Mercury in Goliath Grouper

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Mercury in seafood

- Seafood is the main source of mercury (inorganic and the more toxic form of methylmercury) in humans
- People who often consume seafood, particularly those living near the coast who have greater access to seafood, typically have the highest concentrations of mercury in their tissues and are therefore at greater risk of mercury poisoning
  - Mercury levels in human consumers are particularly **high on the Florida coast**

Schaefer, A. M., Jensen, E. L., Bossart, G. D., & Reif, J. S. (2014). Hair mercury concentrations and fish consumption patterns in Florida residents. *International journal of environmental research and public health*, *11*(7), 6709-6726.

Effect of low dose mercury toxicity on various organ systems

- Methylmercury is an extremely strong and harmful neurotoxin
  - Chronic exposure even at low levels can result in severe adverse health effects, including those shown here (although this list is not all inclusive)

Nervous system	
Adults	Memory loss, including Alzheimer like dementia, deficit in attention, hypoesthesia, ataxia, dysarthrea, subclinical finger tremor impairment of hearing and vision, sensory disturbances, increased fatigue
Children/infants	Deficit in language (late talking) and memory deficit in attention, Autism
Motor system	
Adults	Disruption of fine motor function, decreased muscular strength, increeased tiredness
Children/infants	Late walking
Renal system	Increases plasma creatinine level
Cardiovascular system	Alters normal cardiovascular homoeostasis
Immune system	Decreases overall immunity of the body, exacerbates lupus like autoimmunity, multiple sclerosis, autoimmune thyroiditis or atopic eczema
Reproductive system	Decreases rate of fertility in both males and females, birth of abnormal offsprings

Table reference: Zahir, F., Rizwi, S. J., Haq, S. K., & Khan, R. H. (2005). Low dose mercury toxicity and human health. *Environmental toxicology and pharmacology*, *20*(2), 351-360.

Risk of Mercury consumption in adult Goliath Grouper

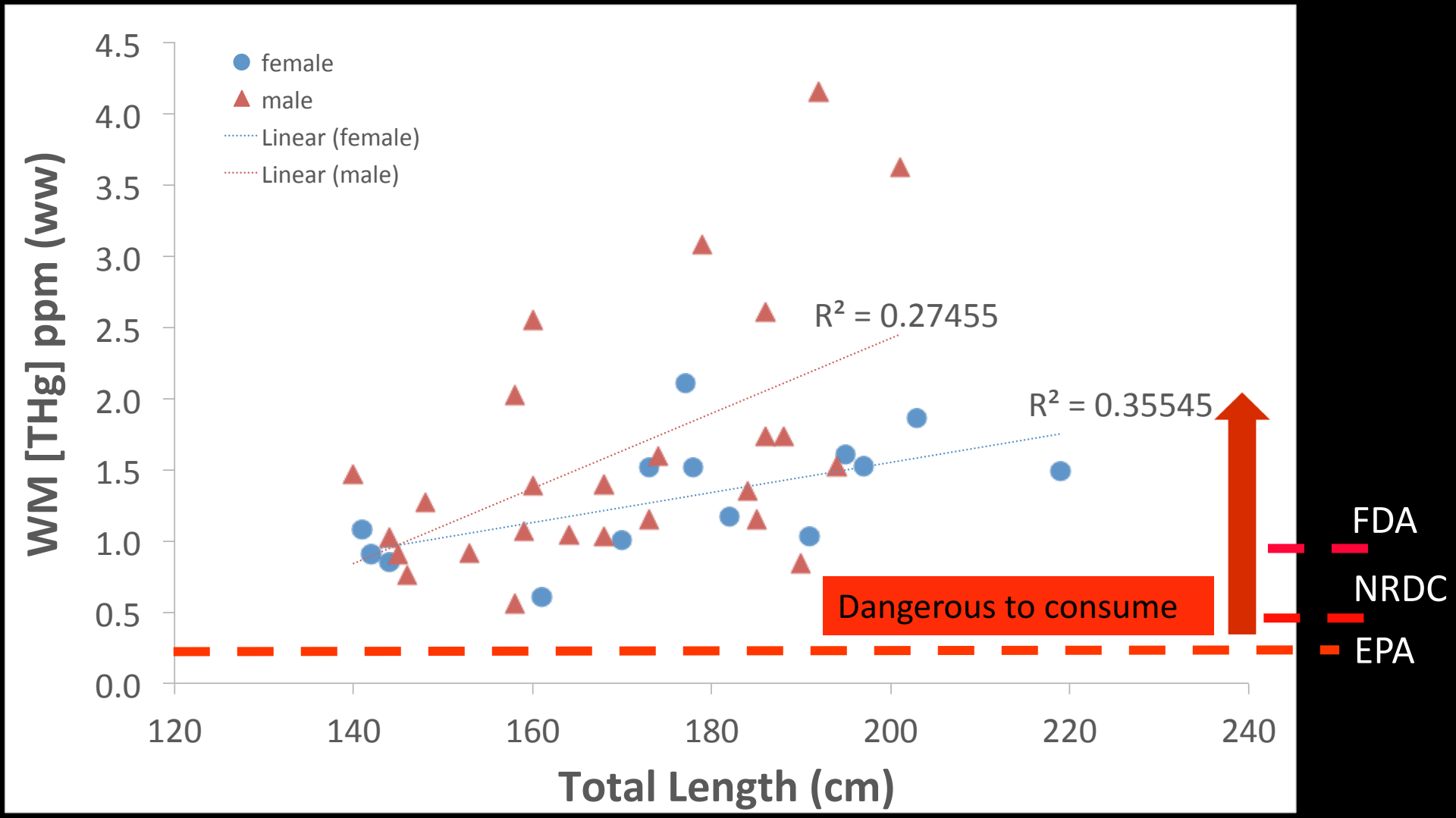

Figure source: Koenig CC, Coleman FC, **Malinowski, CR**, et al. 2016. Regional Age Structure, Reproductive Biology and Trophic Patterns of Adult Goliath Grouper in Florida. NOAA MARFIN Project no. NA11NMF4330123. 161 p.

How much mercury can you safely consume?

- Although there is no simple answer or overall agreement on this, U.S. Environmental Protection Agency (EPA) recommends a daily consumption maximum of 0.1 micrograms (ug) of mercury (Hg) per kilogram (kg) of body weight (1 microgram is one millionth of a gram or one thousandth of a milligram).

So…is it safe to consume Goliath Grouper, if harvest is allowed?

- Based on our data from samples taken all over the state, **Goliath Grouper (at least as adults) are not safe to consume** (see Koenig CC, Coleman FC, **Malinowski, CR**, et al. 2016. Regional Age Structure, Reproductive Biology and Trophic Patterns of Adult Goliath Grouper in Florida. NOAA MARFIN Project no. NA11NMF4330123. 161 p.; **C.R. Malinowski**, unpublished data)

- Goliath Grouper maximum mercury value: 4.15 ug/g
  - Based on EPA estimates, it would take a 176 lb person about 145 years to safely consume the edible filet (~210 lbs) of a 350 lb Goliath Grouper

- Goliath Grouper mean mercury value: 1.52 ug/g
  - Based on EPA estimates, it would take a 176 lb person about 50 years to safely consume the edible filet (~210 lbs) of a 350 lb Goliath Grouper

Risk of Minamata disease through eating Goliath Grouper

- Chronic MeHg exposure as low as 50 ug/day has been shown to increase the risk of dysesthesia and possibly multiple sclerosis (symptoms include pain or abnormal sensations like tingling, burning, and numbness) and other related mercury poisoning effects (*i.e.*, Minamata disease)

- Goliath Grouper maximum mercury value: 4.15 ug/g
  - A person consuming 12 grams [0.4 oz] of fillet per day (3 oz=palm of your hand) could be at risk of Minamata disease

- Goliath Grouper mean mercury value: 1.52 ug/g
  - A person consuming 33 g [1.2 oz] of fillet per day (3 oz=palm of your hand) could be at risk of Minamata disease

Goliath Grouper mercury values based on data from: Koenig CC, Coleman FC, **Malinowski, CR**, et al. 2016. Regional Age Structure, Reproductive Biology and Trophic Patterns of Adult Goliath Grouper in Florida. NOAA MARFIN Project no. NA11NMF4330123. 161 p.; **CR Malinowski**, unpublished data

Calculations based on estimates from: International Program on Chemical Safety. Environmental methylmercury: health criteria 101. Geneva: World Health Organization; 1990. [cited 2012 Oct 2]. Available from: http://www.inchem.org/documents/ehc/ehc/ehc101.htm.

NRDC guide to mercury in seafood

Grouper is in the "Highest Mercury" category of seafood and it is suggested that it should be avoided, especially by pregnant women and children

Goliath Grouper have some of the highest reported mercury levels of any grouper species, putting anyone who consumes this fish at risk of severe health effects

LEAST MERCURY	MODERATE MERCURY	HIGH MERCURY	HIGHEST MERCURY
Enjoy these fish	Eat six servings or less per month	Eat three servings or less per month	Avoid eating
Anchovies	Bass (Saltwater, Striped, Black)	Croaker (White Pacific)	Bluefish
Butterfish	Buffalofish	Halibut (Atlantic, Pacific)	**Grouper**
Catfish	Carp	Mackerel (Spanish, Gulf)	Mackerel (King)
Clam	Cod (Alaskan)	Perch (Ocean)	Marlin
Crab (Domestic)	Lobster	Sablefish	Orange Roughy
Crawfish/Crayfish	Mahi Mahi	Sea Bass (Chilean)	Shark
Croaker (Atlantic)	Monkfish	Tuna (Albacore, Yellowfin)	Swordfish
Flounder	Perch (Freshwater)		Tuna (Bigeye, Ahi)
Haddock (Atlantic)	Sheepshead		
Hake	Skate		
Herring	Snapper		
Jacksmelt (Silverside)	Tilefish (Atlantic)		
Mackerel (N. Atlantic, Chub)	Tuna (Canned chunk light, Skipjack)		
Mullet			
Oyster			
Plaice			
Pollock			
Salmon (Canned)			
Salmon (Fresh)			
Sardine			
Scallop			
Shrimp			
Sole (Pacific)			
Squid (Calamari)			
Tilapia			
Trout (Freshwater)			
Whitefish			
Whiting			

https://www.nrdc.org/stories/smart-seafood-buying-guide

How does mercury in Goliath Grouper compare to other species of grouper around Florida?

Species	Location	Mean size (mm)	Mean Hg (ug/g)	Min Hg (ug/g)	Max Hg (ug/g)
Goliath Grouper	GOM/SA	1,730	1.52	0.56	4.15
Black Grouper	GOM	840	0.91	0.26	1.60
Gag Grouper	GOM	676	0.4	0.13	1.06
Scamp	GOM	533	0.24	0.07	0.59
Red Grouper	GOM	429	0.17	0.03	0.79
Snowy Grouper	478	889	0.20	0.04	0.57

GOM=eastern Gulf of Mexico, off Florida's west coast; SA=south Atlantic, off Florida's southeast coast

- Adult Goliath Grouper (within the size range proposed for harvest by FWC) are much higher in mercury concentration than any of the other grouper species reported throughout Florida's waters
- Black Grouper appear to have the second highest concentrations of mercury (mean values above safe limits set by EPA and NRDC, and so consumption should be limited for this species as well

Data source: Adams et al., 2003; Tremain & Adams, 2012; Koenig, Coleman, Malinowski et al., 2016