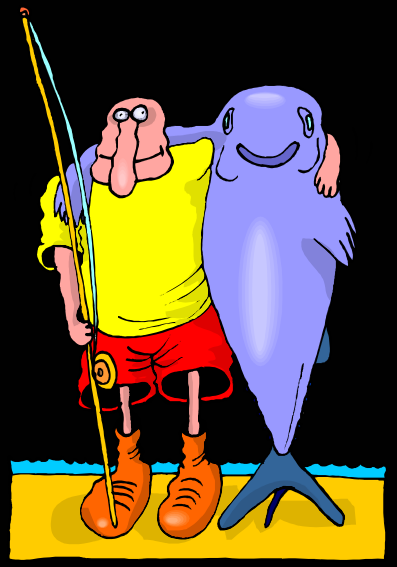
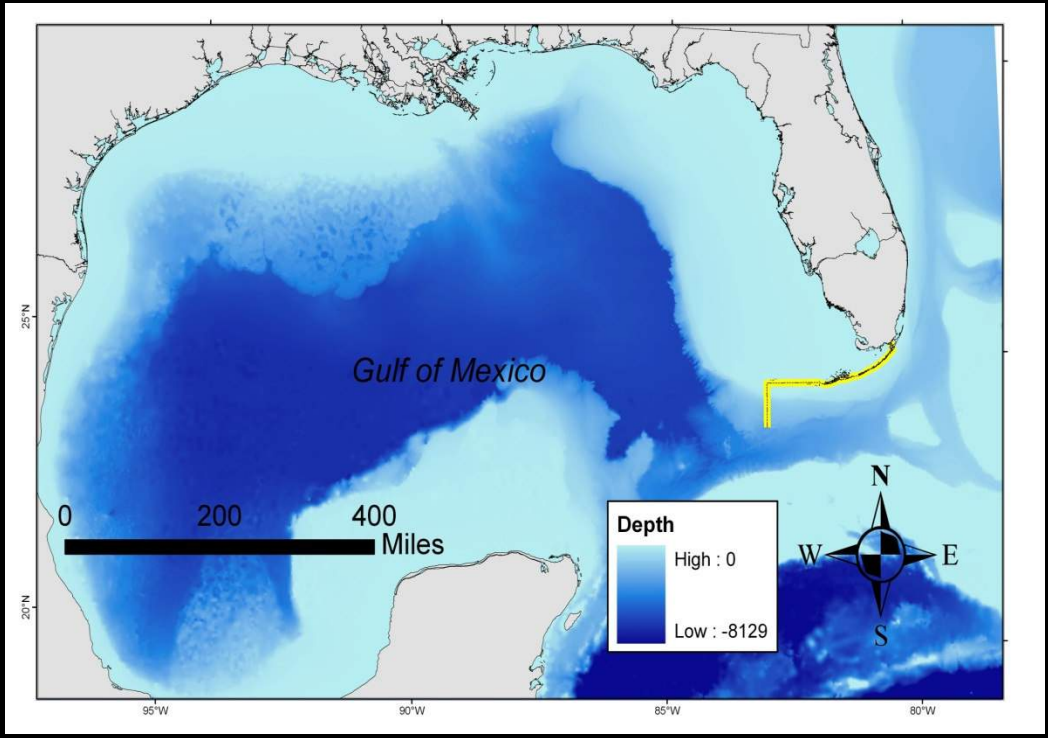
Barotrauma in Gulf of Mexico Reef Fish Fisheries

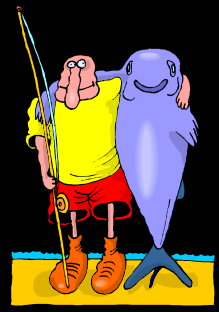
March 2011



9th Largest Water Body in the World
Bordered by the United States, Mexico, Cuba and the Caribbean Sea

Area: 580,000 cubic miles of water
Average Depth: 5,299 ft





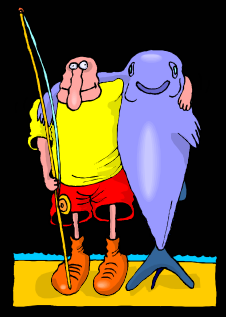
Recreational Reef Fish Fisheries

70 Species Managed 42 are Reef Fishes

Most Belong to the Grouper/Snapper Complex

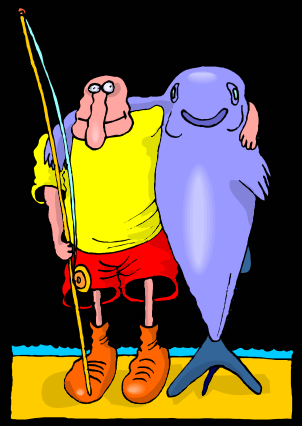
Highest Recreational Catch: red grouper, gag,black grouper, scamp, yellow edge, snowy grouper, Warsaw grouper,, red snapper, vermilion snapper, mutton snapper, gray snapper, and lane snapper

Other Species: greater amberjack, hogfish blueline tilefish, gray triggerfish, and red drum



Reef Fish Species

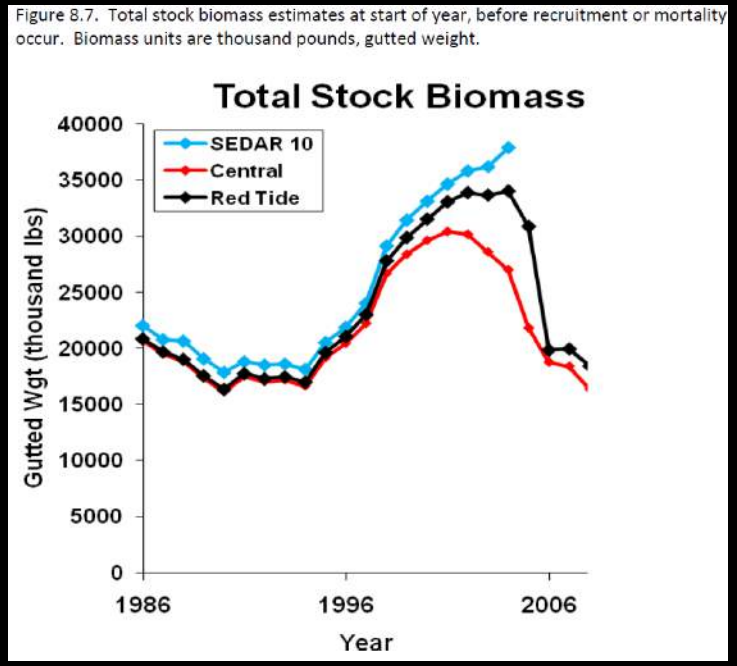
Long Lived
Slow to Reproduce
Some Are Hermaphroditic
Some Form Spawning Aggregations
Territorial



Gag Stock Abundance

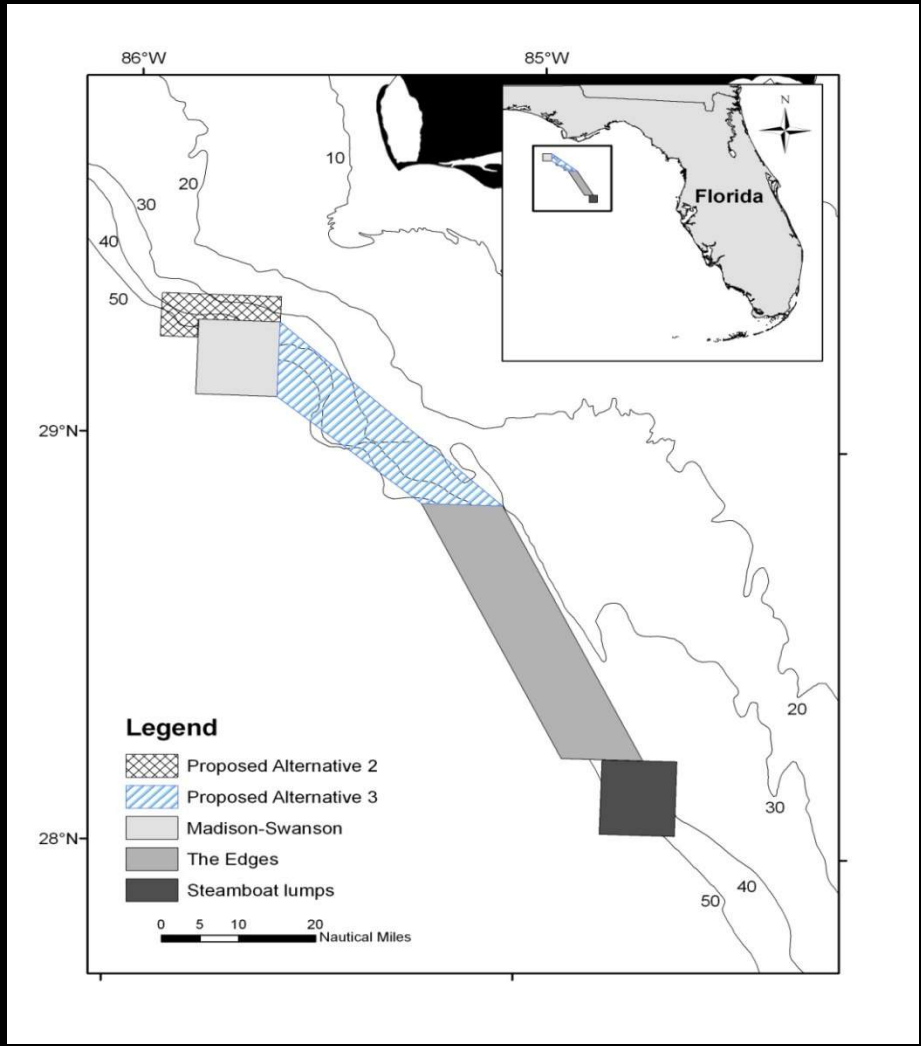
Classification: Overfished and Undergoing Overfishing

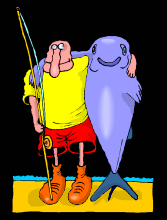
Figure 8.7. Total stock biomass estimates at start of year, before recruitment or mortality occur. Biomass units are thousand pounds, gutted weight.



Subject to Barotrauma
High Hook Mortality

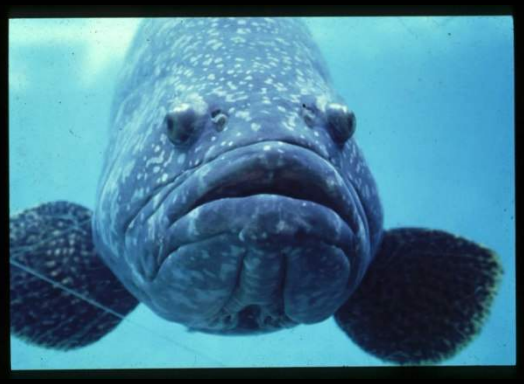
Marine Protected Areas to Protect Gag Spawning Aggregations





Protected Species - Moratorium

Goliath Grouper



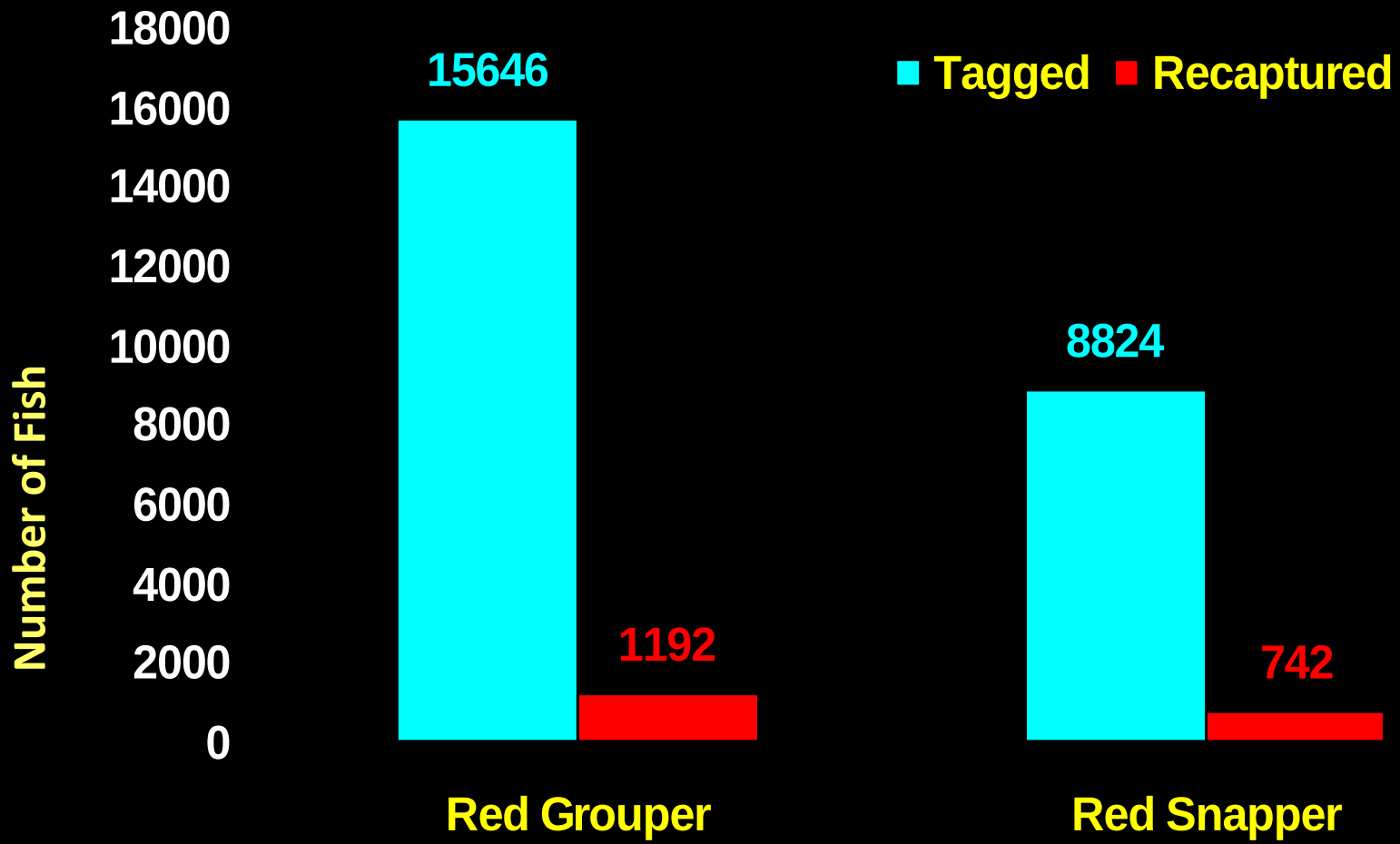
Red Drum

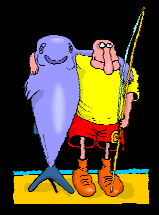
Nassau Grouper

Nassau grouper Copyright 2006 by Emagine (Bahamas) Ltd. The webpage is at: http://www.breef.org/OurMarineResources/Grouper/Othergrouperspecies/tabid/81/Default.aspx

Marine Protected Areas

Number of Tagged and Recaptured Fish

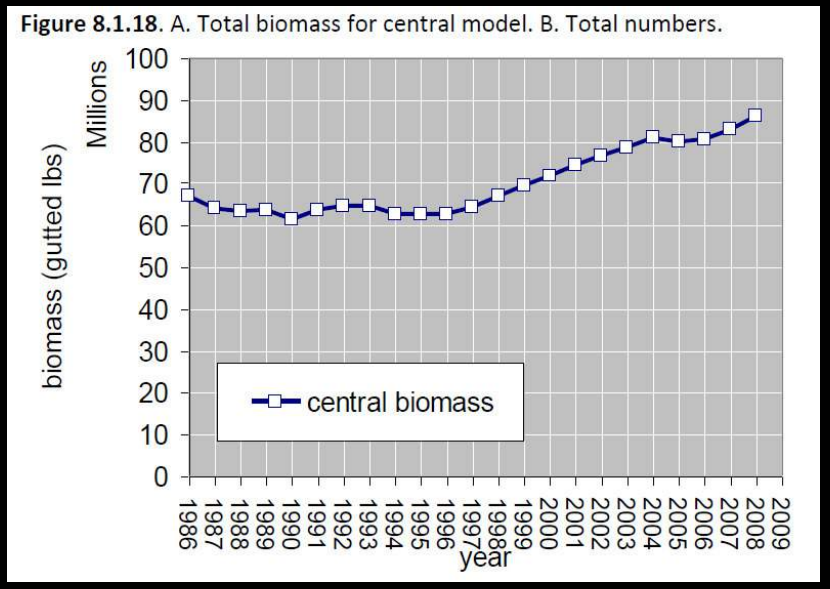




Red Grouper Stock Abundance

Classification: Not Overfished, Not Undergoing Overfishing

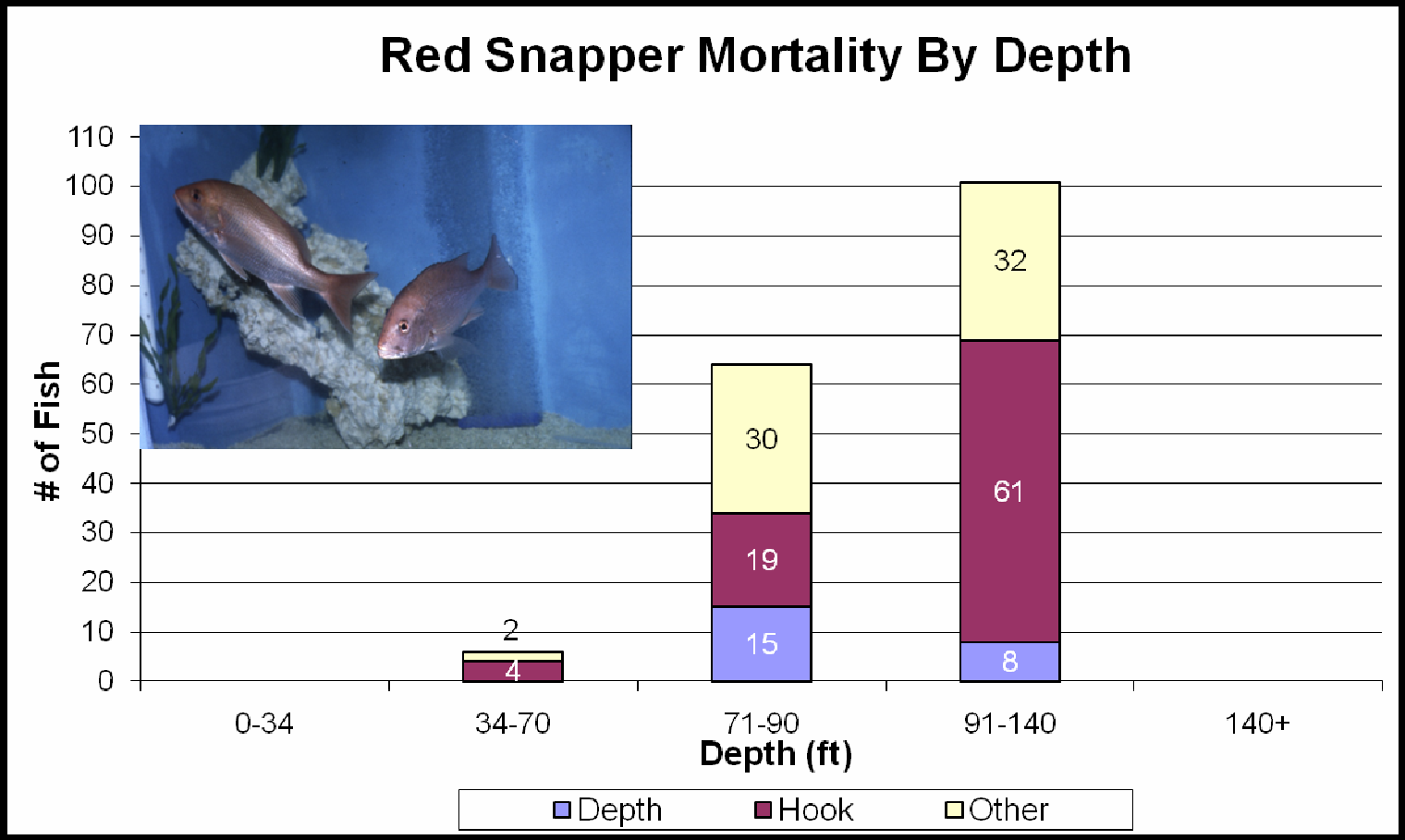
Subject to Barotrauma
Low Hook Mortality



Red grouper SEDAR stock assessment

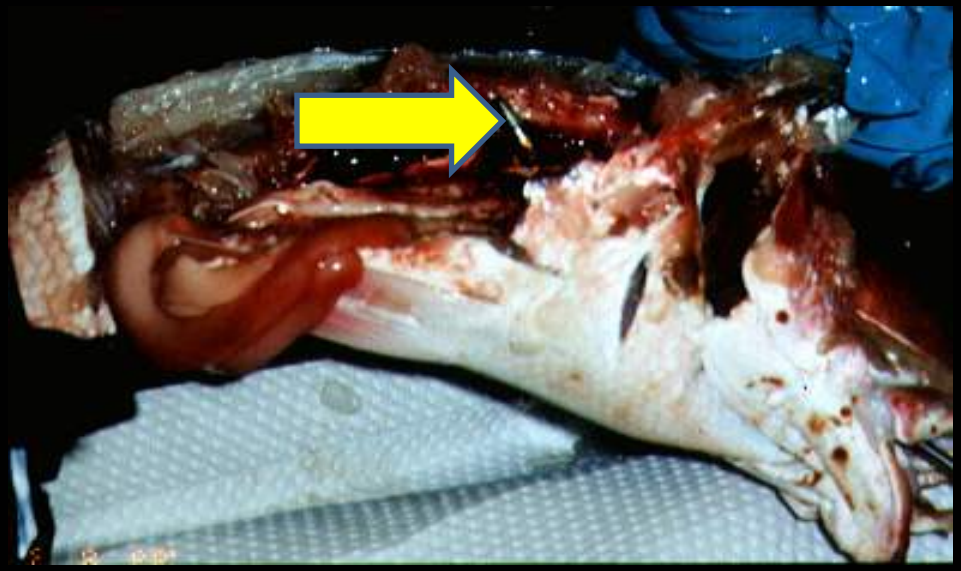
Red Grouper Caught From a Headboat

Mortality Effects Determined by Necropsy

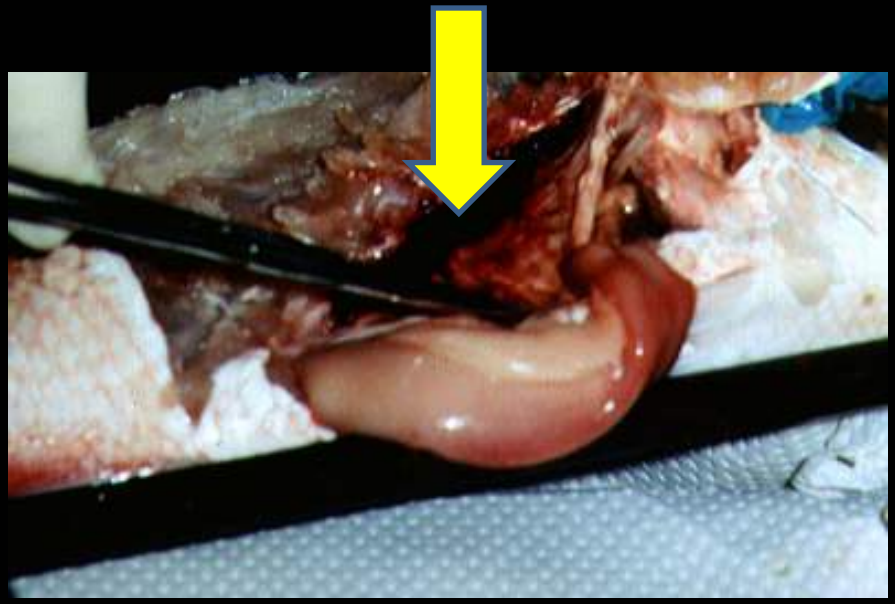


Acute and **Latent** Hook Mortality in Red Snapper

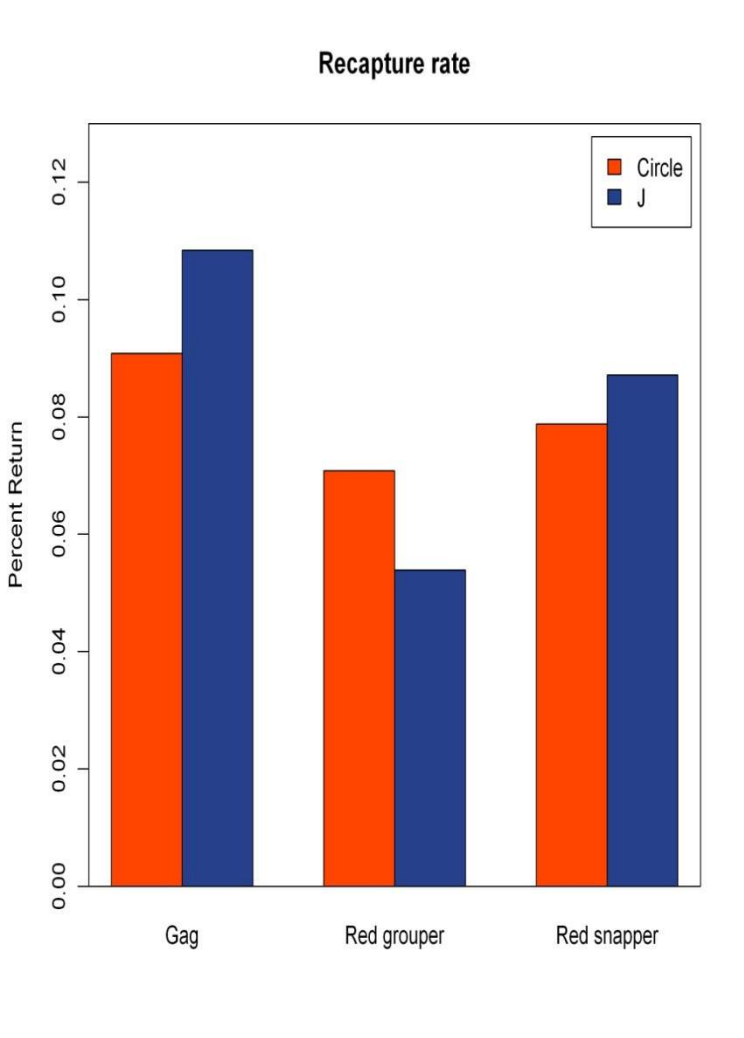
Acute



Latent



Recaptures from Circle vs J Hooks

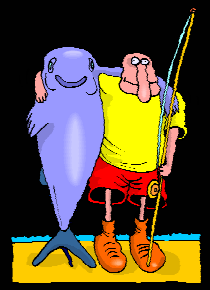


Species	Hook Type	Tagged (n)	Recaptured (n)	Recaptured %
Gag	Circle	1,024	93	9
	J	3,183	345	11
Red Grouper	Circle	2,160	153	7
	J	8,381	452	5
Red Snapper	Circle	3,630	286	8
	J	5,129	447	9

Predation

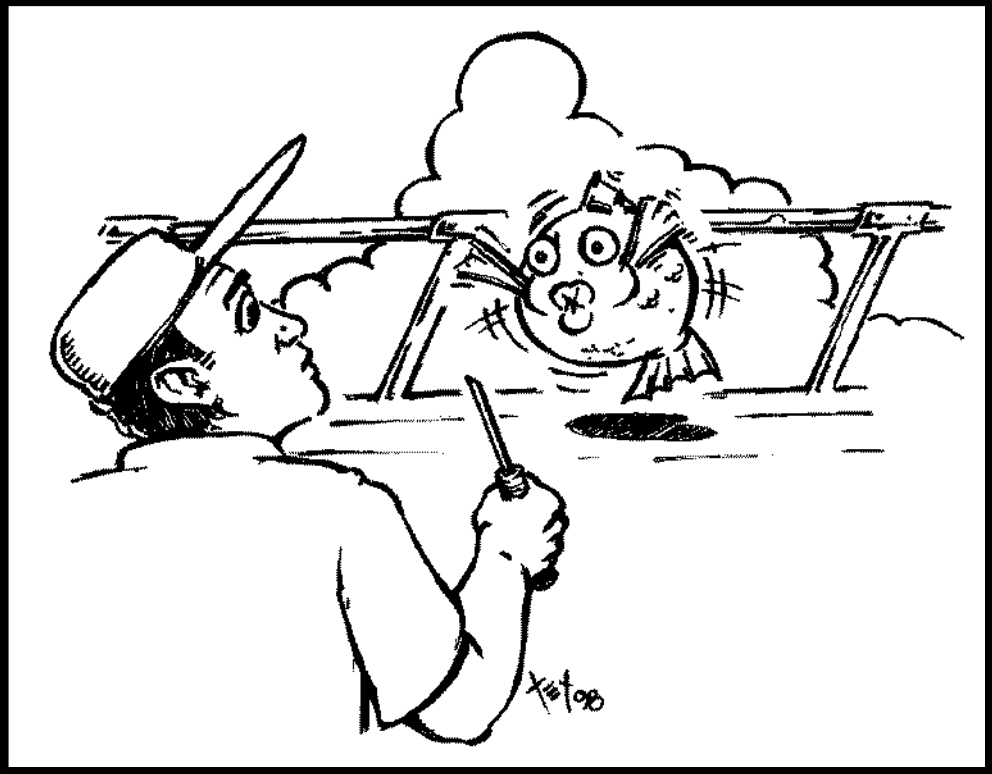
Panama City: 2 trips: 6.9% & 2.9 % confirmed

21.7 & 20% chased downward: probable take

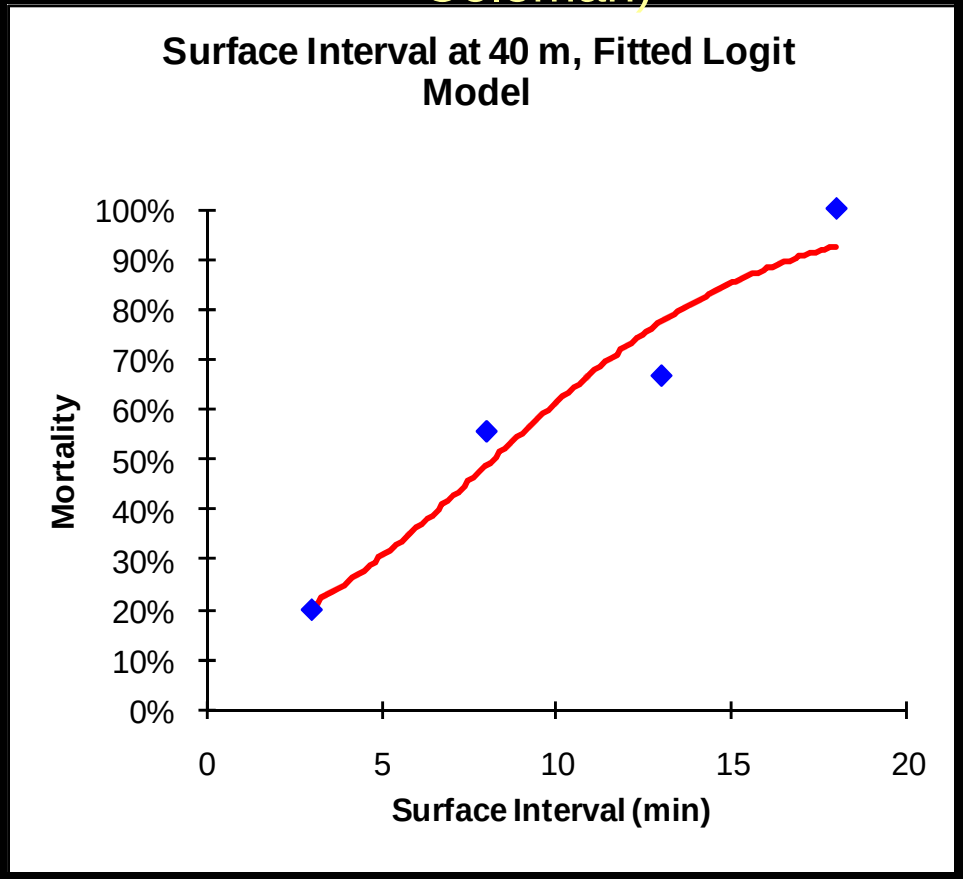


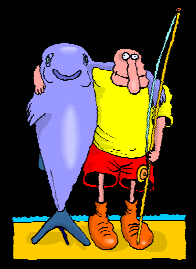
Venting

- Seasonality
- Thermal Shock
- Surface Interval
- Species Differences
- Pelagic vs Benthic
- Improper Venting
- Gear Differences



Relationship Between Surface Interval of Captured Red Grouper, Red Snapper, and Gag and Mortality at 40 m Capture Depth (Chris Koenig & Felicia Coleman)

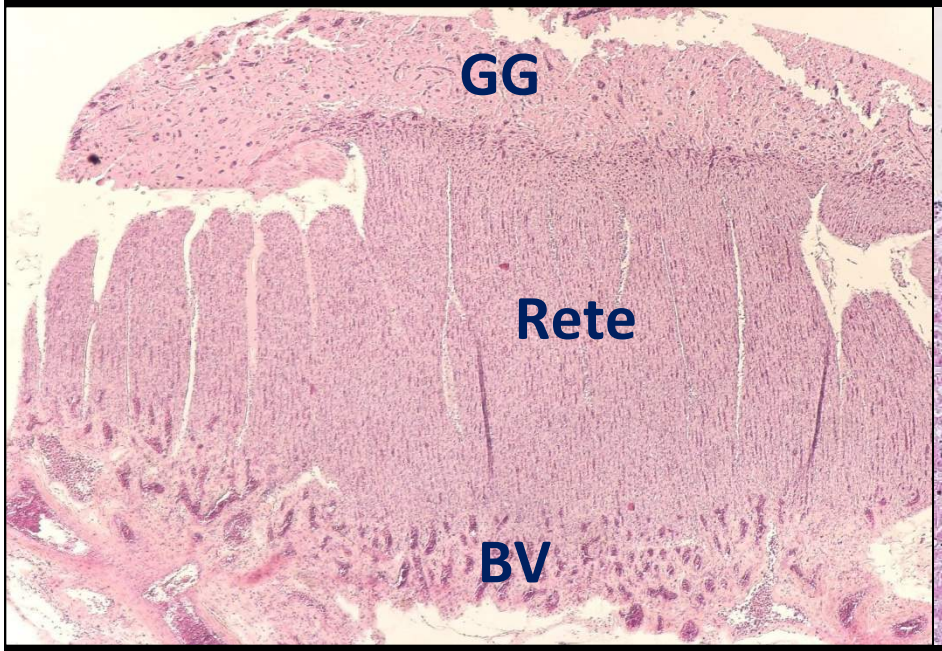




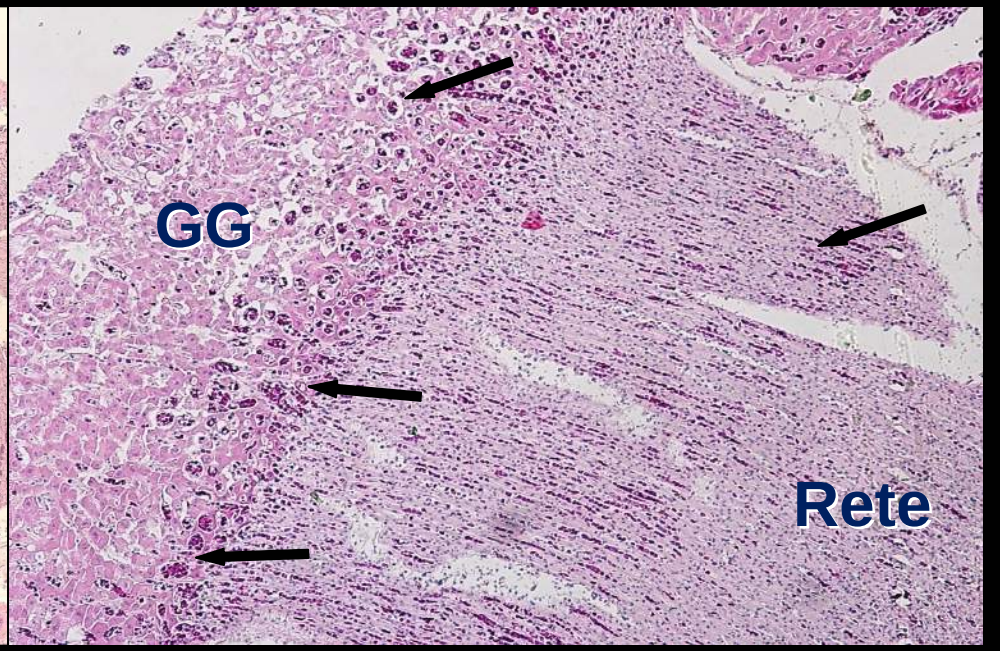
Swim Bladder Histology

- Angler caught fishes from headboats
- Measured hemorrhaging as a function of fish size

Red Grouper

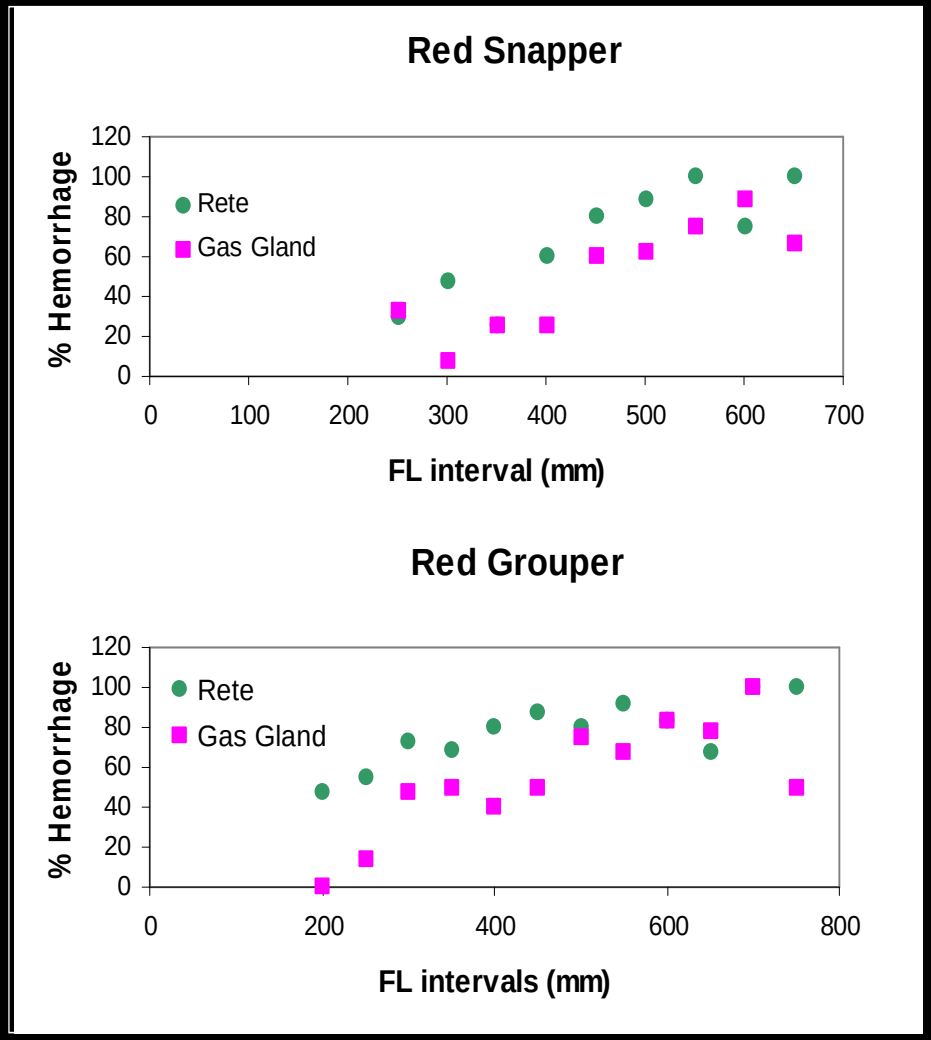


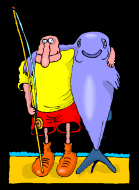
Red Snapper



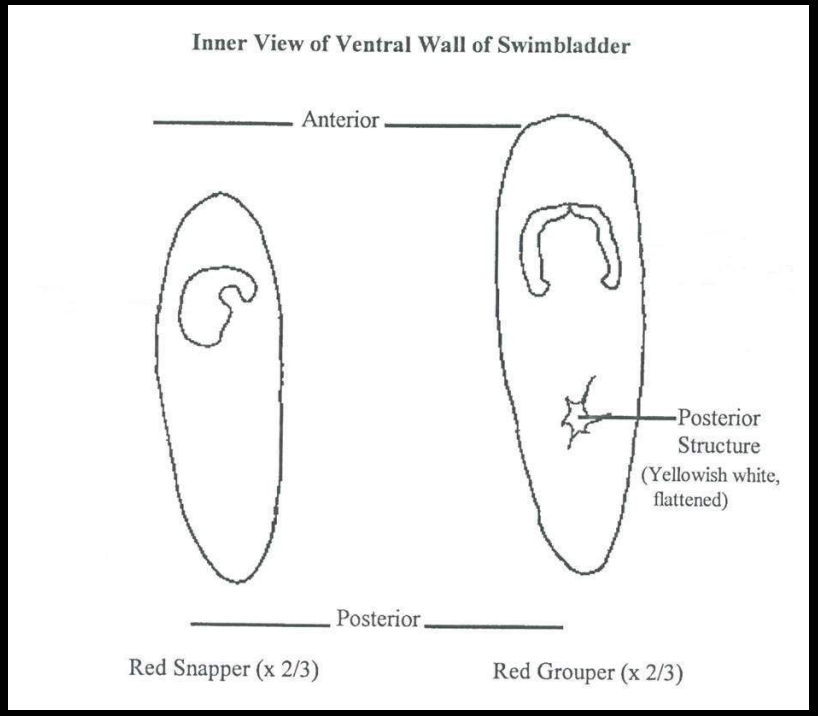
GG = Gas Gland, BV = Blood Vessel

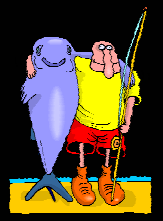
Differences in % Hemorrhaging by Species by Size



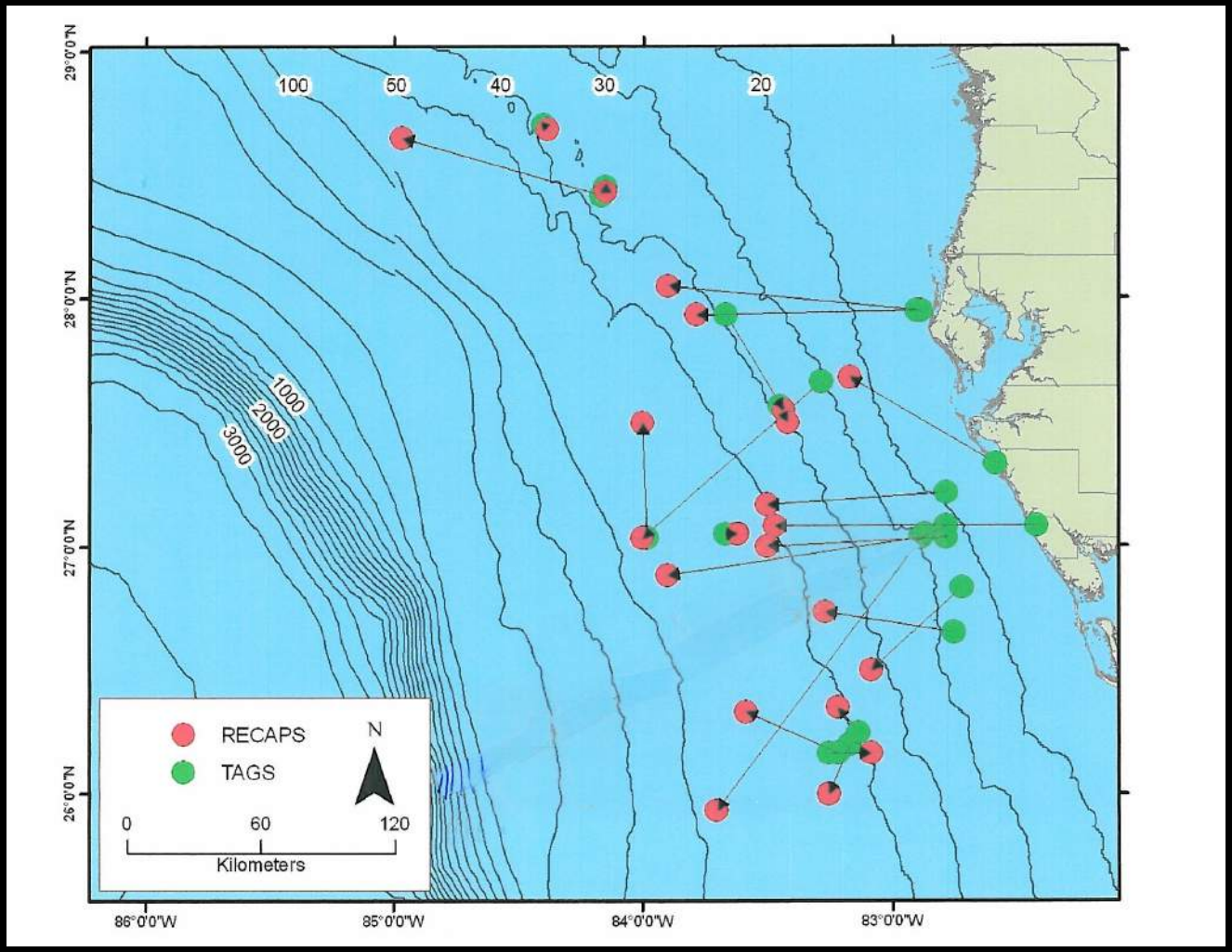


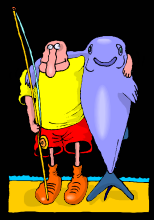
Differences in Swim Bladder Structure Between the Species





Red Grouper Offshore Ontogenetic Movement



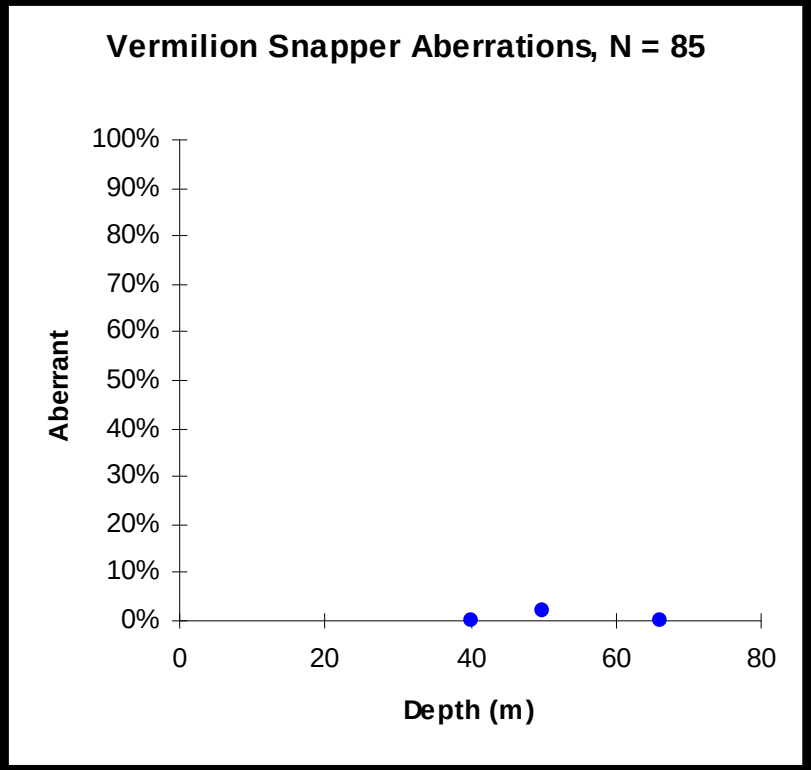


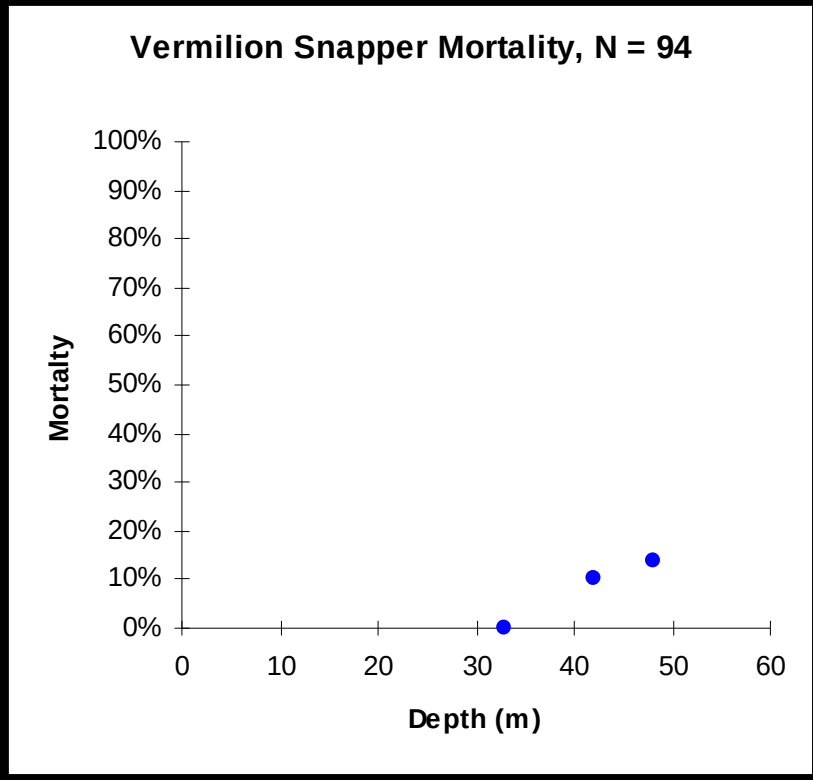
Vermilion Snapper

Small pelagic species
Found offshore
Poor tag recapture rates
High Survival from barotrauma for fish captured up 62 m (200 ft) when placed in tanks or cages

Rhomboplites aurorubens

Chris Koenig's Cage Study Data

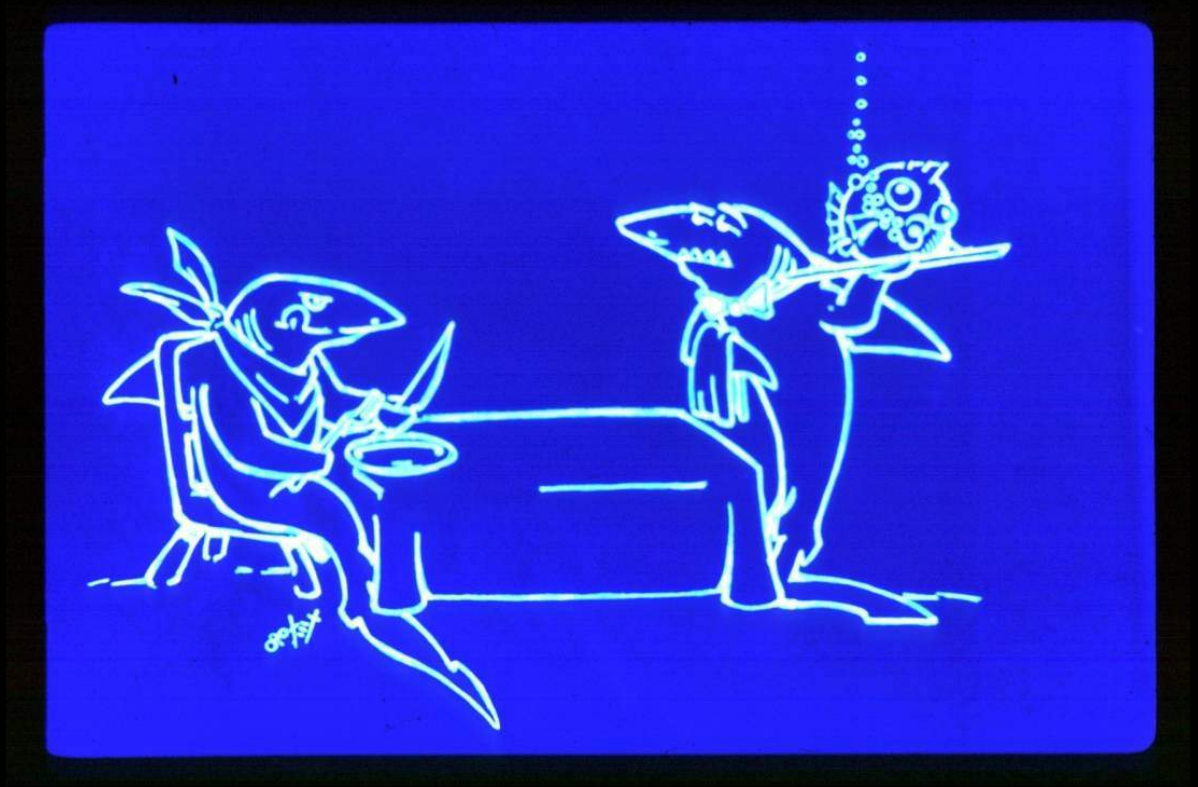




Depth Related Aberrations = stomach or intestine prolapse, or exophthalmia

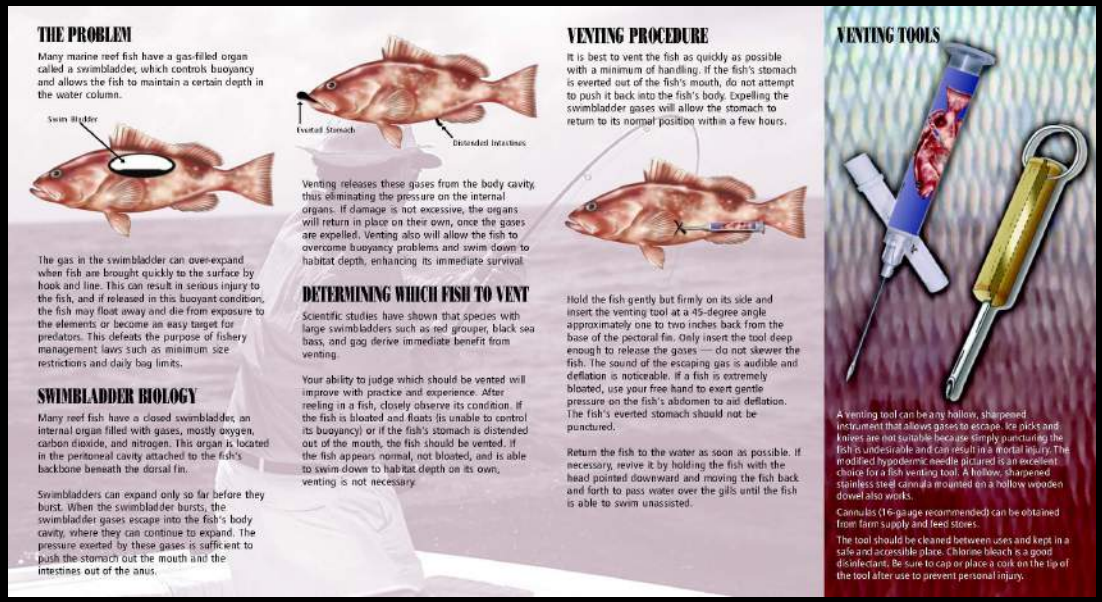
Predation

Vermilion snapper kept safe in cages or in tanks following rapid decompression and swim bladder rupture healed sufficiently within 2-4 days to return to the water column.
At sea, they were subject to predation for 2-4 days until they were able to return to the water column



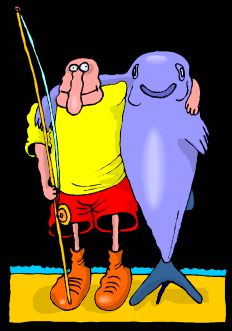
Vermilion Snapper at 62 m (200 ft)
Photo taken from an ROV camera

Gulf Council Outreach Program

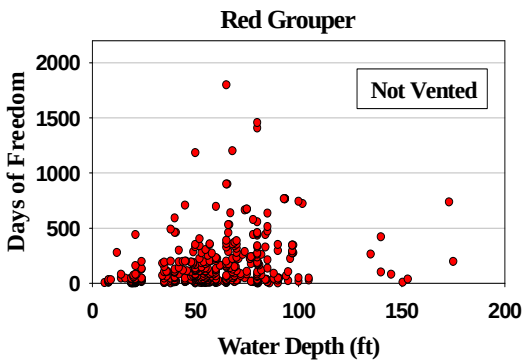


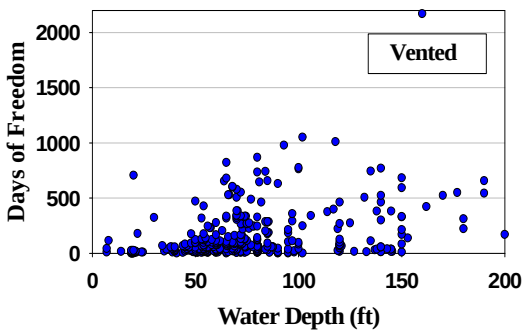
Control Group: Fish caught, tagged and vented in shallow water : less than or equal to 21 m (70 ft)

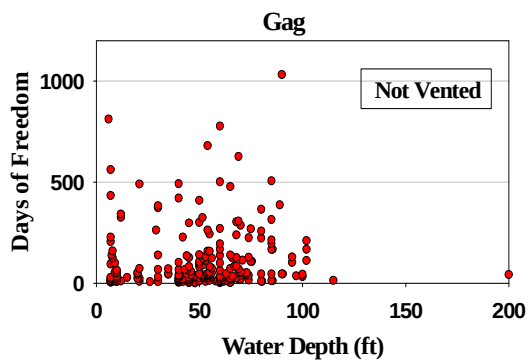
Species	No. Tagged & Vented	No. Recaps & Vented	% Recap	No. Tagged Not Vented	No. Recaps Not Vented	% Recap	G crit	*p* value
Red Grouper	322	27	8.4	192	17	8.9	3.8414	0.8671
Red Snapper	441	36	8.2	90	8	8.9	3.8414	0.8376

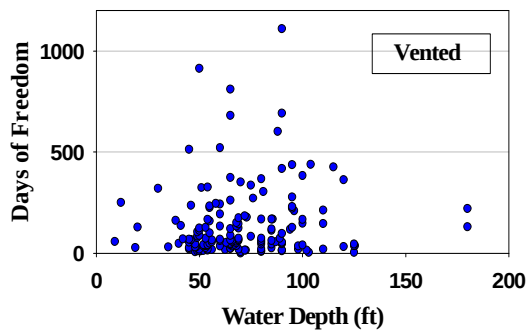


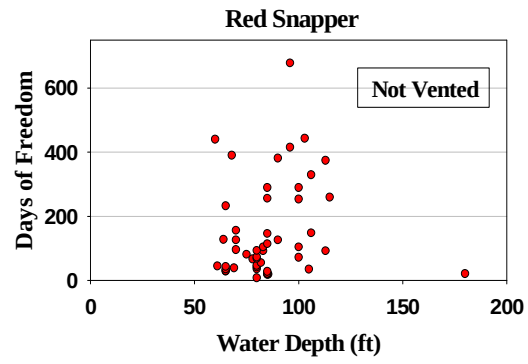
Comparison of DOF for Vented & Non-Vented Fish By Depth

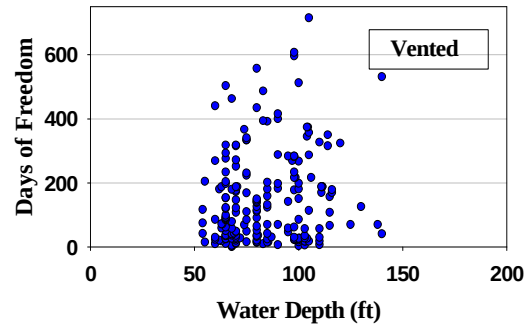












Rapid Decompression Experiments

Fish compressed to depth (21,27, 43, 61 m; 4 replicates per trial; two trials)

- After acclimation confirmed, rapidly decompressed
- Fish removed, vented
- Sacrificed immediately, 2, 4, 7 days
- Characterized trauma and healing

Hyperbaric Chambers: Variability of Mortality Between Species

	Depth (m)	21.3	27.4	42.7	61.0
Red Grouper N=8/depth	% By Depth	0	50	75	100
Red Snapper N=8/depth	% By Depth	0	0	40	45

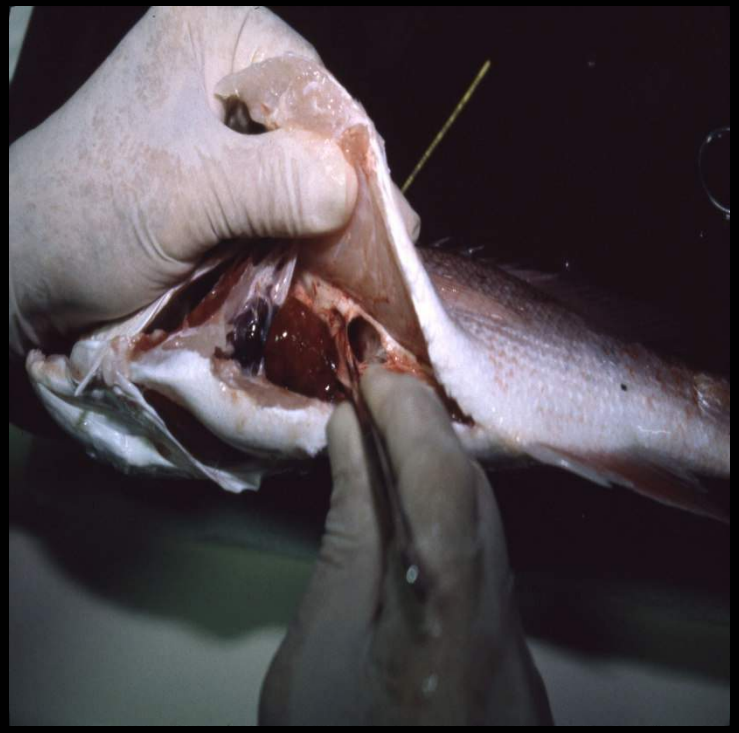
Stepwise Decompression Experiment

- Acclimated fish to 42.7 m
- Lowered pressure until fish could not regulate buoyancy
- Allowed fish to acclimate and regain buoyancy
- Lowered pressure again
- Repeated until at 1 atmosphere

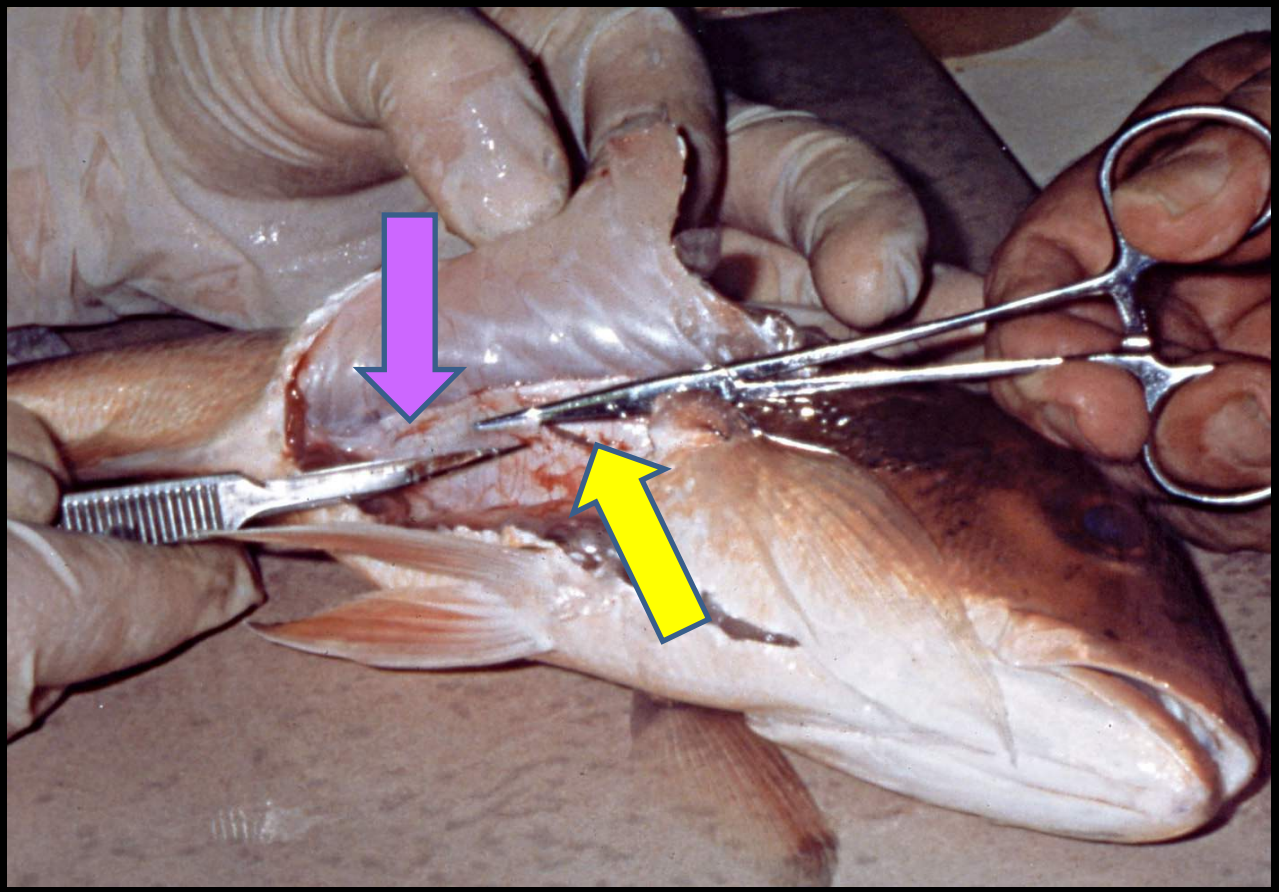
Incremental Step-wise Decompression Results from 42.7 m Simu**lations**

	Pressure Increments (*psi*)					Time (h)
Red Grouper (n=8/depth)	60	50	35	20	5	76.5
Red Snapper (n=8/depth)	63	40	25	15		104 .0

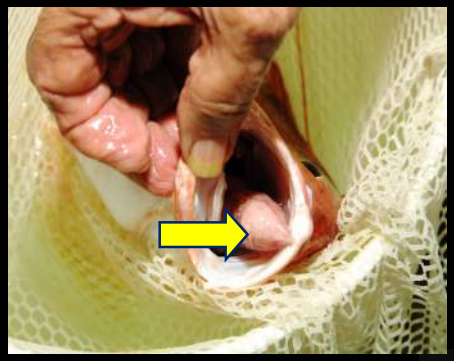
Difference in Trauma, Survival and Healing Dependent Upon Fish Sanitation



New (from Chamber yellow)and Healed (from Original Capture purple) Ruptures in Red Snapper at 21.3 m (70 ft)

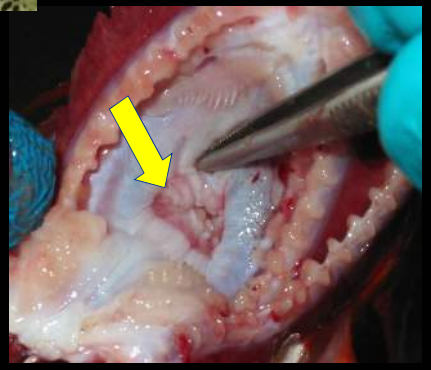


Post-experimental Fish Feeding



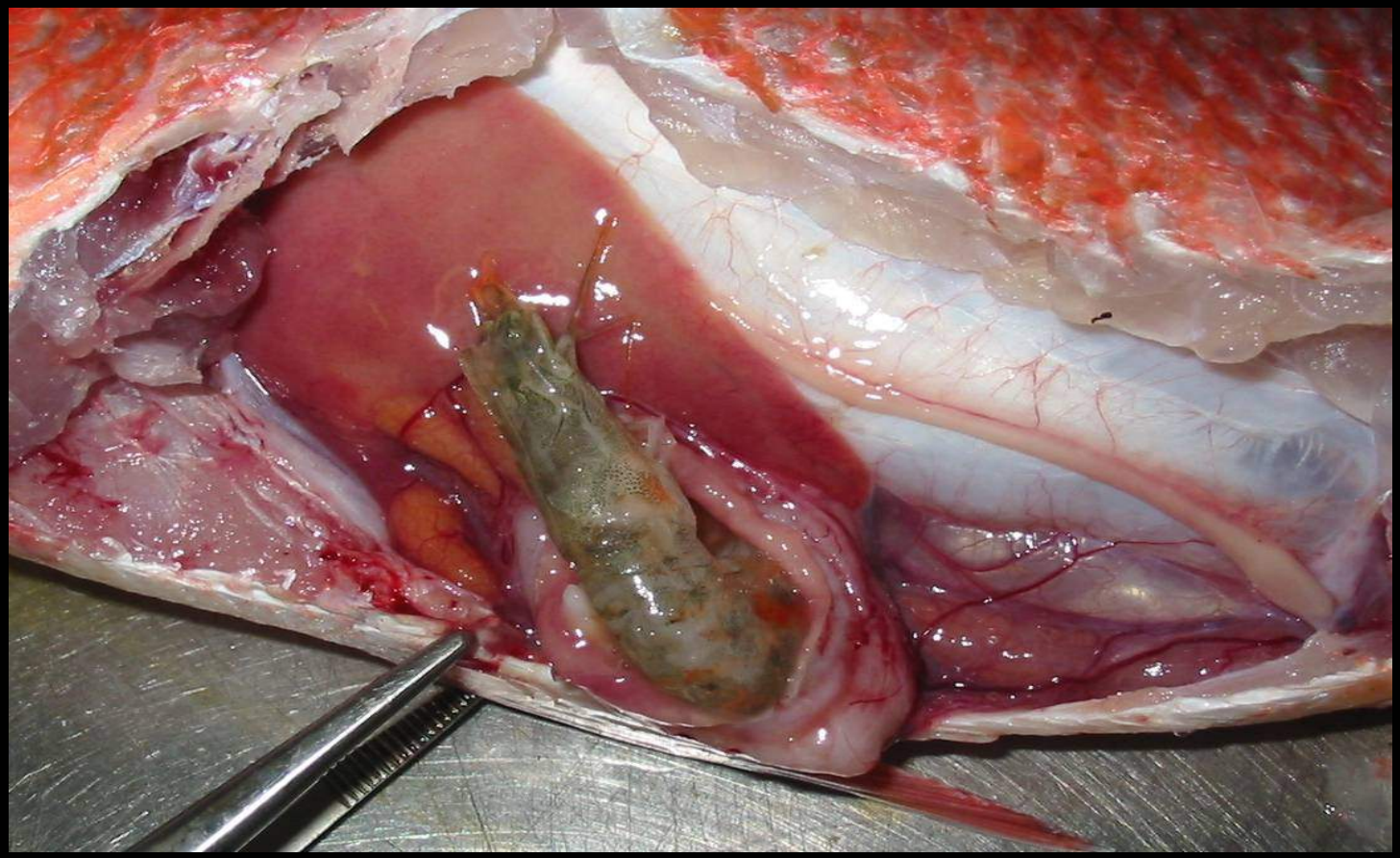
Stomach Prolapse in Red Snapper

Esophageal Ring in Red Snapper



Species	Depth (m)	Time (hrs)
Red Grouper	21.3 27.4 42.7	2 2 12-24
Red Snapper	21.3 27.4	1 1
	42.7	4

Red Snapper 7 Days After Rupture at 61 m Depth Simulation



Red Grouper Caught on the Same Long-line Set Exhibiting Various Degrees of Exophthalmia.

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• Snapper and mulloway are two of the most highly prized target species in coastal waters of SE Australia. and suffer decompression trauma (barotrauma)
Both are overfished and are regulated by size limits requireing undersized fish to be discarded..

OBJECTIVES:

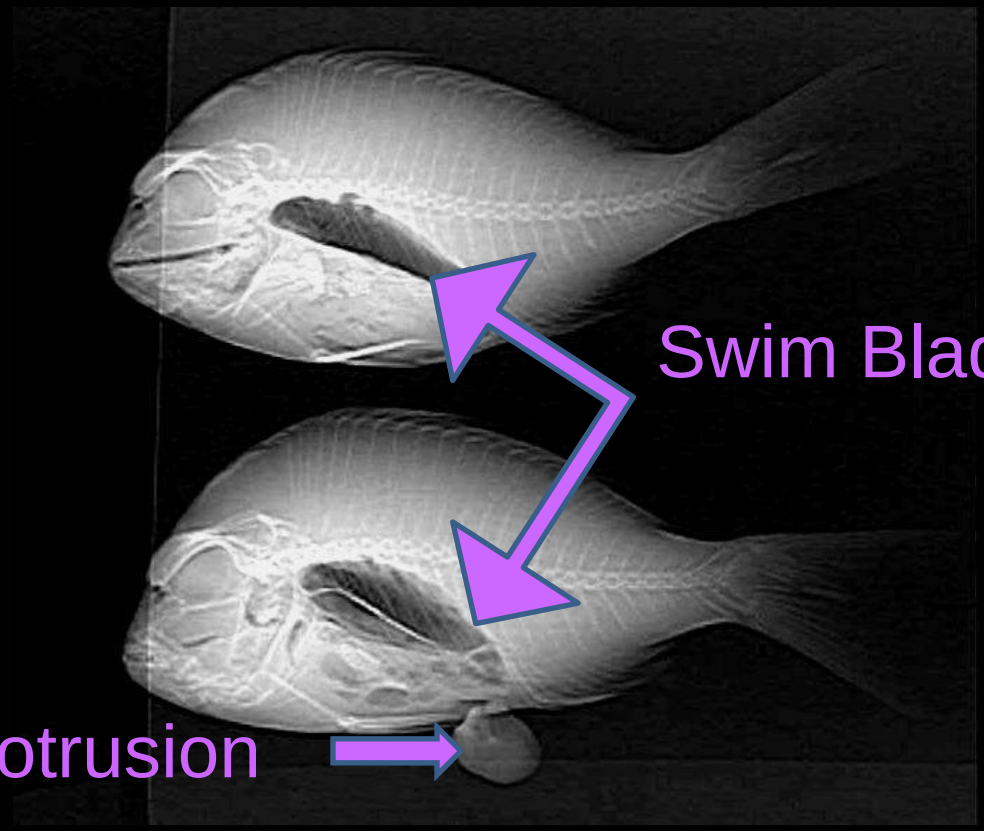
• Determine key effects of barotrauma on snapper and mulloway by comparing CT scans of fish caught at different depths.

• Determine effects of gear type on barotrauma in snapper by comparing CT scans of fish caught by hook and line vs versus traps.

CT scan of air in a) the swim bladder and b) swim bladder and body cavity of a snapper caught at 7 m. The ruptured swim bladder still contains over 75% of the total air volume.

Diamond, S.L., J. Stewart, D. Ferrell, and R. Wrigley. 2011. Fish and barotrauma: what causes the variability in symptoms? MS in prep.

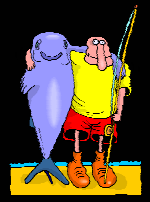
CT Scan of Snapper Caught in Traps. Lower Fish Has Intestinal Protrusion and Twice the Volume of Air in the Swim Bladder, Although Caught at the Same Depth



Sandra Diamond 1,2, Mark Greco 1, John Stewart 3, and Doug Ferrell 3: 1=University of Western Sydney, Hawkesbury Campus; 2=Texas Tech University, Lubbock, TX, USA; 3=NSW Department of Primary Industries, Cronulla Fisheries Research Centre

Trap Studies GOM Fish Captured at 180 ft.

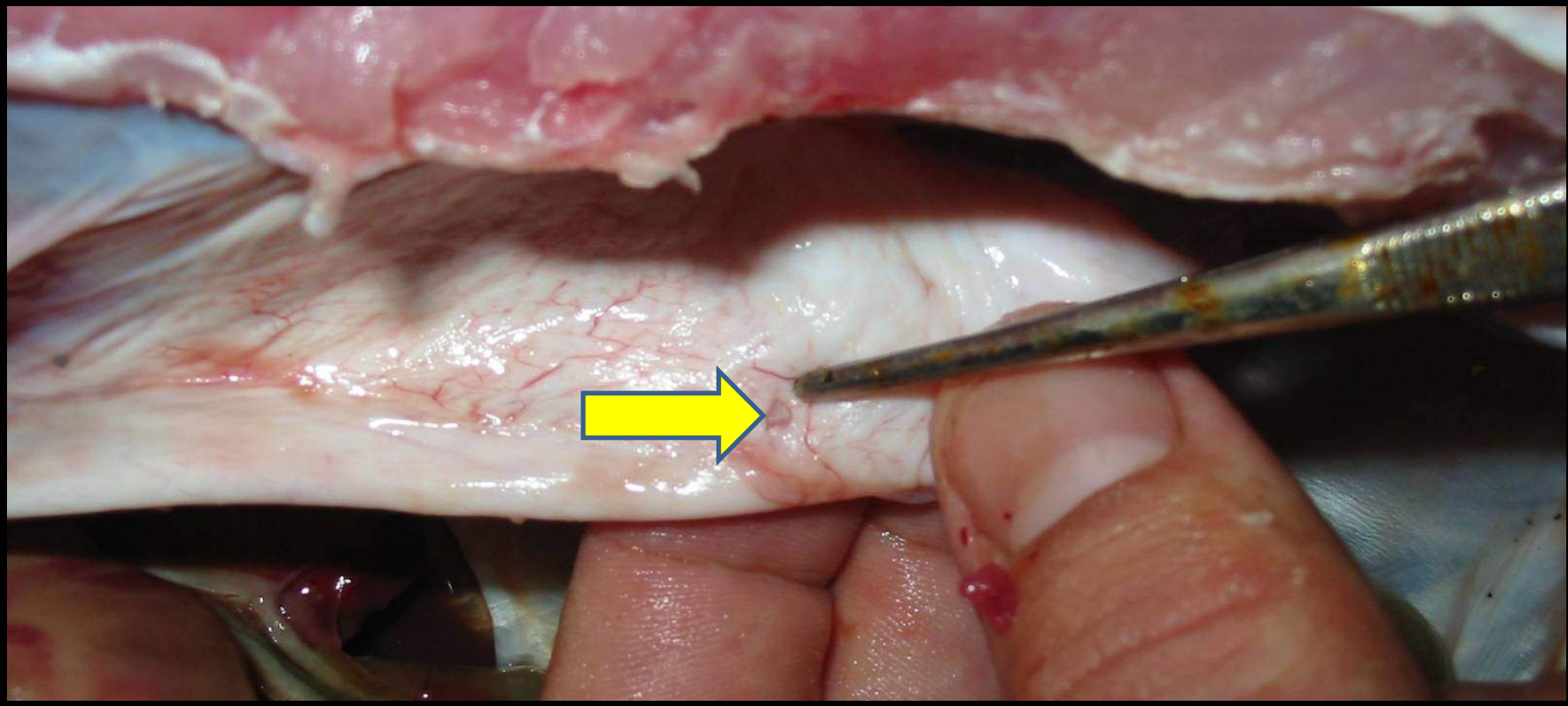
Most, but not all reef fishes caught in fish traps, did not exhibit outward signs of barotrauma and were able to return to capture depth unaided



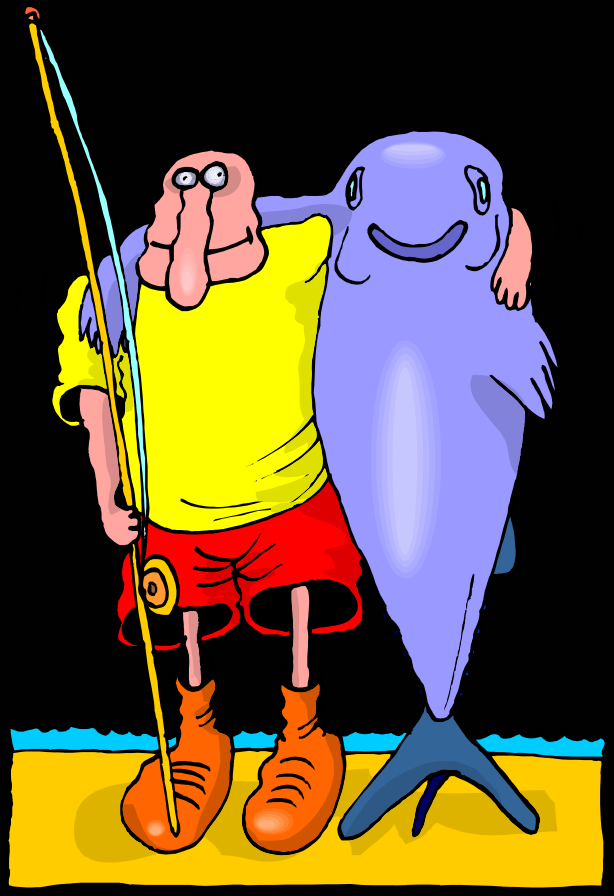
Red Grouper Caught in Commercial Fish Traps at 54.9 and 61 m

Excised Inflated Swim Bladder from 700 mm FL Trap Caught Red Grouper Captured at 61 m

Trap Caught (62 m) Red Grouper Exhibiting Pinhole Wound in Deflated Swim Bladder



In Conclusion

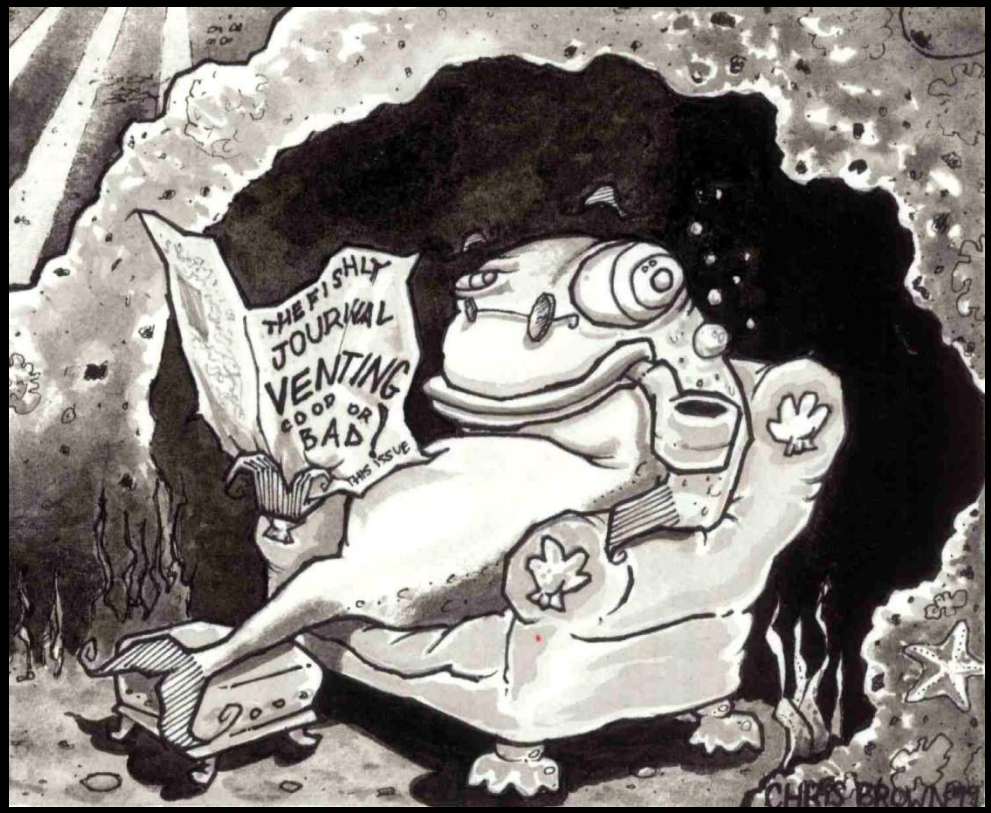


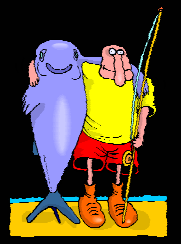
Conclusions

Factors affecting mortality can be synergistic so each factor must be identified and its impacts assessed

Survival is both depth and species specific

Differences in trauma and survival occur among and within gear types





Conclusions From Down Under:

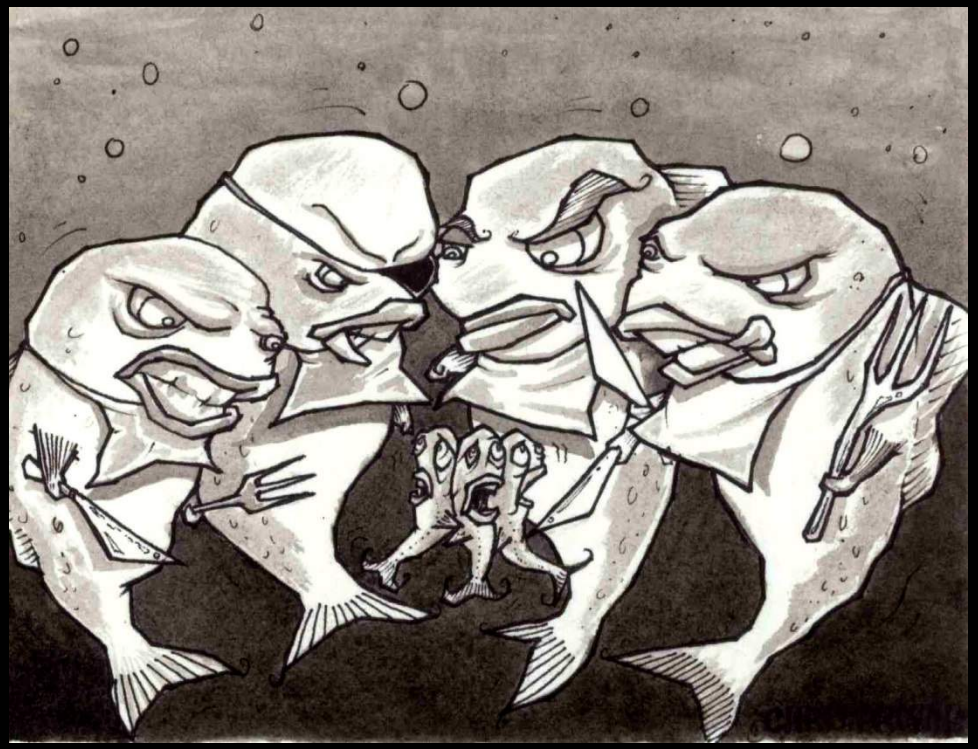
- **Symptoms of barotrauma vary with species, gear type, depth of capture, and among individuals caught under the same conditions.**
- **Some symptoms such as exopthalmia are relatively rare in snapper and mulloway at the depths tested.**
- **Stomach eversion and intestinal protrusion may be related to gut fullness, diet (hard vs soft particles), and feeding method that changes the amount of gas in the stomach and intestines.**
- **The caudal lobes may be caused by spaces between the rear muscles that are filled by the swim bladder when it expands due to barotrauma.**

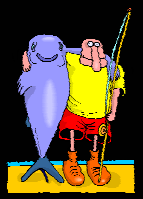
Conclusions

Hook mortality can be a greater factor than barotrauma for some species because it occurs at all depths and a range of fish sizes

Conclusions

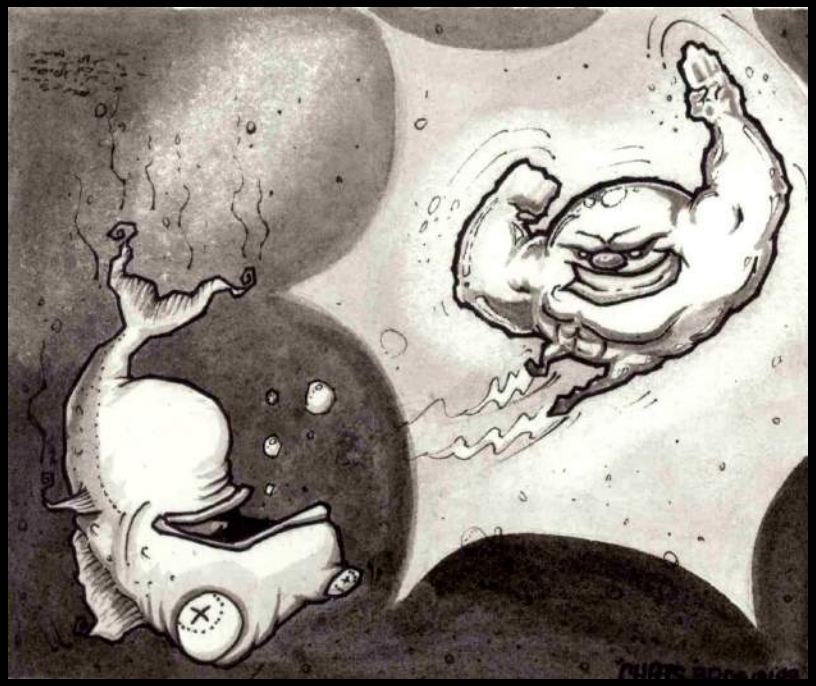
Predation is an important and often overlooked factor in the survival of released fish that needs to be studied

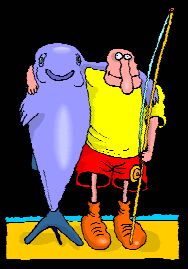




Conclusions

Barotrauma affects individual species differently. A fish's anatomy, eco-morphology, physiology, and behavior appear to affect its response. Species have evolved to occupy different niches and these differences appear to determine responses to fishing and fishing gear.

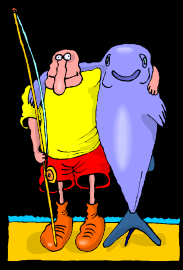




Gulf of Mexico Accounted for > 40%
of All U.S. Marine Recreational
Fishery Catches in 2006

56% of Marine Recreational Fishing
Catch in 2006 in the Gulf of Mexico
Was Released Out of A Total of
Catch 193 Million Fish,
Not Including Texas

Source: NOAA



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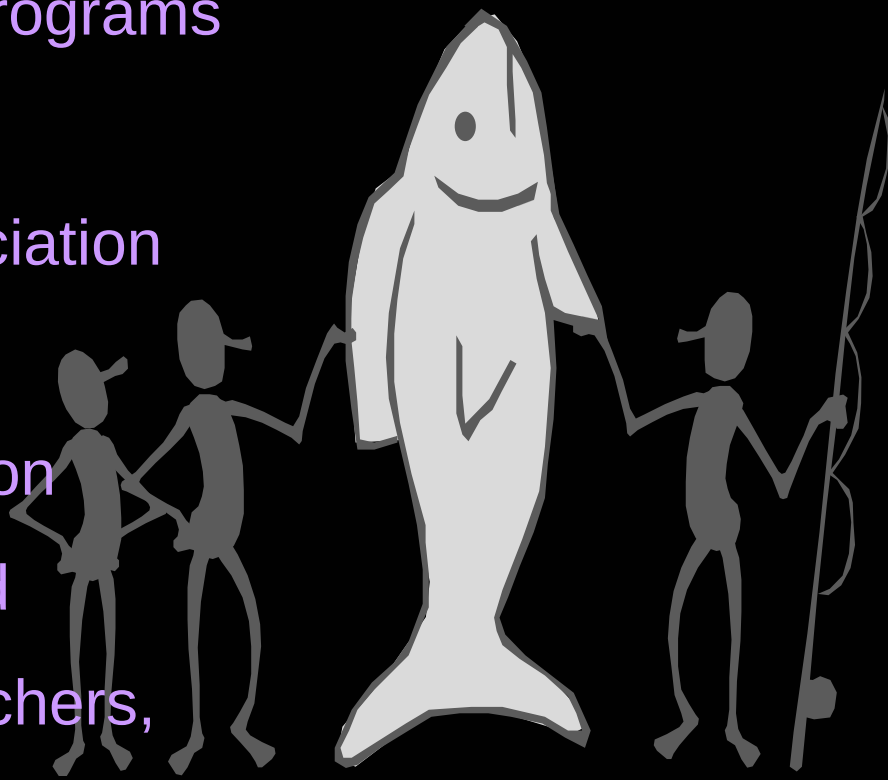
- Florida Offshore Anglers
- Florida Sports Fishing Association
- Fishermen's Environmental Fund
- All Participating Fishers, Researchers,
- and Student Interns



Thank you