

Four Reasons That Goliath Grouper Fishery Should Remain Closed

Chair Rodney Barreto and FWC Commissioners
Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600

May 7, 2021

Dear Chair Barreto and FWC Commissioners:

We, the undersigned scientists, write this letter in opposition to the FWC staff recommendation to allow a limited harvest of the vulnerable Atlantic Goliath Grouper (*Epinephelus itajara*) (hereafter referred to as Goliath Grouper) in Florida state waters. Note that two of us have worked on this species since 1994 and all three of us have provided data and input to FWC over the years.

Our greatest criticism regarding the fishery opening is that the data do not support it. Indeed, the stock assessment reports indicating the potential to support a fishery were rejected as flawed under peer review three times. The following are the primary reasons that Goliath Grouper should not be fished: (1) recruitment to adult populations is limited; (2) high mercury concentrations in fish tissues present severe consequences to Goliath Grouper and to humans that consume them; (3) the public perception that Goliath Grouper are invasive and destroying habitat is flawed; and (4) viable alternate economic considerations have not been addressed. We expound on these points below. A more detailed discussion appears in our publication [ATLANTIC GOLIATH GROUPE OF FLORIDA: TO FISH OR NOT TO FISH](#) (Koenig et al. 2020), which was written expressly to provide the best available scientific information on the conservation and management of this species (also other papers by Coleman, Koenig, and Malinowski in the references) and should prove particularly helpful to decision-makers in the upcoming May 12, 2021, FWC Review and Discussion meeting. We believe that greater consideration in evaluating these four items is required before a decision is made.

1. RECRUITMENT TO ADULT POPULATIONS IS LIMITED

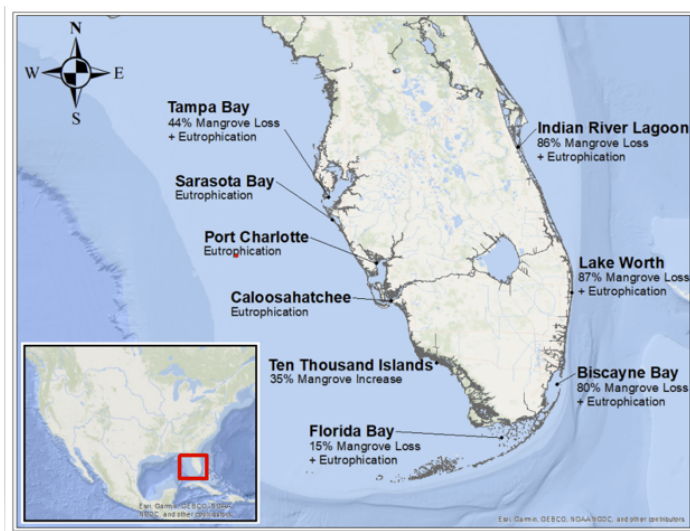


Figure 1. From Koenig et al. 2020

Recruitment limitation of Goliath Grouper in Florida is largely due to tremendous losses of mangrove habitat, habitat that is *essential* for the juvenile stage and thus the recovery of this vulnerable species, and to severe eutrophication of coastal waters, the primary acute symptoms of which are hypoxia and harmful algal blooms (Figure 1). These coupled events pose a significant bottleneck to the full recovery required to support even a limited fishery. Virtually all of South Florida's major estuarine systems suffer from these combined effects.

Given your strong interest in healthy fisheries and pristine waters <https://myfwc.com/wildlifehabitats/> it would behoove FWC to restore the historic quantity, quality, and timing of water discharges that reach coastal ecosystems and to support effective mangrove restoration. This would help support recovery of Goliath Grouper and other fishes that require healthy mangrove habitat. It can be done. Tampa Bay serves as an excellent example (Greening et al. 2014), as does the *Comprehensive Everglades Restoration Plan* – [CERP Project Planning | South Florida Water Management District](#), a long-term multi-billion dollar project underway in South Florida's greater Everglades and coastal ecosystems.

Red tide blooms of the dinoflagellate *Karenia brevis* can have devastating consequences to fishes (including Goliath Grouper), shellfish, and other marine organisms. These events occur almost annually in South Florida, with fewer less severe events in North Florida. In 2018, red tide persisted for months, killing an enormous number of fishes. A local charterboat captain reported finding 30-40 dead Goliath Grouper washed up along the beach at Boca Grande. These events have been much less severe and of shorter duration in the last few years. However, the fact that eutrophication in coastal waters and submarine groundwater amplifies red tide blooms emphasizes the need to reduce nutrient input into coastal systems.

Goliath Grouper juveniles cannot withstand temperatures below 15°C (59°F). While temperatures this low rarely occur in the shallow South Florida waters that they inhabit, they do occur with sufficient frequency (~ once every decade since the 1980s) to have devastating effects on recruitment to the adult population. Such an event in 2010 in Everglades National Park resulted in more than 90% mortality of resident juveniles with no recovery at all after 8-9 years. Combining the effects of a major red tide event in 2005 with cold event kills in both 2008 and 2010 resulted in serious declines in the adult population and little recruitment success (SEDAR 2016).

An increase in the adult Goliath Grouper population is impossible in light of the recent (2019) juvenile population recovery. That is, there was not enough time for juvenile development in the estuaries of South Florida to increase the adult population size. This is because the juveniles remain in the estuaries for 5-6 years before joining the adult population. So, the earliest recruitment of juveniles would be in 2023, assuming that juveniles would not be detected in the estuaries until a year after settlement.

2. HIGH MERCURY CONCENTRATIONS PRESENT SEVERE CONSEQUENCES TO GOLIATH GROUPE AND TO HUMANS THAT CONSUME THEM

Methylmercury is a highly potent neurotoxicant that poses a serious threat to human health at all life stages, but with particularly damaging effects on the central nervous system of children. In infants, symptoms of congenital methylmercury poisoning are mental retardation, movement problems, seizures, and speech difficulty. Relatively low doses in the diet of mothers may produce brain damage in the fetus, while the mother may be asymptomatic.

The U.S. Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) in their joint agreement regarding mercury set the upper risk level for human consumption of total mercury at 0.46 ppm in 2020. The Florida Department of Health (DOH) followed suit. These organizations deem king mackerel (0.730 ppm), shark (0.979 ppm), tilefish in the Gulf of Mexico (1.123 ppm), and Bigeye Tuna (0.689 ppm) among the species to avoid eating. We note here that

Goliath Grouper in Florida waters have among the highest concentrations of mercury reported in any wild fish species – average concentrations of 1.28 ppm on the Atlantic coast and 0.94 ppm on the Gulf Coast (Malinowski 2019) – in particular methylmercury, by far the most toxic form of this compound.

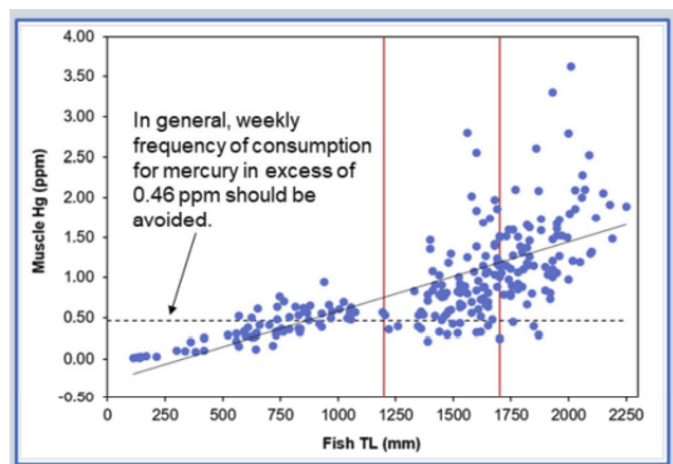


Figure 2. Muscle mercury levels in Goliath Grouper by size (total length mm). FWC figure for Review & Discussion May 12, 2021. Most of the data provided by Malinowski.

FWC proposes to have a slot limit of 47-67 inches (= 1194-1701 mm TL, 70-200 lb fish) for harvest of Goliath Grouper. We note that 89% of the Goliath Grouper sampled in this size range contained mercury levels that exceeded the EPA-FDA and DOH advisories. These conclusions are supported by FWC's figure, seen here (Figure 2) and appearing in their presentation, "Review and Discussion, May 12, 2021" available to the public on the FWC website:

<https://myfwc.com/media/26546/7b-presentation-goliathgrouper.pdf>. **The point is that no matter how you define slot limits of adult fish, mercury concentrations clearly exceed levels deemed safe for human consumption.** Thus it is unclear why FWC, the EPA, FDA, or DOH would allow the harvest and consumption of this species. The FDA in fact has been sued for ignoring its own standards and allowing seafood that is high in mercury to be sold. Chronic biomarkers such as hair-growth segments can provide a recent history of relative dose levels to the mother and can implicate methylmercury as the cause of possible impairments to a newborn child.

Beyond the effects on humans, there are several lines of evidence that Goliath Grouper suffer tissue damage and reproductive consequences of accumulating high concentrations of mercury in their tissues, including lesions in the liver, kidney, and gills (Adams and Sonne 2013), with multiple significant physiological health consequences and immune system responses (Malinowski et al. 2021); possible feminization and reduced sperm production in males fishes; and damage to developing eggs and larvae.

The presence of high levels of a protein typically only found in females and responsible for egg-yolk production (the nutritional source for developing embryos) is found in males with high methylmercury concentrations in their tissues (Malinowski et al 2021). Its presence in males suggests direct endocrine effects, such as demasculinization (i.e., feminization), which can negatively affect sperm production and thus could have devastating population-level effects in reducing the fertilization of eggs (Mills et al., 2003). Mercury concentrations in eggs of Goliath Grouper (mean = 0.39 ppm) were among the highest recorded in wild fishes – tenfold higher than in any other species, exceeding levels that cause abnormalities. Further, seasonal patterns suggest that females offload significant amounts of mercury into their eggs during the spawning season (Malinowski et al. 2021). This is perhaps of greatest concern because when the mercury burden in female fish is transferred to their eggs, it can severely reduce the survival of embryos and larvae, adding yet another concern for limiting population recovery.

3. THE PUBLIC PERCEPTION THAT GOLIATH GROUPE ARE INVASIVE AND DESTROYING HABITAT IS FLAWED

Fishers in the State of Florida can be divided into two groups, (1) those with long-term reef fishing experience that started decades prior to the 1990 Goliath Grouper fishing moratorium; and (2) those who entered the reef fish fishery since the moratorium went into effect. The former group has a historical perspective on just how abundant Goliath Grouper were, but the latter group does not. The old-time fishers see the increase in abundance as a good thing, a recovery of a vastly overfished species, while the more recent fishers lacking that perspective view the native Goliath Grouper as an invasive species with an expanding population that is eating all the other reef fish, destroying the ecology of the reefs, and must be controlled by fishing. Scientists refer to this phenomenon as “shifting baselines” wherein first experiences are perceived as ‘normal’, and against which all subsequent changes are measured. The perceptions of those lacking the long view with Goliath Grouper are misguided. Research shows that Goliath Grouper juveniles and adults eat primarily crabs and slow-moving fishes (Figure 3). Further, it

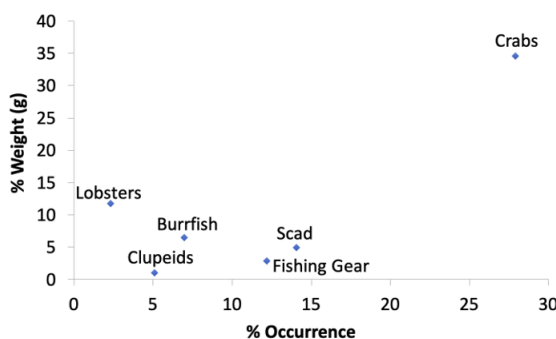


Figure 3. Diet of Goliath Grouper from. Based on data from Koenig and Coleman 2016.

demonstrates that Goliath Grouper often enhance the biodiversity and abundance of the reefs on which they occur (Koenig et al. 2011). Clearly, these misperceptions about the historical abundance and ecology of Goliath Grouper should not influence FWC’s decision to re-establish a fishery.

4. VIABLE ALTERNATE ECONOMIC CONSIDERATIONS HAVE NOT BEEN ADDRESSED

Twenty countries in the world promote dive ecotourism for viewing marine life, especially sharks and rays. This activity nets over \$300 million in direct revenues per year for those countries. The Bahamas, where conservation efforts for sharks and rays started 30 years ago – about the same time that Goliath Grouper were first protected – is especially notable for ecotourism efforts that contributed \$114 million to the Bahamian economy in 2014 and attracted 19,000 divers (43% of all dive tourists) specifically intent on diving with sharks (Haas et al. 2017). Florida conservation officials could gain significantly by exploring alternative economic perspectives such as this one before opening a fishery on a vulnerable species that has not fully recovered from exploitation or the other pressures that limit its recruitment and survival.

There are no other places in the world where a diver can consistently see and photograph many large groupers up close except in South Florida. Indeed, during the spawning months of August through October, one hundred or more adults may be gathered in predictable spawning aggregations off the east and west coasts of Florida. Because the fish spawn at night (Koenig et al. 2017) tourist observational divers diving during the day would not disrupt spawning behavior.

There are between 2.7 and 3.5 million active scuba divers in the United States and as many as 6 million active scuba divers worldwide (Diving Equipment and Marketing Association [DEMA]: <https://cdn.ymaws.com/www.dema.org/resou rce/.../Diving%20Fas t%20Facts-2013.pdf>). This is a potentially enormous market for the Florida dive industry, which would benefit greatly from this resource through direct expenditures of the divers, and to area businesses, which would benefit via indirect revenues from car and hotel rentals, restaurants, and tourist attractions such as Disney enterprises. To ignore this potential revenue is short-sighted.

CONCLUSIONS AND RECOMMENDATIONS

Based on this review, we feel that FWC should avoid opening a fishery for the iconic and vulnerable Goliath Grouper in perpetuity. The extraordinarily high concentrations of mercury in this species cannot be avoided, which presents reason enough to ensure that citizens do not fish for and consume these fish, given the damaging health effects that can ensue.

To ensure Goliath Grouper's survival in perpetuity, elements that need to be addressed immediately include:

1. Reversing habitat loss and eutrophication in South Florida estuaries to increase recruitment of Goliath Grouper and of many other ecologically and economically important fish species while potentially decreasing the effects of red tide;
2. Developing an effective mangrove restoration plan in those estuaries;
3. Exploring the economic potential of Goliath Grouper to support a non-consumptive ecotourism diving industry in Florida.

These recommendations are intended as a good-faith effort to help FWC make an informed decision based on the best available science, much of which we conducted while employed at the Florida State University Coastal & Marine Laboratory. We look forward to working with you to further conservation efforts in Florida.

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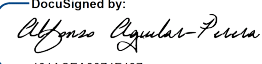
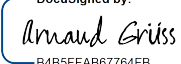
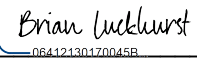

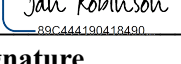
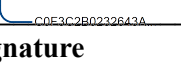
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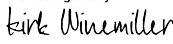




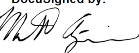
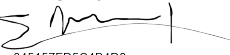
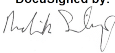

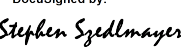
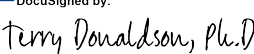
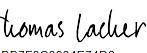
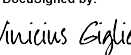
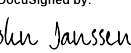
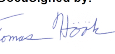
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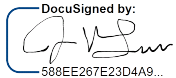
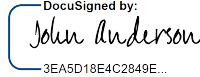
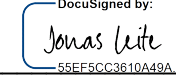
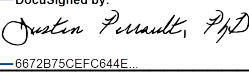
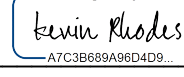

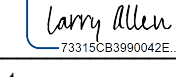
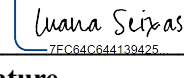
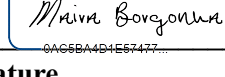
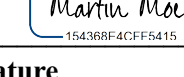
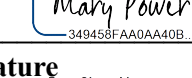
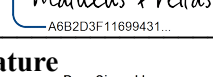
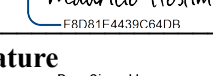
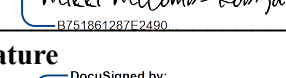
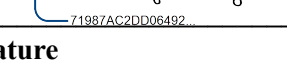
SCIENTISTS AND CONSERVATIONISTS SUPPORTING THIS DOCUMENT


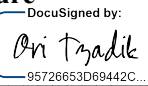


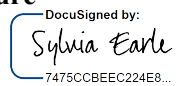

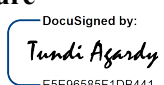

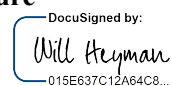


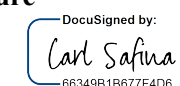
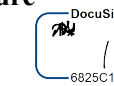
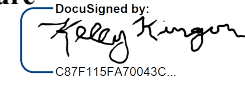
Universidad Autonoma de Yucatan	/	Alfonso Aguilar-Perera	/	DocuSigned by:  461ACEA8074F437...
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NIWZ	/	Arnaud Grüss	/	DocuSigned by:  B4B5EEAB67264EB
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Sargasso Sea Commission	/	Brian Luckhurst	/	DocuSigned by:  06412130170045B
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SCRFA.org	/	Jan Robinson	/	DocuSigned by:  B9C444190418490
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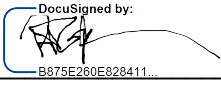
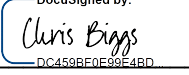
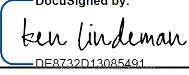
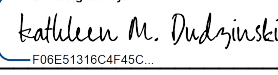
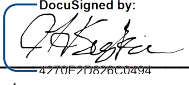







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Instituto Meros do Brasil	Johnatas Adelir-Alves	<small>DocuSigned by:</small> <i>Johnatas Adelir-Alves</i> <small>E2C45E895826498...</small>
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Affiliation	Full Name	Signature
Federal University of Pernambuco	Beatrice Ferreira	<small>DocuSigned by:</small> <i>BPF</i> <small>B050FF4628AC480...</small>
Affiliation	Full Name	Signature
	Bill Parks	<small>DocuSigned by:</small> <i>Bill Parks</i> <small>6729CD57DAD84DF...</small>
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Mission Blue, Director Comms	Brett Loveman	<small>DocuSigned by:</small> <i>Brett Loveman</i> <small>BF946B395CC9478...</small>
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Game & Wildlife Conservation Trust	Celine Artero	<small>DocuSigned by:</small> <i>Celine Artero</i> <small>6C446D1179C04F1...</small>
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Natural History Museum, London	/	Diva Amon	/	DocuSigned by: Diva Amon 445A6DA01C2748B...
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Sea Samples	/	Don DeMaria	/	DocuSigned by: Don DeMaria E4C0EDE2725144D...
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Instituto Meros do Brasil	/	Eduardo Sanches	/	DocuSigned by: ES FR9ACC5165C1468
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AWWA	/	Geoff Shideler	/	DocuSigned by: Geoff Shideler 8F136A030BFB449...
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U. of Louisiana	/	James Nelson	/	DocuSigned by: jnel C04E26F352884FB...
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Mote Marine Lab	/	Jim Locascio	/	 DocuSigned by: 588EE267E23D4A9...
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Instituto Meros do Brasil	/	Jonas Leite	/	 DocuSigned by: 55EF5CC3E10A49A...
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MarAlliance	/	Kevin Rhodes	/	 DocuSigned by: A7C3B689A96D4D9...
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SLU AQUA	/	Lachlan Fetterplace	/	 DocuSigned by: 197094C99F704EC...
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Instituto Meros do Brasil	/	Luana Seixas	/	 DocuSigned by: 7EC64C644139425...
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Aqualife Research, retired	/	Martin Moe	/	 DocuSigned by: 154368F4CFF5415...
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Instituto Meros do Brasil	/	Matheus Freitas	/	 DocuSigned by: A6B2D3F11699431...
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Ocean First Institute	/	Mikki McComb-Kobza	/	 DocuSigned by: B751861287E2490...
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Tuskegee University	/	Natassjia Ragbeer	/	 DocuSigned by: 71987AC2DD06492...
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University of Florida	/ Nicole Stacy	/ 
Affiliation	Full Name	Signature
University of South Florida	/ Ori Tzadik	/ 
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Univ of Connecticut/ Mystic Aquarium, Senior Scientist	/ Peter Auster, PhD	/ 
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MarAlliance	Rachel Graham	 DocuSigned by: B875E260E828411...
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University of Texas at Austin	Chris Biggs	 DocuSigned by: DC459BF0E99E4BD
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Coastal Sci & Policy, Inc.	Ken Lindeman	 DocuSigned by: DE8732D13085491
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Dolphin Communication Project	Kathleen M. Dudzinski	 DocuSigned by: F06E51316C4F45C...
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HS Environmental Law	Jodi Habush Sinykin	 DocuSigned by: 4270F217676C04994
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Director, FSU Coastal & Marine Laboratory	Joel C. Trexler	Digitally signed by Joel C. Trexler DN: cn=Joel C. Trexler, o=Florida State University, ou=Coastal & Marine Laboratory, email=jtrexler@fsu.edu, c=US Date: 2021.05.11 18:38:25 -04'00'
Affiliation	Full Name	Signature
eOceans	Christine Ward-Paige	
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