Survey. 50 p. [accessed 14 April 2020]. https://pubs.usgs.gov/ds/2006/146/

Burns KM, Froeschke JT. 2012. Survival of red grouper (*Epinephalus morio*) and red snapper (*Lutjanus campechanus*) caught on J-hooks and circle hooks in the Florida recreational and recreational-for-hire fisheries. Bull Mar Sci. 88(3):633-646.

Burns KM, Neidig C, Lotz J, Overstreet R (Mote Marine Laboratory, Sarasota, FL). 1998. Cobia (*Rachycentron canadum*) stock assessment study in the Gulf of Mexico and in the South Atlantic. St. Petersburg (FL): National Oceanic and Atmospheric Administration, Marine Fisheries Service. 134 p. Award No.: NA57FF0294 (MARFIN). Report No.: Mote Marine Laboratory Technical Report No. 571 and SEDAR28-RD28.

Burns KM, Neidig CL (Mote Marine Laboratory, Sarasota, FL). 1992. Cobia (*Rachycentron canadum*), amberjack (*Seriola dumerili*), and dolphin (*Coryphaena hipurus*) migration and life history study off the southwest coast of Florida. 100 p. St. Petersburg (FL): National Oceanic and Atmospheric Administration, Marine Fisheries Service. Award No.: NA90AA-H-MF747 (MARFIN). Report No.: Mote Marine Laboratory Technical Report No. 267 and SEDAR28-RD22.

Burton ML. 2001. Age, growth, and mortality of gray snapper, *Lutjanus griseus*, from the east coast of Florida. Fish Bull. 99:254-265.

Abbott R, Reyff JA (Strategic Environmental; Illingworth & Rodki, Inc., n.p.; Cotati, CA). 2004. San Francisco–Oakland Bay Bridge East Span Seismic Safety Project: fisheries and hydroacoustic monitoring program compliance report. Oakland (CA): Caltrans. 148 p. Contract Nos.: 04-SF-80 KP 12.2/KP 14.3 and 04-ALA-80 KP 0.0/KP 2.1.

Campana SE. 2001. Accuracy, precision and quality control in age determination, including a review of the use and abuse of age validation methods. J Fish Biol. 59(2):197-242.

Campanella F, Taylor JC. 2016. Investigating acoustic diversity of fish aggregations in coral reef ecosystems from multifrequency fishery sonar surveys. Fish Res. 181:63-76.

Campbell M, Pollack A, Henwood T, Provaznik J, Cook M (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Summary report of the red snapper (*Lutjanus campechanus*) catch during the 2011 expanded annual stock assessment (EASA). Pascagoula (MS): National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS. 26 p. Report No.: SEDAR31-DW17.

Campbell MD, Driggers WB, Sauls B (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Release mortality in the red snapper fishery: a synopsis of three decades of research. North Charleston (SC): SEDAR. 23 p. Report No.: SEDAR31-DW22.

Campbell MD, Driggers WB, III, Sauls B, Walter JF. 2014. Release mortality in the red snapper (*Lutjanus campechanus*) fishery: a meta-analysis of 3 decades of research. Fish Bull. 112(4):283-296.

Campbell MD, Pollack AG, Driggers WB, Hoffmayer ER. 2014. Estimation of hook selectivity of red snapper and vermilion snapper from fishery-independent surveys of natural reefs in the northern Gulf of Mexico. Mar Coast Fish. 6(1):260-273.

Campbell MD, Pollack AG, Gledhill CT, Switzer TS, DeVries DA. 2015. Comparison of relative abundance indices calculated from two methods of generating video count data. Fish Res. 170:125-133.

Campbell MD, Rademacher KR, Felts P, Noble B, Felts M, Salisbury J (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2012. SEAMAP reef fish video survey: relative indices of abundance of red snapper. North Charleston (SC): SEDAR. 59 p. Report No.: SEDAR31-DW08.

Campbell MD, Rademacher KR, Felts P, Noble B, Felts M, Salisbury J (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2013. SEAMAP reef fish video survey: relative indices of abundance of greater amberjack. North Charleston (SC): SEDAR. 48 p. Report No.: SEDAR33-DW16.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of almaco jack. North Charleston (SC): SEDAR. 26 p. Report No.: SEDAR49-DW-10.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of lane snapper. North Charleston (SC): SEDAR. 26 p. Report No.: SEDAR33-DW16.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of lesser amberjack. North Charleston (SC): SEDAR. 26 p. Report No.: SEDAR 49-DW11.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of snowy grouper. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR49-DW-12.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of speckled hind. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR49-DW-13.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of wenchman. North Charleston (SC): SEDAR. 21 p. Report No.: SEDAR49-DW-20.

Campbell MD, Rademacher KR, Felts P, Noble B, Salisbury J, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. SEAMAP reef fish video survey: relative indices of abundance of yellowmouth grouper. North Charleston (SC): SEDAR. 17 p. Report No.: SEDAR49-DW-21.

Campbell MD, Rademacher KR, Hendon M, Felts P, Noble B, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. SEAMAP reef fish video survey: relative indices of abundance of grey snapper. North Charleston (SC): SEDAR. 31 p. Report No.: SEDAR51-DW-07.

Campbell MD, Rademacher KR, Hendon M, Felts P, Noble B, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. SEAMAP reef fish video survey: relative indices of abundance of Gulf of Mexico - red snapper. North Charleston, SC: SEDAR. p. 36.

Campbell MD, Rademacher KR, Hendon M, Felts P, Noble B, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2015. SEAMAP reef fish video survey: relative indices of abundance of gray triggerfish. North Charleston, SC: SEDAR. p. 33.

Campbell MD, Rademacher KR, Hendon M, Felts P, Noble B, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2015. SEAMAP reef fish video survey: relative indices of abundance of vermilion snapper. North Charleston (SC): SEDAR. 35 p. Report No.: SEDAR43-WP-12.

Campbell MD, Rose K, Boswell K, Cowan J. 2011. Individual-based modeling of an artificial reef fish community: effects of habitat quantity and degree of refuge. Ecol Model. 222:3895-3909.

Campbell MD, Switzer T, Mareska J, Hendon J, Rester J,et al. 2017. SEAMAP vertical line survey: relative indices of abundance of Gulf of Mexico - red snapper. North Charleston (SC): SEDAR. 28 p. Report No.: SEDAR52-WP-12.

Carlson J, Gulak S, Scott-Denton E, Pulver J (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL and Galveston, TX). 2013. Relative abundance of gag grouper and greater amberjack based on observer data collected in the reeffish bottom longline fishery. North Charleston (SC): SEDAR. 14 p. Report No.: SEDAR33-DW-26.

Carr MH, Hixon MA. 1997. Artificial reefs: the importance of comparisons with natural reefs. Fisheries Spec Iss Artifical Reef Manage. 22(4):28-33.

Carr MH, McGinnis MV, Forrester GE, Harding J, Raimondi PT (University of California, Coastal Marine Institute, Santa Barbara, CA). 2003. Consequences of alternative decommissioning options to reef fish assemblages and implications for decommissioning policy. Santa Barbara (CA): US Department of the Interior, Minerals Management Service. 113 p. Cooperative Agreement No.: 14-35-0001-30758. Report No.: MMS OCS Study 2003-053. [accessed 2020 April 15]. https://marinecadastre.gov/espis/#/search/study/438

Carruthers TR, Punt AE, Walters CJ, MacCall A, McAllister MK, et al. 2014. Evaluating methods for setting catch limits in data-limited fisheries. Fish Res. 153:48-68.

Caselle JE, Love MS, Fusaro C, Schroeder D. 2002. Trash or habitat? Fish assemblages on offshore oilfield seafloor debris in the Santa Barbara Channel, California. ICES J Mar Sci. 59:S258-S265.

Casper BM, Smith ME, Halvorsen MB, Sun H, Carlson TJ, et al. 2013. Effects of exposure to pile driving sounds on fish inner ear tissues. Comp Biochem Physiol A Mol Integr Physiol. 166(2):352-360.

Cass-Calay SL, Porch CE, Goethel DR, Smith MW, Matter V, et al. 2015. Stock assessment of red snapper in the Gulf of Mexico 1872-2013 - with provisional 2014 landings. Report of the update assessment 09-07-2015. Tampa (FL): Science and Statistical Committee Gulf Fishery Management Council. 241 p. Report No.: SEDAR41-RD61.

Chambers RC, Leggett WC. 1989. Event analysis applied to timing in marine fish ontogeny. Can J Fish Aquat Sci. 46:1633-1641.

Chandler J, White D, Techera EJ, Gourvenec S, Draper S. 2017. Engineering and legal considerations for decommissioning of offshore oil and gas infrastructure in Australia. Ocean Eng. 131:338-347.

Chapin AM, Szedlmayer ST, Phelps RP. 2009. Survival and movement of hatchery-reared red snapper on artificial habitats in the northern Gulf of Mexico. Fish Manag Ecol. 16(1):28-36.

Chapman NR. 1985. Measurement of the waveform parameters of shallow explosive charges. J Acoust Soc Am. 78(2):672-681.

Charbonnel E, Serre C, Ruitton S, Harmelin J-G, Jensen A. 2002. Effects of increased habitat complexity on fish assemblages associated with large artificial reef units (French Mediterranean coast). ICES J Mar Sci. 59:S208-S213.

Cheng JCP, Tan Y, Liu X, Wang X. 2016. Application of 4D BIM for evaluating different options of offshore oil and gas platform decommissioning. In: Yakubi N, Makanae K, editors. ICCBE2016: Proceedings of the 16th International Conference on Computing in Civil and Building Engineering [ICCBE]. Osaka, Japan; July 6–8. 2016. Osaka (JP): ICCBE2016 Organizing Committee. p. 1524–1531.

Chih C-P (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Length frequency distributions for red snappers in the Gulf of Mexico from 1984-2011. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR31-DW10.

Chih C-P (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. On the comparisons of regional differences in the growth of red snappers from the Gulf of Mexico. North Charleston (SC): SEDAR. 35 p. Report No.: SEDAR31-DW18.

Chih C-P. 2013. Age frequency distributions estimated with reweighting methods for red snappers in the Gulf of Mexico from 1991 to 2011. North Charleston (SC): SEDAR. 22 p. Report No.: SEDAR31-AW15.

Chih C-P. 2013. Changes in lengths-at-age and size selectivity of red snappers in the Gulf of Mexico from 2002 to 2011. North Charleston (SC): SEDAR. 21 p. Report No.: SEDAR31-AW16

Chih C-P. 2013. Length frequency distributions and reweighted age frequency distributions for greater amberjacks in the Gulf of Mexico from 1984-2012. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR31-DW10

Chih C-P. 2014. Age frequency distributions, age length keys, length at ages, and sex ratios for king mackerels in the Gulf of Mexico and South Atlantic from 1986-2013. North Charleston (SC): SEDAR. 46 p. Report No.: SEDAR38-AW05

Chih C-P. 2014. Length frequency distributions for king mackerels in the Gulf of Mexico and South Atlantics from 1978-2013. North Charleston (SC): SEDAR.36 p. Report No.: SEDAR38-AW06

Chih C-P. 2015. Length and age frequency distributions for vermilion snappers collected in the Gulf of Mexico from 1981 to 2014. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR45-WP08

Chih C-P. 2015. Length frequency distributions for gray triggerfish collected in the Gulf of Mexico from 1986 to 2013. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR43-WP-04

Chih C-P. 2016. Summary of length data and length frequency distributions for eight data limited species collected in the Gulf of Mexico from 1981 to 2015. North Charleston (SC): SEDAR. 24 p. Report No.: SEDAR49-DW-08

Chih C-P. 2017. Length frequency distributions for gray snapper length and age samples collected from the Gulf of Mexico. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR51-DW-04

Chittenden ME Jr, McEachran JD. 1976. Composition, ecology and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire Gulf. College Station (TX): Texas A&M University, Sea Grant College. 104 p. NOAA grant No. 04-5-158-19. Report No.: TAMU-SG-76-208.

Christian EA. 1973. The effects of underwater explosions on swimbladder fish. White Oak (MD): Naval Ordnance Laboratory. 50 p. Report No.: NOLTR 73-103.

Christiansen HM, Switzer TS, Thompson K. 2017. Indices of abundance for red snapper (*Lutjanus campechanus*) from the Florida Fish and Wildlife Research Institute (FWRI) repetitive time drop survey in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 12 p. Report No.: SEDAR52-WP-06.

Christiansen HM, Switzer TS, Thompson K. 2017. Indices of abundance for red snapper (*Lutjanus campechanus*) from the Florida Fish and Wildlife Research Institute (FWRI) vertical longline survey in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 12 p. Report No.: SEDAR52-WP-05.Claisse JT, Pondella DJ II, Love M, Bull AS (Vantuna Research Group, Los Angeles, CA). 2014. Biological productivity of fish associated with offshore oil and gas structures on the Pacific OCS. Camarillo (CA): US Department of the Interior, Bureau of Ocean Energy Management. 70 p. Cooperative Agreement No.: M12AC00003. Report No.: OCS Study BOEM 2014-030.

Claisse JT, Pondella DJ II, Love M, Zahn LA, Williams CM, et al. 2015. Impacts from partial removal of decommissioned oil and gas platforms on fish biomass and production on the remaining platform structure and surrounding shell mounds. PLoS One. 10(9):e0135812.

Claisse JT, Pondella DJ II, Love M, Zahn LA, Williams CM, et al. 2014. Oil platforms off California are among the most productive marine fish habitats globally. Proc Natl Acad Sci. 11(43):15462-15467.

Clardy TR, Patterson WF III, DeVries DA, Palmer C. 2008. Spatial and temporal variability in the relative contribution of king mackerel (*Scomberomorus cavalla*) stocks to winter mixed fisheries off South Florida. Fish Bull. 106(2):152-160.

Claydon J. 2004. Spawning aggregations of coral reef fishes: characteristics, hypotheses, threats and management. Oceanogr Mar Biol Annu Rev. 42:265-302.

Colburn LL, Jepson M, Himes-Cornell A, Kasperski S, Norman K, et al. 2017. Community participation in U.S. catch share programs. Silver Spring (MD): National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 136 p. Report No.: NOAA Technical Memorandum NMFS-F/SPO-179.

Cole RH. 1948. Underwater explosions. Princeton (NJ): Princeton University Press.

Coleman FC, Koenig CC, Collins LA. 1996. Reproductive styles of shallow-water groupers (Pisces: Serranidae) in the eastern Gulf of Mexico and the consequences of fishing spawning aggregations. Environ Biol Fish. 47(2):129-141.

Coleman FC, Koenig CC, Eklund A-M, Grimes CB. 1999. Management and conservation of temperate reef fishes in the grouper–snapper complex of the southeastern United States. In: Musick JA, editor. Life in the slow lane: ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23. Bethesda (MD): American Fisheries Society. p. 233-242.

Coleman FC, Scanlon KM, Koenig CC. 2011. Groupers on the edge: shelf edge spawning habitat in and around marine reserves of the northeast Gulf of Mexico. Prof Geogr. 63(4):456-474.

Coll C, de Morais LT, Laë R, Lebourges-Dhaussy A, Simier M, et al. 2007. Use and limits of three methods for assessing fish size spectra and fish abundance in two tropical man-made lakes. Fish Res. 83:306-318.

Collins A. 2014. An investigation into the habitat, behavior and opportunistic feeding strategies of the protected goliath grouper (*Epinephelus itajara*) [dissertation]. Tampa (FL): University of South Florida.

Connor JG, Jr. 1990. Underwater blast effects from explosive severance of offshore platform legs and well conductors. Dahlgren (VA): Naval Surface Warfare Center. 136 p. Report No.: NAVSWC TR 90-532.

Conrad AS, Kim KH, Gallaway BJ (Greeneridge Sciences, Inc., Santa Barbara, CA, and LGL Ecological Research Associates, Inc., College Station, TX). 2019. Explosive removal of structures: acoustic model application.New Orleans (LA): Department of the Interior, Bureau of Ocean Energy Management. 53 p. Contract No. M16PC00005.

Consoli P, Romeo T, Ferraro M, Sarà G, Andaloro F. 2013. Factors affecting fish assemblages associated with gas platforms in the Mediterranean Sea. J Sea Res. 77:45-52.

Continental Shelf Associates, Inc. (Jupiter, FL). 2004. Explosive removal of offshore structures - information synthesis report. New Orleans (LA): US Department of the Interior, Minerals Management Service. 236 p. Contract No.: 1435-01-02-CT-85237. Report No.: OCS Study MMS 2003-070.

Cowan JH Jr, Boswell KM, Simonsen KA, Saari CR, Kulaw D. 2012. Working paper for Red Snapper Data Workshop (SEDAR 31). North Charleston (SC): SEDAR. 47 p. Report No.: SEDAR31-DW03.

Cowan JH Jr, Grimes CB, Patterson WF III, Walters CJ, Jones AC, et al. 2011. Red snapper management in the Gulf of Mexico: science- or faith-based? Rev Fish Biol Fish. 21(2):187-204.

Cowan JH Jr, Rose KA. 2016. Oil and gas platforms in the Gulf of Mexico: their relationship to fish and fisheries. In: Mikkola H, editor. Fisheries and aquaculture in the modern world. London(GB): InTech. p. 95-122.

Cowan JH Jr, Shipp RL, Bailey HK IV, Haywick DW. 1995. Procedure for rapid processing of large otoliths. Trans Am Fish Soc. 124:280-282.

Crabtree RE, Bullock LH. 1998. Age, growth, and reproductiom of black grouper, *Mycteroperca bonaci*, in Florida waters. Fish Bull. 96(4):735-753.

Craig K (National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, NC). 2012. The Beaufort Assessment Model (BAM) with application to cobia: mathematical description, implementation details, and computer code. North Charleston (SC): SEDAR. 35 p. Report No.: SEDAR28-RW01.

Craig K (National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, NC). 2012. Development and diagnostics of the Beaufort assessment model applied to cobia. North Charleston (SC): SEDAR. 25 p. Report No.: SEDAR28-RW02.

Craig MT, Hastings PA. 2007. A molecular phylogeny of the groupers of the subfamily Epinephelinae (Serranidae) with a revised classification of the Epinephelini. Ichthyol Res. 54(1):1-17.

Crandall CAC, Parkyn DC, Murie DJ (University of Florida, Gainesville, FL). 2013. Regional stock structure of greater amberjack in the southeastern United States using otolith shape analysis. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR33-DW25.

Cripps SJ, Aabel JP. 2002. Environmental and socio-economic impact assessment of Ekoreef, a multiple platform rigs-to-reefs development. ICES J Mar Sci. 59:S300-S308.

Cummings N, Isely J (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Texas Parks and Wildlife catch per unit of effort abundance information for cobia (*Rachycentrum Cendrum*). North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR28-DW10.

Cummings NJ, McClellan DB (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2000. Trends in the Gulf of Mexico greater amberjack fishery through 1998: commercial landings, recreational catches, observed length frequencies, estimates of landed and discarded catch at age, and selectivity at age. North Charleston (SC): SEDAR. Report No.: SEDAR33-RD11 and SFD-99/00-99.

Curtis JM, Johnson MW, Diamond SL, Stunz GW. 2015. Quantifying delayed mortality from barotrauma impairment in discarded red snapper using acoustic telemetry. Mar Coast Fish. 7(1):434-449.

D'Alessandro EK, Sponaugle S, Serafy JE. 2010. Larval ecology of a suite of snappers (family: Lutjanidae) in the Straits of Florida, western Atlantic Ocean. Mar Ecol Prog Ser. 410:159-175.

Dahl PH (University of Washington, Seattle, WA). 2016. Center for Independent Experts (CIE) independent peer review report of Underwater Calculator for Shocks, or UWCv2 (vers 2.0). Seattle, WA.

Daigle ST, Fleeger JW, Cowan JH, Jr., Pascal P-Y. 2013. What is the relative importance of phytoplankton and attached macroalgae and epiphytes to food webs on offshore oil platforms? Mar Coast Fish. 5(1):53-64.

Dance MA, Patterson WF III, Addis DT. 2011. Fish community and trophic structure at artificial reef sites in the northeastern Gulf of Mexico. Bull Mar Sci. 87(3):301-324.

Danovaro R, Gambi C, Mazzola A, Mirto S. 2002. Influence of artificial reefs on the surrounding infauna: analysis of meiofauna. ICES J Mar Sci. 59:S356-S362.

Darden T (South Carolina Department of Natural Resources). 2012. Cobia preliminary data analyses U.S. Atlantic and GOM genetic population structure. North Charleston (SC): SEDAR. 2 p. North Charleston (SC): SEDAR. Report No.: SEDAR28-DW01.

Darden TL, Walker MJ, Brenkert K, Yost JR, Denson MR. 2014. Population genetics of cobia (*Rachycentron canadum*): implications for fishery management along the coast of the southeastern United States. Fish Bull. 112(24-35):24.

Dauterive L (US Department of the Interior, Minerals Management Service, New Orleans LA). 2000. Rigs-to-reefs policy, progress, and perspective. AAUS 20th Symposium Proceedings 2000: diving for science in the twenty-first century. Mobile (AL): AAUS [American Academy of Underwater Sciences]. p. 64-66.

Davis WT. 2014. Ecological and fisheries management implications of competition between red snapper and vermilion snapper [thesis]. Princeton (NJ): Princeton University.

Davis WT, Drymon JM, Powers SP. 2015. Spatial and dietary overlap creates potential for competition between red snapper (*Lutjanus campechanus*) and vermilion snapper (*Rhomboplites aurorubens*). PLoS One. 10(12):e0144051.

Defenbaugh RE. 1976. A study of the benthic macroinvertebrates of the continental shelf of the northern Gulf of Mexico [dissertation]. College Station (TX): Texas A&M University.

DeMarsh G. 2000. The use of explosives in decommissioning and salvage. Paper presented at: The 2000 Offshore Technology Conference; 2000 May 1–4; Houston, TX.

Denit K, Sponaugle S. 2004. Growth variation, settlement, and spawning of gray snapper across a latitudinal gradient. Trans Am Fish Soc. 133:1339-1355.

Dennis GD, Bright TJ. 1988. Reef fish assemblages on hard banks in the northwestern Gulf of Mexico. Bull Mar Sci. 43(2):280-307.

DeVries DA, Gardner CL, Raley P (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2015. Vermilion snapper *Rhomboplites aurorubens* findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey 2004-2014. North Charleston (SC): SEDAR. 25 p. Report Nos.: SEDAR-WP-12 and Panama City Laboratory Contribution 15-19.

DeVries DA, Gardner CL, Raley P, Ingram W (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2015. Gray triggerfish *Balistes capriscus* findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey – 2004-2014. North Charleston (SC): SEDAR. 26 p. Report Nos.: SEDAR-WP-14 and Panama City Laboratory Contribution 15-12.

DeVries DA, Gardner CL, Raley P, Overly K (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2016. Almaco jack *Seriola rivoliana* findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey 2004-2014. North Charleston (SC): SEDAR. 18 p. Report Nos.: SEDAR49-DW-15 and Panama City Laboratory Contribution 16-05.

DeVries DA, Gardner CL, Raley P, Overly K (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2016. Lane snapper *Lutjanus synagris* findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey 2004-2014. North Charleston (SC): SEDAR. 21 p. Report Nos.: SEDAR49-DW-15 and Panama City Laboratory Contribution 16-04.

DeVries DA, Ingram W, Gardner CL, Raley P (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2012. Red snapper findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey – 2004-2011 [draft]. North Charleston (SC): SEDAR. 18 p. Report Nos.: SEDAR31-DW-28 and Panama City Laboratory Contribution 12-xx.

DeVries DA, Raley P, Gardner CL, Ingram W (National Marines FisheriesService, Southeast Fisheries Science Center, Panama City, FL). 2013. Greater amberjack *Seriola dumerili* findings from the NMFS Panama City Laboratory trap & camera fishery-independent survey – 2004-2012. North Charleston (SC): SEDAR. 19 p. Report Nos.: SEDAR33-AW05 and Panama City Laboratory Contribution 13-3.

Diamond SL, Campbell M, Olson D, Panto L, Wang Y, et al. 2007. Movers and stayers: individual variability in site fidelity and movements of red snapper off Texas. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 163-188.

Ditty JG, Shaw RF. 1992. Larval development, distribution, and ecology of cobia *Rachycentron canadum* (Family: RachycentridaeJ in the northern Gulf of Mexico. Fish Bull. 90:668-677.

Dokken QR, Withers K, Childs S, Riggs T (Texas A&M University-Corpus Christi, Corpus Christ, TX). 2000. Characterization and comparison of platform reef communities off the Texas coast. Corpus Christi (TX): Texas Parks and Wildlife Department. Report No.: TAMU-CC-0007-CCS.

Domeier ML, Koenig C, Coleman F. 1996. Reproductive biology of the gray snapper (*Lutjanus griseus*), with notes on spawning for other western Atlantic snappers (Lutjanidae). In: Arreguin-Sanchez F, Munro JL, Balgos MC, Pauly D, editors. Biology and culture of tropical groupers and snappers: proceedings of an EPOMEX/ICLARM International Workshop on tropical snappers and groupers, University of Campeche; Campeche, Mexico; 1993 October 26–29. ICLARM Conf Proc 48. Makati City (PH): International Center for Living Aquatic Resources Management. p. 189-201.

Doray M, Josse E, Gervain P, Reynal L, Chantrel J. 2008. Joint use of echosounding, fishing and video techniques to assess the structure of fish aggregations around moored fish aggregating devices in Martinique (Lesser Antilles). Aquat Liv Res. 20(4):357-366.

Dorf BA, Fisher M (Texas Parks and Wildlife Department, Rockport, TX). 2012. Fishery-independent catch of young-of-the-year red snapper in the Texas territorial sea, 1985–2007. North Charleston (SC): SEDAR. 28 p. Report No.: SEDAR31-RD08.

Downey CH. 2013. Reproduction and diet of red snapper *Lutjanus campechanus* on natural and artifical reefs in the northwestern Gulf of Mexico [thesis]. Corpus Christi (TX): Texas A&M University-Corpus Christi.

Drew K, Defilippi J, Sartwell T. 2012. MRFSS index for Atlantic Spanish mackerel and cobia. North Charleston (SC): SEDAR. 22 p. Report No.: SEDAR28-DW19.

Drumhiller KL, Johnson MW, Diamond SL, Reese Robillard MM, Stunz GW. 2014. Venting or rapid recompression increase survival and improve recovery of red snapper with barotrauma. Mar Coast Fish. 6(1):190-199.

Dufrene TA. 2005. Geological variability and Holocene sedimentary record on the northern Gulf of Mexico inner to mid-continental shelf [thesis]. Baton Rouge (LA): Louisiana State University.

Dunlap Kolden K, Aimone-Martin C (Alaska Seismic & Environmental LLC and Aimone-Martin Associates, LLC) . 2013. Blasting effects on salmonids. Final report. Prepared for the Alaska Department of Fish & Game under agency contract. Douglas (AK): Alaska Department of Fish and Game, Division of Habitat. 33 p. Contract No.: IHP-13-051.

Dzwilewski PT (Applied Research Associates, Littleton, CO). 2014. Water shock prediction for explosive removal of offshore structures: UnderWater Calculater (UWC) version 2.0 update based upon field data. New Orleans (LA): Department of the Interior, Bureau of Safety and Environmental Enforcement. 35 p. Contract No.: GS23F0278M. Report No.: ARA project 001974.

Dzwilewski PT, Fenton G (Applied Research Associates, Littleton, CO). 2003. Shock wave/sound propagation modeling results for calculating marine protected species impact zones during explosive removal of offshore structures. New Orleans (LA): Department of the Interior, Minerals Management Service. 42 p. Contract No.: 0302P057572, ref no. 2-54000124. Report No.: OCS Study MMS 2003-059.

Edwards AWF. 1992. Likelihood. Baltimore (MD): Johns Hopkins University Press.

Emery BM, Washburn L, Love MS, Nishimoto MM, Ohlmann JC. 2006. Do oil and gas platforms off California reduce recruitment of bocaccio (*Sebastes paucispinis*) to natural habitat? An analysis based on trajectories derived from high-frequency radar. Fish Bull. 104:391-400.

Emmrich M, Winfield IJ, Guillard J, Rustadbakken A, Vergès C, et al. 2012. Strong correspondence between gillnet catch per unit effort and hydroacoustically derived fish biomass in stratified lakes. Freshwater Biol. 57(12):2436-2448.

Engås A, Løkkeborg S, Ona E, Soldal AV. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Can J Fish Aquat Sci. 53:2238-2249.

Errigo M, Hiltz E, Byrd J. 2012. SCDNR charterboat logbook program data, 1993 - 2010. [Updated 5 May 2011]. North Charleston (SC): SEDAR. 7 p. Report No.: SEDAR25-DW23.

Fabi G, Grati F, Puletti M, Scarcella G. 2004. Effects on fish community induced by installation of two gas platforms in the Adriatic Sea. Mar Ecol Prog Ser. 273:187-197.

Fabi G, Luccarini F, Panfili M, Solustri C, Spagnolo A. 2002. Effects of an artificial reef on the surrounding soft-bottom community (central Adriatic Sea). ICES J Mar Sci. 59:S343-S349.

Fabi G, Sala A. 2002. An assessment of biomass and diel activity of fish at an artificial reef (Adriatic sea) using a stationary hydroacoustic technique. ICES J Mar Sci. 59:411-420.

Fable WA, Jr. 1980. Tagging studies of red snapper (*Lutjanus campechanus*) and vermilion snapper (*Rhomboplites aurorubens*) off the south Texas coast. Contrib Mar Sci. 23:115-121.

Falace A, Bressan G. 2002. Evaluation of the influence of inclination of substrate panels on seasonal changes in a macrophytobenthic community. ICES J Mar Sci. 59:S116-S121.

Farmer NA, Malinowski RP, McGovern MF, Rubec PJ. 2016. Stock complexes for fisheries management in the Gulf of Mexico. Mar Coast Fish. 8(1):177-201.

Fay RR. 1988. Hearing in vertebrates: a psychophysics databook. Winnetka (IL): Hill-Fay Associates.

Fernandes PG, Gerlotto F, Holliday DV, Nakken O, Simmonds EJ. 2002. Acoustic applications in fisheries science: the ICES contribution. ICES Marine Science Symposia. 215:483-492.

Fewtrell JL, McCauley RD. 2012. Impact of air gun noise on the behaviour of marine fish and squid. Mar Pollut Bull. 64(5):984-993.

Fischer AJ, Baker MS, Jr., Wilson CA. 2004. Red snapper (*Lutjanus campechanus*) demographic structure in the northern Gulf of Mexico based on spatial patterns in growth rates and morphometrics. Fish Bull. 102(4):593-603.

Fischer AJ, Baker MS, Jr., Wilson CA, Nieland DL. 2005. Age, growth, mortality, and radiometric age validation of gray snapper (*Lutjanus griseus*) from Louisiana. Fish Bull. 103:307-319.

Fischer AJ, Wilson CA, Nieland DL. 2002. Age and growth of red snapper, *Lutjanus campechanus*, in the northwestern Gulf of Mexico: implications to the unit stock hypothesis. In: Creswell RL, editor. Proceedings of the 53rd Annual Gulf and Caribbean Fisheries Institute; Biloxi, MS' November 2000. Fort Pierce (FL): Gulf and Caribbean Fisheries Institute. p. 496-506.

Fischer W, editor. 1978. FAO species identification sheets for fishery purposes, western central Atlantic (fishing area 31). Volume II. Rome (IT): Food and Agriculture Organization of the United Nations (FAO)Fisheries Department.

Fisheries Ecosystem Branch, National Marine Fisheries Service, Southeast Fisheries Science Center. 2013. Discards of red snapper (*Lutjanus campechanus*) for the headboat fishery in the US Gulf of Mexico. North Charleston (SC): SEDAR. 10 p. Report No.: SEDAR52-WP-21.

Fisheries Hydroacoustic Working Group. 2008. Memorandum, agreement in principle for guidelines for injury to fish from pile driving activities, NOAA's Fisheries Northwest and Southwest Regions, US Fish and Wildlife Service Regions 1 and 8, California/Washington/ Oregon Departments of Transportation, California Department of Fish and Game, and US Federal Highway Administration. June 12, 2008. 3 p. [accessed 2020 April 23] https://www.wsdot.wa.gov/sites/default/files/2018/01/17/ENV-FW-BA_InterimCriteriaAgree.pdf

Fitzhugh GR, Beech VC, Lyon HM, Colson P. 2017. Reproductive parameters for the Gulf of Mexico gray snapper, *Lutjanus griseus*, 1991-2015. North Charleston (SC): SEDAR. 9 p. Report No.: SEDAR1-DW-06.

Fitzhugh GR, Kline WC, Porch CE, Gardner CL. 2020. Improving the historical baseline of the Gulf of Mexico Red Snapper, *Lutjanus campechanus*, fishery. In: Bortone SA, Szedlmayer ST, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 201-231.

Fitzhugh GR, Lang ET, Lyon H (National Marine Fisheries Service, Southeastern Fisheries Science Center, Panama City, FL). 2012. Expanded annual stock assessment survey 2011: red snapper reproduction. South Charleston (SC): SEDAR. 31 p. Report No.: SEDAR31-DW07 and Panama City Laboratory Contribution Series 12-05.

Fitzhugh GR, Lyon HM, Barnett BK (National Marine Fisheries Service, Southeastern Fisheries Science Center, Panama City, FL). 2015. Reproductive parameters for Gulf of Mexico vermilion snapper, *Rhomboplites aurorubens*, 1991-2014. North Charleston (SC): SEDAR. 5 p. Report No.: SEDAR45-WP-02.

Fitzhugh GR, Lyon HM, Barnett BK (National Marine Fisheries Service, Southeastern Fisheries Science Center, Panama City, FL). 2015. Reproductive parameters of gray triggerfish (*Balistes capriscus*) from the Gulf of Mexico: sex ratio, maturity and spawning fraction. North Charleston (SC): SEDAR. 11 p. Report No.: SEDAR43-WP-03.

Fitzhugh GR, Lyon HM, Beech VC, Colson PM (National Marine Fisheries Service, Southeastern Fisheries Science Center, Panama City, FL). 2017. Reproductive data compiled for the Gulf of Mexico red snapper, *Lutjanus campechanus*. South Charleston (SC): SEDAR. 5 p. Report No.: SEDAR52-WP-15.

Flaherty KE, Switzer TS, Winner BL, Keenan SF. 2013. Regional correspondence in habitat occupancy by gray snapper (*Lutjanus griseus*) in estuaries of the southeastern United States. Estuar Coast. 37(1):206-228.

Flaherty-Walia KE, Switzer TS, Tyler-Jedlund AJ (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2017. Gray snapper abundance indices from inshore surveys of northeastern Gulf of Mexico estuaries. North Charleston (SC): SEDAR. 61 p. Report No.: SEDAR51-DW-11.

Flaherty-Walia KE, Switzer TS, Winner BL, Tyler-Jedlund AJ, Keenan SF. 2015. Improved ability to characterize recruitment of gray snapper in three Florida estuaries along the Gulf of Mexico through targeted sampling of polyhaline seagrass beds. Trans Am Fish Soc. 144(5):911-926.

Flaherty-Walia KE, Winner BL, Tyler-Jedlund AJ, Davis JP. 2016. Short-term discard mortality estimates for gray snapper in a west-central Florida estuary and adjacent nearshore Gulf of Mexico waters. N Am J Fish Manage. 36(2):329-340.

Fodrie FJ, Heck KL, Jr. 2011. Response of coastal fishes to the Gulf of Mexico oil disaster. PLoS One. 6(7):e21609.

Fodrie FJ, Heck KL, Jr, Powers SP, Graham WM, Robinson KL. 2010. Climate-related, decadal-scale assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico. Global Change Biology. 16(1):48-59.

Foote KG, Knudsen HP, Vestnes G, MacLennan DN, Simmonds EJ. 1987. Calibration of acoustic instruments for fish density estimation: a practical guide. Copenhagen (DM): International Council for the Exploration of the Sea [ICES]. 72 p. Report No.: Cooperative Research Report 144.

Forrest RE, McAllister MK, Martell SJD, Walters CJ. 2013. Modelling the effects of density-dependent mortality in juvenile red snapper caught as bycatch in Gulf of Mexico shrimp fisheries: implications for management. Fish Res. 146:102-120.

Foss KL. 2016. Feeding ecology of red snapper and greater amberjack at standing platforms in the northern Gulf of Mexico: disentangling the effects of artificial light [thesis]. Baton Rouge (LA): Louisiana State University.

Fowler AM, Jørgensen A-M, Svendsen JC, Macreadie PI, Jones DOB, et al. 2018. Environmental benefits of leaving offshore infrastructure in the ocean. Front Ecol Environ. doi: 10.1002/fee.1827.

Fowler AM, Macreadie PI, Bishop DP, Booth DJ. 2015. Using otolith microchemistry and shape to assess the habitat value of oil structures for reef fish. Mar Environ Res. 106:103-113.

Fowler AM, Macreadie PI, Booth DJ. 2015. Should we "reef" obsolete oil platforms? Proc Natl Acad Sci. 112(2):E102.

Fowler AM, Macreadie PI, Jones DOB, Booth DJ. 2014. A multi-criteria decision approach to decommissioning of offshore oil and gas infrastructure. Ocean Coast Manage. 87:20-29.

Frankel AS, Barkaszi M, Martin J, Poe W, Giard J, et al. 2017. Explosive offshore structure removal noise measurements. J Acoust Soc Am. 141:3848.

Frankel AS, Ellison WT (Marine Acoustics, Inc., Middletown, RI). 2005. Explosive removal scenario simulation results: final report. New Orleans (LA): US Department of the Interior, Minerals Management Service. 51 p. Contract No.: GS-10F-0164N. Report No.: OCS Study MMS 2004-064.

Franks JS. 2000. A review: pelagic fishes at petroleum platforms in the northern Gulf of Mexico; diversity, interrelationships, and perspective. In: Cayré PA, Taquet M, editors. Tuna Fishing and Fish Aggregating Devices. Symposium Caribbean-Martinque; 15-19 October 1999. Vol. 28. Plouzane (FR): Ifremer [Institut Français de Recherche pour l'Exploitation de la Mer]. p. 502-515.

Franks JS, Brown-Peterson NJ. 2002. A review of age, growth, and reproduction of cobia, *Rachycentron canadum,* from U.S. waters of the Gulf of Mexico and Atlantic Ocean. In: Creswell RL, editor. Proceedings of the 53rd Annual Gulf and Caribbean Fisheries Institute; Biloxi, MS; November 2000. Fort Pierce (FL): Gulf and Caribbean Fisheries Institute. p. 553-569.

Franks JS, Warren JR. 1998. Age and growth of cobia, *Rachycentron canadum*, from the northeastern Gulf of Mexico. Fish Bull. 97:459-471.

Frazer TK, Lindberg WJ. 1994. Refuge spacing similarly affects reef-associated species from three phyla. Bull Mar Sci. 55(2-3):388-400.

Friedlander AM, Ballesteros E, Fay M, Sala E. 2014. Marine communities on oil platforms in Gabon, West Africa: high biodiversity oases in a low biodiversity environment. PLoS One. 9(8):e103709.

Froese R. 2006. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. J Appl Ichthyol. 22(4):241-253.

Froese R, Pauly D, editors. 2018. FishBase (ver. 10/2018). [accessed 2019 Jan 23]. http://www.fishbase.org.

Frumkes DR. 2002. The status of the California Rigs-to-Reefs Programme and the need to limit consumptive fishing activities. ICES J Mar Sci. 59:S272-S276.

Fujii T. 2015. Temporal variation in environmental conditions and the structure of fish assemblages around an offshore oil platform in the North Sea. Mar Environ Res. 108:69-82.

Fujii T. 2016. Potential influence of offshore oil and gas platforms on the feeding ecology of fish assemblages in the North Sea. Mar Ecol Prog Ser. 542:167-186.

Fujii T, Jamieson AJ. 2016. Fine-scale monitoring of fish movements and multiple environmental parameters around a decommissioned offshore oil platform: a pilot study in the North Sea. Ocean Eng. 126:481-487.

Gallaway BJ (LGL Ecological Research Asdociates, Bryan, TX). 1980. Pelagic, reef and demersal fishes, and macro-crustaceans/biofouling communities. Volume II: fishes and macrocrustaceans. In: Jackson WB, Wilkens EP, editors. Environmental assessment of Buccaneer gas and oil field in the northwestern Gulf of Mexico, 1975-1980. Galveston (TX): National Marine Fisheries Center, Galveston Laboratory. 115 p. Interagency Agreement No.: EPA-IAG-D5-E693-E0. Report No.: NOAA Technical Memorandum NMFS-SEFC-48.

Gallaway BJ (LGL Ecological Research Associates, Bryan, TX). 1981. An ecosystem analysis of oil and gas development on the Texas-Louisiana continental shelf. Washington (DC): US Department of the Interior, Fish and Wildlife Service. 97 p. Contract No.: 14-16-0009-80-058. Report No.: FWS/OBS-81/27.

Gallaway BJ, Cole JG (LGL Ecological Research Associates, Inc. Bryan, TX). 1997. Cumulative ecological significance of oil and gas structures in the Gulf of Mexico: a Gulf of Mexico fisheries habitat suitability model—phase II: model description. New Orleans (LA): US Department of the Interior, Minerals Management Service and US Geological Survey. 114 p. Contract No.: 1445-CT0009-96-0005. Report No.: OCS Study MMS 97-0044.

Gallaway BJ, Cole JG, Martin LR (LGL Ecological Research Associates, Inc., Bryan, TX and Coastal Fisheries Institute, Louisiana State University, Baton Rouge, LA). 2008. Platform debris fields associated with the Blue Dolphin (Buccaneer) gas and oil field artificial reef sites offshore Freeport, Texas: extent, composition, and biological utilization. New Orleans (LA): US Department of the Interior, Minerals Management Service. 113 p. Contract No.: 0199CA30951-72406. Report No.: OCS Study MMS 2008-048.

Gallaway BJ, Cole JG, Meyer R, Roscigno P. 1999. Delination of essential habitat for juvenile red snapper in the northwestern Gulf of Mexico. Trans Am Fish Soc. 128(4):713-726.

Gallaway BJ, Gazey WJ, Cole JG. 2017. An updated description of the benefits and consequences of red snapper shrimp trawl bycatch management actions in the Gulf of Mexico. N Am J Fish Manage. 37(2):414-419.

Gallaway BJ, Gazey WJ, Cole JG, Fechhelm RG. 2007. Estimation of potential impacts from offshore liquefied natural gas terminals on red snapper and red drum fisheries in the Gulf of Mexico: an alternative approach. Trans Am Fish Soc. 136:655-677.

Gallaway BJ, Johnson MF, Martin LF, Margraff FJ, Lewbel GL, et al. (LGL Ecological Research Associates, Bryan, TX). 1981b. Volume II—The artificial reef studies. In: Bedinger CA, Jr. editor. Ecological investigations of petroleum production platforms in the central Gulf of Mexico. SWRI Project 01-5245. New Orleans (LA): Bureau of Land Management.. Contract No.: AA551-CT8-17. Report No.: 1981-17. p. 1–199.

Gallaway BJ, Konkel WJ, Cole JG. 2019. The effects of modeled dispersed and undispersed hypothetical oil spills on Red Snapper, *Lutjanus campechanus*, stocks in the Gulf of Mexico. In: Szedlmayer ST, Bortone SA, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 123-139.

Gallaway BJ, Lewbel GS (LGL Ecological Research Associates, Inc., Bryan, TX). 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: a community profile. New Orleans (LA): US Department of the Interior, Fish and Wildlife Service and Bureau of Land Management. 91 p. Report No.: FWS/OBS-82/27.

Gallaway BJ, Martin LR (LGL Ecological Research Associates, Bryan, TX). 1980. Effects of gas and oil field structures and effluents on pelagic and reef fishes, demersal fishes and macrocrustaceans. Volume III: fishes and macrocrustaceans. In: Jackson WB, Wilkens EP, editors. Environmental assessment of Buccaneer gas and oil field in the northwestern Gulf of Mexico, 1978-1979. Galveston (TX): National Marine Fisheries Center, Galveston Laboratory. 49 p. Interagency Agreement No.: EPA-IAG-D5-E693-E0. Report No.: NOAA Technical Memorandum NMFS-SEFC-37.

Gallaway BJ, Martin LR, Howard RL, Boland GS, Dennis GD. 1981a. Effects on artificial reef and demersal fish and macrocrustacean communities. In: Middleditch BS, editor. Environmental effects of offshore oil production: the Buccaneer gas and oil field study. Marine Science, volume 145. New York (NY): Plenum Press. p. 237-299.

Gallaway BJ, Martin LR, Howard RL, Boland GS, Dennis GS. 1980. A case study of the effects of gas and oil production on artificial reef and demersal fish and macrocrustacean communties in the northwestern Gulf of Mexico. Paper presented at: Environmental effects of offshore oil production: the Buccaneer oil field study, EXPOCHEM '80, October 6–9, 1980. Houston, TX.

Gallaway BJ, Szedlmayer ST, Gazey WJ. 2009. A life history review for red snapper in the Gulf of Mexico with an evaluation of the importance of offshore petroleum platforms and other artificial reefs. Rev Fish Sci. 17(1):48-67.

Garcia A. 2013. A comparison of site fidelity and habitat use of red snapper (*Lutjanus campechanus*) to evaluate the performance of two artificial reefs in south Texas utilizing acoustic telemetry [thesis]. Brownsville (TX): University of Texas at Brownsville.

Gardner CL, DeVries DA, Overly KE, Pollack AG (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2017. Gray snapper *Lutjanus griseus* findings from the NMFS Panama City Laboratory camera fishery-independent survey 2005-2015. North Charleston (SC): SEDAR. 25 p. Report No.: SEDAR51-DW-05.

Gardner CL, Overly KE (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2017. Red snapper *Lutjanus campechanus* findings from the NMFS Panama City Laboratory camera & trap fishery-independent survey 2004-2016. North Charleston (SC): SEDAR. 34 p. Report No.: SEDAR52-WP-10.

Garner SB, Patterson WF. 2015. Direct observation of fishing effort, catch, and discard rates of charter boats targeting reef fishes in the northern Gulf of Mexico. Fish Bull. 113:157-166.

Gaspin JB. 1975. Experimental investigations of the effects of underwater explosions on swimbladder fish, I: 1973 Chesapeake Bay tests. Silver Spring (MD): Naval Surface Weapons Center. 80 p. Report No.: NSWC/WOL/TR 75-58. [accessed 2020 April 24] https://apps.dtic.mil/sti/pdfs/ADA014561.pdf

Gaspin JB, Goertner JA, Blatstein IM. 1979. The determination of acoustic source levels for shallow underwater explosions. J Acoust Soc Am. 66(5):1453-1462.

Gaspin JB, Shuler VK. 1971. Source levels of shallow underwater explosions. White Oak (MD): Naval Ordinance Laboratory. Report No.: NOLTR 71-160.

Gaspin JB, Wiley ML, Peters GB. 1976. Experimental investigation of the effects of underwater explosions on swimbladder fish, II: 1975 Chesapeake Bay tests. Silver Spring (MD) Naval Surface Weapons Center. 70 p.Report No.: NSWC/WOL/TR 76-61.

Gazey WJ. 2004. Impact on yield from density dependence of red snapper juvenile life stages. South Charleston (SC): SEDAR. 9 p. Report No. SEDAR-AW-12.

Gazey WJ, Gallaway BJ, Cole JG. 2012. An update to the age composition, growth, and density-dependent mortality in juvenile red snapper estimated from observer data from the Gulf of Mexico penaeid shrimp fishery [slideshow]. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR31-DW06.

Gazey WJ, Gallaway BJ, Cole JG. 2013. Response to comments on: age composition, growth and density-dependent mortality in juvenile red snapper estimated from observer data from the Gulf of Mexico penaeid shrimp fishery. North Charleston (SC): SEDAR. 10 p. Report No.: SEDAR31-AW17.

Gazey WJ, Gallaway BJ, Cole JG, Fournier DA. 2008. Age composition, growth, and density-dependent mortality in juvenile red snapper estimated from observer data from the Gulf of Mexico penaeid shrimp fishery. N Am J Fish Manage. 28(6):1828-1842.

Gazey WJ, Gallaway BJ, Cole JG, Fournier DA. 2014. Accounting for fishing mortality when comparing density-dependent with density-independent mortality in Gulf of Mexico red snapper: response to comment. N Am J Fish Manage. 34(2):352-358.

Gazey WJ, Staley MJ. 1986. Population estimation from mark-recapture experiments using a sequential Bayes algorithm. Ecology. 67(4):941-951.

Genesis Oil and Gas Consultants, Ltd. 2011. Overview of international decommissioning regulations. Aberdeen (GB): Genesis Oil & Gas Consultants Ltd. Genesis Ref.: J71807. Document No.: J71807-A-A-PR-001-C1.docm. 41 p.

Gerard T, Muhling B. 2010. Variation in the isotopic signatures of juvenile gray snapper (*Lutjanus griseus*) from five southern Florida regions. Fish Bull. 104:98-105.

Germeroth R, Flaherty-Walia K, Sauls B, Switzer T (Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute, Tallahassee, FL). 2016. Brief summary of FWRI-FDM tag-recapture program and brief summary of FWRI-FIM tag-recapture data. North Charleston (SC): SEDAR. 2 p. Report No.: SEDAR51-DW-01.

Gilmore JA, Canady RR. 1989. Platform removal: reuse, reef, or scrap. In: Reggio, VC, Jr. compiler. Petroleum structures as artificial reefs: a compendium. Fourth International Conference on Artificial Habitats for Fisheries Rigs-To-Reefs Special Session, Miami, FL, November 4, 1987. p. 69-76. New Orleans (LA): Minerals Management Service. Report No.: OCS Study MMS 89-0021.

Gitschlag GR, Herczeg BA. 1994. Sea turtle observations at explosive removals of energy structures. Mar Fish Rev. 56(2):1-8.

Gitschlag GR, Herczeg BA, Barcak TR. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf Res Rep. 9(4):247-262.

Gitschlag GR, Schirripa MJ, Powers JE (National Marine Fisheries Service Southeast Fisheries Science Center, Miami, FL). 2000. Estimation of fisheries impacts due to underwater explosives used to sever and salvage oil and gas platforms in the U.S. Gulf of Mexico: final report. New Orleans (LA): Minerals Management Service Gulf of Mexico OCS Region. 80 p. Report No.: OCS Study MMS 2000-087.

Gitschlag GR, Schirripa MJ, Powers JE. 2003. Impacts of red snapper mortality associated with the explosive removal of oil and gas structures on stock assessments of red snapper in the Gulf of Mexico. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, Reefs, and Offshore Development. American Fisheries Society Symposium 36. Bethesda (MD): American Fisheries Society. p. 83-94.

Gledhill CT, Lyczkowski-Shultz J, Rademacher K, Kargard E, Crist G, Grace MA. 1996. Evaluation of video and acoustic methods for assessing reef-fish populations. ICES J Mar Sci. 53:483-485.

Glenn HD, Cowan JH, Jr., Powers JE. 2017. A comparison of red snapper reproductive potential in the northwestern Gulf of Mexico: natural versus artificial habitats. Mar Coast Fish. 9(1):139-148.

Gloeckner D (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2014. Methods used to compile South Atlantic shrimp effort used in the estimation of king mackerel bycatch in the South Atlantic shrimp fishery. North Charleston (SC): SEDAR. 22 p. Report Nos.: SEDAR38-RW-02 and Sustainable Fisheries Division Contribution No SFD-2014-013.

Godoy EAS, Almeida TCM, Zalmon IR. 2002. Fish assemblages and environmental variables on an artificial reef north of Rio de Janeiro, Brazil. ICES J Mar Sci. 59:S138-S143.

Goertner JF. 1978. Dynamical model for explosion injury to fish. Silver Spring (MD): Naval Surface Weapons Center White Oak Lab. 44 p. Report No.: NSWC/WOL TR 76-155.

Goertner JF. 1978. Fish killing potential of a cylindrical charge exploded above the water surface. Silver Spring (MD): Naval Surface Weapons Center White Oak Lab. 137 p. Report No.: NSWC/WOL TR 77-90.

Goertner JF, Wiley ML, Young GA, McDonald WW. 1994. Effects of underwater explosions on fish without swimbladders. Silver Spring (MD): Naval Surface Warfare Center Dahlgren Division White Oak Detachment. 113 p. Report No.: NSWC TR 88-114.

Goethel DR, Smith MW (National Marine Fisheries Service Southeast Fisheries Science Center, Miami, FL). 2018. The impact of a reduction in shrimp effort thresholds on SEDAR 52 Gulf of Mexico red snapper catch limit projections [working paper]. Tampa (FL): Gulf of Mexico Fishery Management Council; [accessed 22 Nov 2019]. http://gulfcouncil.org/wp-content/uploads/D-4b-SEFSC-report-on-bycatch-reduction-thresholds-for-the-shrimp-fishery.pdf.

Goethel DR, Smith MW, Cass-Calay SL, Porch CE. 2018. Establishing stock status determination criteria for fisheries with high discards and uncertain recruitment. N Am J Fish Manage. 38(1):120-139.

Gold JR, Saillant E, Ebelt ND, Lem S. 2009. Conservation genetics of gray snapper (*Lutjanus griseus*) in U.S. waters of the northern Gulf of Mexico and western Atlantic Ocean. Copeia. 2009(2):277-286.

Gold JR, Sun F, Richardson LR. 1997. Population structure of red snapper from the Gulf of Mexico as inferred from analysis of mitochondrial DNA. Trans Am Fish Soc. 126(3):386-396.

Goodman LA. 1960. On the exact variance of products. J Am Stat Assoc. 55(292):708-713.

Goodyear CP. 1995. Red snapper in U.S. waters of the Gulf of Mexico. Miami (FL): NMFS-SEFSC. 171 p. Report No.: NMFS-SEFSC Miami Laboratory Contribution No. MIA-95/96-05.

Goodyear CP, Schirripa MJ. 1991. A biological profile for vermilion snapper with a description of the fishery in the Gulf of Mexico. Miami (FL): NMFS-SEFSC. 55 p. Report No.: NMFS-SEFSC Miami Laboratory Contribution No. MIA-90/91-78.

Govoni JJ, West MA, Settle LR, Lynch RT, Greene MD. 2008. Effects of underwater explosions on larval fish: implications for a coastal engineering project. J Coast Res. 24(2B):228-233.

Graham RT, Castellanos DW. 2005. Courtship and spawning behaviors of carangid species in Belize. Fish Bull. 103:426-432.

Gray AM, Sauls B (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2015. Hook selectivity in Gulf of Mexico gray triggerfish when using circle or ‘J’ hooks. North Charleston (SC): SEDAR. 6 p. Report No.: SEDAR43-WP-09.

Greeneridge Sciences Inc. (Santa Barbara, CA), LGL Ecological Research Associates, Inc (College Station, TX). 2017. Explosive removal of structures: fisheries impact assessment. Acoustic synthesis report. Final report for Bureau of Ocean Energy Management, New Orleans, LA. 24 p. Contract No.: M16PC00005.

Gregalis KC, Schlenker LS, Drymon JM, Mareska JF, Powers SP. 2012. Evaluating the performance of vertical longlines to survey reef fish populations in the northern Gulf of Mexico. Trans Am Fish Soc. 141(6):1453-1464.

Griffin WL, Woodward RT. 2011. Determining policy-efficient management strategies in fisheries using data envelopment analysis (DEA). Mar Policy. 35:496-507.

Grimes CB, Manooch CS, Huntsman GR. 1982. Reef and rock outcropping fishes of the Outer Continental Shelf of North Carolina and South Carolina, and ecological notes on the red porgy and vermilion snapper. Bull Mar Sci. 32(1):277-289.

Grossman GD, Jones GP, Seaman WJ, Jr. 1997. Do artificial reefs increase regional fish production? A review of existing data. Fisheries Spec Iss Artifical Reef Manage. 22(4):17-23.

Guerin AJ. 2010. Marine communities of North Sea offshore platforms, and the use of stable isotopes to explore artificial reef food webs [thesis]. [Southampton (GB)]: University of Southampton.

Gulak SJB, Carlson JK (National Marine Fisheries Service Southeast Fisheries Science Center-Panama City Laboratory, Panama City, FL). 2013. Catch and bycatch of greater amberjack in the Gulf of Mexico shark and reeffish bottom longline fishery based on observer data. North Charleston (SC): SEDAR. 25 p. Report No.: SEDAR33-DW24.

GMFMC [Gulf of Mexico Fishery Management Council]. 2013. Gulf of Mexico greater amberjack management history. North Charleston (SC): SEDAR. 14 p. Report No.: SEDAR33-RD05.

GMFMC. 2016. Revision of the red snapper recreational sector separation sunset provision. Amendment 45 to the fishery management plan for the reef fish resources of the Gulf of Mexico inclusing environmental assessment, fishery impact statement, regulatory impact review, and Regulatory Flexibility Act analysis, July 2016. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. xi + 148 p. Award No.: NA15NMF4410011.

GMFMC. 2017. Establish a vermilion snapper MSY proxy and adjust the stock annual catch limit. Final amendment 47 to the fishery management plan for the reef fish resources of the Gulf of Mexico including environmental assessment, fishery impact statement, regulatory impact review, and Regulatory Flexibility Act analysis, July 2017. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. xv + 130 p. Award No.: NA15NMF4410011.

GMFMC. 2017. Gray triggerfish rebuilding plan. Final amendment 46 to the fishery management plan for the reef fish resources of the Gulf of Mexico including environmental assessment, fishery impact statement, regulatory impact review, and Regulatory Flexibility Act analysis, May 2017. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. xvii + 200 p. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2017. Minimum stock size threshold (MSST) revision for reef fish stocks with existing status determination criteria. Final amendment 44 (revised) to the fishery management plan for the reef fish resources of the Gulf of Mexico including environmental assessment and fishery impact statement, July 2017. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office.. x + 123 p. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2017. Modifications to greater amberjack allowable harvest and rebuilding plan. Final framework action to the fishery management plan for the reef fish resources of the Gulf of Mexico including environmental assessment, regulatory impact review, and Regulatory Flexibility Act analysis, September 2017. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. viii + 111 p. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2017. Modifications to the greater amberjack fishing year and the recreational fixed closed season. Final framework action to the fishery management plan for the reef fish resources of the Gulf of Mexico including environmental assessment, regulatory impact review, and Regulatory Flexibility Act analysis, November 2017. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. viii + 90 p. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2017. Species listed in the fishery management plans of the Gulf of Mexico Fishery Management Council [last revised 11 Apr 2017]. 2. p. Tampa (FL): GMFMC; [accessed 3 May 2018]. http://archive.gulfcouncil.org/docs/Species%20Groupings/Species%20Managed%204_2017.pdf.

[GMFMC] Gulf of Mexico Fishery Management Council. 2018. Commercial fishing regulations for Gulf of Mexico federal waters for species managed by the Gulf of Mexico Fishery Management Council. Tampa (FL): GMFMC. 57 p. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2018. Modification to the recreational red snapper annual catch target buffers. Framework action to the fishery management plan for reef fish resources in the Gulf of Mexico. 93 p. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2019. Commercial fishing regulations for Gulf of Mexico federal waters for species managed by the Gulf of Mexico Fishery Management Council. 56 p. Tampa (FL): GMFMC. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2019. Recreational fishing regulations for Gulf of Mexico federal waters for species managed by the Gulf of Mexico Fishery Management Council. 40 p. Tampa (FL): GMFMC. Award No.: NA15NMF4410011.

[GMFMC] Gulf of Mexico Fishery Management Council. 2019. State management program for recreational red snapper. Final draft amendment 50A to the fishery management plan for the reef fish resources of the Gulf of Mexico including programmatic environmental impact statement, April 2019. 251 p. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. Award No.: NA15NMF4410011. Report No.: Tab B, No. 6a, 3/13/2019.

[GMFMC] Gulf of Mexico Fishery Management Council Scientific and Statistical Committee. 2017. Review of SEDAR 33 update: Gulf of Mexico greater amberjack, March 27-29, 2017. 4 p. Tampa (FL): GMFMC.

Hanisko DS, Lyczkowski-Shultz J (NOAA Fisheries Southeast Fisheries Science Center, Pascagoula, MS). 2013. King mackerel (*Scomberomorus cavalla*) larval indices of relative abundance from SEAMAP fall plankton surveys, 1986 to 2012. North Charleston (SC): SEDAR. 32 p. Report No.: SEDAR38-DW-01.

Hanisko DS, Pollack A (NOAA Fisheries Southeast Fisheries Science Center, Pascagoula, MS). 2017. Summary of length and weight data for gray snapper (*Lutjanus griseus*) collected during NMFS and SEAMAP fishery-independent surveys in the Gulf of Mexico. North Charleston (SC): SEDAR. 6 p. Report No.: SEDAR51-DW-02.

Hanisko DS, Pollack A, Zapfe G (NOAA Fisheries Southeast Fisheries Science Center, Pascagoula, MS). 2015. Vermilion snapper (*Rhomboplites aurorubens*) larval indices of relative abundance from SEAMAP fall plankton surveys, 1986 to 2012. North Charleston (SC): SEDAR. 34 p. Report No.: SEDAR45-WP-05.

Hanisko DS, Pollack AG, Drass DM, Bond PJ, Stepongzi C, et al. (NOAA Fisheries Southeast Fisheries Science Center, Pascagoula, MS). 2017. Red snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP fall plankton surveys, 1986 to 2016. North Charleston (SC): SEDAR. 36 p. Report No.: SEDAR52-WP-11.

Harford WJ, Grüss A, Schirripa MJ, Sagarese SR, Bryan M, Karnauskas M. 2018. Handle with care: establishing catch limits for fish stocks experiencing episodic natural mortality events. Fisheries. 43(10):463-471.

Harris PJ (Marine Resources Research Institute, South Carolina Department of Natural Resources, Charleston, SC). 2004. Analytical report: age, growth, and reproduction of greater amberjack, *Seriola dumerili*, in the southwestern North Atlantic. North Charleston (SC). 37 p. Report No.: SEDAR33-RD12.

Harris PJ, Wyanski DM, White DB, Mikell PP, Eyo PB. 2007. Age, growth, and reproduction of greater amberjack off the southeastern U.S. Atlantic coast. Trans Am Fish Soc. 136(6):1534-1545.

Hartford WJ, Sagarese SR, Nuttal MA, Karnauskas M, Liu H, Lauretta M, Schirripa M, Walter JF. 2014. Can climate explain temporal trends in king mackerel (*Scomberomorus cavalla*) catch-per-unit effort and landings? North Charleston (SC): SEDAR. 29 p. Report No.: SEDAR38-AW-04.

Harwell GE. 2013. Acoustic biomass of fish associated with an oil and gas platform before, during and after "reefing" it in the northern Gulf of Mexico [thesis]. Baton Rouge (LA): Louisiana State University.

Hastings MC, Popper AN. 2005. Effects of sound on fish. Sacramento (CA): Jones & Stokes. 82 p. California Department of Transportation Contract No.: 43A0139, Task Order 1.

Hastings RW, Ogren LH, Mabry MT. 1976. Observations on the fish fauna associated with offshore platforms in the northeastern Gulf of Mexico. Fish Bull. 74(2):387-402.

Hawkins AD, Popper AN. 2016. A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES J Mar Sci.fsw205.

Helvey M. 2002. Are southern California oil and gas platforms essential fish habitat? ICES J Mar Sci. 59:S266-S271.

Hendon JR, Franks JS (University of Southern Mississippi, Ocean Springs, MS). 2010. Sport fishing tag and release in Mississippi coastal waters and the adjacent Gulf of Mexico. Final report: project F-132, segments 7-9. Biloxi (MS): Mississippi Department of Marine Resources and Atlanta (GA): US Fish and Wildlife Service. 34 p. Report No.: SEDAR28-RD23,

Herbig JL. 2014. Movement patterns of gray triggerfish, *Balistes capriscus*, around artificial reefs in the northern Gulf of Mexico [thesis.]. Auburn (AL): Auburn University.

Herbig JL, Szedlmayer ST. 2016. Movement patterns of gray triggerfish, *Balistes capriscus*, around artificial reefs in the northern Gulf of Mexico. Fish Manag Ecol. 23(5):418-427.

Hernandez FJ Jr, Shaw RF. 2002. The across-shelf larval, postlarval, and juvenile fish communities associated with offshore oil and gas platforms west of the Mississippi River delta. In: Creswell RL, editor. Proceedings of the 53rd Annual Gulf and Caribbean Fisheries Institute, Biloxi, MS, November 2000. Fort Pierce (FL): GCFI. p. 646-658.

Hernandez FJ Jr, Shaw RF, Cope JS, Ditty JG, Benfield MC, et al. (Coastal Marine Institute, Louisiana State University, Baton Rouge, LA). 2001. Across-shelf larval, postlarval, and juvenile fish collected at offshore oil and gas platforms and a coastal rock jetty west of the Mississippi River delta. New Orleans (LA): US Department of the Interior, Minerals Management Service. MMS Contract No.: 14-35-0001-30660-19926. Report No.: MMS 2001-077.

Hernandez FJ, Jr., Shaw RF, Cope JS, Ditty JG, Farooqi T et al. 2003. The across-shelf larval, postlarval, and juvenile fish assemblages collected at offshore oil and gas platforms west of the Mississippi River delta. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, Reefs, and Offshore Development. American Fisheries Society Symposium 36. Bethesda (MD): American Fisheries Society. p. 39-72.

Heupel MR, Simpfendorfer CA. 2002. Estimation of mortality of juvenile blacktip sharks, *Carcharhinus limbatus*, within a nursery area using telemetry data. Can J Fish Aquat Sci. 59(4):624-632.

Hightower JE, Jackson JR, Pollock KH. 2001. Use of telemetry methods to estimate natural and fishing mortality of striped bass in Lake Gaston, North Carolina. Trans Am Fish Soc. 130(4):557-567.

Hill SH. 1978. A guide to the effects of underwater shock waves on Arctic marine mammals and fish. Sidney (BC): Institute of Ocean Sciences. 60 p. Report No.: Pacific Marine Science Report 78-26.

Hixon MA, Beets JP. 1989. Shelter characterisitics and Caribbean fish assemblages: experiments with artificial reefs. Bull Mar Sci. 44(2):666-680.

Holbrook SJ, Ambrose RF, Botsford L, Carr MH, Raimondi PT et al. 2000. Ecological issues related to decommissioning of California's offshore production platforms. Santa Barbara (CA): University of California. 41 p. [accessed 2020 May 11]. https://www.coastalresearchcenter.ucsb.edu/cmi/files/decommreport.pdf

Hollenbeck CM, Portnoy DS, Saillant E, Gold JR. 2015. Population structure of red snapper (*Lutjanus campechanus*) in U.S. waters of the western Atlantic Ocean and the northeastern Gulf of Mexico. Fish Res. 172:17-25.

Hood PB, Johnson AK. 1999. Age, growth, mortality and reproduction of vermilion snapper, *Rhomboplites aurorubens*, from the eastern Gulf of Mexico. Fish Bull. 97:828-841.

Hopkins JA, Wooten R. 2018. (Plat)forms that function. [US Coast Guard] Proceedings of the Marine Safety & Security Council.. Spring 75(1):88–93.

Horswill C, Kindsvater HK, Juan-Jordá MJ, Dulvy NK, Mangel M, Matthiopoulos J, Arlinghaus R. 2019. Global reconstruction of life-history strategies: a case study using tunas. J Appl Ecol. 56(4):855-865.

Hubbs CL, Rechnitzer AB. 1952. Report on experiments designed to determine effects of underwater explosions on fish life. Calif Fish Game. 38:333-366.

Huntsman GR, Potts J, Mays RW, Vaughan D. 1999. Groupers (Serranidae, Epinephelinae): endangered apex predators of reef communities. In: Musick JA, editor. Life in the slow lane: ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23. Bethesda (MD): American Fisheries Society. p. 217-231.

Hyun KH, He R. 2010. Coastal upwelling in the South Atlantic Bight: a revisit of the 2003 cold event using long term observations and model hindcast solutions. J Mar Syst. 83:1-13.

Ihde TF, Wilberg MJ, Secor DH, Miller TJ. 2011. FishSmart: harnessing the knowledge of stakeholders to enhance U.S. marine recreational fisheries with application to the Atlantic king mackerel fishery. In: Gido KB, Jackson DA, editors. Community ecology of stream fishes: concepts, approaches, and techniques. American Fisheries Society Symposium 73. Bethesda (MD): American Fisheries Society. p. 75-93.

Ingram GW, Jr. 2001. Stock structure of gray triggerfish, *Balistes capriscus*, on multiple spatial scales in the Gulf of Mexico [thesis]. Mobile (AL): University of South Alabama. Report No.: SEDAR41-RD45.

Ingram GW, Jr., Patterson WF, III. 2001. Movement pattems of red snapper (*Lutjanus campechanus*), greater amberjack (*Seriola dumerili*), and gray triggerfish (*Balistes capriscus*) in the Gulf of Mexico and the utility of marine reserves as management tools. Proceedings of the 52nd Annual Gulf and Caribbean Fisheries Institute. Key West (FL): GCFI. p. 686-669.

Ingram GW, Jr., Pollack AG (NOAA Fisheries Southeast Fisheries Science Center, Pascagoula, MS). 2012. Abundance indices of red snapper collected in NMFS bottom longline surveys in the northern Gulf of Mexico. 24 p. Report No.: SEDAR31-DW19.

Ingram W. 2013. Combined index for Florida Fish and Wildlife Research Institute and NMFS Panama video surveys. North Charleston (SC): SEDAR. 2 p. Report No.: SEDAR31-AW14.

Ingram W. 2013. Dauphin Island Sea Lab bottom longline survey incorporation into the NMFS bottom longline survey. North Charleston (SC): SEDAR. 2 p. Report No.: SEDAR31-AW13.

Isely J. 2017. Updated shrimp bycatch estimates for SEDAR 52. North Charleston (SC): SEDAR. 7 p. Report No.: SEDAR52-WP-23.

Isely J, Cummings N (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Size frequency distribution of cobia from dockside sampling of recreational and commercial landings in the Gulf of Mexico 1986-2011. North Charleston (SC): SEDAR. 19 p. Report No.: SEDAR28-DW08.

Isely JJ (NOAA Southeast Fisheries Science Center, Miami, FL). 2016. Shrimp fishery bycatch estimates for Gulf of Mexico data limited species: wenchman and lane snapper, 1972-2014. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR49-DW-01.

Isely JJ, Cummings NJ (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Size frequency distribution of cobia and Spanish mackerel from the Galveston, Texas, reef fish observer program 2006-2011. North Charleston (SC): SEDAR. 4 p. Report No.: SEDAR28-DW11.

Isely JJ, Smith MW, Chih C-P (NOAA Southeast Fisheries Science Center, Miami, FL). 2016. Size composition of eight SEDAR49 data limited species by sector and gear. North Charleston (SC): SEDAR. 11 p. Report No.: SEDAR49-DW-14.

Jackson WB, Wilkens EP. 1980. Vol. I: Synopsis/Data management. In: Jackson WB, Wilkens EP, editors. Environmental assessment of Buccaneer gas and oil field in the northwestern Gulf of Mexico, 1978-1979. Interagency Agreement EPA-IAG-D5-E693-E0. Galveston (TX): NMFS-SEFSC. Report No.: NOAA Technical Memorandum NMFS-SEFC-35.

Jagerroos S, Krause PR. 2016. Rigs-to-reef; impact or enhancement on marine biodiversity. J Ecosys Ecograph. 6(2):1000187.

Jaxion-Harm J, Szedlmayer ST. 2015. Depth and artificial reef type effects on size and distribution of red snapper in the northern Gulf of Mexico. N Am J Fish Manage. 35(1):86-96.

Jensen A. 2002. Artificial reefs of Europe: perspective and future. ICES J Mar Sci. 59:S3-S13.

Johnson AG, Collins LA, Keim CP (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 1994. Age-size structure of gray snapper from the southeastern United States: a comparison of two methods of back-calculating size at age from otolith data. Proc Annu Conf Southeast Assoc Fish and Wildl Agencies. 48:592-600. Report No. SEDAR51-RD-24.

Johnson C (Coastal Carolina University, Conway, SC). 2013. Trends from non-CPUE standardized king mackerel landing logs from Long Bay, South Carolina recreational pier fishery. North Charleston (SC): SEDAR. 48 p. Report No.: SEDAR38-DW-12.

Johnson DR (University of Miami, Miami, FL). 2013. Observer reported size distribution and discard characteristics of Gulf of Mexico greater amberjack from the commercial vertical line and bottom longline fisheries. Sustainable Fisheries Division Contribution SFD-2013-11. North Charleston (SC): SEDAR. 26 p. Report No.: SEDAR33-DW14.

Johnson DR, Perry HM. 2020. Red snapper, *Lutjanus campechanus*, larval dispersal in the Gulf of Mexico. In: Szedlmayer ST, Bortone SA, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 7-25.

Johnson DR, Perry HM, Lyczkowski-Shultz J (University of Southern Mississippi, MS and National Marine Fisheries Service Southeast Fisheries Science Center, Pascagoula, MS). 2012. Connections between Campeche Bank and red snapper populations in the Gulf of Mexico via modeled larval transport. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR31-RD45.

Johnson DR, Perry HM, Lyczkowski-Shultz J, Hanisko D. 2009. Red snapper larval transport in the northern Gulf of Mexico. Trans Am Fish Soc. 138:458-470.

Johnson MW, Powers SP, Hightower CL, Kenworthy M. 2010. Age, growth, mortality, and diet composition of vermilion snapper from the north-central Gulf of Mexico. Trans Am Fish Soc. 139(4):1136-1149.

Jones DT, Wilson CD, De Robertis A, Rooper CN, Weber TC, Butler JL. 2012. Evaluation of rockfish abundance in untrawlable habitat: combining acoustic and complementary sampling tools. Fish Bull. 110(3):332-343.

Jørgensen T, Løkkeborg S, Soldal AV. 2002. Residence of fish in the vicinity of a decommissioned oil platform in the North Sea. ICES J Mar Sci. 59:S288-S293.

Kaiser MJ, Liu M. 2018. A scenario-based deepwater decommissioning forecast in the U.S. Gulf of Mexico. J Petroleum Sci Eng. 165:913-945.

Kaiser MJ, Mesyanzhinov DV, Pulsipher AG (Coastal Marine Institute, Louisiana State University, Baton Rouge, LA). 2005. Modeling structure removal processes in the Gulf of Mexico. New Orleans (LA): Minerals Management Service. 135 p. MMS Contract: 1435-01-99-CA-30951-85246. Report No.: OCS Study MMS 2005-029.

Kaiser MJ, Narra S. 2018. A hybrid scenario-based decommissioning forecast for the shallow water U.S. Gulf of Mexico, 2018–2038. Energy. 163:1150-1177.

Kaiser MJ, Pulsipher AG. 2005. Rigs-to-reefs programs in the Gulf of Mexico. Ocean Dev Int Law. 36:119-134.

Kaplan EL, Meier P. 1958. Nonparametric estimation from incomplete observations. J Am Stat Assoc. 53(282):457-481.

Karnauskas M, Walter JF, III, Campbell MD, Pollack AG, Drymon JM, Powers S. 2017. Red snapper distribution on natural habitats and artificial structures in the northern Gulf of Mexico. Mar Coast Fish. 9(1):50-67.

Karnauskas M, Walter JF, III, Paris CB (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL and University of Miami, Miami, FL). 2013. Use of the connectivity modeling system to estimate movements of red snapper (*Lutjanus campechanus*) recruits in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 18 p. Report No.: SEDAR31-AW10.

Karnauskas M, Walter JF, III, Paris CB (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL and University of Miami, Miami, FL). 2017. Use of the connectivity modeling system to estimate movements of red snapper (*Lutjanus campechanus*) recruits in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR52-WP-20.

Kasprzak RA. 1998. Use of oil and gas platforms as habitat in Louisiana's artificial reef program. Gulf Mex Sci. 1998(1):37-45.

Kaye SM. 1983. Encyclopedia of explosives and related items. Vol. 10. Picatinny Arsenal (NJ): US Army Research and Development Command (ARRADCOM), TACOM, ARDEC, Warheads, Energetics and Combat Support Center.

Keenan SF, Benfield MC, Blackburn JK. 2007. Importance of the artificial light field around offshore petroleum platforms for the associated fish community. Mar Ecol Prog Ser. 331:219-231.

Keevin TM, Hempen GL. 1997. The environmental effects of underwater explosions with methods to mitigate impacts. St. Louis (MO): US Army Corps of Engineers. 99 p.

Kennish R, Wilson KDP, Lo J, Clarke SC, Laister S. 2002. Selecting sites for large-scale deployment of artificial reefs in Hong Kong: constraint mapping and prioritization techniques. ICES J Mar Sci. 59:S164-S170.

Klima EF, Gitschlag GR, Renaud ML. 1988. Impacts of explosive removal of offshore petroleum platforms on sea turtles and dolphins. Mar Fish Rev. 50(3):33-42.

Klima EF, Wickham DA. 1971. Attraction of coastal pelagic fishes with artificial structures. Trans Am Fish Soc. 100:86-99.

Koenig CC, Bueno LS, Coleman FC, Cusick JA, Ellis RD, et al. 2017. Diel, lunar, and seasonal spawning patterns of the Atlantic goliath grouper, *Epinephelus itajara*, off Florida, United States. Bull Mar Sci. 92(2):391-406.

Koenig CC, Coleman FC, Kingon K. 2011. Pattern of recovery of the goliath gouper *Epinephelus itajara* population in the southeastern US. Bull Mar Sci. 87(4):891-911.

Koenig CC, Stallings CD. 2015. A new compact rotating video system for rapid survey of reef fish populations. Bull Mar Sci. 91(3):365-373.

Koslow JA. 2009. The role of acoustics in ecosystem-based fishery mangement. ICES J Mar Sci. 66(6):966–973.

Kracker L. 2007. Hydroacoustic surveys: a non-destructive approach to monitoring fish distributions at national marine sanctuaries. Charleston (SC): National Oceanic and Atmospheric Administration National Ocean Service. 24 p. Report No.: NOAA Technical Memorandum NOS NCCOS 66.

Kraus RT, Friess C, Hill RL, Rooker JR. 2007. Characteristics of the snapper-grouper-grunt complex, benthic habitat description, and patterns of reef fish recruitment at Sonnier Bank in the northwestern Gulf of Mexico. In: Proceedings of the 59th Gulf and Caribbean Fisheries Institute. Fort Pierce (FL): GCFI. p. 165-170.

Kulaw D. 2012. Habitat- and region-specific reproductive biology of female red snapper (*Lutjanus campechanus*) in the Gulf of Mexico [thesis]. Baton Rouge (LA): Louisiana State University. Report No.: SEDAR31-RD38.

Kurz RC. 1995. Predator-prey interactions between gray triggerfish *Balistes capricus* (Gmelin), and a guild of sand dollars around artificial reefs in the northeastern Gulf of Mexico. Bull Mar Sci. 56(1):150-160.

Lang ET, Falterman BJ (Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA). 2017. A comparison of sampling methods and continuation of red snapper life history metrics. North Charleston (SC): SEDAR. 10 p. Report No.: SEDAR52-WP-07.

Lang ET, Falterman BJ (Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA). 2017. A continuation of results in the spatial distribution and occurrence of red snapper, *Lutjanus campechanus*, sampled off the Louisiana Coast during nearshore trawl sampling efforts. North Charleston (SC): SEDAR. 10 p. Report No.: SEDAR52-WP-08.

Lang ET, Fitzhugh GR (Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA and National Marine Fisheries Service, Panama City, FL). 2015. Oogenesis and fecundity type of gray triggerfish (*Balistes capriscus*) in the Gulf of Mexico. North Charleston (SC): SEDAR. 29 p. Report No.: SEDAR43-WP-02.

Langland T. 2015. Fish assemblage structure, distribution, and trophic ecology at northwestern Gulf of Mexico banks [dissertation]. Baton Rouge (LA): Louisiana State University.

Lauretta M. 2014. Virtual population analyses of Atlantic king mackerel. North Charleston (SC): SEDAR. 69 p. Report No.: SEDAR38-RW-03.

Lauretta M. 2014. Virtual population analyses of Gulf of Mexico king mackerel. North Charleston (SC): SEDAR. 69 p. Report No.: SEDAR38-RW-04.

Lauretta M, Cass-Calay SL (National Marine Fisheries Service, Miami, FL). 2013. Updated standardized catch rates of king mackerel (*Scomberomorus cavalla*) from the headboat fishery in the U.S. Gulf of Mexico and U.S. South Atlantic. North Charleston (SC): SEDAR. 27 p. Report Nos.: SEDAR38-DW-16 and Sustainable Fisheries Division Contribution No SFD-2008-001.

Lauretta M, Walter J (National Marine Fisheries Service, Miami, FL). 2013. Updated standardized catch rates of king mackerel, *Scomberomorus cavalla* from the Marine Recreational Fisheries Statistical Survey MRFSS. North Charleston (SC): SEDAR. 10 p. Report Nos.: SEDAR38-DW04 and Sustainable Fisheries Division Contribution SFD-2013-.

Lazarre D, Sauls B, Germeroth R (Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL). 2017. A summary of data on the size distribution and release condition of red snapper discards from recreational fishery surveys in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 17 p. Report No.: SEDAR52-WP-19.

Levesque JC, Richardson A. 2011. Characterization of the recreational fisheries associated with the Flower Garden Banks National Marine Sanctuary (USA). Wildl Biol Pract. 7(1):90-115.

LGL Ecological Research Associates Inc. 1998. Cumulative ecological significance of oil and gas structures in the Gulf of Mexico: a Gulf of Mexico fisheries habitat suitability model—phase II model description. New Orleans (LA): US Department of the Interior, Minerals Management Service. 114 p. Report No.: OCS Study MMS 97-0044.

LGL Ecological Research Associates Inc. 1998. Cumulative ecological significance of oil and gas structures in the Gulf of Mexico: a Gulf of Mexico fisheries habitat suitability model--phase II user manual. New Orleans (LA): US Department of the Interior, Minerals Management Service. 28 p. Report No.: OCS Study MMS 97-0043.

LGL Ecological Research Associates, Inc. (College Station, TX). 2017. Explosive removal of structures: fisheries impact assessment. Assemblage characterization synthesis report. Final report. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 118 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX). 2017. Explosive removal of structures: fisheries impact assessment. Field season 1: sampling report. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 34 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX). 2017. Explosive removal of structures: fisheries impact assessment. Field season 2 sampling report. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 88 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX). 2018. Explosive removal of structures: fisheries impact assessment. Field season 3 sampling report. , New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 56 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX). 2019. Characterization of fish assemblages associated with offshore oil and gas platforms in the Gulf of Mexico. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 74 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX), Auburn University, Marine Science Institute (Auburn, AL). 2018. Explosive removal of structures: fisheries impact assessment. Field season 2 assemblage characterization report. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 74 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX), Auburn University, Marine Science Institute (Auburn, AL). 2018. Explosive removal of structures: fisheries impact assessment. Field season 3 assemblage characterization report. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 62 p. Contract No.: M16PC00005.

LGL Ecological Research Associates, Inc. (College Station, TX), Science Applications International Corporation (Reston, VA). 1998. Cumulative ecological significance of oil and gas structures in the Gulf of Mexico: information search, synthesis, and ecological modeling. Phase I, final report. Kearneysville (WV): US Geological Survey Biological Resources Division and New Orleans (LA): US Department of the Interior, Minerals Management Service. 137 p. BRD Contract 1445-CT96-0005. Report Nos.: USGS/BRD/CR-1997-0006 and OCS Study MMS 97-0036.

Lindberg WJ, Frazer TK, Porter KM, Vose F, Loftin J, et al. 2006. Density-dependent habitat selection and performance by a large mobile reef fish. Ecol Appl. 16(2):731-746.

Lindberg WJ, Frazer TK, Stanton GR. 1990. Population effects of refuge dispersion for adult stone crabs (Xanthidae, *Menippe*). Mar Ecol Prog Ser. 66:239-249.

Lindeman KC, Pugliese R, Waugh GT, Ault JS. 2000. Developmental patterns within a multispecies reef fishery: management applications for essential fish habitats and protected areas. Bull Mar Sci. 66(3):929-956.

Lindquist DC, Shaw RF, Hernandez FJ, Jr. 2005. Distribution patterns of larval and juvenile fishes at offshore petroleum platforms in the north-central Gulf of Mexico. Estuar Coast Shelf Sci. 62(4):655-665.

Linton B (National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, FL). 2012. Methods for estimating shrimp bycatch of Gulf of Mexico Spanish mackerel and cobia: addendum. North Charleston (SC): SEDAR. 12 p. Report Nos.: SEDAR31-DW30 and Sustainable Fisheries Division Contribution SFD-2012-002.

Linton B (National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, FL). 2012. Shrimp fishery bycatch estimates for Gulf of Mexico red snapper, 1972-2011. North Charleston (SC): SEDAR. 9 p. Report Nos.: SEDAR28-DW06 and Sustainable Fisheries Division Contribution SFD-2012-017.

Linton BC (National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, FL). 2013. Age composition of red snapper bycatch in the Gulf of Mexico shrimp fishery, 1997-2011. North Charleston (SC): SEDAR. 12 p. Report Nos.: SEDAR31-AW05 and Sustainable Fisheries Division Contribution SFD-2013-001.

Linton BC (National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, FL). 2013. Shrimp trawl index of abundance for Gulf of Mexico red snapper, 1967-1989. North Charleston (SC): SEDAR. 10 p. Report Nos.: SEDAR-AW06 and Sustainable Fisheries Division Contribution SFD-2013-002.

Logan RK, Lowe CG. 2019. Space use and inferred spawning activity of three exploited gamefish species on a large artificial reef. Fish Manag Ecol. 26:558-569.

Lokkeborg S. 2002. Spatio-temporal variations in gillnet catch rates in the vicinity of North Sea oil platforms. ICES J Mar Sci. 59:S294-S299.

Løkkeborg S, Ona E, Vold A, Salthaug A. 2012. Sounds from seismic air guns: gear- and species-specific effects on catch rates and fish distribution. Can J Fish Aquat Sci. 69:1278-1291.

Lombard L, Allman R, Thornton L, Palmer C (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2015. Description of age data and estimated growth for vermilion snapper from the northern Gulf of Mexico: 1994-2014. Panama City Laboratory Contribution 2015-18. North Charleston (SC): SEDAR. 29 p. Report Nos.: SEDAR45-WP01 and Panama City Laboratory Contribution 2015-018.

Lombardi L (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2013. Ageing error matrices for SEDAR33: gag grouper and greater amberjack. North Charleston (SC): SEDAR. 9 p. Report Nos.: SEDAR33-AW-22 and NMFS Panama City Library Contribution #13-05.

Lombardi L (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2014. Growth models for king mackerel from the south Atlantic and Gulf of Mexico. North Charleston (SC): SEDAR. 62 p. Report Nos.: SEDAR38-AW-01 and Panama City Laboratory Contribution 14-01.

Lombardi L (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2015. Gray triggerfish ageing error. North Charleston (SC): SEDAR. 5 p. Report Nos.: SEDAR43-WP-13 and NMFS Panama City Library Contribution 15-11.

Lombardi L (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2017. Summary of red snapper age-length data by data providers for SEDAR52. North Charleston (SC): SEDAR. 24 p. Report Nos.: SEDAR52-WP-14 and Panama City Library Contribution 17-08.

Lombardi L, Allman R, Pacicco A (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2015. Description of age data and estimated growth for gray triggerfish from the northern Gulf of Mexico: 2003-2013. North Charleston (SC): SEDAR. 34 p. Report Nos.: SEDAR43-WP-10 and Panama City Library Contribution 15-02.

Lombardi L, Campbell M, Sauls B, McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL, Pascagoula, MS, and Miami, FL and Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2013. A meta-data analysis of discard mortality estimates for gag grouper and greater amberjack. North Charleston (SC): SEDAR. 22 p. Report No.: SEDAR33-DW19.

Lombardi-Carlson LA, Cook M, Lyon H, Barnett B, Bullock L. 2012. A description of age, growth, and reproductive life history traits of scamps from the northern Gulf of Mexico. Mar Coast Fish. 4(1):129-144.

Lorenzen K, Camp EV. 2019. Density-dependence in the life history of fishes: when is a fish recruited? Fish Res. 217:5-10.

Lotz JM, Overstreet RM, Franks JS. 1996. Gonadal maturation in the cobia, *Rachycentron canadum*, from the northcentral Gulf of Mexico. Gulf Res Rep. 9(3):147-159.

Lounder C. 2009. Recruitment dynamics and otolith chemical signatures of juvenile gray snapper, *Lutjanus griseus*, among west Florida estuarine and coastal marine ecosystems [thesis]. Pensacola (FL): University of West Florida. North Charleston (SC): SEDAR. 103 p. Report No.: SEDAR51-RD-10.

Love M, Hyland J, Ebeling A, Herrlinger T, Brooks A, Imamura E. 1994. A pilot study of the distribution and abundances of rockfishes in relation to natural environmental factors and an offshore oil and gas production platform off the coast of southern California. Bull Mar Sci. 55(2-3):1062-1085.

Love MS, Brothers E, Schroeder DM, Lenarz WH. 2007. Ecological performance of young-of-the-year blue rockfish (*Sebastes mystinus*) associated with oil platforms and natural reefs in California as measured by daily growth rates. Bull Mar Sci. 80(1):147-157.

Love MS, Caselle J, Snook L. 1999. Fish assemblages on mussel mounds surrounding seven oil platforms in the Santa Barbara Channel and Santa Maria Basin. Bull Mar Sci. 65(2):497-513.

Love MS, Caselle JE, Snook L. 2000. Fish assemblages around seven oil platforms in the Santa Barbara Channel area. Fish Bull. 98:96-117.

Love MS, Nishimoto M, Clark S, Schroeder DM. 2012. Recruitment of young-of-the-year fishes to natural and artificial offshore structure within central and southern California waters, 2008–2010. Bull Mar Sci. 88(4):863-882.

Love MS, Nishimoto M, Schroeder D (Marine Science Institute, University of California, Santa Barbara, CA). 2010. Fish assemblages associated with platforms and natural reefs in areas where data are non-existent or limited. Camarillo (CA): US Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement. 101 p. MMS Cooperative Agreement No.: 1435-01-05-CA-39322; NSL-PC-05-01 and MMS Cooperative Agreement No.: M07AC13380; NSL-PC-07-04. Report No.: OCS Study BOEMRE Study 2010-012.

Love MS, Nishimoto MM, Clark S, Bull AS (Marine Science Institute, University of California, Santa Barbara, CA. 2015. Analysis of fish populations at platforms off Summerland, California. Camarillo (CA): US Department of the Interior, Bureau of Ocean Energy Management. 56 p. BOEM Cooperative Agreement No.: M12AC00004. Report No.: OCS Study BOEM 2015-019.

Love MS, Schroeder DM, Lenarz W, MacCall A, Scarborough Bull A, Thorsteinson L. 2006. Potential use of offshore marine structures in rebuilding an overfished rockfish species, bocaccio (*Sebastes paucispinis*). Fish Bull. 104:383-390.

Love MS, Schroeder DM, Nishimoto MM (Marine Science Institute, University of California, Santa Barbara, CA. 2003. The ecological role of oil and gas production platforms and natural outcrops on fishes in southern and central California: a synthesis of information. Seattle (WA): US Geological Survey and Camarillo (CA): US Department of the Interior, Minerals Management Service. 66 p. Report No.: OCS Study MMS 2003-032.

Love MS, York A. 2005. A comparison of fish assemblages associated with an oil/gas pipeline and adjacent seafloor in the Santa Barbara Channel, Southern California Bight. Bull Mar Sci. 77(1):101-117.

Love MS, York A. 2006. The relationships between fish assemblages and the amounts of bottom horizontal beam exposed at California oil platforms: fish habitat preferences at man-made platforms and (by inference) and natural reefs. Fish Bull. 104(4):542-549.

Love RH. 1971. Measurements of fish target strength: a review. Fish Bull. 69(4):703-715.

Lowe CG, Anthony KM, Jarvis ET, Bellquist LF, Love MS. 2009. Site fidelity and movement patterns of groundfish associated with offshore petroleum platforms in the Santa Barbara Channel. Mar Coast Fish. 1(1):71-89.

Lowerre-Barbieri S, Crabtree L, Switzer T, Walters Burnsed S, Guenther C. 2015. Assessing reproductive resilience: an example with South Atlantic red snapper *Lutjanus campechanus*. Mar Ecol Prog Ser. 526:125-141.

Lowerre-Barbieri S, Crabtree L, Switzer TS, McMichael RH Jr. 2012. Spatio-temporal dynamics in red snapper reproduction on the West Florida Shelf, 2008-2011. p. 10.

Lowerre-Barbieri S, DeCelles G, Pepin P, Catalán IA, Muhling B, Erisman B, Cadrin SX, Alós J, Ospina-Alvarez A, Stachura MM et al. 2017. Reproductive resilience: a paradigm shift in understanding spawner-recruit systems in exploited marine fish. Fish Fish. 18(2):285-312.

Lyczkowski-Shultz J, Hanisko DS. 2007. A time series of observations on red snapper larvae from SEAMAP surveys 1982-2003: seasonal occurrence, distribution, abundance, and size. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 3-24.

Mackinson S, Freeman S, Flatt R, Meadows B. 2004. Improved acoustic surveys that save time and money: integrating fisheries and ground-discrimination acoustic technologies. J Exp Mar Biol Ecol. 305:129-140.

Maclennan DN, Fernandes PG, Dalen J. 2002. A consistent approach to definitions and symbols in fisheries acoustics. ICES J Mar Sci. 59:365-369.

Maclennan DN, Simmonds EJ. 1992. Fisheries acoustics. London (GB): Chapman & Hall.

Macreadie PI, Fowler AM, Booth DJ. 2011. Rigs-to-reefs: will the deep sea benefit from artificial habitat? Front Ecol Environ. 9(8):455-461.

Madsen PT. 2005. Marine mammals and noise: problems with root mean square sound pressure levels for transients. J Acoust Soc Am. 117(6):3952-3957.

Mallet D, Pelletier D. 2014. Underwater video techniques for observing coastal marine biodiversity: a review of sixty years of publications (1952–2012). Fish Res. 154:44-62.

Mann DA, Hawkins AD, Jech JM. 2008. Active and passive acoustics to locate and study fish. In: Webb JF, Fay RR, Popper AN, editors. Fish bioacoustics. Springer Handbook of Auditory Research, Volume 32. New York (NY): Springer. p. 279-309.

Mann DA, Locascio JV, Coleman FC, Koenig CC. 2009. Goliath grouper *Epinephelus itajara* sound production and movement patterns on aggregation sites. Endang Spec Res. 7:229-236.

Manooch CS, III, Potts JC. 1997. Age, growth and mortality of greater amberjack, *Seriola dumereli*, from the U.S. Gulf of Mexico headboat fishery. Bull Mar Sci. 61(3):671-683.

Martin CJB, Lowe CG. 2010. Assemblage structure of fish at offshore petroleum platforms on the San Pedro Shelf of southern California. Mar Coast Fish. 2(1):180-194.

Matter V (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2012. Recreational survey data for red snapper in the Gulf of Mexico. North Charleston (SC): SEDAR. 20 p. Report Nos.: SEDAR31-DW04 and Sustainable Fisheries Division Contribution No SFD-2012- 015.

Matter V (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2012. Recreational survey data for Spanish mackerel and cobia in the Atlantic and the Gulf of Mexico from the MRFSS and TPWD surveys. North Charleston (SC): SEDAR. 32 p. Report Nos.: SEDAR28-DW14 and Sustainable Fisheries Division Contribution No SFD-2012- 004.

Matter VM, Cummings N, Isely JJ, Brennan K, Fitzpatrick K (Nationa Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL and Beaufort, NC). 2012. Estimated conversion factors for calibrating MRFSS charterboat landings and effort estimates for the South Atlantic and Gulf of Mexico in 1981-1985 with for hire survey estimates with application to Spanish mackerel and cobia landings. North Charleston (SC): SEDAR. 30 p. Report Nos.: SEDAR28-DW12 and Sustainable Fisheries Division Contribution No SFD-2012- 003.

Matter VM, Walter JF (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2013. Headboat discards for red snapper in the Gulf of Mexico. North Charleston (SC): SEDAR. 8 p. Report Nos.: SEDAR31-AW01 and Sustainable Fisheries Division Contribution No SFD-2013-005.

McAllister MK (Statistical Evaluation and Resource Assessment, London, GB). 2004a. Brief review of red snapper data workshop report. Charleston (SC). 10 p. Report No.: SEDAR7-AW13.

McAllister MK (Statistical Evaluation and Resource Assessment, London, GB). 2004b. Identifying some approaches to formulating prior probability distributions for natural mortality rates in age zero and age one Gulf of Mexico red snapper. Charleston (SC). 20 p. Report No.: SEDAR7-AW14.

McCann B, Henrion M, Bernstein B. 2016. A decision support model for platform decommissioning: successful applications in California and implications for worldwide use. Paper presented at: SPE International Conference and Exhibition on Health, Safety, Security, Environment, and Social Responsibility. Society of Petroleum Engineers; Stavanger, Norway, April 11-13, 2016. [accessed 21 Jan 2109]. https://www.onepetro.org/conference-paper/SPE-179415-MS.

McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Calculated discards of Spanish mackerel and cobia from commercial fishing vessels in the Gulf of Mexico and US South Atlantic. North Charleston (SC): SEDAR. 17 p. Report Nos.: SEDAR28-DW04 and Sustainable Fisheries Division Contribution SFD-2012-010.

McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Calculated red snapper discards in the Gulf of Mexico commercial vertical line and bottom longline fisheries: preliminary results. North Charleston (SC): SEDAR. 11 p. Report Nos.: SEDAR31-DW31 and Sustainable Fisheries Division Contribution SFD-2012-019.

McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Observer reported size distribution of Gulf of Mexico red snapper from the commercial vertical line and bottom longline fisheries. North Charleston (SC): SEDAR. 27 p. Report Nos.: SEDAR31-DW32 and Sustainable Fisheries Division Contribution SFD-2012-018.

McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Standardized catch rates of cobia from commercial handline and trolling fishing vessels in the US South Atlantic, 1993-2010. North Charleston (SC): SEDAR. 13 p. Report Nos.: SEDAR28-DW18 and Sustainable Fisheries Division Contribution SFD-2012-008.

McCartney BS, Stubbs AR. 1971. Measurements of the acoustic strengths of fish in dorsal aspect, including swimbladder resonance. J Sound Vib. 15(3):397-420.

McCauley RD, Fewtrell J, Popper AN. 2003. High intensity anthropogenic sound damages fish ears. J Acoust Soc Am. 113(1):638-642.

McClatchie S, Thorne RE, Grimes P, Hanchet S. 2000. Ground truth and target identification for fisheries acoustics. Fish Res. 47:173-191.

McClellan DB, Cummings NJ (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 1997. Preliminary analysis of tag and recapture data of the greater amberjack, *Seriola dumerili*, in the southeastern United States. In: Proceedings of the 49th Gulf and Caribbean Fisheries Institute, Bridgetown, Barbados, November 1996. p. 25-45. Fort Pierce (FL): Gulf and Caribbean Fisheries Institute. Report No. SEDAR33-RD10.

McClenachan L. 2009. Historical declines of goliath grouper populations in South Florida, USA. Endang Spec Res. 7:175-181.

McCormick MI. 1994. Comparison of field methods for measuring surface topography and their associations with a tropical reef fish assemblage. Mar Ecol Prog Ser. 112:87-96.

McDonough M. 2009. Oil platforms and red snapper movement and behavior [thesis]. [Baton Rouge (LA)]: Louisiana State University.

McDonough M, Cowan J. 2007. Tracking red snapper movements around an oil platform with an automated acoustic telemetry system. In: Proceedings of the 50th Gulf and Caribbean Fisheries Institute [GCFI]. p. 159-163. Fort Pierce (FL): GCFI.

McDonough M, Cowan JH, Jr (Louisiana State University, Baton Rouge, LA). 2013. Short-term movement, home range, and behavior of red snapper around petroleum platforms in the northern Gulf of Mexico, as determined by high resolution acoustic telemetry. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. Contract No.: 1435-01-99-CA-30951-73515. 70 p. Report No.: OCS Study BOEM 2013-0123.

McGlaun JM, Thompson SL, Elrick MG. 1990. CTH: a three-dimensional shock wave physics code. Int J Impact Eng. 10:351-360.

McKinstry C, Carlson TJ, Brown RS (Pacific Northwest National Laboratory, Richland, WA). 2007. Derivation of a mortal injury metric for studies of rapid decompression of depth-acclimated physostomous fish. Final report. Portland (OR): US Army Corps of Engineers. 16 p. Contract No.: DE-AC05-76RL01830. Report No.: PNNL-17080.

McKinzie MK, Jarvis ET, Lowe CG. 2014. Fine-scale horizontal and vertical movement of barred sand bass, *Paralabrax nebulifer*, during spawning and non-spawning seasons. Fish Res. 150:66-75.

McLean DL, Partridge JC, Bond T, Birt MJ, Bornt KR, Langlois TJ. 2017. Using industry ROV videos to assess fish associations with subsea pipelines. Cont. Shelf Res. 141:76-97.

Mikulas JJ, Jr., Rooker JR. 2008. Habitat use, growth, and mortality of post-settlement lane snapper (*Lutjanus synagris*) on natural banks in the northwestern Gulf of Mexico. Fish Res. 93(1-2):77-84.

Millar RB, Anderson MJ. 2004. Remedies for pseudoreplication. Fish Res. 70(2-3):397-407.

Miller MW. 2002. Using ecological processes to advance artificial reef goals. ICES J Mar Sci. 59:S27-S31.

Miller TJ, Blair JA, Ihde TF, Jones RM, Secor DH, Wilberg MJ. 2010. FishSmart: an innovative role for science in stakeholder-centered approaches to fisheries management. Fisheries. 35(9):424-433.

Minton RV, Heath SR. 1998. Alabama's artificial reef program: building oases in the desert. Gulf Mex Sci. 16(1):105-106.

Mireles C. 2010. Site fidelity and depth utilization of nearshore reef fish on offshore San Pedro Shelf petroleum platforms [thesis]. Long Beach (CA): California State University.

Mitchell KM, Henwood T, Fitzhugh GR, Allman RJ. 2004. Distribution, abundance, and age structure of red snapper (*Lutjanus campechanus*) caught on research longlines in U.S. Gulf of Mexico. Gulf Mex Sci. 22(2):164-172.

Mitchell WA, Kellison GT, Bacheler NM, Potts JC, Schobernd CM, Hale LF. 2014. Depth-related distribution of postjuvenile red snapper in southeastern U.S. Atlantic Ocean waters: ontogenic patterns and implications for management. Mar Coast Fish. 6(1):142-155.

Mitson RB, Knudsen HP. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquat Liv Res. 16(3):255-263.

Moe MA, Jr. 1963. A survey of offshore fishing in Florida. St. Petersburg (FL): Florida State Board of Conservation Marine Laboratory. 120 p. Report No.: SEDAR28-RD05.

Moncrief T, Brown-Peterson NJ, Peterson MS. 2018. Age, growth, and reproduction of vermilion snapper in the north-central Gulf of Mexico. Trans Am Fish Soc. 147(5):996-1010.

Morison AK, Robertson SG, Smith DC. 1998. An integrated system for production fish aging: image analysis and quality assurance. N Am J Fish Manage. 18(3):587-598.

Morris W, Winters J. 2005. Fish behavioral and physical responses to vibroseis noise Prudhoe Bay, Alaska 2003. Fairbanks (AK): Alaska Department of Natural Resources. Report No.: Technical Report No. 05-02.

Moser JG Jr, Pollack AG, Ingram GW Jr, Gledhill CT, Henwood TA, et al. (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Developing a survey methodology for sampling red snapper, *Lutjanus campechanus*, at oil and gas platforms in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 23 p. Report No.: SEDAR31-DW26.

Mudrak PA, Szedlmayer ST. 2012. Proximity effects of larger resident fishes on recruitment of age-0 red snapper in the northern Gulf of Mexico. Trans Am Fish Soc. 141:487-494.

Mudrak PA, Szedlmayer ST. 2020. Fishing mortality estimates for red snapper, *Lutjanus campechanus*, based on acoustic telemetry and conventional mark-recapture. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton, FL: CRC Press. p. 75-94.

Mudrak PA, Szedlmayer ST. 2020. Juvenile red snapper, *Lutjanus campechanus*, densities on small artificial reefs to estimate year-class strength. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 27-46.

Mueller M (Gulf of Mexico Fishery Management Council, Tampa, FL). 2012. Artificial structure and hard-bottom spatial coverage in the Gulf of Mexico. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR31-DW19.

Muller RG (Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL). 2017. Standardized reef fish visual census index for gray snapper, *Lutjanus griseus*, for the Florida reef track from Biscayne Bay through the Florida Keys for 1997-2016. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR51-DW14.

Munday DR, Ennis GL, Wright DG, Jeffries DC, McGreer ER, et al. 1986. Development and evaluation of a model to predict effects of buried underwater blasting charges on fish populations in shallow water areas. Can Tech Rept Fish Aquat Sci. 1418:x + 49 p.

Munnelly RT. 2016. Fishes associated with oil and gas platforms in Louisiana's river-influenced nearshore waters [thesis]. [Baton Rouge (LA)]: Louisiana State University.

Munnelly RT, Reeves DB, Chesney EJ, Baltz DM, Marx BD. 2019. Habitat suitability for oil and gas platform-associated fishes in Louisiana’s nearshore waters. Mar Ecol Prog Ser. 608:199-219.

Munro JL, Pauly D. 1983. A simple method for comparing the growth of fishes and invertebrates. Fishbyte. 1(1):5-6.

Murie DJ, Parkyn DC (University of Florida, Gainesville, FL). 2008. Age, growth and sex maturity of greater amberjack (*Seriola dumerili*) in the Gulf of Mexico. North Charleston (SC). 41 p. Report Nos.: SEDAR33-RD13 and MARFIN Final Report NA05NMF4331071.

Murie DJ, Parkyn DC (University of Florida, Gainesville, FL). 2013. 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. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR33-DW29.

Murie DJ, Parkyn DC, Austin J (University of Florida, Gainesville, FL). 2011. Seasonal movement and mixing rates of greater amberjack in the Gulf of Mexico and assessment of exchange with the South Atlantic spawning stock. Final report for cooperative research program (NA07NMF4540076). North Charleston (SC): SEDAR. 45 p. Report No.: SEDAR33-DW12.

Murphy HM, Jenkins GP. 2010. Observational methods used in marine spatial monitoring of fishes and associated habitats: a review. Mar Freshwater Res. 61:236-252.

Murray F, Needham K, Gormley K, Rouse S, Coolen JWP, Billett D, Dannheim J, Birchenough SNR, Hyder K, Heard R et al. 2018. Data challenges and opportunities for environmental management of North Sea oil and gas decommissioning in an era of blue growth. Mar Policy. 97:130-138.

NATO [North Atlantic Treaty Organization]. 2010. Manual of NATO safety principles for the storage of military ammunition and explosives. NATO Military Agency for Standardization. Brussels (BE): NATO MAS. Report No.: Allied Ammunition Storage and Transport Publication 1 [AASTP-1], Edition 1.

Neira FJ. 2005. Summer and winter plankton fish assemblages around offshore oil and gas platforms in south-eastern Australia. Estuar Coast Shelf Sci. 63(4):589-604.

Nelson RS, Manooch CS, III. 1982. Growth and mortality of red snappers in the west-central Atlantic Ocean and northern Gulf of Mexico. Trans Am Fish Soc. 111:465-475.

Nieland DL, Wilson CA. 2003. Red snapper recruitment to and disappearance from oil and gas platforms in the northern Gulf of Mexico. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, reefs, and offshore development. American Fisheries Society Symposium 36. Bethesda (MD): American Fisheries Society. p. 73-81.

Nieland DL, Wilson CA, III. 2007. Declining size at age among red snapper in the northern Gulf of Mexico off Louisiana, USA: recovery or collapse? In: Patterson WF, III, Cowan JH, Jr., Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 301-307.

NMFS [National Marine Fisheries Service]. 2016. Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing. Underwater acoustic thresholds for onset of permanent and temporary threshold shifts. Report No.: NOAA Technical Memomorandum NMFS-OPR-55.

[NMFS] National Marine Fisheries Service. 2017. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; reef fish fishery of the Gulf of Mexico; modifications to Greater Amberjack allowable harvest and rebuilding plan. 50 CFR Part 622. [Final rule.] Fed Reg. 82(248): 61485–61487. [accessed 2020 April 14]. https://www.federalregister.gov/documents/2017/12/28/2017-28047/fisheries-of-the-caribbean-gulf-of-mexico-and-south-atlantic-reef-fish-fishery-of-the-gulf-of-mexico

NMFS Beaufort. 2012. Preliminary standardized catch rates of Southeast US Atlantic cobia (*Rachycentron canadum*) from headboat data. North Charleston (SC): SEDAR. 28 p. Report No.: SEDAR28-DW20.

NMFS-SERO [NMFS Souteast Regional Office]. 2017. Headboat collaborative pilot program 2014 annual report. St. Petersburg (FL): NMFS-SERO. Report Nos.: SEDAR52-RD-07 and SERO-LAPP-2015-01.

NOAA [National Oceanic and Atmospheric Administration]. 2015. National Oceanic and Atmospheric Administration draft guidance for assessing the effects of anthropogenic sound on marine mammal hearing: underwater acoustic threshold levels for onset of permanent and temporary threshold shifts. 180 p.

NOAA [National Oceanic and Atmospheric Administration] Fisheries. 2018. NOAA announces the 2018 Gulf of Mexico red snapper recreational seasons and clarifies permit regulations for vessels fishing in federal waters. [accessed 13 Feb 2020]. https://www.fisheries.noaa.gov/bulletin/noaa-announces-2018-gulf-mexico-red-snapper-recreational-seasons-and-clarifies-permit.

NOAA [National Oceanic and Atmospheric Administration] Fisheries. 2019. State recreational red snapper management exempted fishing permits. [accessed Nov 22, 2019]. https://www.fisheries.noaa.gov/southeast/state-recreational-red-snapper-management-exempted-fishing-permits.

NOAA [National Oceanic and Atmospheric Administration] SEFSC [Southeast Fisheries Science Center]. 2012. Gulf of Mexico red snapper 2011 projection update. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR31-RD03.

Nowling LK, Cowan JH, Jr., Shaw RF (Coastal Marine Institute, Louisiana State Univeristy). 2010. Proof of concept for platform recruited fish, phase I: do platforms provide habitat for subadult red snapper? New Orleans (LA): US Department of the Interior, Minerals Management Service. Cooperative Agreement No.: 1435-99-CA-30951-18181. 80 p. Report No.: OCS Study MMS 2010-002.

Ogden JC, Ebersole JP. 1981. Scale and community structure of coral reef fishes: a long-term study of a large artificial reef. Mar Ecol Prog Ser. 4:97-103.

O'Hop J, Sauls B (Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL). 2012. Index of abundance for pre-fishery recruit red snapper from Florida headboat observer data. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR31-DW09.

Ona E, Mitson RB. 1996. Acoustic sampling and signal processing near the seabed: the deadzone revisited. ICES J Mar Sci. 53:677-690.

Orbesen E (National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, FL). 2012. Constituent based tagging of cobia in the Atlantic and Gulf of Mexico waters. North Charleston (SC): SEDAR. 9 p. Report Nos.: SEDAR28-DW13 and Sustainable Fisheries Division Contribution SFD-2012-XXX.

Orhum R, Wrege B. 2018. Commercial landings of gray or mangrove snapper (*Lutjanus griseus*) from the Gulf of Mexico. North Charleston (SC): SEDAR. 10 p. Report No.: SEDAR51-RW-01.

Osenberg CW, St. Mary CM, Wilson JA, Lindberg WJ. 2002. A quantitative framework to evaluate the attraction-production controversy. ICES J Mar Sci. 59:S214-S221.

Ouzts AC, Szedlmayer ST. 2003. Diel feeding patterns of red snapper on artificial reefs in the north-central Gulf of Mexico. Trans Am Fish Soc. 132(6):1186-1193.

Overholtz WJ, Hare JA, Keith CM. 2011. Impacts of interannual environmental forcing and climate change on the distribution of Atlantic mackerel on the U.S. northeast continental shelf. Mar Coast Fish. 3:219-232.

Pacunski RE, Palsson WA, Greene HG, Gunderson D. 2008. Conducting visual surveys with a small ROV in shallow water. In: Reynolds JR, Green HG, editors. Marine habitat mapping for Alaska. Fairbanks (AK): Alaska Sea Grant College Program, University of Alaska Fairbanks. p. 109-128.

Page HM, Dugan JE, Schroeder DM, Nishimoto MM, Love MS, Hoesterey JC. 2007. Trophic links and condition of a temperate reef fish: comparisons among offshore oil platform and natural reef habitats. Mar Ecol Prog Ser. 344:245-256.

Pajuelo JG, González JA, Triay-Portella R, Martín JA, Ruiz-Díaz R, Lorenzo JM, Luque Á. 2016. Introduction of non-native marine fish species to the Canary Islands waters through oil platforms as vectors. J Mar Syst. 163:23-30.

Palmer C, DeVries D, Fioramonti C, Lang H (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Panama City, FL). 2013. A review of Gulf of Mexico and Atlantic king mackerel (*Scomberomorus cavalla*) age data, 1986 – 2013, from the Panama City Laboratory, Southeast Fisheries Science Center, NOAA Fisheries Service. North Charleston (SC): SEDAR. 59 p. Report Nos.: SEDAR38-DW-15 and Panama City Laboratory Contribution 13-09.

Parente V, Ferreira D, Moutinho dos Santos E, Luczynski E. 2006. Offshore decommissioning issues: deductibility and transferability. Energy Policy. 34(15):1992-2001.

Parker RO, Jr., Colby DR, Willis TD. 1983. Estimated amount of reef habitat on a portion of the U.S. South Atlantic and Gulf of Mexico continental shelf. Bull Mar Sci. 33(4):935-940.

Parker SJ, Schultz AW, Schroeder WW. 1992. Sediment characteristics and seafloor topography of a palimpsest shelf, Mississippi-Alabama continental shelf. In: Fletcher CH, III, Wehmiller JF, editors. Quaternary coasts of the United States: marine and lacustrine system. SEPM Special Publication No 48. Tulsa (OK): SEPM Society for Sedimentary Geology. p. 243-251.

Parker-Stetter SL, Rudstam LG, Sullivan PJ, Warner DM. 2009. Standard operating procedures for fisheries acoustic surveys in the Great Lakes. Ann Arbor (MI): GLFC. Report No.: Great Lakes Fishery Commission Special Publication 09-01.

Parrack NC, McClellan DB (National Marine Fisheries Service, Southeast Fisheries Center, Miami, FL). 1986. Trends in Gulf of Mexico red snapper population dynamics, 1979-85. Miami, FL. North Charleston (SC): SEDAR. 125 p. Report Nos.: SEDAR31-RD15 and Coastal Resources Division Contribution No. CRD-86/87-4.

Parsons GR. 2012. Relative abundance of juvenile red snapper, *Lutjanus campechanus* in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 6 p. Report No.: SEDAR31-DW01.

Pattengill-Semmens CV. 2007. Fish assemblages of the Gulf of Mexico, including the Flower Garden Banks National Marine Sanctuary. Proceedings of the 59th Gulf and Caribbean Fisheries Institute. Fort Pierce (FL): GCFI. p. 229-238.

Patterson WF, III. 1999. Aspects of the population ecology of red snapper *Lutjanus campechanus* in an artificial reef area off Alabama [thesis]. Mobile (AL): University of South Alabama.

Patterson WF, III. 2007. A review of movement in Gulf of Mexico red snapper: implications for population structure. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 221-235. Report No.: SEDAR31-RD35.

Patterson WF, Cowan JH. 2003. Site fidelity and dispersion of red snapper associated with artificial reefs in the northern Gulf of Mexico. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, reefs, and offshore development. American Fisheries Society Symposium 36. Bethesda (MD); American Fisheries Society. p. 181-193.

Patterson WF, III, Cowan JH, Jr., Barnett BK, Zapp Sluis M (University of West Florida, Pensacola, FL and Louisiana State University, Baton Rouge, LA). 2010. Estimation of the source of red snapper recruits to west Florida and south Texas with otolith chemistry: implications for stock structure and management. North Charleston (SC): SEDAR. 49 p. Grant No. NA05NMF4331072. Report Nos.: SEDAR31-RD14 and MaRFIN Final Report.

Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL. 2007. Red snapper ecology and fisheries in the U.S. Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society.

Patterson WF III, Cowan JH Jr, Wilson CA, Chen Z. 2008. Temporal and spatial variability in juvenile red snapper otolith elemental signatures in the northern Gulf of Mexico. Trans Am Fish Soc. 137(2):521-532.

Patterson WF III, Cowan JH Jr, Wilson CA, Shipp RL. 2001b. Age and growth of red snapper, *Lutjanus campechanus*, from an artificial reef area off Alabama in the northern Gulf of Mexico. Fish Bull. 99:617-627.

Patterson WF III, Dance MA, Addis DT. 2008. Development of a remotely operated vehicle based methodology to estimate fish community structure at artificial reef sites in the northern Gulf of Mexico. Proceedings of the 61st Gulf and Caribbean Fisheries Institute. Fort Pierce (FL): GCFI. p. 263-270.

Patterson WF, III, Porch CE, Tarnecki JH, Strelcheck AJ. 2012. Effect of circle hook size on reef fish catch rates, species composition, and selectivity in the northern Gulf of Mexico recreational fishery. Bull Mar Sci. 88(3):647-665.

Patterson WF III, Shepard KE (University of West Florida, Pensacola, FL). 2013. A cooperative research approach to estimating Atlantic and Gulf of Mexico king mackerel stock mixing and population dynamics parameters. North Charleston (SC): SEDAR. 38 p. Grant No. NA06NMF4540060. Report No.: SEDAR38-RD-03.

Patterson WF III, Tarnecki JH, Neese JT (University of West Florida, Pensacola, FL). 2010. Examination of red snapper fisheries ecology on the northwest Florida shelf (FWC-08304): final report. North Charleston (SC): SEDAR. 40 p. Report No.: SEDAR31-RD27.

Patterson WF III, Watterson JC, Shipp RL, Cowan JH Jr. 2001a. Movement of tagged red snapper in the northern Gulf of Mexico. Trans Am Fish Soc. 130:533-545.

Patterson WF III, Wilson CA, Bentley SJ, Cowan JH Jr, Henwood T, et al. 2005. Delineating juvenile red snapper habitat on the northern Gulf of Mexico continental shelf. In: Barnes PW, Thomas JP, editors. Benthic habitats and the effects of fishing. American Fisheries Society Symposium 41. Bethesda (MD): American Fisheries Society. p. 277-288.

Peabody MB. 2004. The fidelity of red snapper (*Lutjanus campechanus*) to petroleum platforms and artificial reefs in the northern Gulf of Mexico [thesis]. Baton Rouge (LA): Louisiana State University.

Peabody MB, Wilson CA (Louisiana State University, Baton Rouge, LA). 2006. Fidelity of red snapper (*Lutjanus campechanus*) to petroleum platforms and artificial reefs in the northern Gulf of Mexico. New Orleans (LA): US Department of the Interior, Minerals Management Service. 73 p. MMS Contract No.: 1435-01-99-CA-30951-70414. Report No.: OCS Study MMS 2006-005.

Peabody MB, Wilson CA III, Stanley DR. 2005. The fidelity of red snapper, *Lutjanus campechanus*, to petroleum platforms and artificial reefs in the northern Gulf of Mexico. Proceedings of the 56th Gulf and Caribbean Fisheries Institute. Fort Pierce (FL): GCFI. p. 842-843.

Pequegnat WE (TerEco Corporation, College Station, TX). 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Metairie (LA): US Department of the Interior, Minerals Management Service. 696 p. Contract No.: AA851-CT1-12. Report No.: 1983-11.

Perkinson M, Denson M. 2012. Evaluation of cobia movements and distribution using tagging data from the Gulf of Mexico and South Atlantic coast of the United States. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR28-DW05.

Perkol-Finkel S, Benayahu Y. 2007. Differential recruitment of benthic communities on neighboring artificial and natural reefs. J Exp Mar Biol Ecol. 340:25-39.

Pickering H, Whitmarsh D. 1997. Artificial reefs and fisheries exploitation: a review of the 'attraction versus production' debate, the influence of design and its significance for policy. Fish Res. 31:39-59.

Pickering H, Whitmarsh D, Jensen A. 1998. Artificial reefs as a tool to aid rehabilitation of coastal ecosystems: investigating the potential. Mar Pollut Bull. 37(8-12):505-514.

Piko AA, Szedlmayer ST. 2007. Effects of habitat complexity and predator exclusion on the abundance of juvenile red snapper. J Fish Biol. 70:758-769.

Pinkard DR, Kocak DM, Butler JL. 2005. Use of a video and laser system to quantify transect area for remotely operated vehicle (ROV) rockfish and abalone surveys. Proc Oceans 2005 MTS/IEEE. 3:2824-2829.

Piraino MN, Szedlmayer ST (Auburn University, Fairhope, AL). 2012. Fine-scale movements and home ranges of red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 28 p. Report No.: SEDAR31-DW14.

Piraino MN, Szedlmayer ST. 2014. Fine-scale movements and home ranges of red snapper around artificial reefs in the northern Gulf of Mexico. Trans Am Fish Soc. 143(4):988-998.

Pitcher TJ, Buchary EA, Hutton T. 2002. Forecasting the benefits of no-take human-made reefs using spatial ecosystem simulation. ICES J Mar Sci. 59:S17-S26.

Poe WT, Adams CF, Janda R, Kirklewski D. 2009. Effect of depth below mudline of charge placement during explosive removal of offshore structures (EROS). New Orleans (LA): US Department of the Interior, Minerals Management Service. Report No.: TAR Project No. 570.

Pollack A. 2016. Bottom longline analytical data collected in Gulf of Mexico from 1995-01-01 to 2013-12-30. Asheville (NC): Nationa Oceanic and Atmospheric Administration, National Centers for Environmental Information. [accessed 11 Oct 2016]. http://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:0147683.

Pollack AG (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. Continuity run - bottom longline. North Charleston (SC): SEDAR. 3 p. Report No.: SEDAR52-WP-17.

Pollack AG (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. Continuity run - groundfish. North Charleston (SC): SEDAR. 3 p. Report No.: SEDAR52-WP-18.

Pollack AG, Campbell MD, Driggers WB (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2013. Estimation of hook selectivity on red snapper (*Lutjanus campechanus*) during a fishery independent survey of natural reefs in the Gulf of Mexico. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR31-AW12.

Pollack AG, Hanisko DS, Ingram GW Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. Lane snapper abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 27 p. Report No.: SEDARDW-17.

Pollack AG, Hanisko DS, Ingram GW,Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. Wenchman abundance indices from MSLABS small pelagics surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR49-DW-18.

Pollack AG, Hanisko DS, Ingram GW Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2016. Wenchman abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 27 p. Report No.: SEDAR49-DW-19.

Pollack AG, Hanisko DS, Ingram GW Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. Gray snapper abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 28 p. Report No.: SEDAR51-DW-03.

Pollack AG, Hanisko DS, Ingram GW Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. Red snapper abundance indices from bottom longline surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 38 p. Report No.: SEDAR52-WP-16.

Pollack AG, Hanisko DS, Ingram GW Jr (National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS). 2017. Red snapper abundance indices from groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 76 p. Report No.: SEDAR52-WP-24.

Pollack AG, Hanisko DS, Lyczkowski-Shultz J, Jones CM, Ingram GW Jr (NOAA Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Red snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP fall plankton surveys, 1986 to 2010. North Charleston (SC): SEDAR. 65 p. Report No.: SEDAR31-DW27.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Spanish mackerel and cobia abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 40 p. Report No.: SEDAR28-DW03.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2013. Greater amberjack and gag grouper catches from Mississippi Laboratories fishery independent surveys. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR33-DW01.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2013. King mackerel abundance indices from NMFS small pelagics surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 18 p. Report No.: SEDAR38-DW-03.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2013. King mackerel abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 69 p. Report No.: SEDAR38-DW02.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2015. Gray triggerfish abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 30 p. Report No.: SEDAR43-WP-11.

Pollack AG, Ingram GW Jr (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2015. Vermilion snapper abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 37 p. Report No.: SEDAR45-WP-10.

Pollack AG, Ingram GW Jr, Campbell MD, DeVries DA, Gardner CL, et al. 2015. Vermilion snapper reef fish video index for the eastern Gulf of Mexico: a combined index from three fishery-independent surveys. North Charleston (SC): SEDAR. 23 p. Report No.: SEDAR45-WP-09.

Pollack AG, Ingram GW Jr, Foster DG (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2012. Red snapper abundance indices from SEAMAP groundfish surveys in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 235 p. Report No.: SEDAR31-DW20.

Pollack AG, Ingram GW Jr, Henwood TA (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Pascagoula, MS). 2013. Red snapper abundance indices from combined bottom trawl surveys in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 25 p. Report No.: SEDAR31-AW07.

Pollock KH, Winterstein SR, Bunck CM, Curtis PD. 1989. Survival analysis in telemetry studies: the staggered entry design. J Wildlife Manage. 53(1):7-15.

Polovina JJ, Sakai I. 1989. Impacts of artificial reefs on fishery production in Shimamaki, Japan. Bull Mar Sci. 44(2):997-1003.

Pondella DJ, Zahn LA, Love MS, Siegel D, Bernstein BB. 2015. Modeling fish production for southern California's petroleum platforms. Integr Enviro Assess Manag. 11(4):584-593.

Ponti M, Abbiati M, Ceccherelli VU. 2002. Drilling platforms as artificial reefs: distribution of macrobenthic assemblages of the "Paguro" wreck (northern Adriatic Sea). ICES J Mar Sci. 59:S316-S323.

Popper AN, Halvorsen MB, Casper BM, Carlson TJ (University of Maryland, College Park, MD). 2013. Effects of pile driving sounds on non-auditory tissues of fish. Herndon (VA): US Department of the Interior, Bureau of Ocean Energy Management. 72 p. Contract No.: M08PC20010. Report No.: BOEM 2012-105.

Popper AN, Halvorsen MB, Kane A, Miller DL, Smith ME, Song J, Stein P, Wysocki LE. 2007. The effects of high-intensity, low-frequency active sonar on rainbow trout. J Acoust Soc Am. 122:623-635.

Popper AN, Hastings MC. 2009. The effects of anthropogenic sources of sound on fishes. J Fish Biol. 75:455-489.

Popper AN, Hastings MC. 2009. The effects of human-generated sound on fish. Integr Zool. 4:43-52.

Popper AN, Hawkins AD, Fay RR, Mann DA, Bartol S, et al. 2014. Sound exposure guidelines for fishes and sea turtles: a technical report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4TR-2014. Springer Briefs in Oceanography. New York (NY): Springer.

Popper AN, Smith ME, Cott PA, Hanna BW, MacGillivray AO, et al. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. J Acoust Soc Am. 117:3958-3971.

Porch CE (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2013. Reconstructed time series of offshore shrimp trawl effort in the Gulf of Mexico from 1945 to 1972 for use in the SEDAR 31 Gulf of Mexico red snapper assessment. North Charleston (SC): SEDAR. 8 p. Report No.: SEDAR31-AW09.

Porch CE, Cass-Calay SL (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2001. Status of the vermilion snapper fishery in the Gulf of Mexico: assessment 5.0. Miami (FL): NOAA Fisheries Southeast Fisheries Science Center. 66 p. Report No.: Sustainable Fisheries Division contribution No. SFD-01/02-129.

Porch CE, Fitzhugh GR, Linton BC (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL and Panama City, FL). 2013. Modeling the dependence of batch fecundity and spawning frequency on size and age for use in stock assessments of red snapper in U.S. Gulf of Mexico waters. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR31-AW03.

Porch CE, Turner SC (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2004. Reconstructed time series of shrimp trawl effort in the Gulf of Mexico and the associated bycatch of red snapper from 1948 to 1972. North Charleston (SC): SEDAR. 14 p. Report Nos.: SEDAR31-RD41 and Sustainable Fisheries Division Contribution No. SFD-2004-055.

Porch CE, Turner SC, Schirripa MJ (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2004. The commercial landings of red snapper in the Gulf of Mexico from 1872 to 1962. North Charleston (SC): SEDAR. 20 p. Report Nos.: SEDAR31-RD46 and Sustainable Fisheries Division Contribution No. SFD-2004-054.

Powers JE, Brooks EN (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2004. Red snapper compensation in the stock-recruitment function and bycatch mortality. Charleston (SC): SEDAR. 10 p. Report No.: SEDAR7-AW-8.

Powers SP, Drymon JM, Hightower CL, Spearman T, Bosarge GS, et al. 2018. Distribution and age composition of red snapper across the Inner Continental Shelf of the North-Central Gulf of Mexico. Trans Am Fish Soc. 147:791-805.

Powers SP, Grabowski JH, Peterson CH, Lindberg WJ. 2003. Estimating enhancement of fish production by offshore artificial reefs: uncertainty exhibited by divergent scenarios. Mar Ecol Prog Ser. 264:265-277.

Prytherch HF. 1983. A descriptive survey of the bottom longline fishery in the Gulf of Mexico. Miami (FL): National Marines Fisheries Service, Southeast Fisheries Center. Report No.: National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SEFC-122.

Pulley TE. 1952. A zoogeographic study based on the bivalves of the Gulf of Mexico [thesis]. Cambridge (MA): Harvard University.

Quist MC, Pegg MA, DeVries DR. 2012. Age and growth. In: Zale AV, Parrish DL, Sutton TM, editors. Fisheries techniques. 3rd ed. Bethesda (MD): American Fisheries Society. p. 677-731.

Rabalais NN, Cai W-J, Carstensen J, Conley DJ, Fry B, et al. 2014. Eutrophication-driven deoxygenation in the coastal ocean. Oceanography. 27(1):172-183.

Rabalais NN, Wiseman WJ Jr, Turner RE. 1994. Comparison of continuous records of near-bottom dissolved oxygen from the hypoxia zone along the Louisiana coast. Estuaries. 17(4):850-851.

Rabaoui L, Lin Y-J, Qurban MA, Maneja RH, Franco J, et al. 2015. Patchwork of oil and gas facilities in Saudi waters of the Arabian Gulf has the potential to enhance local fisheries production. ICES J Mar Sci. 72(8):2398-2408.

Rademacher KR, Render JH. 2003. Fish assemblages around oil and gas platforms in the northeastern Gulf of Mexico: developing a survey design. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, reefs, and offshore development. American Fisheries Society Symposium 36. Bethesda MD: American Fisheries Society. p. 101-122.

Radford CA, Montgomery JC, Caiger P, Higgs DM. 2012. Pressure and particle motion detection thresholds in fish: a re-examination of salient auditory cues in teleosts. J Exp Biol. 215:3429-3435.

Ramos J, Santos MN, Whitmarsh D, Monteiro CC. 2007. Stakeholder perceptions regarding the environmental and socio-economic impacts of the Algarve artificial reefs. Hydrobiologia. 580:181-191.

Reeves DB. 2015. Oil and gas platforms on Ship Shoal, northern Gulf of Mexico, as habitat for reef-associated organisms [thesis]. Baton Rouge (LA): Louisiana State University.

Reeves DB, Chesney EJ, Munnelly RT, Baltz DM, Maiti K. 2019. Trophic ecology of sheepshead and stone crabs at oil and gas platforms in the northern Gulf of Mexico's hypoxic zone. Trans Am Fish Soc. 148:324-338.

Reeves DB, Chesney EJ, Munnelly RT, Baltz DM, Marx BD. 2017. Abundance and distribution of reef-associated fishes around small oil and gas platforms in the northern Gulf of Mexico’s hypoxic zone. Estuar Coast. 41(7):1835-1847.

Reggio VC Jr, Kasprzak R. 1991. Rigs to reefs: fuel for fisheries enhancement through cooperation. In: Benner CS, Middleton RW, editors. Fisheries and oil development on the continental shelf American Fisheries Society Symposium 11. Bethesda (MD): American Fisheries Society. p. 9-17.

Relini G, Relini M, Torchia G, Palandri G. 2002. Ten years of censuses of fish fauna on the Loano artificial reef. ICES J Mar Sci. 59:S132-S137.

Render JH. 1995. The life history (age, growth, and reproduction) of red snapper (*Lutjanus campechanus*) and its affinity for oil and gas platforms [thesis]. [Baton Rouge (LA)]: Louisiana State University.

Reynolds EM. 2015. Fish biomass and community structure around standing and toppled oil and gas platforms in the northern Gulf of Mexico using hydroacoustic and video surveys [thesis]. Baton Rouge (LA): Louisiana State University.

Reynolds EM, Cowan JH, Jr. 2014. Hydroacoustic and video surveys in the northern Gulf of Mexico in support of Louisiana’s artificial reef planning area: a comparison of biomass and community structure. Proceedings of the 67th Gulf and Caribbean Fisheries Institute, November 3-7, 2014, Christ Church, Barbados. Fort Pierce (FL): GCFI. p. 169-170.

Reynolds EM, Cowan JH, Lewis KA, Simonsen KA. 2018. Method for estimating relative abundance and species composition around oil and gas platforms in the northern Gulf of Mexico, U.S.A. Fish Res. 201:44-55.

Rios A (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2013. Estimating historical recreational angler effort in the Gulf of Mexico for the private, charter, and headboat fishing modes. North Charleston (SC): SEDAR. 9 p. Report No.: SEDAR31-AW11.

Rios A (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2013. Standardized catch rates for greater amberjack from the Gulf of Mexico headboat fishery 1986-2012. North Charleston (SC): SEDAR. 17 p. Report Nos.: SEDAR33-AW19 and Sustainable Fisheries Division Contribution Number: SFD-2013-17.

Rios A (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL). 2013. Standardized catch rates of greater amberjack from the Gulf of Mexico recreational cand private boat fisheries (MRFSS) 1986 to 2012. North Charleston (SC)`: SEDAR. 23 p. Report Nos.: SEDAR33-AW20 and Sustainable Fisheries Division Contribution Number: SFD-2013-16.

Rios A, Matter VM, Walter JF, Farmer N, Turner SC (National Oceanic and Atmospheric Administration Fisheries, Southeast Fisheries Science Center, Miami, FL and Southeast Regional Office, St. Petersburg, FL). 2012. Estimated conversion factors for adjusting MRFSS Gulf of Mexico red snapper catch estimates and variances in 1981-2003 to MRIP estimates and variances. North Charleston (SC)`: SEDAR. 12 p. Report Nos.: SEDAR31-DW25 and Sustainable Fisheries Contribution No SFD-2012-016.

Roberts CE, Szedlmayer ST. 2020. Polycyclic aromatic hydrocarbons in red snapper, *Lutjanus campechanus*, and sediment samples after the Deepwater Horizon oil spill. In: Bortone SA, Szedlmayer ST, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 97-121.

Rodriguez Estrada U, Yasumaru FA, Tacon AGJ, Lemos D. 2015. Cobia (*Rachycentron canadum*): a selected annotated bibliography on aquaculture, general biology and fisheries 1967–2015. Rev Fish Sci Aquacult. 24(1):1-97.

Rogers PH, Zeddies DG. 2009. Multipole mechanisms for directional hearing in fish. In: Webb JF, Popper AN, Fay RR, editors. Fish bioacoustics. New York (NY): Springer-Verlag. p. 233-252.

Rooker JR, Dokken QR, Pattengill CV, Holt GJ. 1997. Fish assemblages on artificial and natural reefs in the Flower Garden Banks National Marine Sanctuary, USA. Coral Reefs. 16:83-92.

Rothbach D. 2007. Rigs-to-reefs: refocusing the debate in California. Duke Environ Law Policy Forum. 17:283-295.

Rountree RA. 1989. Association of fishes with fish aggregation devices: effect of structure size on fish abundance. Bull Mar Sci. 44(2):960-972.

Rountree RA, Gilmore RG, Goudey CA, Hawkins AD, Luczkovich JJ, Mann DA. 2006. Listening to fish: applications of passive acoustics to fisheries science. Fisheries. 31(9):433-446.

Rouse S, Kafas A, Catarino R, Peter H. 2017. Commercial fisheries interactions with oil and gas pipelines in the North Sea: considerations for decommissioning. ICES J Mar Sci. (2017):doi:10.1093/icesjms/fsx1121.

Rudstam LG, Jech JM, Parker-Stetter SL, Horne JK, Sullivan PJ, et al. 2012. Fisheries acoustics. In: Zale AV, Parrish DL, Sutton TM, editors. Fisheries techniques. Third ed. Bethesda (MD): American Fisheries Society. p. 1-40.

Rudstam LG, Parker-Stetter SL, Sullivan PJ, Warner DM. 2009. Towards a standard operating procedure for fishery acoustic surveys in the Laurentian Great Lakes, North America. ICES J Mar Sci. 66(6):1391-1397.

Rummer JL. 2007. Factors affecting catch and release (CAR) mortality in fish: insight into CAR mortality in red snapper and the influence of catastrophic decompression. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 113-132.

S51 Stock ID Working Group. 2017. SEDAR 51 stock ID working paper. North Charleston (SC): SEDAR. 12 p. Report No.: SEDAR51-DW-09.

Saari CR. 2011. Comparison of the age and growth of red snapper (*Lutjanus campechanus*) amongst habitats and regions in the Gulf of Mexico [thesis]. Baton Rouge(LA): Louisiana State University. Report No. SEDAR31-RD39.

Saari CR (National Marine Fisheries Service, Southeast Fisheries Science Center). 2013. Sampling history of the king mackerel commercial fisheries in the southeastern United States by the federal Trip Interview Program (TIP). North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR38-DW-09.

Saari CR, Cowan JH, Jr., Boswell KM. 2014. Regional differences in the age and growth of red snapper (*Lutjanus campechanus*) in the U.S. Gulf of Mexico. Fish Bull. 112(4):261-273.

Sadovy de Mitcheson Y, Craig MT, Bertoncini AA, Carpenter KE, Cheung WWL, et al. 2012. Fishing groupers towards extinction: a global assessment of threats and extinction risks in a billion dollar fishery. Fish Fish. 14(2):119-136.

Sagarese S, Rios A (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2017. Using a censored regression modeling approach to standardize red snapper catch per unit effort using recreational fishery data affected by a bag limit. 27 p. North Charleston (SC): SEDAR. 27 p. Report No.: SEDAR52-WP-13.

Saillant E, Bradfield SC, Gold JR. 2010. Genetic variation and spatial autocorrelation among young-of-the-year red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico. ICES J Mar Sci. 67:1240-1250.

Saillant E, Gold JR. 2006. Population structure and variance effective size of red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico. Fish Bull. 104:136-148.

Saint-Arnaud D, Pelletier P, Poe W, Fowler J. 2004. Oil platform removal using engineered explosive charges: in-situ comparison of engineered and bulk explosive charges - final report. Herndon (VA): US Department of the Interior, Minerals Management Service Technology Assessment and Research Program. Report No.: TAR Project No. 429.

Sakaguchi S, Fukuhara O, Umezawa S, Fujiya M, Ogawa T. 1976. The influence of underwater explosion on fishes. Bull Nansei Reg Fish Res Lab. 9:33-65.

Salz R, Miller T, Williams E, Walter J, Katie D, Bray G. 2012. MRFSS/MRIP Calibration Workshop Ad-hoc Working Group report. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR31-RD48.

Sánchez-Jerez P, Gillanders BM, Ruiz-Rodríguez S, Ramos-Esplá AA. 2002. Effect of an artificial reef in Posidonia meadows on fish assemblage and diet of *Diplodus annularis*. ICES J Mar Sci. 59:S59-S68.

SAS Institute Inc. 2016. SAS online documentation, version SAS 9.4 TS Level 1M5. [accessed 23 Jan 2019]. https://support.sas.com/documentation/94/.

Saul S (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2013. Commercial indices of abundance for greater amberjack in the Gulf of Mexico. North Charleston (SC): SEDAR. 15 p. Report Nos.: SEDAR33-AW18 and Sustainable Fisheries Division Contribution No. SFD-2013-018.

Saul S, Walter J (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2012. Using a censored regression modeling approach to standardize red snapper catch per unit effort using recreational fishery data affected by a bag limit. North Charleston (SC): SEDAR. p. 69 p. Report Nos.: SEDAR31-DW33 and Sustainable Fisheries Division Contribution No. SFD-2012-020.

Saul S, Walter JF, Shipp B, Powers S, Powers M (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL and University of South Alabama, Mobile, AL). 2013. The effect of hook type on red snapper catch. North Charleston (SC): SEDAR. 11 p. Report Nos.: SEDAR31-AW04 and Sustainable Fisheries Division Contribution No. SFD-2013-003.

Saul SE, Ingram GW Jr. 2007. A categorical approach to modeling catch at age for various sectors of the gray triggerfish (*Balistes capriscus*) fishery in the Gulf of Mexico. Proceedings of the 58th Gulf and Caribbean Fisheries Institute. Ft. Pierce (FL): GCFI. p. 199-207.

Saul SE, Walter JF III, Die DJ, Naar DF, Donahue BT. 2013. Modeling the spatial distribution of commercially important reef fishes on the West Florida Shelf. Fish Res. 143:12-20.

Sauls B (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2012. Release mortality estimates for recreational hook-and-line caught red snapper derived from a large-scale tag-recapture study in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 19 p. Report No.: SEDAR31-DW23.

Sauls B (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2012. A summary of data on the size distribution and release condition of red snapper discards from recreational fishery surveys in the Gulf of Mexico. North Charleston (SC): SEDAR. 27 p. Report No.: SEDAR31-DW11.

Sauls B (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2015. Size distribution of vermilion snapper discards observed from for-hire recreational vessels in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 9 p. Report No.: SEDAR45-WP-07.

Sauls B, Ayala O. 2012. Circle hook requirements in the Gulf of Mexico: application in recreational fisheries and effectiveness for conservation of reef fishes. Bull Mar Sci. 88(3):667-679.

Sauls B, Ayala O, Germeroth R, Solomon J, Brody R (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL and Jacksonville, FL). 2017. Red snapper discard mortality in Florida’s recreational fisheries. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR52-WP-09.

Sauls B, Cermak B (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2013. Characterization of greater amberjack discards in recreational for-hire fisheries. North Charleston (SC): SEDAR. 22 p. Report No.: SEDAR33-DW04.

Sawada K, Furusawa M, Williamson NJ. 1993. Conditions for the precise measurement of fish target strength in situ. J Mar Acoust Soc Japan. 20:15-21.

Sayer MDJ, Baine MSP. 2002. Rigs to reefs: a critical evaluation of the potential for reef development using decommissioned rigs. J Soc Underwater Technol. 25(2):93-97.

Scarborough Bull A, Kendal JJ Jr. 1992. Preliminary investigation: platform removal and associated biota. In: Cahoon LB, editor. Diving for science. Costa Mesa (CA): American Academy of Underwater Sciences. p. 31-38.

Scarborough Bull A, Love MS. 2019. Worldwide oil and gas platform decommissioning: a review of practices and reefing options. Ocean Coast Manage. 168:274-306.

Scarborough-Bull A, Kendall JJ Jr. 1994. An indication of the process: offshore platforms as artificial reefs in the Gulf of Mexico. Bull Mar Sci. 55:1086-1098.

Scarborough-Bull A, Love MS, Schroeder DM. 2008. Artificial reefs as fishery conservation tools: contrasting the roles of offshore structures between the Gulf of Mexico and the Southern California Bight. In: Nielsen J, Dodson JJ, Friedland K, Hamon TR, Musick J, et al, editors. Reconciling fisheries with conservation: proceedings of the Fourth World Fisheries Congress .Volume I. American Fisheries Society Symposium 49. Bethesda (MD): American Fisheries Society. p. 899-915.

Scarcella G, Grati F, Fabi G. 2011. Temporal and spatial variation of the fish assemblage around a gas platform in the northern Adriatic Sea, Italy. Turkish J Fish Aquat Sci. 11(3):433-444.

Schirripa MJ, Legault CM. 1999. Status of the red snapper in U.S. waters of the Gulf of Mexico: updated through 1998. Miami (FL): National Marine Fisheries Service, Southeast Fisheries Science Center. 106 p. Report No.: Sustainable Fisheries Division Contribution SFD-99/00-75.

Schirripa MJ, Legault CM. 2000. Status of the vermilion snapper fishery in the Gulf of Mexico: assessment update (version 4.5). Miami (FL): National Marine Fisheries Service, Southeast Fisheries Science Center. 34 p. Report No. Sustainable Fisheries Division Contribution No. SFD-99/00-108.

Schirripa MJ, Methot R, SEDAR 33 IEA Working Group. 2013. Incorporating various Gulf of Mexico integrated ecosystem assessment products into the stock synthesis integrated assessment model framework. North Charleston (SC): SEDAR. 15 p. Report No.: SEDAR33-DW10.

Schobernd ZH, Bacheler NM, Conn PB. 2014. Examining the utility of alternative video monitoring metrics for indexing reef fish abundance. Can J Fish Aquat Sci. 71(3):464-471.

Schrandt MN, Powers SP, Mareska JF. 2015. Habitat use and fishery dynamics of a heavily exploited coastal migrant, Spanish mackerel. N Am J Fish Manage. 35(2):352-363.

Schroeder DM, Love MS. 2004. Ecological and political issues surrounding decommissioning of offshore oil facilities in the Southern California Bight. Ocean Coast Manage. 47:21-48.

Schroeder WW, Schultz AW, Dindo JJ. 1988. Inner-shelf hard bottom areas, northeastern Gulf of Mexico. Gulf Coast Assoc Geol Soc Trans. 38:535-541.

Schroeder WW, Schultz AW, Pilkey OH. 1995. Late Quaternary oyster shells and sea-level history, inner shelf, northeast Gulf of Mexico. J Coast Res. 11(3):664-674.

Schroepfer RL, Szedlmayer ST. 2006. Estimates of residence and site fidelity for red snapper *Lutjanus campechanus* on artificial reefs in the northereastern Gulf of Mexico. Bull Mar Sci. 78(1):93-101.

Schwartzkopf BD. 2014. Assessment of habitat quality for red snapper, *Lutjanus campechanus*, in the northwestern Gulf of Mexico: natural vs. artificial reefs [thesis]. Baton Rouge (LA): Louisiana State University.

Schwartzkopf BD, Langland TA, Cowan JH. 2017. Habitat selection important for red snapper feeding ecology in the northwestern Gulf of Mexico. Mar Coast Fish. 9(1):373-387.

Scott GP (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2004. Estimates of historical red snapper recreational catch levels using US Census data and recreational survey information. 12 p. North Charleston (SC): SEDAR. Report No.: SEDAR31-RD47.

Scott ME, Smith JA, Lowry MB, Taylor MD, Suthers IM. 2015. The influence of an offshore artificial reef on the abundance of fish in the surrounding pelagic environment. Mar Freshwater Res. 66(5):429-437.

Scott-Denton E, Cryer PF, Gocke JP, Harrelson MR, Kinsella DL, et al. 2011. Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data. Mar Fish Rev. 73(2):1-26.

Seaman DE, Powell RA. 1996. An evaluation of the accuracy of kernel density estimators for home range analysis. Ecology. 77(7):2075-2085.

Seaman W Jr. 2002. Unifying trends and opportunities in global artificial reef research, including evaluation. ICES J Mar Sci. 59:S14-S16.

Seaman W Jr, Lindberg WJ, Gilbert CR, Frazer TK. 1989. Fish habitat provided by obsolete petroleum platforms off southern Florida. Bull Mar Sci. 44(2):1014-1022.

SEAMAP Reef Fish Work Group. Proceedings of the Reef Fish Workshop for the Southeast Area Monitoring and Assessment Program (SEAMAP); 1995 November; Grande Terre (LA). Gulf States Marine Fisheries Commission. Ocean Springs (MS): Gulf States Marine Fisheries Commission. 80 p.

Seavy NE, Quader S, Alexander JD, Ralph CJ. 2005. Generalized linear models and point count data: statistical considerations for the design and analysis of monitoring studies. In: Ralph C, Rich TD, editors. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference; 2002 March 20–24; Asilomar, CA. Volume 2. Albany (CA): US Department of Agriculture, Forest Service, Southwest Research Station. Report No.: Gen Tech Rep PSW-GTR-191. p. 744-753.

Seber GAF. 2002. The estimation of animal abundance and related parameters. Caldwell (NJ): Blackburn Press.

SEDAR 38 Indices Working Group. 2014. SEDAR standardized report cards used for review of indices of abundance for Atlantic and Gulf of Mexico king mackerel. North Charleston (SC): SEDAR. 47 p. Report No.: SEDAR38-DW-05.

SEDAR [Southeast Data, Assessment, and Review]. 2003. Complete stock of yellowtail snapper in the Southeastern United States. SEDAR3 assessment report 1. North Charleston (SC): SEDAR. 330 p.

SEDAR. 2005. Stock assessment report of SEDAR 7: Gulf of Mexico red snapper. SEDAR7 assessment report 1. North Charleston (SC): SEDAR. 480 p.

SEDAR. 2006. Stock assessment report of SEDAR 9: Gulf of Mexico greater amberjack stock assessment report. North Charleston (SC): SEDAR. 178 p.

SEDAR. 2008. SEDAR 15A – stock assessment report 3 (SAR 3): South Atlantic and Gulf of Mexico mutton snapper. North Charleston (SC): SEDAR. 410 p.

SEDAR. 2009. SEDAR procedural guidance document 2: addressing time-varying catchability. North Charleston (SC): SEDAR. 32 p. Report No.: SEDAR24-RD48.

SEDAR. 2010. SEDAR 19 – stock assessment report: Gulf of Mexico and South Atlantic black grouper. North Charleston (SC): SEDAR. 661 p.

SEDAR. 2011. SEDAR 9 stock assessment update: Gulf of Mexico greater amberjack. No. SEDAR44-RD02. North Charleston (SC): SEDAR. 190 p.

SEDAR. 2012. Gulf of Mexico red snapper management history.. North Charleston (SC): SEDAR. 14 p. Report No.: SEDAR31-RD09.

SEDAR. 2005. Stock assessment report of SEDAR 7: Gulf of Mexico red snapper. Charleston, SC. North Charleston (SC): SEDAR. 408 p. Report No.: SEDAR 7 assessment report 1.

SEDAR. 2012. Stock assessment of red snapper in the Gulf of Mexico–SEDAR update assessment.[SEDAR red snapper update (2009).] . North Charleston (SC): SEDAR. 224 p.

SEDAR. 2013. SEDAR 28 – Gulf of Mexico cobia stock assessment report. North Charleston (SC): SEDAR. 616 p.

SEDAR. 2013. SEDAR 28 – Gulf of Mexico Spanish mackerel stock assessment report. North Charleston (SC): SEDAR. 444 p.

SEDAR. 2013. SEDAR 31 – Gulf of Mexico red snapper stock assessment report. North Charleston (SC): SEDAR. 1103 p.

SEDAR. 2014. SEDAR 38 – stock assessment report: Gulf of Mexico king mackerel. North Charleston (SC): SEDAR. 465 p.

SEDAR. 2014a. SEDAR 33 – Gulf of Mexico gag stock assessment report. North Charleston (SC): SEDAR. 609 p.

SEDAR. 2014b. SEDAR 33 – Gulf of Mexico greater amberjack stock assessment report. North Charleston (SC): SEDAR. 499 p.

SEDAR. 2015. SEDAR 43 – final stock assessment report: Gulf of Mexico gray triggerfish. North Charleston (SC): SEDAR. 193 p.

SEDAR. 2016. SEDAR 33 stock assessment update report Gulf of Mexico greater amberjack (*Seriola dumerili*). North Charleston (SC): SEDAR. 499 p.

SEDAR. 2016a. SEDAR 45 – stock assessment report: Gulf of Mexico vermilion snapper. North Charleston (SC): SEDAR. 88 p.

SEDAR. 2016b. SEDAR 49 Gulf of Mexico data-limited species: red drum, lane snapper, wenchman, yellowmouth grouper, speckled hind, snowy grouper, almaco jack, lesser amberjack. Section II: data workshop report. North Charleston (SC): SEDAR. 619 p.

SEDAR. 2017. SEDAR 62 Gulf of Mexico gray triggerfish assessment terms of reference, January 2017. North Charleston (SC): SEDAR. 2 p.

SEDAR. 2018. SEDAR 52 – stock assessment report Gulf of Mexico red snapper. North Charleston (SC): SEDAR. 434 p.

SEDAR. 2018. SEDAR 62 Gulf of Mexico gray triggerfish schedule of events, January 2018. Updated: July 2018. North Charleston (SC): SEDAR. 1 p.

SEDAR. 2018. SEDAR - 51 – stock assessment report: Gulf of Mexico gray snapper. North Charleston (SC): SEDAR. 428 p.

SEDAR. 2019. Southeast Data, Assessment, and Review consolidated SEDAR workshop recommendations for research, monitoring, and SEDAR procedures, SEDAR 1 – SEDAR 63. North Charleston (SC): SEDAR. 377 p.

Sedberry GR, Cuellar N. 1993. Planktonic and benthic feeding by the reef-associated vermilion snapper, *Rhomboplites aurorubens* (Teleostei, Lutjanidae). Fish Bull. 91(4):699-709.

Shaw RF, Lindquist DC, Benfield MC, Farooqi T, Plunket JT (Louisiana State University, Baton Rouge, LA). 2001. Offshore petroleum platforms: functional significance for larval fish across longitudinal and latitudinal gradients. New Orleans (LA): US Department of the Interior, Minerals Management Service. 122 p. Contract No.: 14-35-0001-30660-19961. Report No.: OCS Study MMS 2002-077. [accessed 2020 April 22] https://marinecadastre.gov/espis/#/search/study/60

Shepard K, Patterson WF III, Devries DA, Palmer C. 2008. Age and growth and stock mixing in Gulf of Mexico and Atlantic king mackerel (*Scomberomorous cavalla*). Proceedings of the 60th Gulf and Caribbean Fisheries Institute, November 5-9, 2007, Punta Cana, Dominican Republic. Marathon (FL): Gulf and Caribbean Fisheries Institute. p. 391-397.

Shepard KE. 2008. King mackerel population dynamics and stock mixing in the United States Atlantic Ocean and Gulf of Mexico [thesis]. [Pensacola (FL): University of West Florida.

Shepard KE, Patterson WF III, De Vries DA. 2010. Trends in Atlantic contribution to mixed-stock king mackerel landings in South Florida inferred from otolith shape analysis. Mar Coast Fish. 2:195-204.

Shepard KE, Patterson WF III, DeVries DA, Ortiz M. 2010. Contemporary versus historical estimates of king mackerel (*Scomberomorus cavalla*) age and growth in the U.S. Atlantic Ocean and Gulf of Mexico. Bull Mar Sci. 86(3):515-532.

Sheridan P. 2008. Seasonal foods, gonadal maturation, and length-weight relationships for nine fishes commonly captured by shrimp trawl on the northwest Gulf of Mexico continental shelf. Panama City Beach (FL): Southeast Marine Fisheries Science Center. 37 p. Report No.: NOAA Technical Memorandum NMFS-SEFSC-566.

Sherman RL, Gilliam DS, Spieler RE. 2002. Artificial reef design: void space, complexity, and attractants. ICES J Mar Sci. 59:S196-S200.

Shinn EA. 1974. Oil structures as artificial reefs. Proceedings of an International Conference on Artificial Reefs; 20-22 March, 1974; Houston, TX. College Station (TX): Center for Marine Resources. National Sea Grant Program Grant No.: 04-3-158-18. Report No.: TAMU-SG-74-103. p. 91–96.

Shipley JB, Cowan JH Jr. 2010. Artificial reef placement: a red snapper, *Lutjanus campechanus*, ecosystem and fuzzy rule-based model. Fish Manag Ecol. 18(2):154-167.

Shipp RL, Bortone SA. 2009. A perspective of the importance of artificial habitat on the management of red snapper in the Gulf of Mexico. Rev Fish Sci. 17(1):41-47.

Shively JD, Culbertson JC, Peter DD, Embesi JA, Hammerschmidt PC. 2003. The Texas artificial reef program: over 50 years of marine habitat enhancement in the Gulf of Mexico. Austin (TX): Texas Parks and Wildlife Department. 45 p. Report No.: Management Data Series No. 196.

Shyue S-w, Yang K-c. 2002. Investigating terrain changes around artificial reefs by using a multi-beam echosounder. ICES J Mar Sci. 59:S338-S342.

Simmonds J, MacLennan D. 2005. Fisheries acoustics: theory and practice. 2nd edition. Oxford (UK): Blackwell Publishing. 437 p.

Simmons CM. 2008. Gray triggerfish, *Balistes capriscus*, reproductive behavior, early life history, and competitive interactions between red snapper, *Lutjanus campechanus*, in the northern Gulf of Mexico [dissertation]. Auburn (AL): Auburn University.

Simmons CM, Rindone RR, Larkin MF. 2020. Management strategies influencing recreational Red Snapper, *Lutjanus campechanus*, effort in the Gulf of Mexico: why can't we agree? In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 233-248.

Simmons CM, Szedlmayer ST. 2011. Recruitment of age-0 gray triggerfish to benthic structured habitat in the northern Gulf of Mexico. Trans Am Fish Soc. 140:14-20.

Simmons CM, Szedlmayer ST. 2012. Territoriality, reproductive behavior, and parental care in gray triggerfish, *Balistes capriscus*, from the northern Gulf of Mexico. Bull Mar Sci. 88(2):197-209.

Simmons CM, Szedlmayer ST. 2013. Description of reared preflexion gray triggerfish, *Balistes capriscus*, larvae from the northern Gulf of Mexico. Bull Mar Sci. 89(2):643-652.

Simonsen KA. 2013. Reef fish demographics on Louisiana artificial reefs: the effects of reef size on biomass distribution and foraging dynamics [thesis]. Baton Rouge (LA): Louisiana State University.

Simonsen KA, Cowan JH, Jr., Boswell KM. 2014. Habitat differences in the feeding ecology of red snapper (*Lutjanus campechanus*, Poey 1860): a comparison between artificial and natural reefs in the northern Gulf of Mexico. Environ Biol Fish. 98(3):811-824.

Smart TI, Boylan J (South Carolina Department of Natural Resources, Charleston, SC). 2013. King mackerel index of abundance in coastal US South Atlantic waters based on a fishery-independent trawl survey. North Charleston (SC): SEDAR. p. 39. Contract No.: NA11NMF4350043. Report No.: SEDAR38-DW-11 and SEAMAP-SA Technical Report # 2013-xx.

Smith GH, Jr. 2011. Field based non-lethal sex determination and effects of sex ratio on population dynamics of greater amberjack, *Seriola dumerili* [thesis]. Gainesville (FL): University of Florida.

Smith GH, Murie DJ, Parkyn DC (University of Florida, Gainesville, FL). 2013. Non-lethal sex determination of greater amberjack with direct application to sex ratio analysis of the Gulf of Mexico stock. North Charleston (SC): SEDAR. 38 p. Report No.: SEDAR33-DW27.

Smith GH, Murie DJ, Parkyn DC. 2018. Effects of sex-specific fishing mortality on sex ratio and population dynamics of Gulf of Mexico greater amberjack. Fish Res. 208:219-228.

Smith JW. 1995. Life history of cobia, *Rachycentron canadum* (Osteichthyes: Rachycentridae), in North Carolina waters. Brimleyana. 23:1-23.

Smith MS, Rios A (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. 2016. Catch per unit effort indices and effort timeseries for SEDAR 49 data limited species captured in the Gulf of Mexico recreational headboat fishery (1986–2015). North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR49-DW-02.

Smith MW. 2017. Standardized catch-per-unit effort index for Gulf of Mexico gray snapper *Lutjanus griseus* commercial handline fishery (1993 – 2015). North Charleston (SC): SEDAR. 6 p. Report No.: SEDAR51-DW-1.

Smith MW, Goethel D, Rios A, Isley J (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2015. Standardized catch rate indices for Gulf of Mexico gray triggerfish (*Balistes capriscus*) landed during 1981-2013 by the recreational and private boat fisheries. North Charleston (SC): SEDAR. 8 p. Report No.: SEDAR43-WP-07.

Smith MW, Goethel D, Rios A, Isley J (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2015. Standardized catch rate indices for Gulf of Mexico gray triggerfish (*Balistes capriscus*) landed during 1986-2013 by the headboat fishery. North Charleston (SC): SEDAR. 18 p. Report No.: SEDAR43-WP-06. Smith MW, Goethel D, Rios A, Isley J (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2015. Standardized catch rate indices for Gulf of Mexico gray triggerfish (*Balistes capriscus*) landed during 1993-2013 by the commercial handline fishery. North Charleston (SC): SEDAR. 16 p. Report No. SEDAR43-WP-05.

Smith MW, Goethel DR (National Marine Fisheries Service, Miami, FL). 2015. Standardized catch rate indices for Gulf of Mexico vermilion snapper (*Rhomboplites aurorubens*) commercial handline fishery, 1993-2014. North Charleston (SC): SEDAR. 13 p. North Charleston (SC): SEDAR. Report No.: SEDAR45-WP-04.

Smith-Vaniz WF. 1984. Carangidae. In: Fischer W, Bianchi G, editors. FAO species identification sheets for fishery purposes: western Indian Ocean fishing area 51. Volume 1. Rome (IT): Food and Agriculture Organization of the United Nations (FAO). p. 1-8 [accessed 2020 April 22] http://www.fao.org/3/ad468e/ad468e00.htm

Smith-Vaniz WF. 2002. Carangidae (jacks and scads - bumpers, pompanos, leatherjacks, amberjacks, pilotfishes, rudderfishes). In: Carpenter KE, editor. The living marine resources of the western central Atlantic. Volume 3: bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals. Rome (IT): Food and Agriculture Organization of the United Nations (FAO). p. 1426-1468.

Soldal AV, Svellingen I, Jørgensen T, Løkkeborg S. 2002. Rigs-to-reefs in the North Sea: hydroacoustic quantification of fish in the vicinity of a "semi-cold" platform. ICES J Mar Sci. 59:S281-S287.

Solis D, Agar JJ, del Corral J. 2015. The impact of IFQs on the productivity of the US Gulf of Mexico red snapper fishery. North Charleston (SC): SEDAR. 37 p. Report No. SEDAR45-RD-12.

Soloway AG. 2014. Noise from shallow underwater explosions [thesis]. Seattle (WA): University of Washington.

Soloway AG, Dahl PH. 2014. Peak sound pressure and sound exposure level from underwater explosions in shallow water. J Acoust Soc Am. 136(3):EL218-EL223.

Sommer B, Fowler AM, Macreadie PI, Palandro DA, Aziz AC, et al. 2019. Decommissioning of offshore oil and gas structures - environmental opportunities and challenges. Sci Total Environ. 658:973-981.

Song J, Mann DA, Cott PA, Hanna BW, Popper AN. 2008. The inner ears of northern Canadian freshwater fishes following exposure to seismic air gun sounds. J Acoust Soc Am. 124(2):1360-1366.

Sonnier F, Teerling J, Hoese HD. 1976. Observations on the offshore reef and platform fish fauna of Louisiana. Copeia. 1976(1):105-111.

Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, et al. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquat Mamm. 33(4):411-521.

Stanley D. 1994. Seasonal and spatial abundance and size distribution of fishes associated with a petroleum platform in the northern Gulf of Mexico [dissertation]. Baton Rouge (LA): Louisiana State University.

Stanley DR, Wilson CA. 1990. A fishery-dependent based study of fish species composition and associated catch rates around oil and gas structures off Louisiana. Fish Bull. 88:719-730.

Stanley DR, Wilson CA. 1991. Factors affecting the abundance of selected fishes near oil and gas platforms in the northern Gulf of Mexico. Fish Bull. 89:149-159.

Stanley DR, Wilson CA. 1995. Effect of scuba divers on fish density and target strength estimates from stationary dual-beam hydroacoustics. Trans Am Fish Soc. 124:946-949.

Stanley DR, Wilson CA. 1996. Abundance of fishes associated with a petroleum platform as measured with dual-beam hydroacoustics. ICES J Mar Sci. 53:473-475.

Stanley DR, Wilson CA. 1997. Seasonal and spatial variation in the abundance and size distribution of fishes associated with a petroleum platform in the northern Gulf of Mexico. Can J Fish Aquat Sci. 54:1166-1176.

Stanley DR, Wilson CA (Louisiana State University, Baton Rouge, LA). 2000a. Seasonal and spatial variation in the biomass and size frequency distribution of the fish associated with oil and gas platforms in the northern Gulf of Mexico. New Orleans (LA): Department of the Interior, Minerals Management Service. 276 p. Contract No.: 14-35-30660-19915. Report No.: OCS Study MMS 2000-005. [accessed 2020 April 21] https://marinecadastre.gov/espis/#/search/study/13]

Stanley DR, Wilson CA. 2000b. Variation in the density and species composition of fishes associated with three petroleum platforms using dual beam hydroacoustics. Fish Res. 47:161-172.

Stanley DR, Wilson CA. 2003. Seasonal and spatial variation in the biomass and size frequency distribution of fish associated with oil and gas platforms in the northern Gulf of Mexico. In: Stanley DR, Scarborough-Bull A, editors. Fisheries, Reefs, and Offshore Development American Fisheries Society Symposium 36. Bethesda (MD): American Fisheries Society. p. 123-153.

Stanley DR, Wilson CA. 2004. Effect of hypoxia on the distribution of fishes associated with a petroleum platform off coastal Louisiana. N Am J Fish Manage. 24(2):662-671.

Starck WA II, Schroeder RE. 1971. Investigations on the gray snapper, *Lutjanus griseus*. Studies in Tropical Oceanography No. 10. Robins CR, Leigh WH, de Sylva DP, editors. Coral Gables(FL): University of Miami Press. 227 p.

Steimle F, Foster K, Kropp R, Conlin B. 2002. Benthic macrofauna productivity enhancement by an artificial reef in Delaware Bay, USA. ICES J Mar Sci. 59:S100-S105.

Stephan CD, Dansby BG, Osburn HR, Matlock GC, Riechers RK, et al. 1990. Texas artificial reef fishery management plan. Austin (TX): Texas Parks and Wildlife Department. 26 p. Fisheries Management Plan Series Number 3.

Stephen JA (National Marine Fisheries Service, St. Petersburg, FL). 2012. Brief overview on Gulf of Mexico red snapper IFQ program. North Charleston (SC): SEDAR. 4 p. Report No.: SEDAR31-DW02.

Stephens J, Jr., Pondella D, II. 2002. Larval productivity of a mature artificial reef: the ichthyoplankton of King Harbor, California, 1974-1997. ICES J Mar Sci. 59:S51-S58.

Stierhoff K, Cutter G, Murfin D, Demer D. 2012. An overview of visual survey research and imaging technology development at the Southwest Fisheries Science Center. In: Williams K, Rooper C, Harms J, editors. Report of the National Marine Fisheries Service Automated Image Processing Workshop; September 4-7, 2010; Seattle, WA. Seattle (WA): National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO0121. p. 13-17.

Stone Jackson L, Drymon JM, Nelson TR, Powers SP. 2018. Biotelemetry based estimates of greater amberjack (*Seriola dumerili*) post-release mortality in the northern Gulf of Mexico. Fish Res. 208:239-246.

Stoner AW, Ryer CH, Parker SJ, Auster PJ, Wakefield WW. 2008. Evaluating the role of fish behavior in surveys conducted with underwater vehicles. Can J Fish Aquat Sci. 65:1230-1243.

Streever B, Raborn SW, Kim KH, Hawkins AD, Popper AN. 2016. Changes in fish catch rates in the presence of air gun sounds in Prudhoe Bay, Alaska. Arctic. 69(4):346-358.

Streich MK, Ajemian MJ, Wetz JJ, Shively JD, Shipley JB, et al. 2017. Effects of a new artificial reef complex on red snapper and the associated fish community: an evaluation using a before–after control–impact approach. Mar Coast Fish. 9(1):404-418.

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2017b. A comparison of fish community structure at mesophotic artificial reefs and natural banks in the western Gulf of Mexico. Mar Coast Fish. 9(1):170-189.

Streich MK, Ajemian MJ, Wetz JJ, Stunz GW. 2018. Habitat-specific performance of vertical line gear in the western Gulf of Mexico: a comparison between artificial and natural habitats using a paired video approach. Fish Res. 204:16-25.

Streich MK, Ajemian MJ, Wetz JJ, Williams JA, Shipley JB, et al. 2017. A comparison of size structure, age, and growth of red snapper from artificial and natural habitats in the western Gulf of Mexico. Trans Am Fish Soc. 146(4):762-777.

Strelcheck AJ, Cowan JH Jr, Patterson WF III. 2007. Site fidelity, movement, and growth of red snapper: implications for artificial reef management. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 135-148.

Strelcheck AJ, Cowan JH, Jr., Shah A. 2005. Influence of reef location on artificial-reef fish assemblages in the northcentral Gulf of Mexico. Bull Mar Sci. 77(3):425-440.

Stroup WW. 2013. Generalized mixed models: modern concepts, methods, and applications. Boca Raton (FL): CRC Press.

Stunz GW, Ajemian MJ, Streich MK, Brewton R, Downey C, Hall Q (Texas A&M University–Corpus Christi, Corpus Christi, TX). 2016. Investigation of the relative habitat value of oil/gas platforms and natural banks in enhancing stock building of reef fish in the western Gulf of Mexico. St. Petersburg (FL): National Marine Fisheries Service, Southeast Regional Office. 108 p. Grant No.: NA14NMF4330219. Report No.: SEDAR-RD-02.

Stunz GW, Curtis J (Texas A&M University–Corpus Christi, Corpus Christi, TX). 2012. Examining delayed mortality in barotrauma afflicted red snapper using acoustic telemetry and hyperbaric experimentation. North Charleston (SC): SEDAR. 13 p. Report No.: SEDAR31-DW21.

Swisdak MM Jr, editor. 1978. Explosion effects and properties: part II–explosion effects in water. Dahlgren (VA): Naval Surface Weapons Center. 112 p. Contract No.: F33354. Report No.: NSWC/WOL TR 76-116.

Switzer TS, Chesney EJ, Baltz DM. 2015. Habitat use by juvenile red snapper in the northern Gulf of Mexico: ontogeny, seasonality, and the effects of hypoxia. Trans Am Fish Soc. 144(2):300-314.

Switzer TS, Keenan SF, McMichael RH Jr. 2012. Fisheries-independent data for red snapper from reef-fish surveys on the West Florida Shelf, 2008-2011. North Charleston (SC): SEDAR. 11. Report No.: SEDAR31-DW24.

Switzer TS, Keenan SF, McMichael RH Jr, Ingram W. 2013. Fisheries-independent data for gag and greater amberjack from reef-fish video surveys on the West Florida Shelf, 2008-2012. North Charleston (SC): SEDAR. 19 p. Report No.: SEDAR33-AW01.

Syc, Szedlmayer. 2012. A comparison of the size and age of red snapper, *Lutjanus campechanus*, to the age of artificial reefs in the northern Gulf of Mexico. North Charleston (SC): SEDAR. 31 p. Report No.: SEDAR31-DW12.

Syc TS, Szedlmayer ST. 2012. A comparison of size and age of red snapper (*Lutjanus campechanus*) with the age of artificial reefs in the northern Gulf of Mexico. Fish Bull. 110:458-469.

Szedlmayer ST. 1997. Ultrasonic telemetry of red snapper, *Lutjanus campechanus*, at artificial reef sites in the northeast Gulf of Mexico. Copeia. (4):846-850.

Szedlmayer ST. 2007. An evaluation of the benefits of artificial habitats for red snapper, *Lutjanus campechanus*, in the northeast Gulf of Mexico. Proceedings of the 59th Gulf and Caribbean Fisheries Institute. Fort Pierce (FL): GCFI. p. 205-211.

Szedlmayer ST. 2011. The artificial habitat as an accessory for improving estimates of juvenile reef fish abundance in fishery management. In: Bortone SA, Pereira Brandini F, Fabi G, Otake S, editors. Artificial reefs in fisheries management. Boca Raton (FL): CRC Press. p. 31-44.

Szedlmayer ST, Beyer SG. 2011. Validation of annual periodicity in otoliths of red snapper, *Lutjanus campechanus*. Environ Biol Fish. 91:219-230.

Szedlmayer ST, Brewton RA. 2020. Diet analyses of red snapper, *Lutjanus campechanus*, based on DNA barcoding from artificial reefs in the northern Gulf of Mexico. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 143-165.

Szedlmayer ST, Fedewa EJ, Paris ML. 2020. Timing of opaque band formation and validation of annular increments in otoliths of red snapper, *Lutjanus campechanus*. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 167-183.

Szedlmayer ST, Grundy DJ. 2020. A comparison of age determination between whole and sectioned otoliths in red snapper, *Lutjanus campechanus*. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 185-198.

Szedlmayer ST, Lee JD. 2004. Diet shifts of juvenile red snapper (*Lutjanus campechanus*) with changes in habitat and fish size. Fish Bull. 102:366-375.

Szedlmayer ST, Mudrak PA. 2014. Influence of age-1 conspecifics, sediment type, dissolved oxygen, and the Deepwater Horizon oil spill on recruitment of age-0 red snapper in the northeast Gulf of Mexico during 2010 and 2011. N Am J Fish Manage. 34:443-452.

Szedlmayer ST, Mudrak PA, Jaxion-Harm J. 2020. A comparison of two fishery-independent surveys of Red Snapper, *Lutjanus campechanus*, from 1999–2004 and 2011–2015. In: Bortone SA, Szedlmayer ST, editors. Red Snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 249-274.

Szedlmayer ST, Schroepfer RL. 2005. Long-term residence of red snapper on artificial reefs in the northeastern Gulf of Mexico. Trans Am Fish Soc. 134:315-325.

Szedlmayer ST, Shipp RL. 1994. Movement and growth of red snapper, *Lutjanus campechanus*, from an artificial reef area in the northeastern Gulf of Mexico. Bull Mar Sci. 55(2-3):887-896.

Tarnecki JH, Patterson WF, III. 2015. Changes in red snapper diet and trophic ecology following the Deepwater Horizon oil spill. Mar Coast Fish. 7(1):135-147.

Teleki GC, Chamberlain AJ. 1978. Acute effects of underwater construction blasting on fishes in Long Point Bay Lake Erie. J Fish Res Bd Can. 35:1191-1198.

Thomas GL, Thorne RE. 2003. Acoustical-optical assessment of Pacific herring and their predator assemblage in Prince William Sound, Alaska. Aquat Liv Res. 16:247-253.

Thompson BA, Wilson CA, Render JH, Beasley M, Cauthron C (Coastal Fisheries Institute, Louisiana State University, Baton Rouge, LA). 1992. Age, growth, and reproductive biology of greater amberjack and cobia from Louisiana waters. Washington (DC): National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 80 p. Cooperative Agreement No.: NA90AA-H-MF722 (MARFIN). Report No.: SEDAR28-RD26.

Thompson KA, Switzer TS, Christman MC, Keenan SF, Gardner C, et al. 2017. Indices of abundance for red snapper (*Lutjanus campechanus*) using combined data from three independent video surveys. North Charleston (SC): SEDAR. 19 p. Report No.: SEDAR52-WP-01.

Thompson KA, Switzer TS, Christman MC, Keenan SF, Gardner C, et al. 2017. Indices of abundance for gray snapper (*Lutjanus griseus*) using combined data from three independent video surveys. North Charleston (SC): SEDAR. 20 p. Report No.: SEDAR51-DW-15.

Thompson KA, Switzer TS, Keenan SF (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2015. Indices of abundance for gray triggerfish (*Balistes capriscus*) from the Florida Fish and Wildlife Research Institute (FWRI) video survey on the West Florida Shelf. North Charleston (SC): SEDAR. 21 p. Report No.: SEDAR43-WP-08.

Thompson KA, Switzer TS, Keenan SF (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2017. Indices of abundance for gray snapper (*Lutjanus griseus*) from the Florida Fish and Wildlife Research Institute (FWRI) video survey on the West Florida Shelf. North Charleston (SC): SEDAR. 22 p. Report No.: SEDAR51-DP-10.

Thompson KA, Switzer TS, Keenan SF (Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL). 2017. Indices of abundance for red snapper (*Lutjanus campechanus*) from the NFWF-expanded Florida Fish and Wildlife Research Institute (FWRI) video survey in the eastern Gulf of Mexico. North Charleston (SC): SEDAR. 16 p. Report No.: SEDAR52-WP-04.

Thompson KA, Switzer TS, Keenan SF, McDermott JP. 2017. Indices of abundance for red snapper (*Lutjanus campechanus*) from the Florida Fish and Wildlife Research Institute (FWRI) video survey on the west Florida shelf. North Charleston (SC): SEDAR. 24 p. Report No.: SEDAR52-WP02.

Thompson NB. 1995. An assessment of cobia in southeast U.S. waters. Miami (FL): National Mrine Fisheries Service, Southeast Fisheries Science Center. Report No.: MIA-94/95-31.

Thornton L, Palmer C, Lombardi L, Allman R. 2015. Utilizing paired readings and an otolith reference collection to determine ageing precision of vermilion snapper, (*Rhomboplites aurorubens*). North Charleston (SC): SEDAR. 11 p. Report No.: SEDAR51-DW08.

Thornton LA, Lombardi LA, Allman RJ (National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City, FL). 2017. Description of age data and estimated growth of gray snapper from the northern Gulf of Mexico: 1982-1983 and 1990-2015. North Charleston (SC): SEDAR. 29 p. Report No.: SEDAR51-DW-08.

Tolan JM. 2001. Patterns of reef fish larval supply to petroleum platforms in the northern Gulf of Mexico [dissertation]. Baton Rouge (LA): Louisiana State University.

Tolan JM, Fisher M. 2009. Biological response to changes in climate patterns: population increases of gray snapper (*Lutjanus griseus*) in Texas bays and estuaries. Fish Bull. 107(36-44):36.

Topping DT, Szedlmayer ST. 2011. Home range and movement patterns of red snapper (*Lutjanus campechanus*) on artificial reefs. Fish Res. 112:77-84.

Topping DT, Szedlmayer ST. 2011. Site fidelity, residence time and movements of red snapper *Lutjanus campechanus* estimated with long-term acoustic monitoring. Mar Ecol Prog Ser. 437:183-200.

Topping DT, Szedlmayer ST (Auburn University, Fairhope, AL). 2012. Use of ultrasonic telemetry to estimate natural and fishing mortality of red snapper. North Charleston (SC): SEDAR. 43 p. Report No.: SEDAR31-DW13.

Topping DT, Szedlmayer ST. 2013. Use of ultrasonic telemetry to estimate natural and fishing mortality of red snapper. Trans Am Fish Soc. 142(4):1090-1100.

Trenkel VM, Lorance P, Mahévas S. 2004. Do visual transects provide true population density estimates for deepwater fish? ICES J Mar Sci. 61:1050-1056.

Trenkel VM, Ressler PH, Jech M, Giannoulaki M, Taylor C. 2011. Underwater acoustics for ecosystem-based management: state of the science and proposals for ecosystem indicators. Mar Ecol Prog Ser. 442:285-301.

Truchon SP, Brzuzy LP, Fawcett D, Fonseca M. 2015. Innovative assessments for selecting offshore-platform-decommissioning alternatives. Oil Gas Facil. 4(5):47-55.

Tupper M, Hunte W. 1998. Predictability of fish assemblages on artificial and natural reefs in Barbados. Bull Mar Sci. 62(3):919-935.

Turner SC, Cummings NJ, Porch CE. 2000. Stock assessments of Gulf of Mexico greater amberjack using data through 1998. Miami (FL): National Marine Fisheries Service, Southeast Fisheries Science Center. 27 p. Report No.: SFD 99/00-100.

Turpin RK, Bortone SA. 2002. Pre- and post-hurricane assessment of artificial reefs: evidence for potential use as refugia in a fishery management strategy. ICES J Mar Sci. 59:S74-S82.

Tusting RF, Davis DL. 1992. Laser systems and structured illumination for quantitative undersea imaging. Mar Tech Soc J. 26(4):5-12.

Tzeng MW, Hare JA, Lindquist DG. 2003. Ingress of transformation stage gray snapper, *Lutjanus griseus* (Pisces: Lutjanidae) through Beaufort Inlet, North Carolina. Bull Mar Sci. 72(3):891-908.

US Department of the Interior, Minerals Management Service. 2005. Structure-removal operations on the Gulf of Mexico Outer Continental Shelf—programmatic environmental assessment. New Orleans (LA): US Department of the Interior, Minerals Management Service. 333 p. Report No.: OCS EIS/EA MMS 2005-013.

US Department of the Navy. 2001. Final environmental impact assessment: shock trial of the Winston S. Churchill (DDG 81). Washington (DC): Department of the Navy.

Uchupi E. 1967. Bathymetry of the Gulf of Mexico. Gulf Coast Assoc Geol Soc Trans. 17:161-172.

Valle M, Legault CM, Ortiz M. 2001. A stock assessment for gray triggerfish, *Balistes capriscus*, in the Gulf of Mexico. North Charleston (SC): SEDAR. Report No.: SFD-00/01-124.

VanderKooy S, editor. 2009. A practical handbook for determining the ages of Gulf of Mexico fishes. 2nd edition. Ocean Springs (MS): Gulf States Marine Commission. 157 p. Award No.: NA05NMF4070005. Report No.: GSMFC Publication No. 167.

Vaught Shaffer R, Nakamura EL. 1989. Synopsis of biological data on the cobia *Rachycentron canadum* (Pisces: Rachycentridae). Washington (DC): National Oceanic and Atmospheric Administration, and National Marine Fisheries Service. 30 p. Report No.: No. NOAA Technical Report NMFS 82 and FAO Fisheries Synopsis 153.

Venables WN, Dichmont CM. 2004. GLMs, GAMs and GLMMs: an overview of theory for applications in fisheries research. Fish Res. 70:319-337.

Venables WN, Ripley BD. 2002. Modern applied statistics with S. New York (NY): Springer-Verlag.

Venables WN, Ripley BD. 2002. Random and mixed effects. Modern applied statistics with S Statistics and computing. New York (NY): Springer Science. p. 271-300.

Versar, Inc. (Columbia, MD). 2008. Literature search and data synthesis of biological information for use in management decisions concerning decommissioning of offshore oil and gas structures in the Gulf of Mexico. North Charleston (SC): SEDAR. 129 p. Contract No. 1435-01-05-39082. Report No. SEDAR31-RD43.

Versar, Inc. (Columbia, MD). 2009. Review and synthesis of biological information for use in management decisions concerning decommissioning offshore oil and gas structures in the Gulf of Mexico. DRAFT Final Report. New Orleans (LA): US Department of the Interior, Minerals Management Service. Contract No. 1435-01-05-39082. Report No. OCS Study MMS 2009-_____.

Vincent MT (Virginia Polytechnic and State University, Blacksburg, VA). 2013. Accounting for changes in fishing mortality when comparing density-dependent to density-independent mortality in Gulf of Mexico red snapper. North Charleston (SC): SEDAR. Report No.: SEDAR31-AW02. 5 p.

Vincent MT. 2014. Comment: accounting for fishing mortality when comparing density-dependent with density-independent mortality in Gulf of Mexico red snapper. N Am J Fish Manage. 34(2):349-351.

Walker BK, Henderson B, Spieler RE. 2002. Fish assemblages associated with artificial reefs of concrete aggregates or quarry stone offshore Miami Beach, Florida, USA. Aquat Liv Res. 15:95-105.

Walsh HJ, Richardson DE, Marancik KE, Hare JA (National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI). 2014. King mackerel and Spanish mackerel larval data on the northeast U.S. Shelf. North Charleston (SC): SEDAR. Report No.: SEDAR38-RW-05. 8 p.

Walter J. 2014. Addendum to "SEDAR 38-10": New South Atlantic logbook index based upon revised mixing zone definition and new indices for the Gulf and South Atlantic using only trolling gear. North Charleston (SC): SEDAR. Report No.: SEDAR38-AW-02. 35 p.

Walter J, Drymon M, Gardner C, Hightower C, Patterson W, et al. 2017. A multinomial predictive model to incorporate visual surveys of red snapper lengths. North Charleston (SC): SEDAR. Report No.: SEDAR52-WP-22. 21 p.

Walter J, Drymon M, Patterson W, Powers S, Williams J. 2013. A proposed methodology to incorporate ROV length data into red snapper stock assessments. North Charleston (SC): SEDAR. Report No. SEDAR31-AW-08. 14 p.

Walter J, Isley J. 2014. South Atlantic shrimp fishery bycatch of king mackerel. North Charleston (SC): SEDAR. Report No. SEDAR38-RW-01. 18 p.

Walter J, McCarthy K (National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL). 2014. Standardized catch rates of from commercial logbook data for king mackerel from the United States Gulf of Mexico, South Atlantic, and Mixing Zone, 1993-2013. North Charleston (SC): SEDAR. Report No.: SEDAR38-DW-10. 47 p.

Walter JF, McInerny S. 2013. Standardized catch rates of Atlantic king mackerel (*Scomberomorus cavalla*) from the North Carolina Commercial fisheries trip tickets 1994-2013. North Charleston, (SC): SEDAR. Report No.: SEDAR38-DW-06. 18 p.

Ward CH, Bender ME, Reish DJ. 1980. The offshore ecology investigation: effects of oil drilling and production in a coastal environment. Rice University Studies Vol. 65, Nos. 4 & 5. In: Drew KF, editor. Rice University Studies. Houston (TX): William Marsh Rice University.

Ward PD. 2015. Assessing the impact of explosive blast on marine life. Soundings. 64:27-29.

Watterson JC, Patterson WF III, Shipp RL, Cowan JH Jr. 1998. Movement of red snapper, *Lutjanus campechanus*, in the north central Gulf of Mexico: Potential effects of hurricanes. Gulf Mex Sci. 1998(1):92-104.

Wells RJD. 2007. The effects of trawling and habitat use on red snapper and the associated community [dissertation]. Baton Rouge (LA): Louisiana State University.

Wells RJD, Boswell KM, Cowan JH Jr, Patterson WF III. 2008. Size selectivity of sampling gears targeting red snapper in the northern Gulf of Mexico. Fish Res. 89:294-299.

Wells RJD, Cowan JH Jr, Fry B. 2008. Feeding ecology of red snapper *Lutjanus campechanus* in the northern Gulf of Mexico. Mar Ecol Prog Ser. 361:213-225.

Wells RJD, Cowan JH Jr, Patterson WF III. 2008. Habitat use and the effect of shrimp trawling on fish and invertebrate communities over the northern Gulf of Mexico continental shelf. ICES J Mar Sci. 65:1610-1619.

Wells RJD, Cowan JH Jr, Patterson WF III, Walters CJ. 2008. Effect of trawling on juvenile red snapper (*Lutjanus campechanus*) habitat selection and life history parameters. Can J Fish Aquat Sci. 65:2399-2411.

Wells RJD, Rooker JR. 2004a. Distribution, age, and growth of young-of-the-year greater amberjack (*Seriola dumerili*) associated with pelagic *Sargassum*. Fish Bull. 102:545-554.

Wells RJD, Rooker JR. 2004b. Spatial and temporal patterns of habitat use by fishes associated with *Sargassum* mats in the northwestern Gulf of Mexico. Bull Mar Sci. 74(1):81-99.

Westmeyer MP, Wilson CA III, Nieland DL. 2007. Fidelity of red snapper to petroleum platforms in the northern Gulf of Mexico. In: Patterson WF III, Cowan JH Jr, Fitzhugh GR, Nieland DL, editors. Red snapper ecology and fisheries in the US Gulf of Mexico. American Fisheries Society Symposium 60. Bethesda (MD): American Fisheries Society. p. 105-121.

White GC. 2014. Introduction to program MARK. [accessed 22 Nov 2019]. http://sites.warnercnr.colostate.edu/gwhite/introduction-program-mark/.

Wiggers RK (South Carolina Department of Natural Resources). 2010. South Carolina marine game fish tagging program 1978–2009. North Charleston (SC): SEDAR. 62 p. Report No.: SEDAR28-RD21.

Wilding TA, Sayer MDJ. 2002. Evaluating artificial reef performance: approaches to pre- and post-deployment research. ICES J Mar Sci. 59:S222-S230.

Wiley ML, Gaspin JB, Goertner JF. 1981. Effects of underwater explosions on fish with a dynamical model to predict fishkill. Ocean Sci Eng. 6:223-284.

Williams EH. 2001. Assessment of cobia, *Rachycentron canadum*, in the waters of the U.S. Gulf of Mexico. Beaufort (NC): National Oceanic and Atmospheric Administration, Center for Coastal Fisheries and Habitat Research. 61 p. Report No.: NOAA Technical Memorandum NMFS-SEFSC-469.

Williams LJ, Herbig JL, Szedlmayer ST. 2015. A cage release method to improve fish tagging studies. Fish Res. 172:125-129.

Williams-Grove LJ. 2015. Red snapper, *Lutjanus campechanus*, mortality, movements, and habitat use based on advanced telemetry methods [dissertation]. Auburn (AL): Auburn University.

Williams-Grove LJ, Szedlmayer ST. 2016. Acoustic positioning and movement patterns of red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico. Mar Ecol Prog Ser. 553:233-251.

Williams-Grove LJ, Szedlmayer ST. 2016. Mortality estimates for red snapper based on ultrasonic telemetry in the northern Gulf of Mexico. N Am J Fish Manage. 36:1036-1044.

Williams-Grove LJ, Szedlmayer ST. 2017. Depth preferences and three-dimensional movements of red snapper, *Lutjanus campechanus*, on an artificial reef in the northern Gulf of Mexico. Fish Res. 190:61-70.

Williams-Grove LJ, Szedlmayer ST. 2020. A review of Red Snapper, *Lutjanus campechanus*, acoustic telemetry studies. In: Bortone SA, Szedlmayer ST, editors. Red snapper biology in a changing world. Boca Raton (FL): CRC Press. p. 49-74.

Wilson CA, Miller MW, Allen YC, Boswell KM, Nieland DL. 2006. Effects of depth, location, and habitat type on relative abundance and species composition of fishes associated with petroleum platforms and Sonnier Bank in the northern Gulf of Mexico. New Orleans (LA): US Department of the Interior, Minerals Management Service. 97 p. Contract No.: 1435-0001-30660-19947. Report No.: OCS Study MMS 2006-037. [accessed 20 April 2020] https://marinecadastre.gov/espis/#/search/study/48

Wilson CA, Nieland DL. 2001. Age and growth of red snapper, *Lutjanus campechanus*, from the northern Gulf of Mexico off Louisiana. Fish Bull. 99:653-664.

Wilson CA, Nieland DL. 2004. The role of oil and gas platforms in providing habitat for northern Gulf of Mexico red snapper, *Lutjanus campechanus*. Proceedings of the 55th Annual Meeting of the Gulf and Caribbean Fisheries Institute; Quintana Roo, Mexico; 11–16 November 2002 Fort Pierce (FL): Gulf and Caribbean Fisheries Institute. p. 757–764.

Wilson CA, Pierce A, Miller MW (Louisiana State University, Baton Rouge, LA). 2003. Rigs and reefs: a comparison of the fish communities at two artificial reefs, a production platform, and a natural reef in the northern Gulf of Mexico. New Orleans (LA): US Department of the Interior, Minerals Management Service. 105 p. Contract No.: 14-35-0001-30660-119960. Report No.: OCS Study MMS 2003-009. [accessed 20 April 2020] https://marinecadastre.gov/espis/#/search/study/59

Wilson CA, Stanley DR. 1989. Utilization of offshore platforms by recreational fishermen and SCUBA divers off the Louisiana coast. Bull Mar Sci. 44(2):767-775.

Wilson CA, Van Sickle VR (Louisiana State University, Baton Rouge, LA). 1987. Louisiana artificial reef plan. Louisiana Department of Wildlife and Fisheries Technical Bulletin No. 41. Baton Rouge (LA): Louisiana Sea Grant College Program. 166 p.

Wilson J, Osenberg CW, St. Mary CM, Watson CA, Lindberg WJ. 2001. Artificial reefs, the attraction-production issue, and density dependence in marine ornamental fishes. Aquarium Sci Conserv. 3:95-105.

Wilson KDP, Leung AWY, Kennish R. 2002. Restoration of Hong Kong fisheries through deployment of artificial reefs in marine protected areas. ICES J Mar Sci. 59:S157-S163.

Worcester T. 2006. Effects of seismic energy on fish: a literature review; Effets de l'energie sismique sur les poissons–examen de la litterature. Ottawa (CA): Canadian Science Advisory Secretariat. 70 p.

Workman I, Shah A, Foster D, Hataway B. 2002. Habitat preferences and site fidelity of juvenile red snapper (*Lutjanus campechanus*). ICES J Mar Sci. 59:S43-S50.

Workman IK, Foster DG. 1994. Occurrence and behavior of juvenile red snapper, *Lutjanus campechanus,* on commercial shrimp fishing grounds in the northeastern Gulf of Mexico. Mar Fish Rev. 56(2):9-11.

Worton BJ. 1989. Kernel methods for estimating the utilization distribution in home-range studies. Ecology. 70(1):164-168.

Wuenschel MJ, Hare JA, Kimball ME, Able KW. 2012. Evaluating juvenile thermal tolerance as a constraint on adult range of gray snapper (*Lutjanus griseus*): a combined laboratory, field and modeling approach. J Exp Mar Biol Ecol. 436-437:19-27.

Yelverton JT, Richmond DR, Fletcher ER (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1973. Safe distances from underwater explosions for mammals and birds. Washington (DC): Defense Nuclear Agency. 67 p. Contract Nos.: DASA 01-70C-0075 and DASA 01-71C-0013. Report No. DNA 3114T.

Yelverton JT, Richmond DR, Hicks W, Saunders K, Fletcher ER (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1975. The relationship between fish size and their response to underwater blast. Washington (DC): Defense Nuclear Agency.42 p. Contract No. DNA 001-74-C-0120. Report No.: DNA 3677T.

Young GA. 1991. Concise methods for predicting the effects of underwater explosions on marine life. Dahlgren (VA): Naval Surface Warfare Center . 19 p. Report No.: NAVSWC MP 91-220.

Yule DL, Adams JV, Hrabik TR, Vinson MR, Woiak Z, Ahrenstorff TD. 2013. Use of classification trees to apportion single echo detections to species: application to the pelagic fish community of Lake Superior. Fish Res. 140:123-132.

Yurista PM, Yule DL, Balge M, VanAlstine JD, Thompson JA, et al. 2014. A new look at the Lake Superior biomass size spectrum. Can J Fish Aquat Sci. 71:1324-1333.

Zapp Sluis M, Cowan JH Jr (Louisiana State University, Baton Rouge, LA). 2013. Platform recruited reef fish, phase II: do platforms provide habitat that increases the survival of reef fishes? New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. 50 p. Contract No.: M08AX12679. Report No.: OCS Study BOEM 2013-0120. [accessed 20 April 2020] https://marinecadastre.gov/espis/#/search/study/23147

Zhang H, Ludsin SA, Mason DM, Adamack AT, Brandt S, et al. 2009. Hypoxia-driven changes in the behavior and spatial distribution of pelagic fish and mesozooplankton in the northern Gulf of Mexico. J Exp Mar Biol Ecol. 381:S80-S91.

Appendix 2. Data Tables

Appendix Table 2.1 Model estimates of the abundance of fish at the "average platform" in the four depth zones defined in this study

Provides detail for Table 5.

		Depth zone (m)											
Common Name	**Scientific Name**	**10 - 17**			**18 - 30**			**31 - 90**			**91 - 300**		
Almaco Jack	*Seriola rivoliana*	5	(1-25)		16	(8-32)	*	129	(90-183)	*	111	(-)	*
Angelfish sp.	*Pomacanthidae* sp.	0.4	(0-5)		2	(1-6)	*	47	(18-122)	*	0.7	(0-3)	
Atlantic Bumper	*Chloroscombrus chrysurus*	4,362	(1105-17216)	*	6,227	(3507-11054)	*	841	(585-1210)	*	324	(171-612)	
Atlantic Moonfish	*Selene setapinnis*	19	(4-82)		514	(261-1011)	*	97	(68-138)	*	23	(11-47)	
Atlantic Spadefish	*Chaetodipterus faber*	1,815	(463-7117)	*	926	(457-1876)	*	481	(323-716)	*	60	(31-115)	
Bar Jack	*Carangoides ruber*	1	(0-9)		4	(2-10)		13	(7-24)	*	178	(42-745)	*
Bermuda Chub	*Kyphosus sectatrix*	39	(8-179)		162	(89-293)	*	838	(545-1288)	*	1,405	(521-3787)	*
Black Jack	*Caranx lugubris*	0.1	(0-4)		0.2	(0-2)		0.1	(0-1)		23	(10-55)	*
Blue Runner	*Caranx chrysos*	622	(152-2539)	*	1,712	(956-3063)	*	3,971	(2805-5622)	*	691	(343-1390)	*
Bluefish	*Pomatomus saltatrix*	2	(0-14)		4	(2-9)	*	0.6	(0-1)		0.6	(0-2)	
Butterflyfish sp.	*Chaetodontidae* sp.	0.1	(0-3)		0.4	(0-2)		8	(-)	*	0.2	(0-2)	
Cobia	*Rachycentron canadum*	57	(14-230)	*	13	(6-26)	*	24	(16-36)	*	1.4	(0-5)	
Crevalle Jack	*Caranx hippos*	16	(3-76)		148	(83-263)	*	326	(234-456)	*	2,074	(941-4571)	*
Dog Snapper	*Lutjanus jocu*	0.2	(0-5)		0.1	(0-1)		0.5	(0-2)	*	0.05	(0-1)	
Filefish sp.	*Monacanthidae* sp.	-	(-)		-	(-)		0.2	(0-1)	*	-	(-)	
Gray Snapper	*Lutjanus griseus*	137	(35-528)	*	400	(255-710)	*	491	(345-698)	*	37	(19-70)	
Gray Triggerfish	*Balistes capriscus*	1.3	(0-11)		13	(6-26)	*	63	(40-101)	*	2	(1-6)	
Great Barracuda	*Sphyraena barracuda*	4	(1-24)		27	(14-51)	*	75	(50-113)	*	478	(206-1107)	*
Greater Amberjack	*Seriola dumerili*	14	(3-60)		32	(17-59)	*	487	(176-1347)	*	587	(313-1099)	*
Grouper sp.	*Epinephelinae* sp.	0.2	(0-5)		0.7	(0-3)		16	(-)	*	0.3	(0-2)	
Guaguanche	*Sphyraena guachancho*	3	(0-19)		32	(17-60)	*	22	(14-33)	*	2	(1-8)	
Gulf Menhaden	*Brevoortia patronus*	67	(17-266)		2,876	(1642-5039)	*	169	(120-239)		105	(56-197)	
Horse-eye Jack	*Caranx latus*	3	(1-20)		19	(10-37)	*	86	(56-133)	*	416	(187-925)	*
King Mackerel	*Scomberomorous cavalla*	4	(1-23)		81	(45-146)	*	38	(26-57)	*	5	(2-12)	
Leatherjack	*Oligoplites saurus*	26	(6-106)		105	(59-187)		706	(475-1051)	*	45	(23-86)	
Lookdown	*Selene vomer*	3	(1-16)		26	(14-50)	*	107	(72-159)	*	8	(5-13)	
Ocean Triggerfish	*Canthidermis sufflamen*	0.6	(0-9)		1	(0-4)		10	(5-17)	*	20	(10-42)	*
Rainbow Runner	*Elagatis bipinnulata*	13	(3-67)		266	(133-529)	*	53	(36-78)	*	405	(178-924)	*
Red Drum	*Sciaenops ocellatus*	0.1	(0-2)		4	(1-13)	*	0.2	(-)		0.2	(-)	
Red Snapper	*Lutjanus campechanus*	359	(94-1367)	*	1,015	(541-1904)	*	2,980	(875-10152)	*	133	(72-246)	*
Sheepshead	*Archosargus probatocephalus*	0.3	(0-3)		19	(9-39)	*	6	(-)	*	1	(-)	
Spanish Hogfish	*Bodianus rufus*	0.1	(0-2)		0.3	(0-1)		2	(-)	*	0.1	(0-1)	
Spanish Mackerel	*Scomberomorous maculatus*	0.2	(0-6)		-	(-)	*	0.1	(0-1)	*	-	(-)	
Unidentified Fish		142	(39-520)	*	250	(140-446)	*	276	(196-389)	*	13,090	(5363-31952)	*
Vermilion Snapper	*Rhomboplites aurorubens*	45	(11-180)		118	(67-210)		3,506	(428-28743)	*	57	(30-109)	
Yellow Jack	*Carangoides bartholomaei*	0.8	(0-11)		0.9	(0-3)	*	7	(4-13)	*	0.5	(0-3)	
Total		**7,764**			**15,014**			**15,877**			**20,284**		
Confidence Intervals		(1975-30517)			(8593-26234)			(6349-39700)			(10169-40459)		
Total Taxa Verified by SRV Observation		7			26			32			13		
Total Number Verified by SRV Observation		7,494			14,784			15,707			19,611		
Percent of Model Abundance Verified by SRV		96.5			98.5			98.9			96.7		

Appendix Table 2.2. The 47 platform sites with water depth, number of explosions, and the mean number of fish placed at each site (in 10,000 simulated runs)

				More Conservative Model Input Parameters			Less Conservative Model Input Parameters		
Site	Depth (m)	Number of Explosions	Mean Number of Fish Placed	Exposure Count	Range for Survival (m)	Average Count of Unexposed	Exposure Count	Range for Survival (m)	Average Count of Unexposed
A1_2017	15.2	15	380	380	462	0	380	256	0
A2_2017	15.2	3	380	380	506	0	380	253	0
A3_2017	11.6	4	311	311	458	0	311	253	0
B1_2017	25.9	16	969	969	458	0	969	253	0
B2_2017	30.5	8	1123	1123	506	0	1123	285	0
B3_2017	29	1	1072	1072	506	0	1072	285	0
B4_2017	28.3	2	1052	1052	506	0	1052	285	0
B5_2017	26.8	12	1000	1000	374	0	1000	207	0
B6_2017	25.9	8	969	969	398	0	969	220	0
B7_2017	21.6	10	806	806	442	0	806	244	0
B8_2017	21	4	772	772	420	0	772	231	0
B9_2017	21.3	6	789	789	423	0	789	233	0
B10_2017	22.3	15	841	841	439	0	841	239	0
B11_2017	21.3	4	789	789	440	0	789	243	0
B12_2017	25.9	6	969	969	506	0	969	285	0
C1_2017	35.4	3	2897	2897	506	0	2897	285	0
C2_2017	39.9	4	3319	3319	503	0	3319	279	0
C3_2017	50.6	8	4131	4131	436	0	4131	241	0
C4_2017	64	20	5928	5928	481	0	5928	267	0
C5_2017	64	4	5928	5928	356	0	5928	194	0
C6_2017	50.9	4	4153	4153	453	0	4153	250	0
C7_2017	42.7	2	3568	3568	293	0	3568	154	0
C8_2017	48.8	10	4001	4001	453	0	4001	250	0
D1_2017	**91.4**	**4**	**669**	**669**	**300**	**0**	**668**	**157**	**1**
A1_2018	15.8	2	388	388	413	0	388	225	0
A2_2018	12.2	4	333	333	453	0	333	250	0
A3_2018	16.8	1	400	400	291	0	400	160	0
A4_2018	17.4	10	408	408	388	0	408	214	0
A5_2018	13.1	15	352	352	296	0	352	162	0
A6_2018	12.8	4	348	348	293	0	348	161	0
A7_2018	12.8	8	348	348	503	0	348	279	0
A8_2018	13.4	15	356	356	440	0	356	243	0
A9_2018	10.7	1	278	278	449	0	278	231	0
A10_2018	10.7	5	278	278	449	0	278	227	0
A11_2018	10.1	21	256	256	356	0	256	194	0
B1_2018	27.4	6	1021	1021	297	0	1021	163	0
C1_2018	50.3	9	4110	4110	356	0	4110	194	0
C2_2018	60	4	5368	5368	312	0	5368	172	0
C3_2018	68.6	6	6537	6537	312	0	6537	172	0
C4_2018	64	8	5928	5928	307	0	5928	169	0
C5_2018	64	4	5928	5928	449	0	5928	249	0
C6_2018	59.1	3	5235	5235	309	0	5235	160	0
C7_2018	68	4	6456	6456	356	0	6456	194	0
C8_2018	45.7	8	3785	3785	356	0	3785	197	0
C9_2018	31.1	3	2423	2423	458	0	2423	253	0
C10_2018	44.8	7	3720	3720	440	0	3720	243	0
D1_2018	92.7	8	671	671	444	0	671	246	0

Appendix Table 2.3. Red snapper median abundance by age on explosively removed platforms in 2017 (24 platforms removed) and 2018 (23 platforms removed).

Provides detail for Table 13.

Year 2017

East GOM

Depth Zone (m)	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	0	0	0	0	0	0	0	0	0	0	0	0	0
18_30	0	0	0	0	0	0	0	0	0	0	0	0	0
31_90	0	0	0	0	0	0	0	0	0	0	0	0	0
91_300	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Biomass (lbs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

West GOM

Depth Zone (m)	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	0	646	323	108	0	0	0	0	0	0	0	0	1,077
18_30	161	1768	4790	1704	3279	321	96	32	0	0	32	0	12,183
31_90	0	258	2384	2899	11533	3801	1675	1095	129	0	0	64	23,839
91_300	0	1	13	16	64	21	9	6	1	0	0	0	133
Total	**161**	**2673**	**7510**	**4727**	**14876**	**4144**	**1781**	**1134**	**130**	**0**	**32**	**65**	**37,232**
Biomass (lbs)	**46**	**2829**	**17219**	**18029**	**81335**	**29601**	**15588**	**11596**	**1497**	**0**	**470**	**994**	**179,202**

Total GOM

Depth Zone (m)	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	0	646	323	108	0	0	0	0	0	0	0	0	1,077
18_30	161	1768	4790	1704	3279	321	96	32	0	0	32	0	12,183
31_90	0	258	2384	2899	11533	3801	1675	1095	129	0	0	64	23,839
91_300	0	1	13	16	64	21	9	6	1	0	0	0	133
Total	**161**	**2673**	**7510**	**4727**	**14876**	**4144**	**1781**	**1134**	**130**	**0**	**32**	**65**	**37,232**
Biomass (lbs)	**46**	**2829**	**17219**	**18029**	**81335**	**29601**	**15588**	**11596**	**1497**	**0**	**470**	**994**	**179,202**

2018

East GOM

Depth Zone	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	29	223	91	12	4	0	0	0	0	0	0	0	359
18_30	0	0	0	0	0	0	0	0	0	0	0	0	-
31_90	0	97	373	864	560	771	214	66	24	3	3	3	2,980
91_300	0	0	0	0	0	0	0	0	0	0	0	0	-
Total	**29**	**320**	**464**	**877**	**564**	**771**	**214**	**66**	**24**	**3**	**3**	**3**	**3,339**
Biomass (lbs)	**8**	**338**	**1064**	**3343**	**3084**	**5506**	**1876**	**672**	**280**	**47**	**51**	**53**	**16,323**

West GOM

Depth Zone	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	318	2451	998	136	45	0	0	0	0	0	0	0	3,948
18_30	11	216	296	403	52	32	2	2	0	0	0	0	1,015
31_90	0	774	2987	6914	4480	6167	1715	525	194	28	28	28	23,839
91_300	0	4	17	39	25	34	10	3	1	0	0	0	133
Total	**329**	**3446**	**4298**	**7492**	**4603**	**6233**	**1726**	**531**	**195**	**28**	**28**	**28**	**28,936**
Biomass (lbs)	**94**	**3646**	**9854**	**28573**	**25166**	**44525**	**15111**	**5428**	**2249**	**382**	**406**	**427**	**135,862**

Total GOM

Depth Zone	Age 1	2	3	4	5	6	7	8	9	11	12	13	Total
10_17	347	2674	1089	149	50	0	0	0	0	0	0	0	4,307
18_30	11	216	296	403	52	32	2	2	0	0	0	0	1,015
31_90	0	871	3360	7778	5040	6938	1929	591	218	31	31	31	26,819
91_300	0	4	17	39	25	34	10	3	1	0	0	0	133
Total	**358**	**3765**	**4762**	**8368**	**5167**	**7004**	**1941**	**596**	**219**	**31**	**31**	**31**	**32,275**
Biomass (lbs)	**103**	**3984**	**10918**	**31916**	**28251**	**50032**	**16987**	**6100**	**2528**	**429**	**457**	**480**	**152,185**

Appendix Table 2.4. Median abundance of red snapper by age on the 1,171 standing platforms present in federal waters of the Gulf of Mexico in 2018

Provides detail for Table 14.

East GOM:

	Age												
Depth Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**11**	**12**	**13**	**Total**
10_17	1,300	10,026	4,085	557	186	-	-	-	-	-	-	-	16,153
18_30	228	4,325	5,919	8,059	1,047	637	46	46	-	-	-	-	20,306
31_90	-	7,840	30,241	70,003	45,362	62,442	17,361	5,320	1,960	280	280	280	241,369
91_300	-	91	350	810	525	723	201	62	23	3	3	3	2,794
Total	**1,527**	**22,282**	**40,595**	**79,429**	**47,120**	**63,803**	**17,607**	**5,427**	**1,983**	**283**	**283**	**283**	**280,622**
Biomass (lbs)	**438**	**23,579**	**93,075**	**302,940**	**257,625**	**455,741**	**154,104**	**55,519**	**22,905**	**3,890**	**4,140**	**4,346**	**1,378,303**

West GOM:

	Age												
Depth Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**11**	**12**	**13**	**Total**
10_17	8,693	67,061	27,321	3,726	1,242	-	-	-	-	-	-	-	108,043
18_30	2,379	45,198	61,850	84,212	10,943	6,661	476	476	-	-	-	-	212,194
31_90	-	39,008	150,459	348,285	225,689	310,670	86,375	26,470	9,752	1,393	1,393	1,393	1,200,888
91_300	-	393	1,517	3,512	2,276	3,132	871	267	98	14	14	14	12,108
Total	**11,072**	**151,661**	**241,148**	**439,734**	**240,149**	**320,464**	**87,721**	**27,212**	**9,850**	**1,407**	**1,407**	**1,407**	**1,533,233**
Biomass (lbs)	**3,173**	**160,490**	**552,905**	**1,677,143**	**1,313,005**	**2,289,062**	**767,768**	**278,367**	**113,793**	**19,327**	**20,568**	**21,592**	**7,217,193**

Total GOM:

	Age												
Depth Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**11**	**12**	**13**	**Total**
10_17	9,993	77,087	31,406	4,283	1,428	-	-	-	-	-	-	-	124,195
18_30	2,606	49,523	67,769	92,270	11,990	7,298	521	521	-	-	-	-	232,500
31_90	-	46,848	180,700	418,288	271,051	373,113	103,735	31,790	11,712	1,673	1,673	1,673	1,442,257
91_300	-	484	1,867	4,322	2,801	3,855	1,072	328	121	17	17	17	14,903
Total	**12,599**	**173,942**	**281,742**	**519,163**	**287,269**	**384,266**	**105,329**	**32,640**	**11,833**	**1,690**	**1,690**	**1,690**	**1,813,855**
Biomass (lbs)	**3,611**	**184,069**	**645,980**	**1,980,083**	**1,570,630**	**2,744,803**	**921,872**	**333,885**	**136,698**	**23,218**	**24,709**	**25,938**	**8,595,497**

Appendix Table 2.5. Median abundance of red snapper by age on the 1,115 standing platforms within 100 miles of major fishing ports in 2018

(Provides detail for Table 19)

Depth Zone (m)	**Age 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**11**	**12**	**13**	**Total**
10_17	9,993	77,087	31,406	4,283	1,428	-	-	-	-	-	-	-	124,195
18_30	2,606	49,523	67,769	92,270	11,990	7,298	521	521	-	-	-	-	232,500
31_90	-	45,106	173,980	402,732	260,970	359,237	99,877	30,608	11,276	1,611	1,611	1,611	1,388,619
91_300	-	320	1,234	2,856	1,850	2,547	708	217	80	11	11	11	9,846
Total	**12,599**	**172,036**	**274,388**	**502,140**	**276,238**	**369,082**	**101,107**	**31,346**	**11,356**	**1,622**	**1,622**	**1,622**	**1,755,161**
Biomass (lbs)	**3,611**	**182,051**	**629,119**	**1,915,159**	**1,510,320**	**2,636,343**	**884,923**	**320,651**	**131,192**	**22,283**	**23,713**	**24,894**	**8,284,260**

Department of the Interior (DOI)

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

BOEM Environmental Studies Program

The mission of the Environmental Studies Program is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).