



Eastern Gulf: A Synopsis of Research on Recreational Fishing Practices and Discard Mortality

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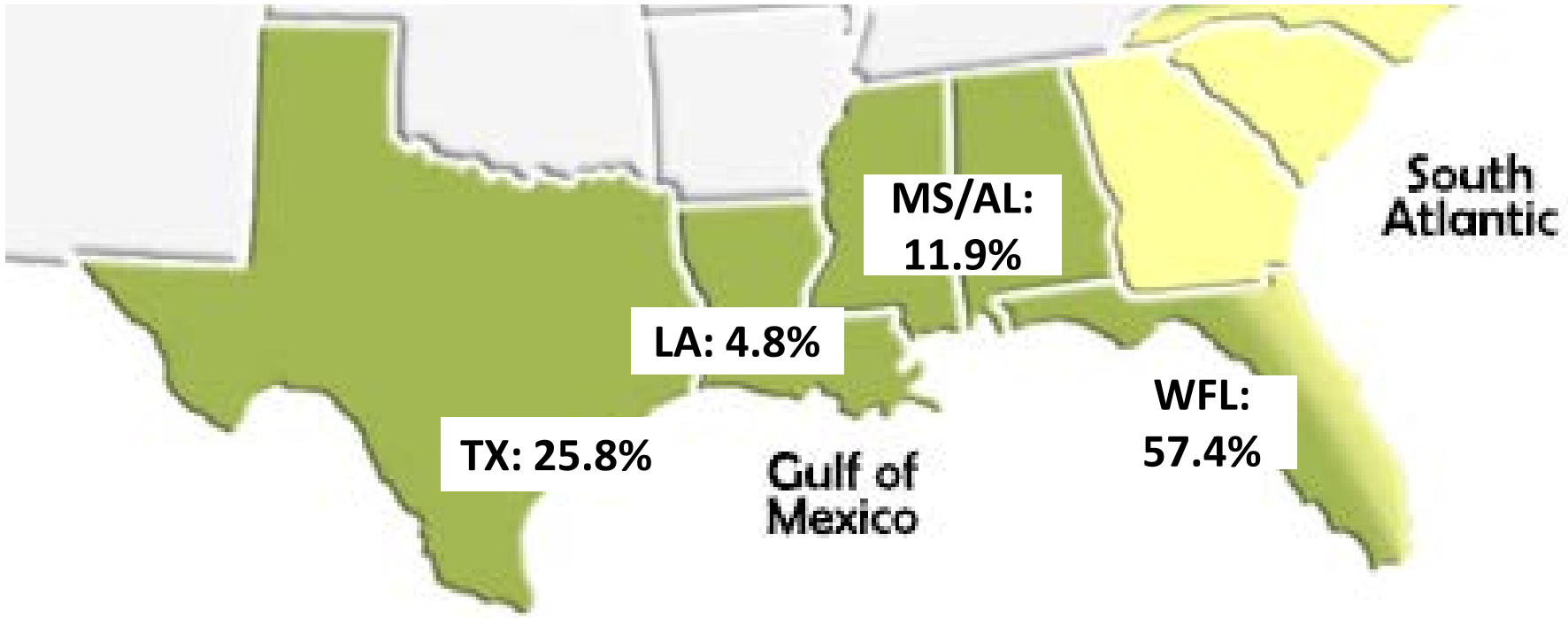
My Background

- Fisheries Dependent Monitoring Program Leader, FWC/FWRI
  - Statewide programs collect vital data on:
    - Magnitude of landings and discards
    - Fishing practices
    - Size and age of landed and discarded fish
    - Discard mortality
  - PI or collaborator on over a decade of monitoring and research related to discard mortality of reef fishes in Gulf of Mexico and South Atlantic
- M.S. Marine Resource Assessment, University of South Florida
  - Discard mortality of gag grouper in recreational fishery

Recreational Effort is Concentrated in Eastern Gulf

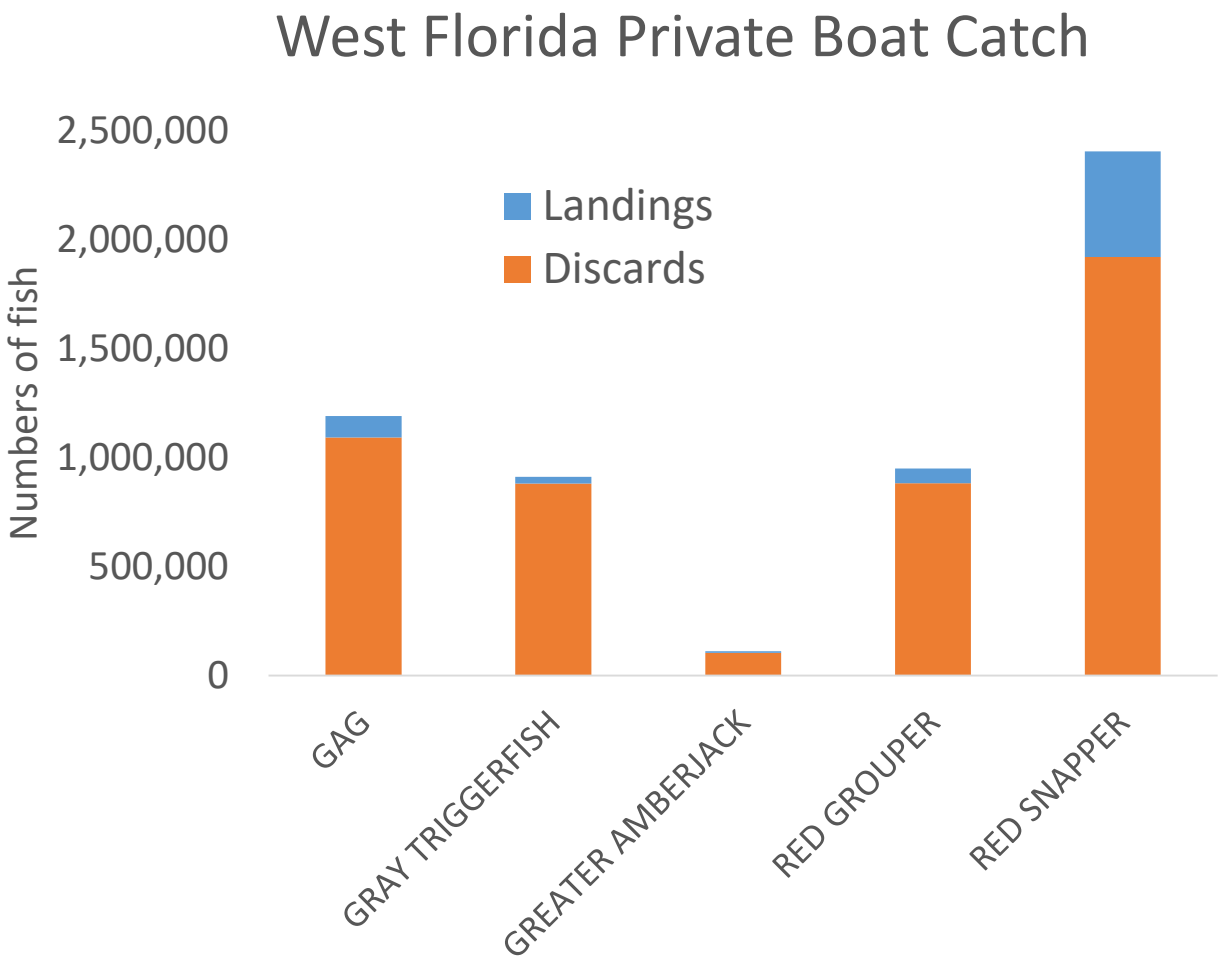


31.6 million angler days

Source: 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation

Discard Rates in Eastern Gulf

- Majority of Reef Fish caught by anglers are discarded
- High effort + high discard rate = large magnitude of discards
- Even low mortality rate equates to significant removals

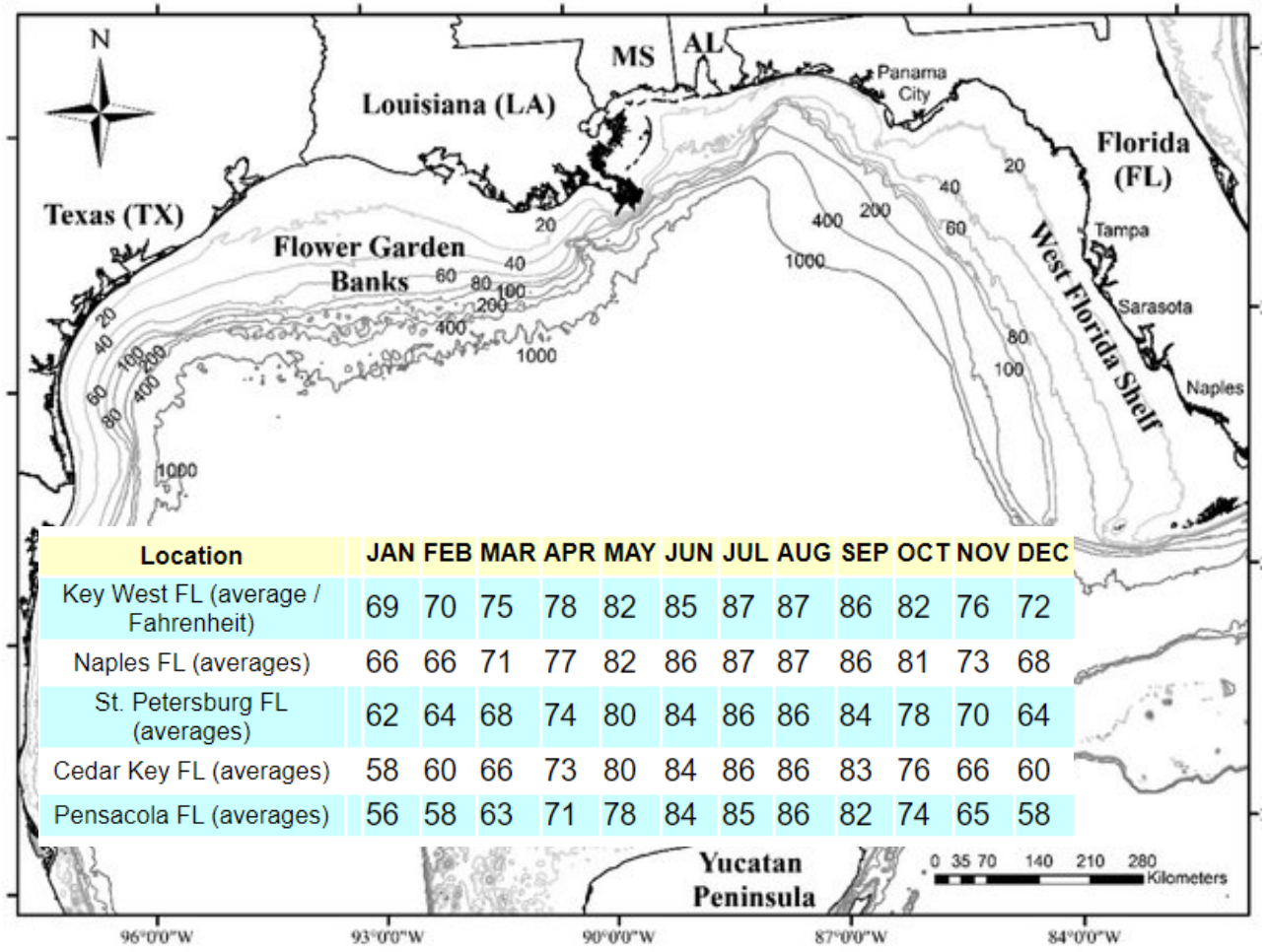


Source: 2017 Gulf Reef Fish Survey

Many Sources of Discard (Release) Mortality

What, Where and When is Important in GOM

- Region
  - Eastern Gulf characterized by broad, shallow West Florida Shelf
- Fishing depth
  - Barotrauma may be mild to severe based on depth of capture
  - Recreational effort concentrated nearshore, offshore fishing more specialized
- Water temperature
  - Warm water holds less oxygen
  - Eastern Gulf ≥80 degrees F May-Sep/Oct
  - Winter temps. higher in southern latitudes
  - Thermocline is weak in Eastern Gulf
- Some species more vulnerable
  - Feeding and mouth morphology
  - Volume and elasticity of swim bladder
  - Life history

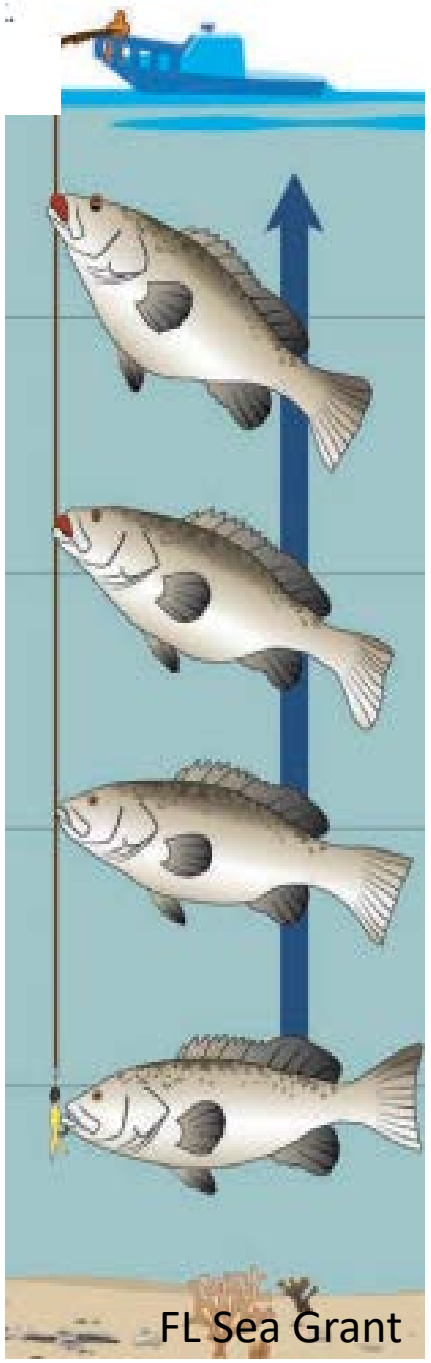


Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Key West FL (average / Fahrenheit)	69	70	75	78	82	85	87	87	86	82	76	72
Naples FL (averages)	66	66	71	77	82	86	87	87	86	81	73	68
St. Petersburg FL (averages)	62	64	68	74	80	84	86	86	84	78	70	64
Cedar Key FL (averages)	58	60	66	73	80	84	86	86	83	76	66	60
Pensacola FL (averages)	56	58	63	71	78	84	85	86	82	74	65	58

Map: Sagarese et al. 2017

Depth-Related Barotrauma

- As fish are retrieved to surface, air becomes less compressed (termed decompression) and swim bladder expands.
  - Inflated swim bladder may cause other complications – barotrauma
- Mortality in shallow depths relatively low, mostly attributed to factors other than barotrauma
  - Gray Snapper: 1.4% inshore up to 10m, 14.4% nearshore in 10-25m
    - (Flaherty-Walia et al. 2016, N. Amer. J. Fish. Mgt.)
  - Gag: <10% in depths up to 20m, 15% 21-30m
    - (Sauls 2014, Fish. Res.; Lombardi et al. 2013, SEDAR 33)
- Increased swimming impairment with depth and fish size
  - Red Snapper, Gray Triggerfish (Patterson et al. 2002, GCFI)
  - Red Snapper (Sauls et al. 2017, SEDAR 52)
- Injuries may be catastrophic in deeper depths
  - Red Grouper: Severe exopthalmia and cranial hemorrhaging at 43m
    - (Burns 2009, PhD Dissertation)
  - Red Snapper: Mortality as low as 20% at 0-20m, increased to 100% at 110m
    - (Rummer 2007, AFS Symp. 60; Rummer and Bennett 2005, Trans. Amer. Fish. Soc.)



Swim Bladder Physiology

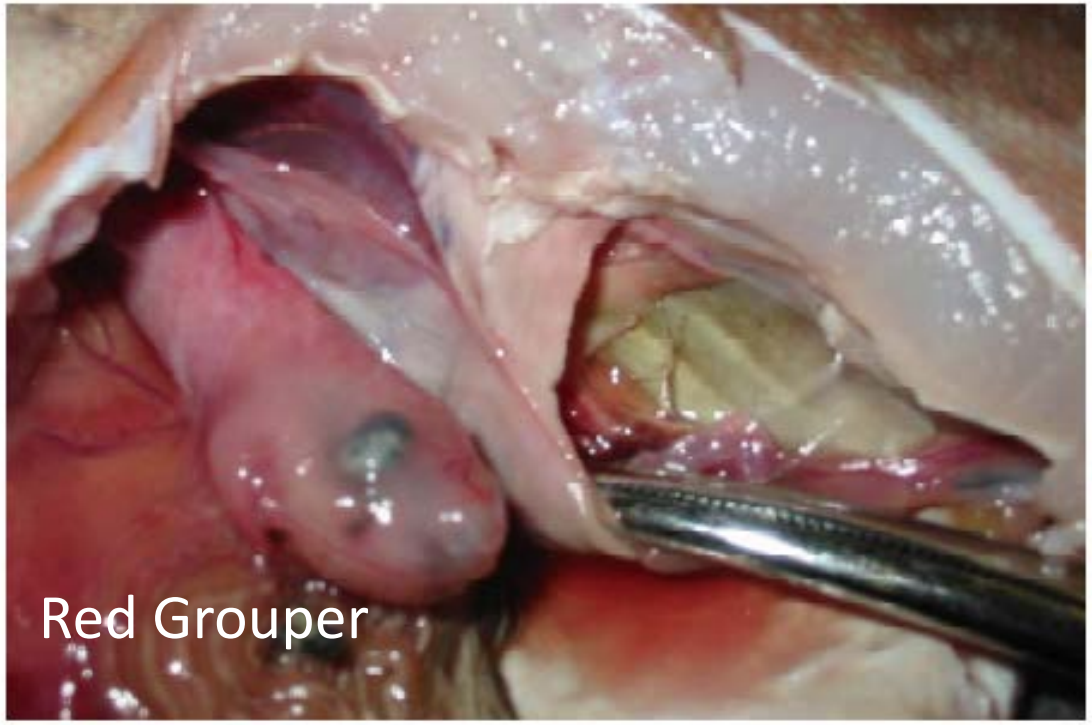


Figure 3-9. Initial rupture in a red grouper swim bladder.

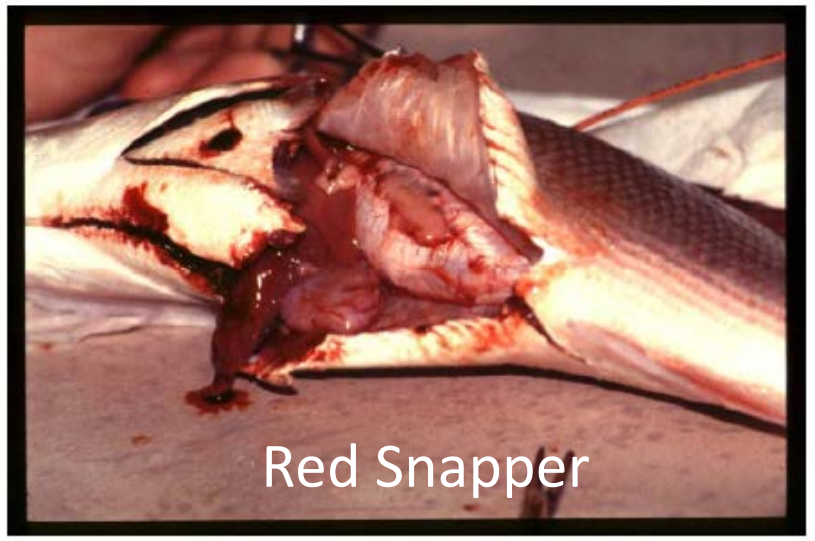


Figure 3-8. Inflated red snapper swim bladder showing swim bladder size in proportion to total body size.

Figure 3-10. Initial rupture in a red snapper swim bladder.

Karen Burns, 2009 PhD Dissertation

Murie, D.J., and D.C. Parkyn. 2013. 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. Final report for Cooperative Research Program NA09NMF4330147 (08/01/2009 - 07/31/2013)

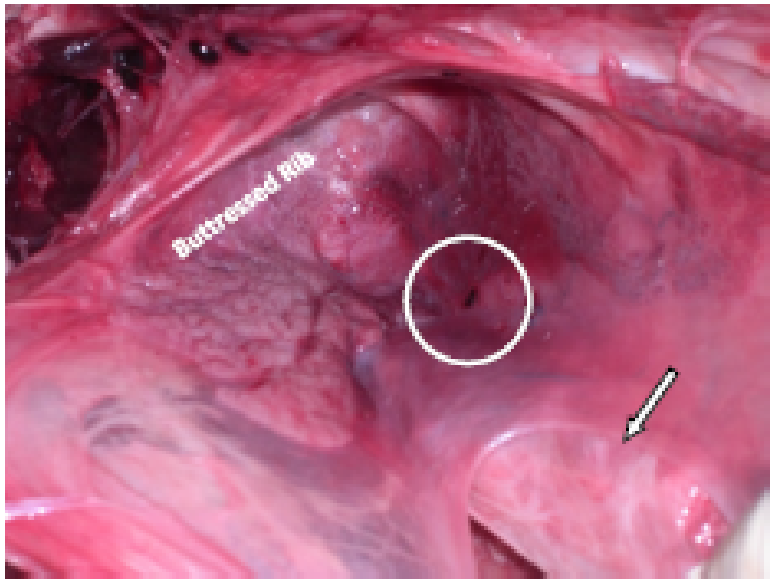


Figure 11. Inside view of the anterio-dorsal portion of a swimbladder from a greater amberjack that self-vented on ascent. A tear in tissue in anterior portion of the swimbladder at the supracleithral bone as viewed from inside the bladder (enclosed by the circle). This is the source of gas bubbles coming out of the operculum of fish being brought to the surface. The relaxed edge of the sphincter muscle of the ovale is indicated by the white arrow. In physoclistic fish, this sphincter is typically contracted in a neutrally buoyant animal to prevent oxygen from being resorbed into the bloodstream from the gas bladder. One of the strong buttressing ribs of the thoracic region is labelled. Photo by D. Parkyn.

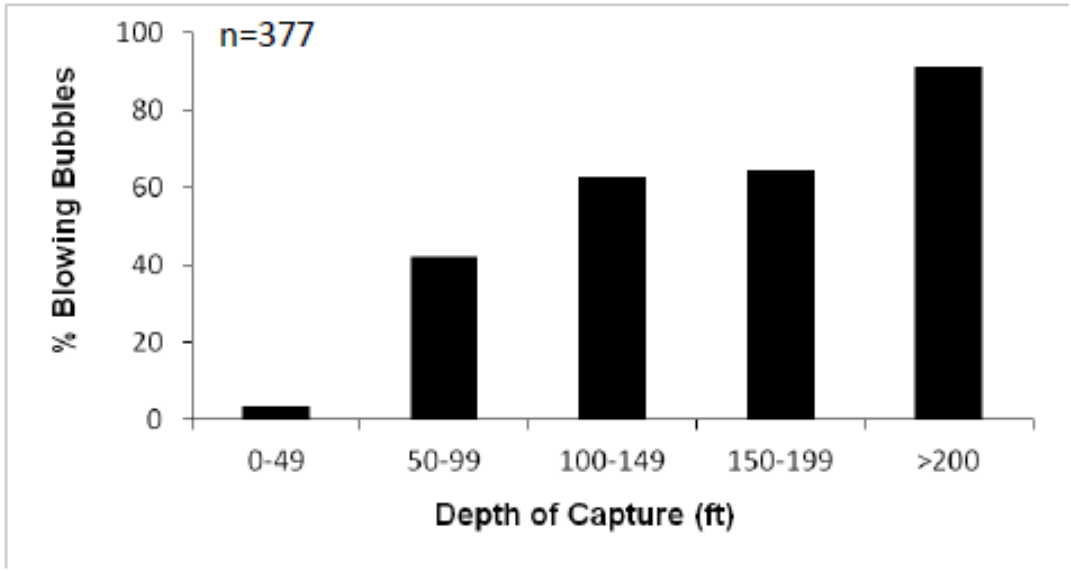


Figure 13. Percentage of greater amberjack self-venting by "blowing bubbles" as a function of capture depth.

Venting improved survival of Gr. Amberjack caught >200'

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Low discard survival of gray triggerfish in the southeastern US hook-and-line fishery

Brendan J. Runde[a,*], Paul J. Rudershausen[a], Beverly Sauls[b], Chloe S. Mikles[a], Jeffrey A. Buckel[a]

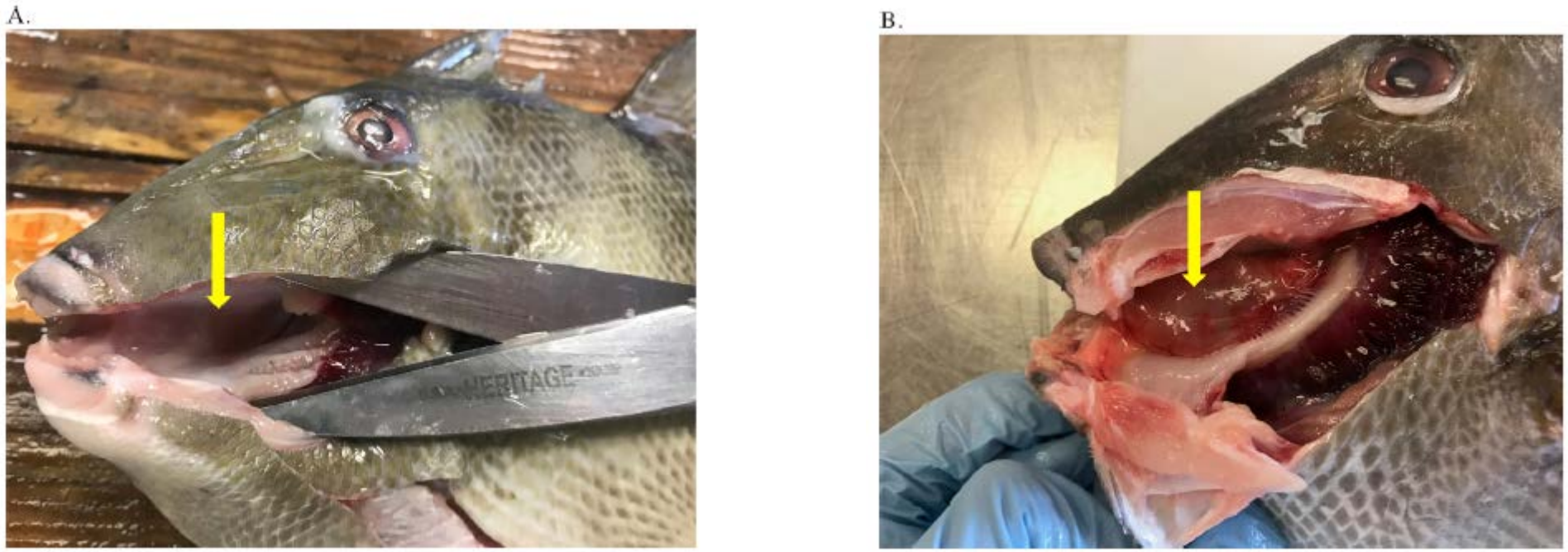


Fig. 4. Image of gray triggerfish *Balistes capriscus* with a clear buccal cavity (A) and of gray triggerfish with a buccal cavity blocked by intestine (B). Yellow arrows indicate the buccal cavity, and in B, prolapsed intestine in the buccal cavity and caught in the first gill arch. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Other Important Factors

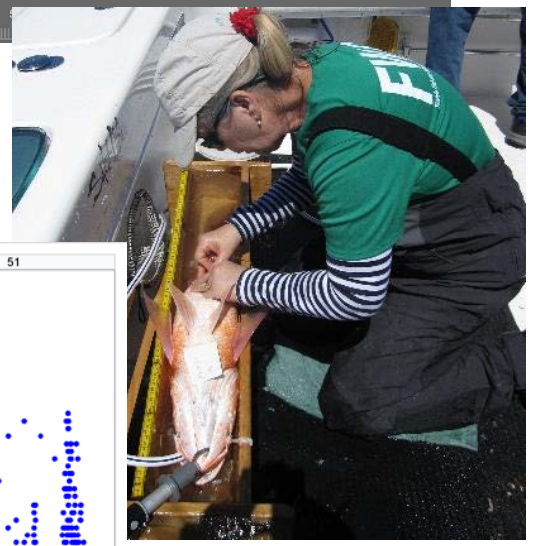
- Air exposure
  - High temperatures (hot deck)
  - Oxygen depravation
  - Prolonged during measurement for legality, hook removal, barotrauma mitigation
- Predation
  - Displaced fish swim through water column to return to protective habitat
  - Recompression helps fish overcome impairments, rapidly returns fish to habitat
  - Unimpaired fish may be less able to escape predation when tethered to device (needs more research)

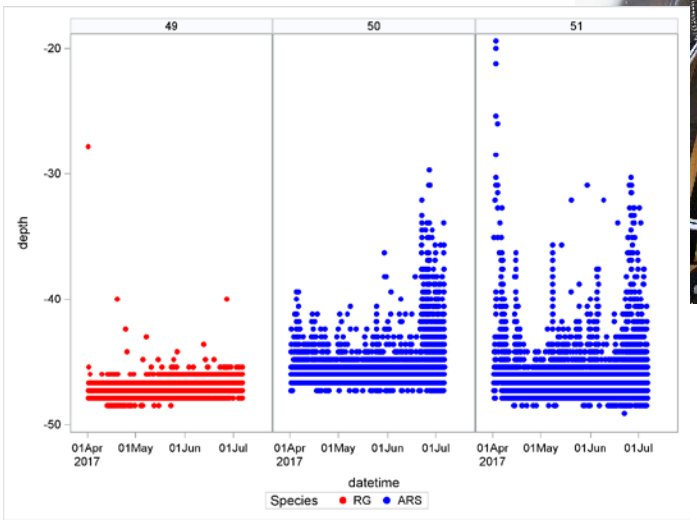
Measuring Discard Mortality in a Fishery

- Requires comprehensive studies that take into account the many variable factors:
  - Spatial and temporal distribution of fishing effort
    - How it relates to species abundance and life history
  - Selectivity
  - Gear used
    - Hook types, de-hooking methods
  - Release methods
    - Factors influencing decision to mitigate barotrauma
    - Variable methods for venting or recompressing fish
- Requires ongoing monitoring for up-to-date assessment and management
  - Fisheries change in response to regulations, fish abundance, social norms, networking

Tagging Studies

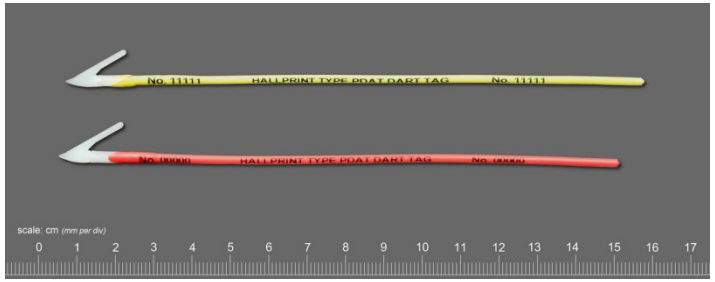
- Measure all sources of mortality
- Conventional tags used to compare relative recapture rates and explain variable survival among groups
  - Pros:
    - Low cost, high sample sizes
    - External tags quickly attached prior to release
    - Good for measuring true conditions within a fishery
  - Cons:
    - Cannot isolate impact of individual effects
    - Low return rates, require very large sample sizes
- Acoustic tags tracks fate of individual fish through time
  - Pros:
    - All fish in array have known fate
    - Can isolate impacts of predation
  - Cons:
    - Expensive, low sample sizes
    - Tags surgically implanted or attached
    - Fish must be in array to be detected
- Use of both types of studies together most informative





Monitoring Recreational Discarding At-Sea

- FWC fishery observers ride along during for-hire fishing trips
- Observe discards as they are caught and record:
  - Location and depth of capture
  - Hook type, size
  - Species and length
  - Injuries and impairments
  - Whether released unvented, vented, or recompressed
- Categorize fish by release condition
- Mark with conventional tags
  - More than 100,000 discards tagged since 2009
  - Model relative recapture rates (Sauls 2014)
  - Estimate survival
- Contributes to regional stock assessments
- Viable method for other regions in the Gulf



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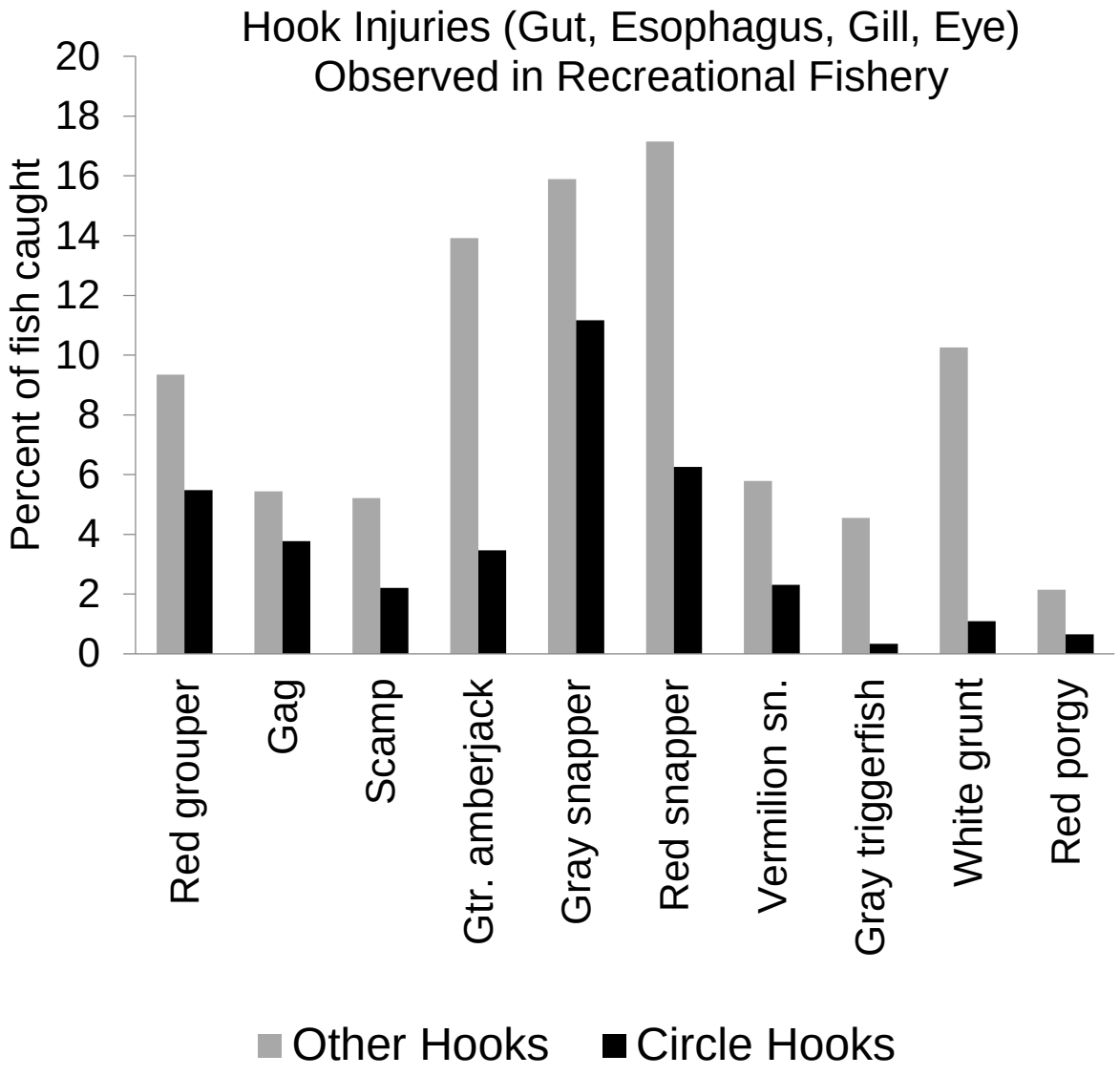
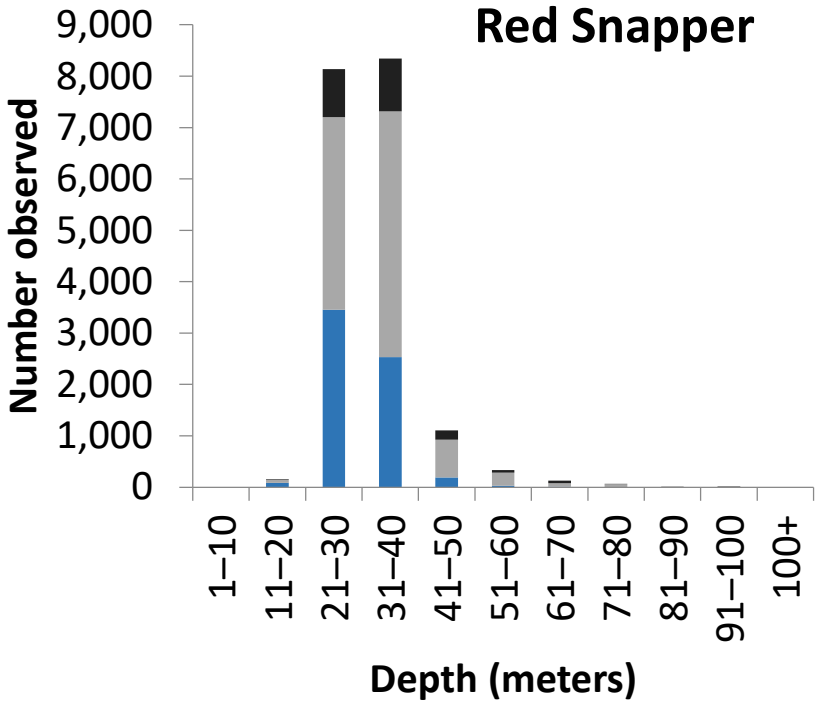
Hook Injuries

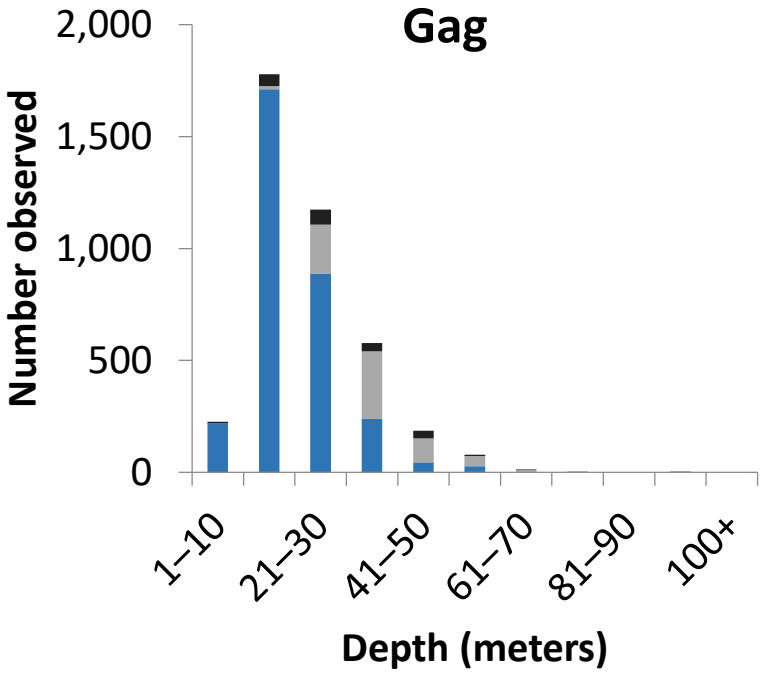
- Different rates among species
  - Can be main source of mortality in shallow depths
- Circle hooks
  - Compliance less than 100%
  - Reduce deep hooking for most reef fishes
    - (Sauls and Ayala 2012, Bull. Mar. Sci.)
  - Yellowtail and mutton snappers caught with offset J hooks had fewer injuries
    - (Sauls and Ayala 2016, MARFIN final report)

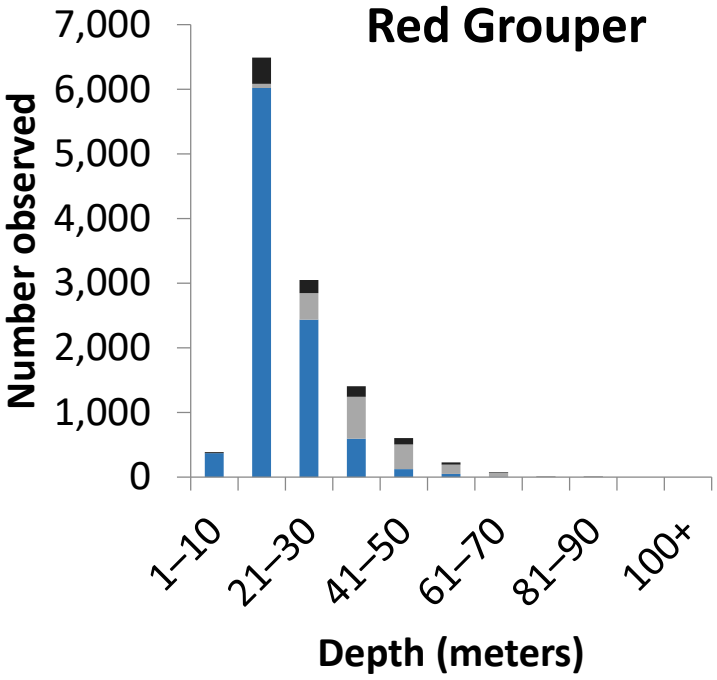


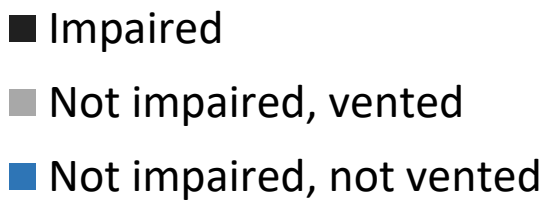
Sauls and Ayala, 2012. Bull. Mar. Sci.

When is Barotrauma Mitigation Needed?





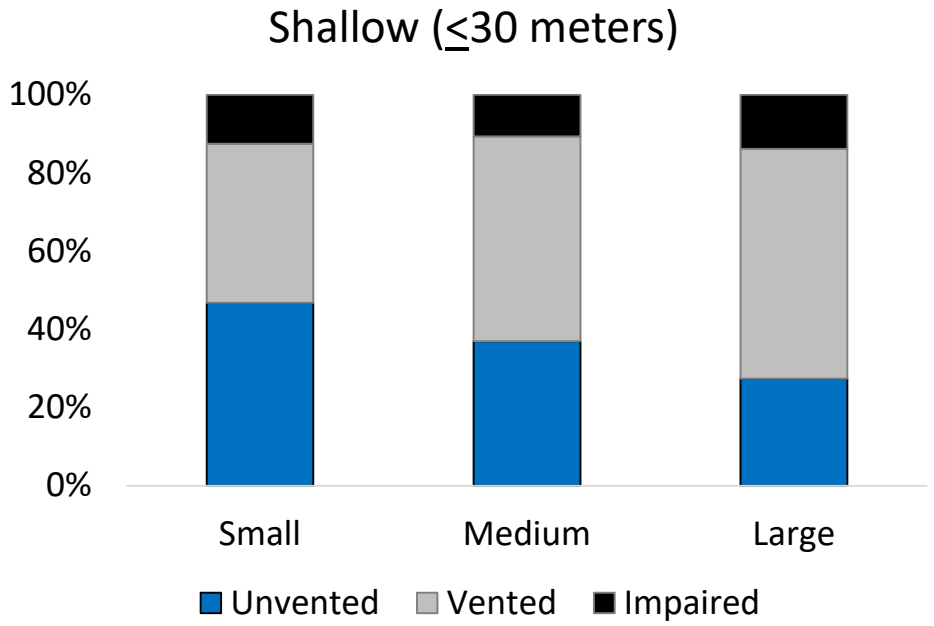


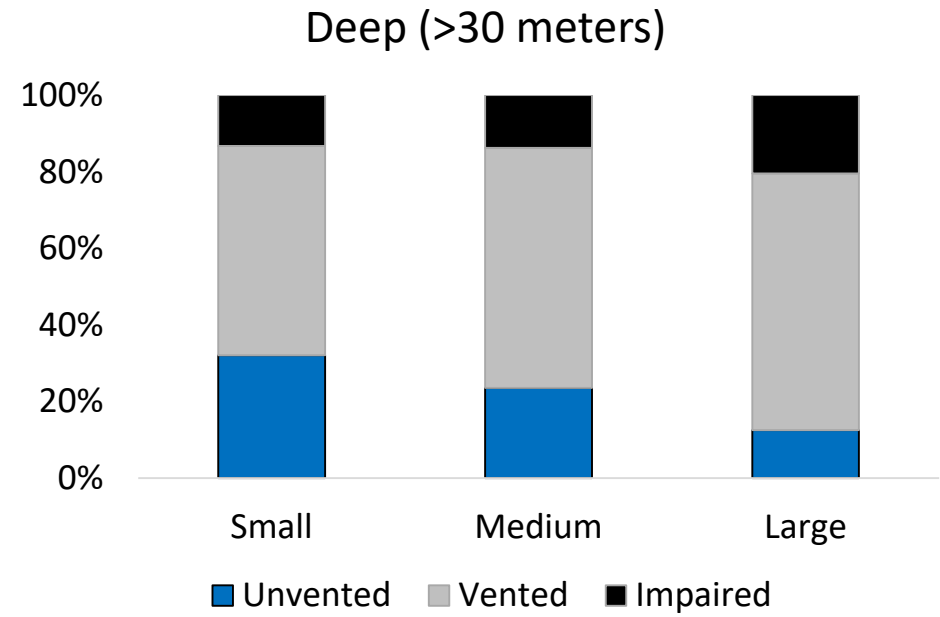


Source: Sauls, B., O. Ayala and R. Cody. 2014.

Red Snapper

- Percentages of discards observed from charter boats and headboats in the Eastern Gulf
  - Fish Length:
    - Small <404mm TL (<16”)
    - Medium 404-507mm TL (16-20”)
    - Large >507mm TL (>20”)
  - Release condition:
    - Unvented: submerged immediately without the need for barotrauma mitigation
    - Vented: submerged immediately after venting
    - Impaired: buoyant, disoriented, injured
- Positive linear association between increased length and severity of impairment
  - Cochran-Mantel-Haenszel Statistic = 448.9, p <0.0001





Source: Sauls et al. 2017. SEDAR 52, Working Paper 09

Fisheries Research 150 (2014) 18–27

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Relative survival of gags *Mycteroperca microlepis* released within a recreational hook-and-line fishery: Application of the Cox Regression Model to control for heterogeneity in a large-scale mark-recapture study

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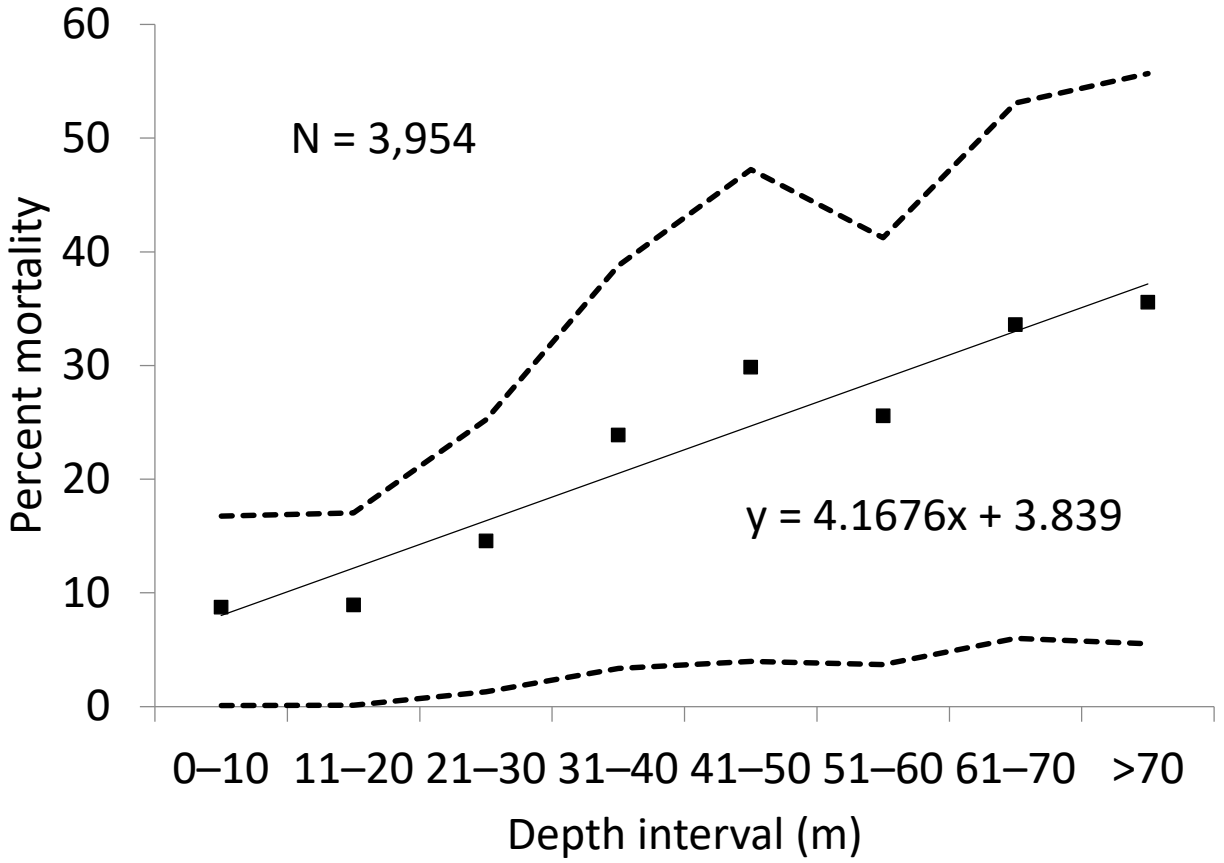
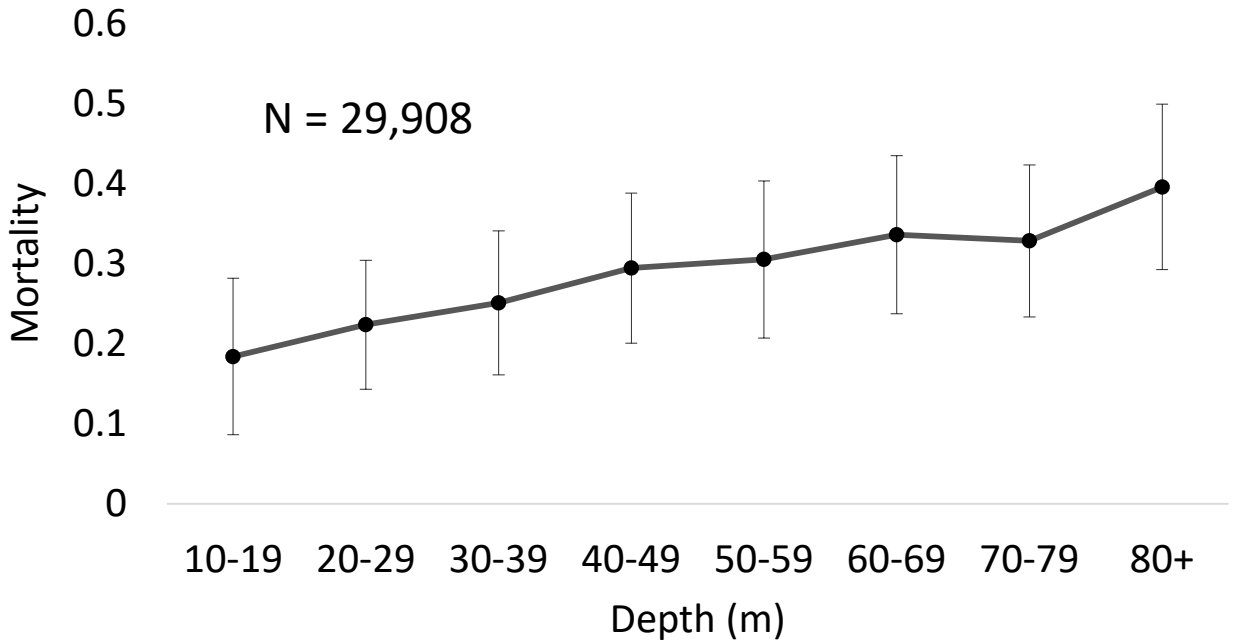
[b] University of South Florida, College of Marine Science, 140 7th Avenue S, MSL 119, Saint Petersburg, FL 33701, USA

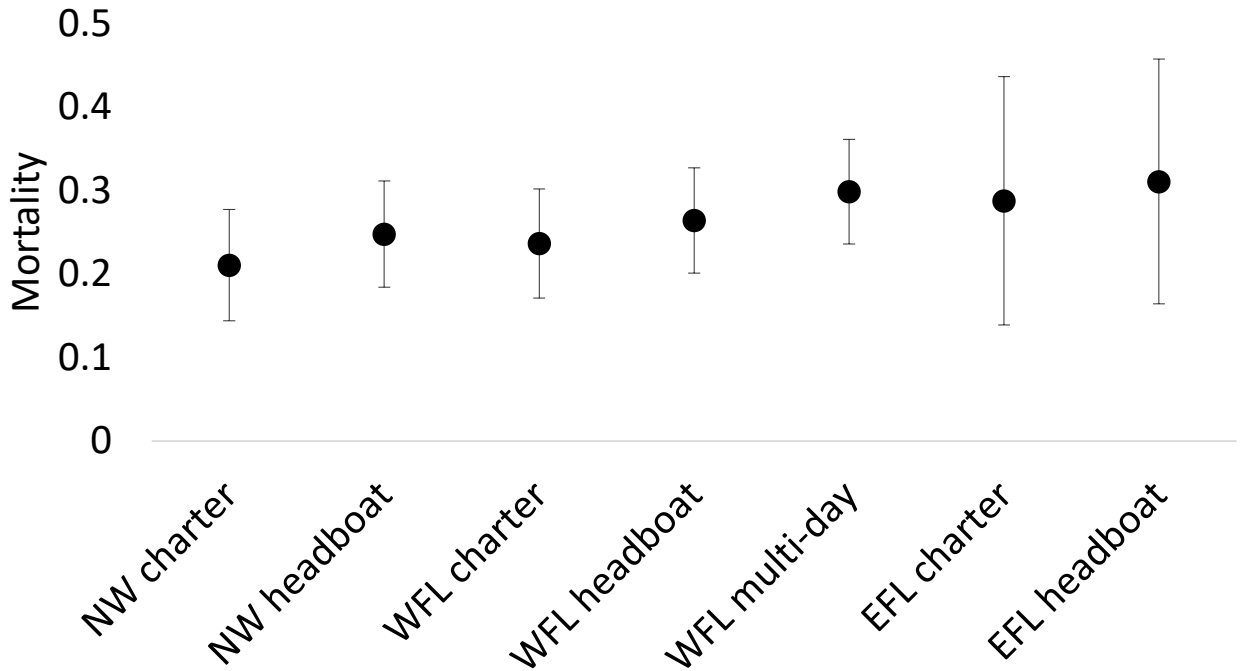
- Modeled times at large among individual fish released in different conditions
  - Uses both recaptured and censored fish
  - Covariates account for variable recapture rates
- Estimated mortality increased with depth
  - ~10% up to 20m
  - 36% at >70m
- Majority of gags caught shallow, no impairment
  - 77% released in good condition without venting
- Overall mortality in fishery 14%



Red Snapper

- Estimated discard mortality increased with depth:
  - 18% <20m
  - 40% >79m
- Across all depths that the fishery operates, overall mortality ranged 21-29% in Gulf





Source: Sauls et al. 2017. SEDAR 52, Working Paper 09

Surface Release vs. Recompression

- Source:
  - O. Ayala, unpublished thesis research
  - Sauls, B., O. Ayala and T. Cross, 2016, BREP
- Compared conventional tag-recapture rates for fish released at surface vs. rapid recompression
  - Fish retrieved from 100-140’ depths
  - Majority of surface released fish required venting
- Red Snapper:
  - Recapture rates higher for recompressed fish
  - A recompression depth of 60 feet is better than 30 feet
  - Fish recompressed >60’, no significant increase in recapture rates
  - Not necessary to recompress fish all the way to the bottom
- Red Grouper:
  - No significant differences in recapture rates between surface released and recompressed fish

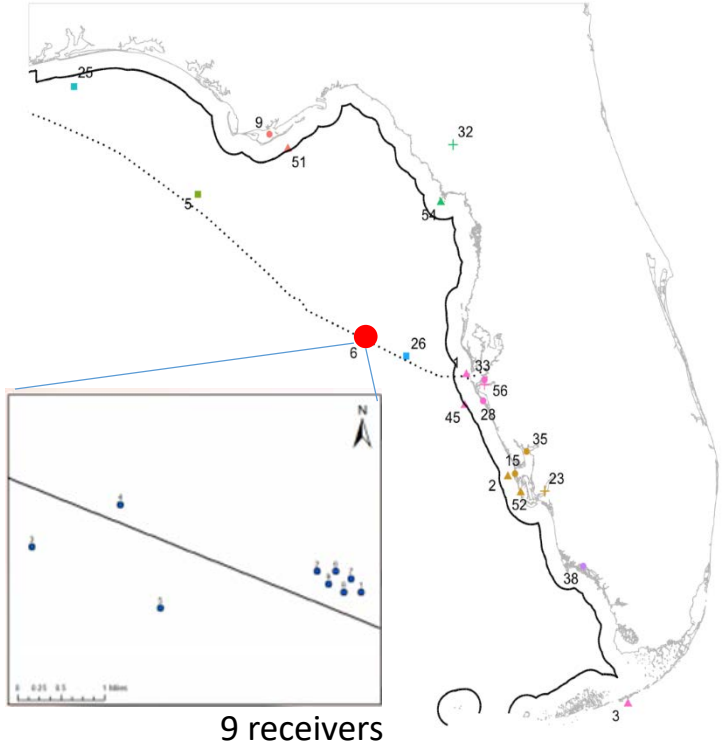
Red grouper and red snapper (depth ~156') collaboration with Ed Walker

- Fish caught on hook and line, acoustically tagged (with pressure sensors), & released w/ seaqualizers; site fidelity & survival were fairly high.

  - **Red grouper (n=27):**
    - 4 fish fate unknown (i.e. detected for less than 2 weeks); 100% survival of fish detected for 2 weeks or more (n=23); 82% detected > 100 d
    - 8 fish recaptured by our research team in consequent sampling, released a second time & survived
    - Emigration with major storms not observed

  - **Red snapper (n=34):**
    - 4 fish detected < 2 weeks=fate unknown; 90% survival of fish detected 2 weeks or more (n=30); 70% of survivors detected > 100 d.
    - Emigration was seen in 6 fish following major storms (Colin, Irma, and Michael)

Acoustic arrays off Florida



9 receivers

Red Snapper and Greater Amberjack (depth ~252') in an MPA

- Fish caught on hook and line, acoustically tagged (with pressure sensors), & released with seaqualizers; red snapper survival from 90% to 36%

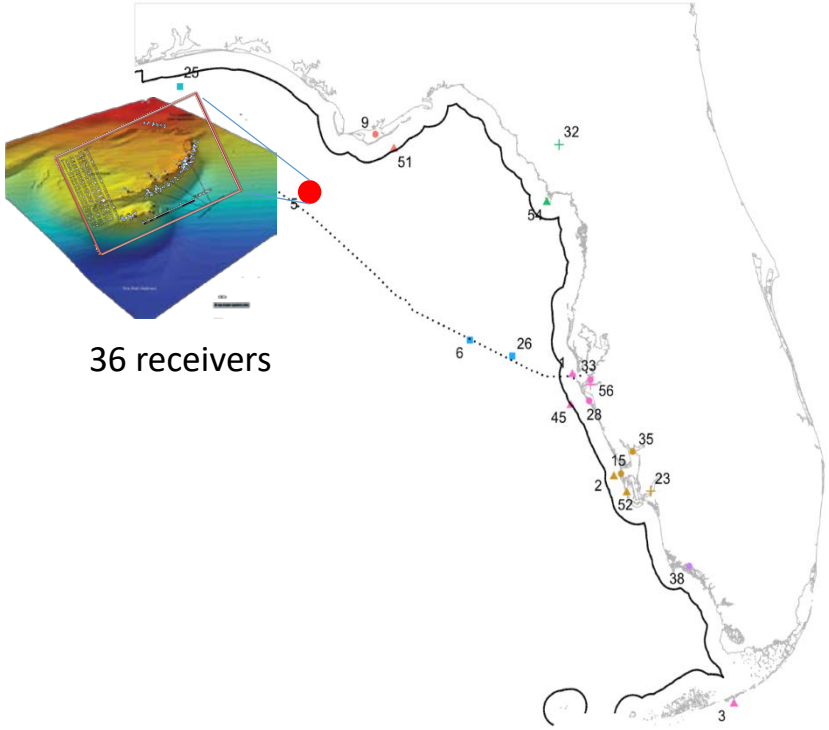
Red snapper (n=36)

- Similar survival with external (n=15) vs internal (n=21) tag attachment
  - 8 fish fate unknown; 36% survival of fish detected for 2 weeks or more (n=28); 75% of survivors (n=8) detected > 100d
  - *One fish with unknown fate recaptured by a fisherman 9/20/2019*
  - 3 fish caught a 2nd time and did not survive

Greater amberjack (n=20):

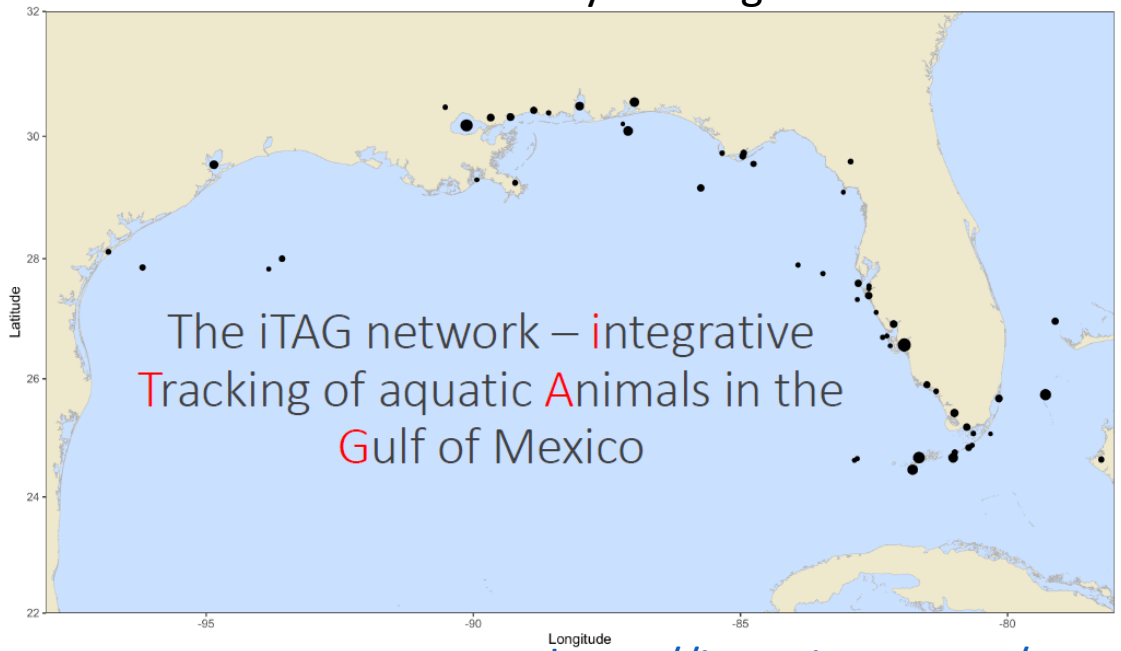
- 3 fish fate unknown; 94% survival of fish detected for 2 weeks or more (n=17)
- Site fidelity tied to spawning season; 8 fish returned the following spawning season

Acoustic arrays off Florida



36 receivers

iTAG members receiver arrays throughout the Gulf



>100 members sharing data https://itagscience.com/

- Discard mortality is caused by multiple causes including predation.
- By integrating traditional tagging with electronic tracking we can begin to predict spatio-temporal windows associated with high predation and/or by-catch potential.
- iTAG can play an important role in this effort, given its proven track record working with scientists throughout the Gulf, cumulative knowledge of best practices, and a steering committee drawing from academia, government, and industry representatives.

iTAG steering committee:

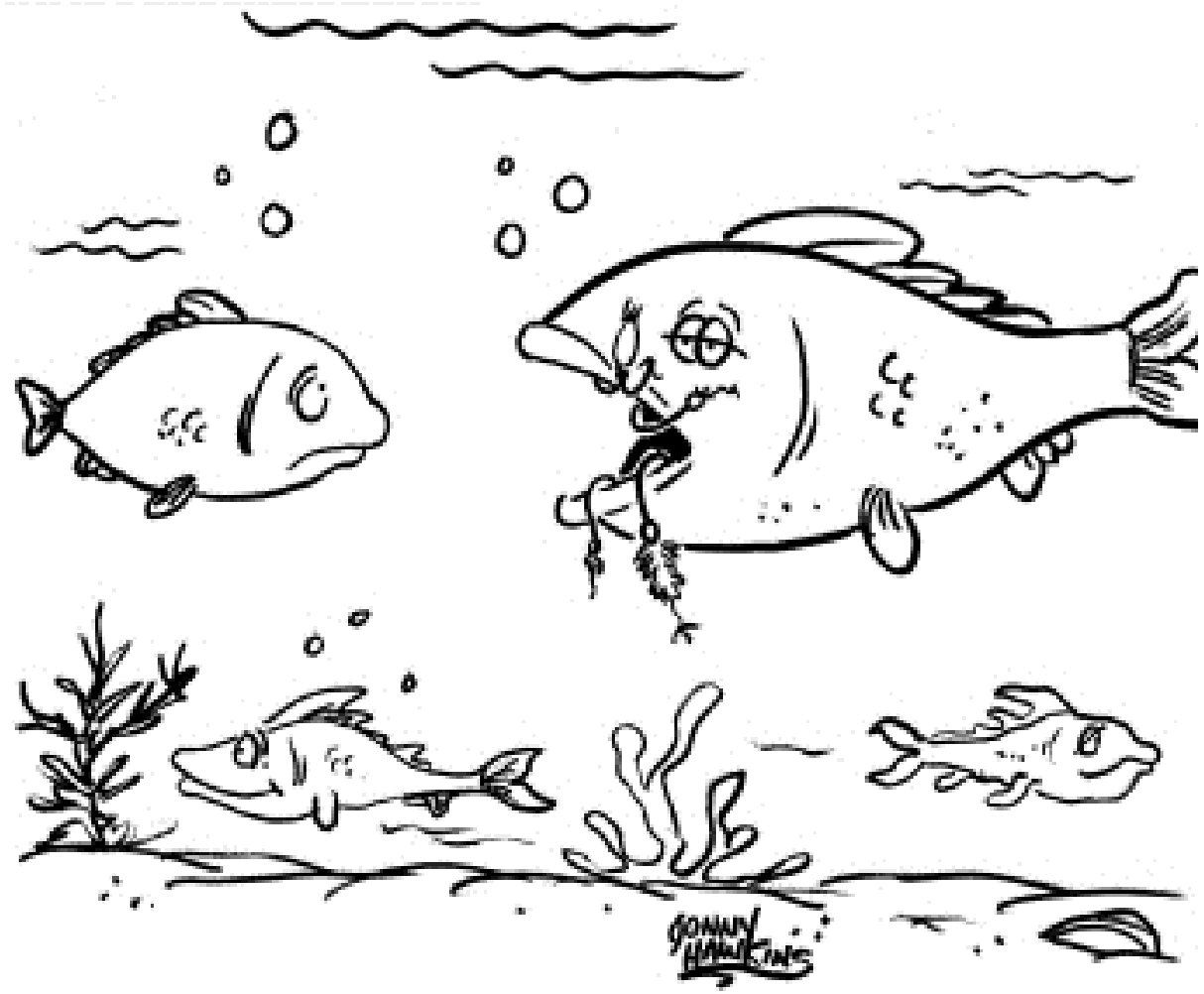
S. Barbieri W. Patterson C. Porch D. Addis G. Stunz R. Perry J. DeLaCruz







Questions?



"Stories? Oh, I have a few."

Literature Cited

- Burns, K. 2009. Evaluation of the efficacy of the minimum size rule in the red grouper and red snapper fisheries with respect to J and circle hook mortality and barotrauma and the consequences for survival and movement. Dissertation, Univ. of South Florida. UMI number 3394136
- Kerry E. Flaherty-Walia, Brent L. Winner, Amanda J. Tyler-Jedlund & John P. Davis (2016) Short-Term Discard Mortality Estimates for Gray Snapper in a West-Central Florida Estuary and Adjacent Nearshore Gulf of Mexico Waters, N. Amer. J. Fish. Mgt., 36:2, 329-340
- Lombardi, L., M.D. Campbell, B. Sauls, and K.J. McCarthy. 2013. A meta-data analysis of discard mortality estimates for gag grouper and greater amberjack. SEDAR33-DW19. SEDAR, North Charleston, SC. 24 pp.
- Patterson, W.F. III, G.W. Ingram, R.L. Shipp, J.H. Cowan. 2002. Indirect estimation of red snapper and gray triggerfish release mortality. GCFI 53: 526-536
- Rummer, J.L., 2007. Factors affecting catch and release (CAR) mortality in fish: insight into CAR mortality in red snapper and the influence of catastrophic decompression. Am. Fish. Soc. Symp. 60, 3–144.
- Rummer, J. and W. Bennett. 2005. Physiological effects of swim bladder overexpansion and catastrophic decompression on red snapper. Trans. Amer. Fish. Soc. 134: 1457-1470.
- Murie, D. and D. Parkyn. 2013. Release mortality of Gulf of Mexico greater amberjack from commercial and recreational hook-and-line fisheries: Integration of fishing practices, environmental parameters, and fish physiological attributes. Final Report for Cooperative Research Program NA09NMF4330147.
- Runde, B.J., P.J. Rudershausen, B. Sauls, C.S. Mickles and J.A. Buckel. 2019. Low discard survival of gray triggerfish in the southeastern U.S. hook-and-line fishery. Fisheries Research 219: 1-9
- Sauls, B., O. Ayala, R. Germeroth, J. Solomon, R. Brody. 2017. Red Snapper Discard Mortality in Florida's Recreational Fisheries. SEDAR52-WP-09. SEDAR, North Charleston, SC. http://sedarweb.org/sedar-52-dataassessment-workshop

Literature Cited (continued)

- Sauls, B. and O. Ayala. 2016. A Survey to Characterize Harvest and Regulatory Discards in the Offshore Recreational Charter Fishery off the Atlantic Coast of Florida. Final report submitted to NOAA Fisheries, Marine Fisheries Initiative (MARFIN). Grant NA12NMF4330094.
- Sauls, B., O. Ayala, T. Cross. 2016. Testing an alternative method for the safe release of reef fishes caught on hook-and-line gear in the recreational fishery in the Gulf of Mexico. Final report submitted to NOAA Fisheries, Bycatch Reduction Engineering Program (BREP). Grant NA13NMF4720270. FWC-FWRI File Code F4146-13-16-F
- 2014. Sauls, B. Relative survival of gags *Mycteroperca microlepis* released within a recreational hook-and-line fishery: application of the Cox regression model to control for heterogeneity in a large-scale mark-recapture study. Fisheries Research 150: 18-27.
- Sauls, B., O. Ayala, R. Cody. 2014. A Directed Study of the Recreational Red Snapper Fisheries in the Gulf of Mexico along the West Florida Shelf. Final Report for grant NA09NMF4720265 to National Marine Fisheries Service, Southeast Region Office. FWC-FWRI file code F2794-09-13-F. Available at: http://sedarweb.org/sedar-42-rd-01-directed-study-recreational-red-snapper-fisheries-gulf-mexico-along-west-florida
- Sauls, B. 2013. Relative survival of gags *Mycteroperca microlepis* released within a recreational hook-and-line fishery: application of the Cox regression model to control for heterogeneity in a large-scale mark-recapture study. Thesis submitted to the University of South Florida, College of Marine Science, Marine Resource Assessment Program. Available at: http://scholarcommons.usf.edu/etd/4940/
- Sauls, B. and O. Ayala. 2012. Circle hook requirements in the Gulf of Mexico: application in recreational fisheries and effectiveness for conservation of reef fishes. Bull. Mar. Sci. 88: 667–979.