Potential Contractual Projects for Council Consideration

A Evaluation of dolphin acoustic deterrent devices as a method to reduce reef fish depredation rates in Gulf of Mexico fisheries

Judd Curtis (PI), Greg Stunz (Co-PI), Matt Streich (Co-PI)

Harte Research Institute for Gulf of Mexico Studies, Texas A&M University-Corpus Christi

Statement of Work: Reducing and characterizing discard mortality in fisheries is one of the more pressing needs pervasive in fisheries management, as it is one of the critical parameters required for successful stock assessments (National Research Council 2006). In recreational fisheries, it has been particularly difficult to quantify, as reporting/observing requirements of catch and discard data are not as readily available as in commercial fisheries. For reef fish species such as red snapper (*Lutjanus campechanus*) that live at multiple depths and are subject to differential fishing pressure, discard mortality due to barotrauma varies spatially and temporally across depth strata (Campbell et al. 2014; Curtis et al. 2015). Compounding with barotrauma effects, discarded fish often experience difficulty quickly re-submerging and orienting, which can lead to easy prey and high post-release mortality from depredation particularly by dolphins. Public testimony at recent management meetings suggests that depredation is rapidly increasing and has negatively affected catch rates and lead to decreased economic returns. For recreational fisheries, these reef fish-dolphin interactions may also affect fishing behavior and experience, specifically in the charter-for-hire sector, where charter captains frequently have to alter their fishing strategies to avoid dolphin depredation and provide an enjoyable fishing experience for paying customers. Fishermen at the most recent Gulf of Mexico Fishery Management Council Meeting alluded to 74 instances of 'dolphin' as an issue or nuisance during public testimony and described situations that have negatively affected their catch rates or charter business (GMFMC 2019). Little research effort has been dedicated to defining fisherman-predator interactions in the offshore reef fish fishery; although, depredation during these encounters can often result in discard mortalities approaching 100%. Thus, the ***overall goals*** of this project are to characterize regulatory discards while estimating instantaneous and post-release mortalities attributed to depredation, and to determine if Acoustic Deterrent Devices (ADDs) currently used in commercial net fisheries could be a tool to reduce discard mortality of Gulf of Mexico reef fishes. These devices have great potential to provide a simple, low cost, and low impact method of increasing survival rates of regulatory discards in the reef fish fishery but need appropriate and rigorous testing and validation. The ***rationale*** for the proposed science is that if red snapper discard mortality can be better estimated and depredation reduced, managers can make the most informed conservation and management decisions for upcoming stock assessments and reduce discard mortality by integrating deterrent devices for effective fisheries management.

The **specific objectives/deliverables** of the project are to:

1. Characterize discard composition and document the frequency of depredation events in recreational fisheries in the Western Gulf of Mexico
2. Determine if acoustic deterrent devices affect catch rates or composition onboard recreational fishing vessels

3. Test the usefulness of acoustic deterrent devices as a technique to mitigate depredation by dolphins and increase survival of discarded reef fish

Project Timeline: Our research team is permitted to carry out this work, and we will update the necessary Letters of Acknowledgement, sampling permits, etc. to conduct this research within the first three months. We will meet with charter captains and conduct scoping meetings Feb-Apr to discuss logistics and sampling plans for the completion of our three objectives that will occur later in the year. Objective #1 will occur concurrently with Objectives #2 and #3, as these discard and depredation data may be collected during ongoing operations throughout the year. Objective #2 will occur prior to the beginning of the federal red snapper season, projected to open June 1. Testing of the ADDs to ensure there is not an effect on fishing operations will be completed by this date. Objective #3 will be conducted onboard charter operations during the federal for-hire recreational red snapper season. The final report will be provided to the Gulf Council at the completion of the full 12-month project.

Activity	2020											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Project start date (January 1st)												
Obtain necessary permits												
Meet with charter captains/scoping meetings												
Objective #1: Discard and depredation observation												
Objective #2: Test ADD effect on CPUE												
Objective #3: Test ADD as dolphin deterrent												
Data analysis												
Final report to sponsor												

Relevance to Stock Assessment and Management: This project will address one of the most critical aspects of red snapper fisheries management by expanding our understanding of the composition of discards and helping to mitigate depredation on discards in the reef fish fishery by dolphins. Fishermen in the Gulf have reported an increasing number of interactions with marine mammals, specifically bottlenose dolphins, that have resulted in substantial depredation and fishing difficulty over the last decade. Despite protections under the Marine Mammal Protection Act (1972), the economic costs that are being experienced by fishermen due to depredation of catch by dolphins has caused some to call for more extreme retaliatory measures that would clearly cause harm to the marine mammals, and have been very vocal in calling for action by the Fishery Management Council to help solve this problem. Here, we propose a potential solution to this conflict. End results of this project will yield information on the possibility for integrating deterrent devices into recreational reef fish fisheries in the Gulf, as well as provide critical data on discard composition and depredation rates from the recreational sector. **Amount Requested**: $90,000

References:

Campbell, M. D., W. B. Driggers, B. Sauls, and J. F. Walter. 2014. Release mortality in the red snapper fishery: a synopsis of three decades of research. SEDAR31-DW22. Fish Bulletin 112:283–296.

Curtis, J. M., M. W. Johnson, S. L. Diamond, and G. W. Stunz. 2015. Quantifying delayed mortality in discarded Red Snapper using acoustic telemetry. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 7(1):434–449.

GMFMC. 2019. Gulf of Mexico Fishery Management Council 275th Meeting, Full Council Session, August 14-15, 2019. New Orleans, LA.

National Research Council. 2006. Review of Recreational Fisheries Survey Methods. National Academies Press, Washington DC.

B **Increasing availability and understanding of fish descender devices**

JM Drymon
Mississippi State University and Mississippi-Alabama Sea Grant

Catch and release angling is based on the notion that released fish will survive; however, fish caught in deep water typically suffer the adverse effects of barotrauma, which often results in post-release mortality. Increasingly, fish descending devices are being used as "best-practice" to mitigate the effects of barotrauma and reduce post-release mortality. For example, at the September 2019 South Atlantic Fisheries Management Council meeting, members approved Amendment 29 to the Snapper Grouper Fishery Management plan, which would "require fishermen fishing for snapper grouper species to have a descending device onboard and readily available for use when fishing in federal waters." Recent studies have suggested that a similar requirement enacted in the Gulf of Mexico would receive little opposition from stakeholders (Crandall et al. 2018). However, despite the proven efficacy of descending devices and the lack of opposition to their requirement, difficulty accessing the devices and a deficiency of knowledge regarding proper use hinder their effectiveness. When surveyed, anglers felt that descending gear "is difficult to use, time consuming, and expensive" (Crandall et al. 2018).

While considerable progress has been made to increase awareness and knowledge of descender devices in Florida (Hazell et al. 2016, Crandall et al. 2018) and Texas (Thompkins 2017), similar efforts are lacking in Mississippi. I therefore propose a two-part strategy whereby I would 1) distribute 500 fish descenders (SeaQualizers) to Mississippi recreational fishermen through the Mississippi Department of Marine Resources "Tails and Scales" program; and 2) develop and disseminate short instructional videos detailing the proper use of the descender devices. To be eligible for the free SeaQualizer, anglers would be required to watch the short (less than 120 second) instructional video. As a fisheries specialist with Mississippi-Alabama Sea Grant, and a member of the Gulf of Mexico Fisheries Management Council's Outreach and Education technical committee, I am well positioned to ensure that this project can be successfully completed by December 2020. In addition, this project would provide material that could be used on the Council's *Fishing For Our Future* website. **Amount Requested:** $75,000.

Usefulness to the Council: this project would 1) provide broad access to descending devices for Mississippi anglers, 2) provide easy to understand instruction on how to use the devices, and 3) provide outreach material that could be used on the Council's *Fishing For Our Future* website.

References

Crandall CA, Garlock TM, Lorenzen K. 2018. Understanding resource-conserving behaviors among fishers: barotrauma mitigation and the power of subjective norms in Florida's reef fisheries. North American Journal of Fisheries Management 38: 271-280.

Hazell J, Krimsky L, Fleuch B, C Adams, Stevely J, Botta R. 2016. Awareness, knowledge and perceptions of barotrauma mitigation: a survey of Florida anglers. Florida Sea Grant College Program, Gainsville, FL.

Thompkins AK. 2017. Utility of rapid recompression devices in the Gulf of Mexico Red Snapper fishery. Master's Thesis, Texas A&M University-Corpus Christi.

C **Understanding population dynamics of adult red drum**

JM Drymon and S.P Powers

Mississippi State University and Mississippi-Alabama Sea Grant
University of South Alabama

Red drum (*Sciaenops ocellatus*) are currently assessed as a data-poor species (SEDAR 49). Despite an abundance of fishery-independent data from state surveys, little is known about the population dynamics of the adult spawning stock. Consequently, the Gulf Council noted that "studies are needed to determine age composition for spawning red drum in federal waters." The Council further noted that "indices of abundance are needed to provide abundance estimates of the adult stock" (GMFMC 2015). Age composition and indices of abundance have been previously reported for adult red drum (Powers et al. 2012) but were based on limited sampling that is now ten years out of date.

We therefore propose an update to Powers et al. 2012 with the following deliverables: 1) sex-specific VBGF parameters based on age estimates from ~ 1000 adult red drum; 2) catchcurve-based estimates of mortality; 3) a standardized index of relative abundance for adult red drum sampled from 2006-2018; and 4) predictions of habitat suitability based on potential environmental covariates (temperature, salinity, dissolved oxygen, etc.) using boosted regression trees. This project would be conducted by the authors of Powers et al. 2012, who were also data contributors to the recent data-poor assessment for red drum (SEDAR 49). This project would fill a critical data gap using samples and data already in hand, can be completed by December 2020, and will result in a peer-reviewed publication. **Amount Requested:** $50,000.

Usefulness to the Council: this work would 1) fill a data need identified in the Council's 2015-2019 research and monitoring priorities, 2) provide the only index of relative abundance for adult red drum in offshore waters, 3) produce sex-specific age and growth parameters for ~ 1000 individuals, 4) provide estimates of mortality, and 5) generate habitat suitability maps.

References

Gulf of Mexico Fishery Management Council. 2015. Monitoring and Research Priorities, 2015-2019.

Powers SP, Hightower CL, Drymon JM, Johnson MW. 2012. Age composition and distribution of red drum (*Sciaenops ocellatus*) in offshore waters of the north central Gulf of Mexico: an evaluation of a stock under a federal harvest moratorium. Fishery Bulletin 110: 283-292.

SEDAR 49. 2016. Gulf of Mexico data-limited species.

D Assessing the influence of *Sargassum* habitat on greater amberjack recruitment in the Gulf of Mexico

Frank Hernandez (lead) and Verena Wang
Division of Coastal Sciences, University of Southern Mississippi, Ocean Springs, MS

Project narrative:

Pelagic *Sargassum* provides structure within the open ocean to support a diverse assemblage of fishes (Wells and Rooker 2004). While *Sargassum* has yet to be designated as Essential Fish Habitat in the Gulf of Mexico, a status that has been granted in the South Atlantic (SAFMC 2002), it is presumed to play an important nursery role given the high densities of *Sargassum*-associated juvenile fishes. It has been hypothesized that measures of *Sargassum* abundance can serve as valuable fisheries-independent recruitment indices, but assessing the relationship between *Sargassum* and fisheries productivity has until recently been hindered by the ephemeral nature of *Sargassum* and the difficulty in accurately quantifying its abundance and distribution. A current NOAA RESTORE-funded project (lead-PI Hernandez) focuses on evaluating the importance of pelagic *Sargassum* to fisheries management in the Gulf of Mexico. Among the objectives of the project, *Sargassum* habitat indices are being developed for the Gulf of Mexico at multiple spatial and temporal scales. These include ship-based *Sargassum* indices, developed from volumetric *Sargassum* measurements recorded during SEAMAP ichthyoplankton surveys beginning in 2002, and remotely sensed *Sargassum* indices, derived from field-validated satellite reflectance observations and water column chlorophyll a, available from 2000 to present. Presently, project efforts are concentrated on assessing the relationship between these *Sargassum* indices and gray triggerfish (*Balistes capriscus*) populations in the Gulf of Mexico.

The proposed work will extend the application of project-developed *Sargassum* indices to evaluate recruitment in Gulf of Mexico greater amberjack (*Seriola dumerili*), a federally managed species which has been designated as overfished and undergoing overfishing (SEDAR 2014). This objective is in line with Priority Code A (stocks designated as overfished and undergoing overfishing or in critical need of an assessment) for priorities associated with individual species or specific research topics in the Gulf of Mexico Fishery Management Council fishery monitoring and research priorities for 2020-2024. Recruitment indices will be obtained from greater amberjack stock assessments (i.e., Stock Synthesis 3 model outputs) in order to examine the relationship between stock recruitment and variation in *Sargassum* abundance and distribution. Age- or length-specific commercial and recreational landings data and fisheries-independent video survey data will also be evaluated for the appropriate *Sargassum* index period based on year class. If *Sargassum* is an effective predictor of greater amberjack recruitment, *Sargassum* habitat indices can used to tune stock assessment models and reduce variability in recruitment estimates. Incorporation of habitat-based parameters would better inform models and contribute to improved understanding of the role of *Sargassum* in supporting the early life stages of target fisheries species. We anticipate this work will be completed by January 2021. **Amount Requested**: $75,000.

References:

Wells, R. and J. Rooker (2004) Spatial and temporal patterns of habitat use by fishes associated with *Sargassum* mats in the northwest Gulf of Mexico. Bull. Mar. Sci. 74:81-99.

SAFMC (South Atlantic Fishery Management Council) (2002) Fishery management plan for pelagic *Sargassum* habitat of the South Atlantic region. South Atlantic Fishery Management Council, Charleston, SC. 228 pp.

SEDAR (Southeast Data, Assessment, and Review) (2014) SEDAR 33 – Gulf of Mexico Greater Amberjack Stock Assessment Report. SEDAR, North Charleston SC. 490 pp.

E Exploring Unexplained Variability in Stock-Recruitment Relationship Estimates for the Gulf of Mexico's Greater Amberjack (*Seriola dumerili*) Stock with Long-Term, Ecological Time Series

Joshua P Kilborn
University of South Florida, College of Marine Science

PROJECT DESCRIPTION: Given that stock-recruitment relationship estimates for Greater Amberjack (*Seriola dumerili*) contain large amounts of unexplained variability (SEDAR 2014, 2016)[1], and that the contemporary stock status has not recovered to pre-1985 levels (Karnauskas et al. 2017), this species represents an ideal candidate for the evaluation of non-traditional, stock-size determinants. In particular, environmental and socio-ecological factors may represent key overlooked aspects contributing to the recent declining stock trends for the Greater Amberjack (GAJ) population and its associated spawning biomass (SEDAR 2014, Karnauskas et al. 2017). Furthermore, preliminary fishery ecosystem models for the Gulf of Mexico covering the period 1985-2015 (J. Kilborn *unpublished; in prep*) and prepared using the Ecosystem-Level Management-Indicator Selection Tool (EL-MIST; Kilborn et al. 2018), show that, while the overall long-term trend has been weakly positive for the full GAJ stock since around the mid-1990s, it generally appears to be varying on a 12.5 year "down-up" cycle since the mid-1980s (not surprising timing, given the magnitude of stock changes over the study period; Karnauskas et al., 2017). However, there appears to be no obvious, measured variable that captures the mechanism of this cyclical trend for GAJ except for, possibly, the net-change in Gulf-wide, artificial reef structures other than oil drilling platforms (J. Kilborn *unpublished; in prep*). Lastly, there is a body of evidence suggesting the importance of additional habitat considerations for early-life stages for GAJ, specifically, the presence of the brown macroalgae *Sargassum* (Wells and Rooker 2003, 2004b, a). With the current expectations for climate change and the likelihood of increased magnitude and frequency of brown-algae blooms in the region (Wang et al. 2019), understanding the baseline connectivity between this important GAJ habitat and its influence on year class strength will be key to estimating future variability in this important fishery resource.

Therefore, for this project, I propose to investigate the unexplained portion of the stock recruitment relationship used for fishery management decisions in the Gulf of Mexico, and as described in the 2014 Southeast Data, Assessment, and Review (SEDAR) final report (SEDAR 2014) and its associated update (SEDAR 2016). I will also utilize the vast collection of environmental and socio-ecological data that comprise the Gulf of Mexico Ecosystem Status Reports, published in 2013 (Karnauskas et al. 2013) and 2017 (Karnauskas et al. 2017), along with additional indices related to *Sargassum* extent, timing, and, magnitude derived from satellite observations and other opportunistic data sources. With these data I will conduct multivariate-statistical modeling exercises both within the EL-MIST framework, and within single-species methods adapted from similar studies from Sablefish stock assessments in the California Current System (Schirripa and Colbert 2006, Schirripa et al. 2009, Tolimieri et al. 2018). The ultimate goal of this project is to determine which additional ecosystem-level, socio-ecological indicators might be used to better constrain the models used to estimate the spawning stock biomass for GAJ and the subsequent annual recruitment levels. For example, up to date information of a *Sargassum* index can be utilized for a "nowcast" of current day recruitment levels, for scenario planning under future states of nature, or for management strategy evaluations. This information will be useful to decision makers seeking

[1] See summary of SEDAR33 update to the Council here: http://archive.gulfcouncil.org/council_meetings/BriefingMaterials//BB-04-2017/B%20-%207(a)(2)-GAJ%20PPT%20April2017.pdf

to better predict stock recruitment variability in order to preserve the GAJ stock for long-term and sustainable use. **Amount Requested:** $85,000.

References

Karnauskas, M., C. R. Kelble, S. Regan, C. Quenée, R. Allee, M. Jepson, A. Freitag, J. K. Craig, C. Carollo, L. Barbero, N. Trifonova, D. Hanisko, and G. Zapfe. 2017. 2017 Ecosystem status report update for the Gulf of Mexico. Technical Memorandum NMFS-SEFSC-706, NOAA, Southeast Fisheries Science Center, Miami, FL.

Karnauskas, M., M. J. Schirripa, C. R. Kelble, G. S. Cook, and J. K. Craig. 2013. Ecosystem status report for the Gulf of Mexico. Technical Memorandum NMFS-SEFSC-653, NOAA, Southeast Fisheries Science Center, Miami, FL.

Kilborn, J. P., M. Drexler, and D. L. Jones. 2018. Fluctuating fishing intensities and climate dynamics reorganize the Gulf of Mexico's fisheries resources. Ecosphere **9**:e02487.

Schirripa, M. J., and J. J. Colbert. 2006. Interannual changes in sablefish (Anoplopoma fimbria) recruitment in relation to oceanographic conditions within the California Current System. Fisheries Oceanography **15**:25-36.

Schirripa, M. J., C. P. Goodyear, and R. M. Methot. 2009. Testing different methods of incorporating climate data into the assessment of US West Coast sablefish. Ices Journal of Marine Science **66**:1605-1613.

SEDAR. 2014. SEDAR 33 Stock Assessment Report - Gulf of Mexico Greater Amberjack. SEDAR, North Charleston, SC.

SEDAR. 2016. SEDAR 33 Stock Assessment Report Update - Gulf of Mexico Greater Amberjack. SEDAR, North Charleston, SC.

Tolimieri, N., M. A. Haltuch, Q. Lee, M. G. Jacox, and S. J. Bograd. 2018. Oceanographic drivers of sablefish recruitment in the California Current. Fisheries Oceanography **27**:458-474.

Wang, M. Q., C. M. Hu, B. B. Barnes, G. Mitchum, B. Lapointe, and J. P. Montoya. 2019. The great Atlantic Sargassum belt. Science **365**:83-+.

Wells, R. J. D., and J. R. Rooker. 2003. Distribution and abundance of fishes associated with Sargassum mats in the NW Gulf of Mexico. Gulf Caribbean Fisheries Inst Gcfi, Ft Pierce.

Wells, R. J. D., and J. R. Rooker. 2004a. Distribution, age, and growth of young-of-the-year greater amberjack (Seriola dumerili) associated with pelagic Sargassum. Fishery Bulletin **102**:545-554.

Wells, R. J. D., and J. R. Rooker. 2004b. Spatial and temporal patterns of habitat use by fishes associated with Sargassum mats in the northwestern Gulf of Mexico. Bulletin of Marine Science **74**:81-99.

F

A Social Network Analysis of Quota Trading in the Gulf of Mexico IFQ Fisheries

Andrew Ropicki
University of Florida

A primary goal of the Gulf of Mexico reef fish individual fishing quota (IFQ) programs (Red Snapper and Grouper-Tilefish) was to reduce overcapacity in the fisheries. With catch shares management more efficient harvesters are expected to place a higher value on quota and buy out their less efficient counterparts leading to decreased overcapacity (Squires et al. 1998). However for this to occur quota trading markets must function effectively; buyers and sellers must be able to find each other with relative ease, participants must have similar access to market trading data and opportunities, and no participants should be able to exert undue influence on quota or dockside markets. Understanding the mechanics of interactions among IFQ participants (fishers and dealers) in both quota and landings (fishers selling to registered dealers) markets can provide valuable information on how the markets are functioning and how those markets are impacting management goals and other socioeconomic outcomes important to fishery managers. Social network analysis (SNA) provides a technique to evaluate the quota and landings markets both spatially and temporally to examine a number of socioeconomic issues important to fishery managers.

While past SNA applied to fisheries management research has analyzed how network structure impacts quota prices (Ropicki and Larkin 2014) and the impacts of management changes on fishery participation (van Putten et al. 2011; Addicott et al. 2018), this research is unique in that it will evaluate a number of socioeconomic outcomes of IFQ management important to the Council. This study proposes employing SNA to both the quota and landings markets in the Gulf of Mexico reef fish IFQ programs to examine connections between the quota and landings markets, evaluate regional differences in the quota market and how the quota market has changed since IFQ implementation, the role and influence of dealers in the quota market, how IFQ management has effected the spatial distribution of the fishery and Gulf working waterfront communities with emphasis on the role of quota trading in the fishery following external shocks (oil spills, red tide events, and hurricanes). Quota trading and landings networks will be created for each quota species group and year of IFQ management and temporal analysis will be performed comparing the networks across years and species groups to evaluate how the IFQ program has developed and changed since implementation. The results of this project will assist the Council in evaluating the socioeconomic impacts of IFQ management on the reef fish fishery and Gulf fishing communities. In addition, the results will be applicable to the next Magnuson-Stevens Act mandated review of the IFQ programs and could serve as a template for similar analyses applied to future reviews.
Amount Requested: $76,000.

References

Addicott, E.T, K. Kroetz, M.N. Reimer, J.N. Sanchirico, D.K. Lew, and J. Huetteman. 2018. "Identifying the potential for cross-fishery spillovers: A network analysis of Alaskan permitting patterns." *Canadian Journal of Fisheries and Aquatic Sciences* 76(1): 56-68.

Ropicki, A.J., and S. Larkin. 2014. "Social Network Analysis of Price Dispersion in Fishing Quota Lease Markets." *Marine Resource Economics* 29(2): 157-176.

Squires, D., H. Campbell, S. Cunningham, C. Dewees, R.Q. Grafton, S.F. Herrick, Jr., J. Kirkley, S. Pascoe, K. Salvanes, B. Shallard, B. Turris, and N. Vestergaard. 1998. "Individual transferable quotas in multispecies fisheries." *Marine Policy* 22(2): 135-159.

van Putten, I., K.G. Hamon, and C. Gardner. "Network analysis of a rock lobster quota lease market." *Fisheries Research* 107(1-3): 122-130.

G

Movement Patterns and Discard Mortality of Cobia in the Gulf of Mexico

Matt Streich (PI), Greg Stunz (Co-PI), Judd Curtis (Co-PI)

Harte Research Institute for Gulf of Mexico Studies, Texas A&M University-Corpus Christi

Statement of Work:
Cobia (*Rachycentron canadum*) is a coastal migratory pelagic species managed jointly by the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC). Cobia support a popular recreational fishery (>90% of landings) but are also captured in commercial fisheries and as bycatch in shrimp fisheries along the U. S. Atlantic coast and throughout the Gulf of Mexico (Gulf; SEDAR 2013; GMFMC 2018). Despite the species popularity as a sportfish, few stock assessments have been conducted, and only recently has Cobia been assessed through the Southeast Data, Assessment, and Review (SEDAR) process. The most recent assessment, conducted in 2012 (SEDAR 28), included separate assessments for Gulf and Atlantic migratory stocks. Although these assessments for Atlantic and Gulf migratory stocks did not suggest overfished status or that overfishing was occurring, confidence in the assessments was low, and management advice for both stocks was greatly hindered by severe data gaps (SEDAR 2013). In particular, deficiencies regarding stock structure, life history, movement patterns, and post-release survival contributed toward high uncertainty in the stock assessment. For example, the southern boundary of the Gulf stock, particularly with respect to Mexican and Texas waters, is unknown (SEDAR 2018). Furthermore, stakeholders fishing for Gulf Cobia have sent clear messages through public testimony in recent Gulf Council meetings expressing dire concerns about the condition of the stock. The Gulf Council has been proactive in addressing these concerns, with an increased minimum size limit recently implemented. This precautionary measure will likely benefit the stock; however, a better understanding of stock structure, and how fishing effort and mortality are distributed is critical to inform future management. Given these data needs, the **overall goal** of this project is to provide new information on movement, stock structure, and discard mortality of Cobia captured in the Gulf recreational hook-and-line fishery using advanced tagging technologies.

The **specific objectives/deliverables** of the project are to:

1) Examine seasonal movement patterns of Cobia and evaluate the degree of mixing between sub-regions in the Gulf of Mexico;

2) Estimate discard mortality for Cobia captured in the U.S. recreational hook-and-line fishery.

To meet these objectives, we will tag 15 Cobia with pop-up satellite archival transmitting tags (PSATs) to examine movement patterns and provide insight into the degree of connectivity between sub-regions of the Gulf including Mexican waters – a region where the paucity of data is striking and limits precise understanding of stock structure. A key benefit of PSAT technology is that it allows for the collection of high-resolution data on movement behavior, but more importantly fate (i.e., mortality) of Cobia following release. To engage stakeholders in the recreational fishery, we will also initiate a cooperative conventional tagging program through our ongoing citizen science initiatives to increase the likelihood of additional connectivity and movement data. The **rationale** for this project is that once we estimate discard mortality in the fishery and evaluate connectivity within an understudied region of the Gulf,

managers will be better able to predict how the stock will respond to new regulations, reduce uncertainty, and make more informed future management decisions.

Project Timeline:
Tagging in the U.S. Gulf will occur during the late spring, summer, and early fall when Cobia are most available to the fishery. As tag pop-off events occur, data will be downloaded with data analysis commencing shortly after. A final report outlining available data on movement patterns and discard mortality estimates will be submitted to the Gulf Council by the end of 2020. Given that some PSATs will likely still be deployed on free-swimming Cobia by the end this project, additional data and updated analyses will be presented to the Gulf Council as they are realized at no-cost.

Activity	2020											
	J	F	M	A	M	J	J	A	S	O	N	D
Tag Deployment												
Tag Pop-off												
Data Analysis												
Final Report												

Relevance of Deliverables to Stock Assessment and Management:
Because sub regional stock structure cobia in the Gulf is largely unknown (SEDAR 2018), this project will provide much improved data for use in upcoming stock assessments. Currently, no studies of mixing exist in the western Gulf, and the southern boundary of the stock is unknown. This has significant implications for management, especially if the degree of mixing between the U.S. Gulf and Mexican waters is high. Specifically, the current assessment models do not account for removals of U.S. Gulf Cobia that may be occurring in Mexico. This project will also provide a much-needed estimate of discard mortality in the recreational fishery that can be directly incorporated into assessment models. Our project will fill all of these important data gaps and allow managers to make optimal decisions based on sound science. Subsequently, the information obtained in this study will be essential in the development of future state and federal fishery management programs aimed at promoting the sustainability of this resource. Furthermore, because Cobia represent an important fishery and contribute to the Gulf States multi-billion dollar fishing industry, coastal communities will reap numerous economic and social benefits from our research. **Amount Requested:** $92,500

Reference List:

GMFMC. 2018. Modifications to Gulf of Mexico migratory group cobia size and possession limits – Draft framework amendment 7 to the Fishery Management Plan for Coastal Migratory Pelagic Resources in the Gulf of Mexico and Atlantic Region. GMFMC, Tampa, FL.

SEDAR (Southeast Data, Assessment, and Review). 2013. SEDAR 28 – Gulf of Mexico cobia stock assessment report. SEDAR, North Charleston, SC.

SEDAR. 2018. SEDAR 58 – Cobia stock ID process report compilation. SEDAR, North Charleston, SC.

H Abundance Estimates and Comparative Habitat Value of Artificial Reefs and Natural Banks for Gulf of Mexico Greater Amberjack and Gray Triggerfish

Greg Stunz (PI), Matt Streich (Co-PI), Judd Curtis (Co-PI)

Harte Research Institute for Gulf of Mexico Studies, Texas A&M University-Corpus Christi

Statement of Work: Artificial reefs currently supplement natural hard-bottom in the Gulf of Mexico as structured habitat that helps sustain healthy populations for many economically important reef fish species (Froeschke and Dale 2014). This includes two highly important federally managed species, Greater Amberjack (*Seriola dumerili*) and Gray Triggerfish (*Balistes capriscus*), and both are very common over these habitat types (Ajemian et al. 2015; Streich et al. 2017). These two species are undergoing rebuilding plans and have recently been identified as high priority targets for further fishery-independent sampling efforts to better inform stock assessment models; thus, there is a tremendous need to gather additional data on the abundance and distribution of these species at both natural and artificial reef environments, something clearly identified as lacking in the last assessments (SEDAR 33, SEDAR 43). The ***overall goal*** of this study is to obtain greatly needed abundance and distribution information for Greater Amberjack and Gray Triggerfish through a combination of video surveys and bioacoustic surveys at artificial reef and natural bank habitats. This project will leverage the extensive database of video and bioacoustic surveys that has been compiled from the ongoing project, "*Estimating the absolute abundance of Red Snapper in the U.S. Gulf of Mexico,"* which is coordinated by the project PI at the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University-Corpus Christi. Transect methods using micro-ROVs will be used to examine fish abundance and density at complex, large-scale habitats such as oil/gas platforms and natural reef habitats (Streich et al. 2017). For these habitats, the use of geo-referenced ROV video allows one to estimate numbers of fish observed within an area surveyed, and thus estimate fish density. Coupled bioacoustic surveys will be conducted to provide more comprehensive coverage of large-scale habitats, or in areas with low visibility, to supplement video survey data and provide scalability (Stanley and Wilson 2000). The addition of bioacoustics surveys to ROV transect methods will be a useful tool for quantifying the spatial and temporal distributions of fish communities and assessing the comparative value of these habitats. Funding for this project will allow us to expand the assessment with video surveys to include Greater Amberjack and Gray Triggerfish, as well as any other reef fish species opportunistically sampled, and provide better data on the comparative value of artificial reefs versus natural banks.

The **specific objectives/deliverables** of the project are to:

1. Determine the abundance and distribution of Greater Amberjack and Gray Triggerfish on artificial and natural reefs using coupled video survey and bioacoustic methods.
2. Compare the species composition between artificial and natural reefs using video transect surveys.

Project Timeline: Assuming a start date of January 1st, project will commence with data collection and aggregation by identifying existing survey data sources from the ongoing Red Snapper project that contain Greater Amberjack and Gray Triggerfish. Video collected from these surveys will be analyzed for these two species to determine proportion of species composition, followed by bioacoustic analysis to determine abundance and distribution. Final statistical analysis and modeling will provide scaled-up estimates and partitioning of the total abundance by various strata such as depth, habitat type, and

region. This information will then be provided to fishery managers and stock assessment scientists for incorporation into the SEDAR process for upcoming assessments. Final project reports will be submitted to the Gulf Council by the end of the year.

Activity	2020											
	J	F	M	A	M	J	J	A	S	O	N	D
Project start date (January 1st)												
Data collection and aggregation												
Video survey review and analysis												
Bioacoustics review and analysis												
Statistical analysis and modeling												
Integrate into SEDAR/stock assessment												
Final report to sponsor												

Relevance to Stock Assessment and Management: Greater Amberjack and Gray Triggerfish are undergoing rebuilding plans and have recently been identified as high priority targets for further fishery-independent sampling efforts to better inform stock assessment models; thus, there is a tremendous need to gather additional data on the abundance and distribution of these species at both natural and artificial reef environments, something clearly identified as lacking in the last assessments. Recent federal funding opportunities (i.e. NOAA-MARFIN) listed "*investigating the value of artificial reefs and oil/gas platforms as fish habitat for enhancing stock building efforts"* as well as *"fishery-independent monitoring and sampling"* as research priorities for both Greater Amberjack and Gray Triggerfish in the Gulf of Mexico. Data obtained from this project will be made available to fishery managers and scientists for incorporation into the SEDAR process for future stock assessments. **Amount Requested**: $75,000.

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I Density estimations of age-0 and age-1 Gray Triggerfish, *Balistes capriscus*, and Vermilion Snapper, *Rhomboplites aurorubens*, from 2007 to 2015, in the northern Gulf of Mexico.

Stephen T. Szedlmayer

Auburn School of Fisheries, Aquaculture and Aquatic Sciences

Densities of age-0 and age-1 Gray Triggerfish, *Balistes capriscus*, and Vermilion Snapper, *Rhomboplites aurorubens*, will be estimated over a nine-year period (2007 to 2015), based on previous SCUBA diver visual surveys on small (1.4 m^3) artificial reefs on the continental shelf in the northern Gulf of Mexico. This time period included years both before and after the Deepwater Horizon oil spill in 2010, before and after substantial changes in Gray Triggerfish management regulations, and more recent substantial increases in the brown macroalgae, *Sargassum* spp., (Wang et al. 2019) that provides an important pelagic nursery habitat for Gray Triggerfish (Dooley 1972; Fahay 1975; Bortone et al. 1977; Wells and Rooker 2004). All of these factors could potentially affect Gray Triggerfish and Vermilion Snapper recruitment densities and subsequent year class strength.

All patch-reefs were placed at least 500 m apart and 500 m distant from any known reefs in the area (Simmons and Szedlmayer 2011; Mudrak and Szedlmayer 2012; Szedlmayer and Mudrak 2014; Mudrak and Szedlmayer In press).

All recruitment reefs were visually surveyed by SCUBA divers. Divers identified fish to species, counted all fish present on the reef and estimated their size in 25-mm total length (TL) intervals. Divers took up stationary positions 2 m from the reef and counted all fish within visible range of the reef over an approximate 15-min survey period. Diver surveys were validated through drop net–rotenone samples. New sets of reefs were deployed each year (N = 10 to 30) and were surveyed July, August, September, and October in each year of deployment and June the following year. At the time of the diver surveys, temperature, salinity and dissolved oxygen parameters were measured within 1 m of the bottom with a remote YSI 6920 meter.

To date, only the densities of Red Snapper, *Lutjanus campechanus*, have been quantified and evaluated from these visual surveys over this eight-year period (Szedlmayer and Mudrak 2014; Mudrak and Szedlmayer In press). The present proposal objective is to quantify, analyze and report on two important species (Gray Triggerfish and Vermilion Snapper) that also showed high recruitment densities to these patch reefs (Figure 1). These analyses and subsequent report would provide valuable information on recruitment patterns and early life history of these species that are presently under management by the Gulf of Mexico fishery Management Council. This report will be completed by December 2020. **Amount Requested:** $75,000.

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Figure 1. Small recruitment reef with new recruits of Gray Triggerfish that was deployed off coastal Alabama, U.S., in the northern Gulf of Mexico.

J Coordinating data and approaches to conduct a Kemp's ridley sea turtle stock assessment

Benny J. Gallaway (PI), Nathan F. Putman (Co-PI)
LGL Ecological Research Associates Inc., Bryan, Texas

Statement of Work
We propose to collaborate with NOAA Southeast Fisheries Science Center to lay the groundwork needed to conduct a stock assessment of the Kemp's ridley sea turtle (*Lepidochelys kempi*). The primary goal of this work will be to identify the modeling approach and data inputs needed to produce a mechanistic understanding of year to year variability and longer-term trends in nest counts at the index beaches in Tamaulipas, Mexico. This will require obtaining up-to-date data on previously used inputs for past stock assessments: hatchling production, strandings, shrimping effort, estimates of clutch frequency/remigration interval, nest counts, etc. (e.g., Gallaway et al. 2016a, 2016b). We will also investigate the value of integrating new data into a stock assessment such as pelagic-neritic juvenile recruitment indices, estimates in variability in distributions, environmental conditions, prey abundance (e.g., *Callinectes* spp.), etc.

This work will be carried out with colleagues at the Southeast Fisheries Science Center to identify what types of stock assessment model(s) would be most appropriate for incorporating the available time- and space-varying demographic, environmental, ecological, and anthropogenic (e.g., fisheries interactions, pollution) data.

In our 2012/2013 efforts to produce a stock assessment model for the Kemp's ridley we prioritized the broad participation of scientists from the state/federal government, academia, and the private sector to assure consensus from all stakeholders. Given that we will be building from that initial effort, we believe a more targeted approach to model updating/extension is the best path forward. This will allow us to use the requested funds primarily on addressing the scientific question at hand – "What is the best way to determine status and drivers of Kemp's ridley population abundance", rather than on travel/lodging costs for a large number of people.

Specific Objectives / Deliverables

1. Identify the biological and environmental information that is important to consider for generating a mechanistic/predictive stock assessment model for the Kemp's ridley (i.e., make a "wish list")
2. Determine the availability and format (e.g., point estimates, time-series, space-varying) of data that could be incorporated into a stock assessment model.
3. Given the types and quality of data available (Obj. 1 & 2), determine what stock assessment model(s) would be most powerful for the Kemp's ridley assessment.
4. Provide a report to the Gulf of Mexico Fisheries Management Council and NOAA Southeast Fisheries Science Center.

Project timeline

We will meet with colleagues at NOAA Southeast Fisheries Science Center to complete Objective 1 and begin Objective 2. Objectives 2 - 4 will be completed through coordination by phone/email.

	2020		
Activity	**Jan**	**Feb**	**Mar**
Project start date (Jan 1, 2020)			
Objective 1: Identify preferred data inputs			
Objective 2: Determine data availability			
Objective 3: Determine best modeling approach			
Provide Report to GMFMC and SEFSC			

Relevance to Stock Assessment and Management

Recently published syntheses on trends in reproductive output (e.g., Gallaway et al. 2016a,b; Caillouet et al. 2016, 2018; Kocmoud et al. 2018) clearly show that the present state of knowledge is insufficient to draw firm conclusions on the status of the Kemp's ridley population. Annual nest counts, the only index of the Kemp's ridley population, were steadily climbing prior to 2010. In that year nesting dropped substantially and have since varied widely; continued recovery of the population has not been indicated.

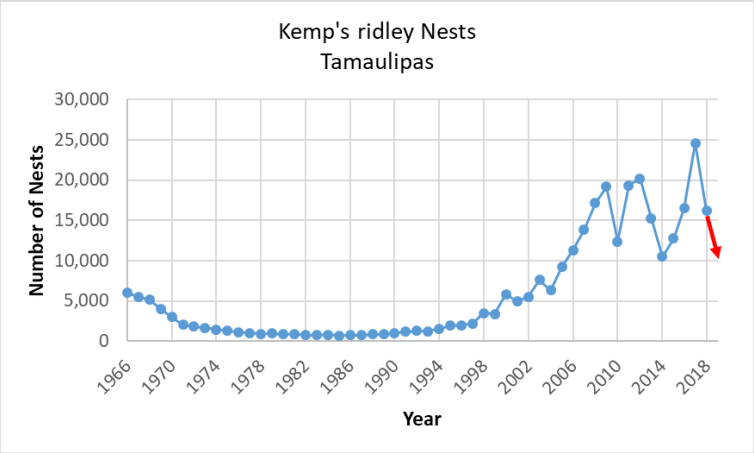

Fig. 1. Kemp's ridley nests at Rancho Nuevo, Mexico from 1966 – 2018, the red arrow is preliminary data for 2019.

In fact, in the past two years large declines in nesting have been observed (Fig. 1). Preliminary indications are that more than two times as many nests would be needed to reach the 25,000 nest benchmark that was set for downlisting. Whether this represents mortality in nesting females or reduced body condition so that fewer nests are laid is not known. Regardless, it means that reproductive output of Kemp's ridley has dropped. What will this mean for Kemp's ridley in the future? What are the implications for managing this species and the fisheries in the Gulf of Mexico? Waiting to see what happens next year is not the answer. With the large drop in nesting over the past two years, even if nesting increased each of the next four years it would be nearly impossible to gauge whether this represented resumed population growth. The lack of continued growth is a concern and determining the causes should be prioritized.

Despite the present uncertainty, it is also apparent that developing a mechanistic understanding of spatiotemporal variation in Kemp's ridley abundance and its role in population dynamics is within reach. In 2012, the GSMFC funded the development of a stock assessment model for Kemp's ridley. For

the first time, spatiotemporal variation in shrimping effort was explicitly considered when estimating Kemp's ridley mortality. Another valuable addition to this model, compared to previous ones, was generating natural mortality estimates based on size data of Kemp's ridley strandings. Further, in 2014, the Gulf of Mexico Fishery Management Council provided funding to update the model. These efforts resulted in two manuscripts published in *Gulf of Mexico Science* (Gallaway et al. 2016a, b). The main conclusions from those papers were that (1) mortality resulting from shrimping was unlikely to be the cause of the apparent departure from exponential growth of the nesting index that occurred in 2010 and (2) the emergence of density-dependence in Kemp's ridley population growth (i.e., owing to an increase in the abundance of neritic age-classes) can account for the lack of "population rebound" following the 2010 downturn in nest counts. By identifying how to incorporate other environmental and anthropogenic indices into a new stock assessment model we anticipate a more robust model that provides a mechanistic understanding of the Kemp's ridley population. This will lead to an improved ability to predict changes in response to management actions in a dynamic marine environment.
Amount requested: $50,000 ($25,000 to LGL, $5,000 for travel, $20,000 to SEFSC)

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