

Mercury levels in Florida sharks - David Evers, BioDiversity Research Institute A Study by the South Florida Student Shark Program

The anthropogenic release of mercury through air emissions and water effluents is a broad concern by local, regional and national policy-makers (USEPA 2005). Atmospheric deposition of mercury has links to many sources in the United States, including municipal incinerators and coal-fired utilities. These and other sources can cause biological mercury hotspots to form (Evers et al. 2007), especially within landscapes that have an ability to effectively methylate the environmental inorganic mercury loads (Driscoll et al. 2007). Marine systems are sensitive to environmental mercury inputs, particularly in shallow, in-shore waters near large local sources.

Mercury contamination in the southeastern United States is so prevalent that the U.S. Fish and Wildlife Service consider mercury as “being the most serious environmental threat to the well being of fish and wildlife resources” for that region (Facemire et al. 1995). In particular, Florida has a well-documented problem of methylmercury bio-amplification in its freshwater ecosystems. Apex predators such as wading birds have exhibited high mercury exposure and at levels that are considered detrimental to them (Heath and Frederick 2005). Recently, reductions of air pollutants, including mercury, have resulted in the lowering of mercury in freshwater fish and bird tissues, which has even been linked to the reversal of poor reproductive success in wading birds (Frederick et al. 2004). How these spatial and temporal trends manifest in Florida’s near-shore marine environment is relatively unknown.

As long-lived, apex predators, various shark species are good indicators for measuring spatial and temporal trends in methylmercury availability for Florida’s near-shore marine waters. Sharks are well known for their ability to biomagnify methylmercury and harbor levels that are unsafe for human consumption. Mercury levels in shark muscle tissue regularly exceed the U.S. Environmental Protection Agency action level of 0.30 ug/g, (wet weight [ww]) for many areas of the world, such as the northeast Atlantic (Branco et al. 2004), southwest Atlantic (Pinho et al. 2002), Mediterranean Sea (Storelli et al. 2002), and Australian waters (Lyle 1984). Mercury levels in Florida sharks were measured in near-shore and off-shore waters of east-central Florida from 1992-1995 and the majority exceeded the threshold level currently used by Florida for human consumption of 0.50 ug/g (ww) (Adams and McMichael 1999).

Further information on how methylmercury is distributed in the marine system that sharks use is needed because (1) human consumption of shark muscle continues and (2) many shark populations are declining and the impacts of environmental stressors such as mercury pollution are unknown. Mercury toxicity levels in fish are relatively undetermined. Friedmann et al. (1996) demonstrated through a dosing study that young walleye with a mean body burden of 2.37 ug/g, ww (the high dose) had significant growth and reproductive impacts.

In 2006, we conducted a pilot study to opportunistically capture and non-lethally sample sharks from Biscayne Bay and Florida Bay in southeastern Florida. Results from this effort are comparable to a similar set of species and size classes from an area on the Florida coastline approximately 100 miles north of our pilot study by Adams and McMichael (1999). Their sampling effort included a mix of age classes of four species from 1992 to 1995.

In our study, 26 sharks representing five species were sampled and analyzed for mercury exposure in 2006 (Figure 1). The nurse shark had the lowest mean mercury level (0.05 +/- 0.05 ug/g, ww) and is likely feeding relatively low in the foodchain. The Atlantic sharpnose shark had the next highest mean mercury level of 0.52 +/- 0.26 ug/g (ww) and was approximately half

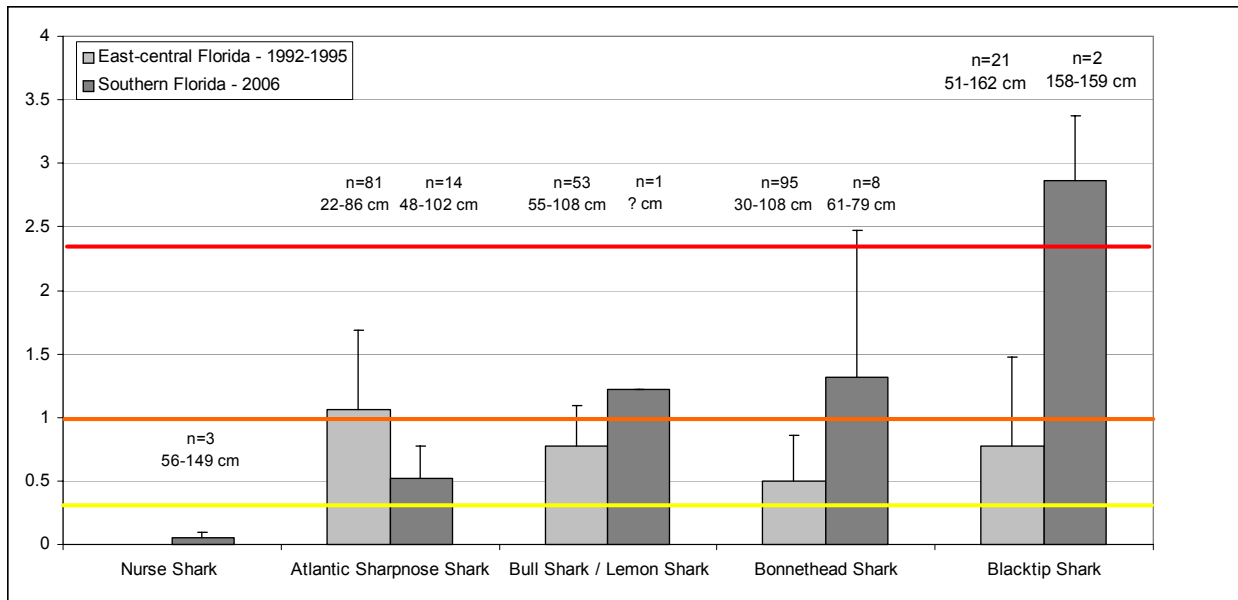


Figure 1. Arithmetic mean (+/- sd) of mercury levels in six shark species. Our pilot study represents southern Florida in 2006. A comparison is made with a nearby study by Adams and McMichael (1999) of sharks sampled in east-central Florida from 1992-1995¹.

¹ The yellow line is the U.S. EPA action level for human health concerns (0.30 ug/g, ww). The orange line is the Federal Drug Administration action level for human health concerns (1.0 ug/g, ww). The red line is the adverse effects level for freshwater fish (2.37 ug/g, ww).

of the levels found in the 1992 to 1995 study. One lemon shark was sampled and its length was not recorded (mean mercury level was 1.22 ug/g, w). It is used here as a comparison with the bull shark as both species tend to feed on pelagic organisms. The bonnethead shark had a mean mercury level of 1.32 +/- 1.15 ug/g (ww). It was more than double the levels found in the 1992 to 1995 study. Two blacktip sharks were sampled and their mean mercury level was 2.86 +/- 0.51 ug/g (ww) and was well above other species from our 2006 pilot study as well as other individuals from Adams and McMichael (1999).

Except for the nurse sharks, two Atlantic sharpnose sharks, and one bonnethead shark, 21 individual sharks (81%) exceeded muscle mercury levels for the U.S. EPA action level: a total of 35% of the sharks exceeded the FDA action level (9 of 26) (Figure 2). Three individual sharks, two blacktips and one bonnethead, exceeded known adverse effect levels that are established for freshwater teleosts (12%). How they levels translate to elasmobranchs is not known.

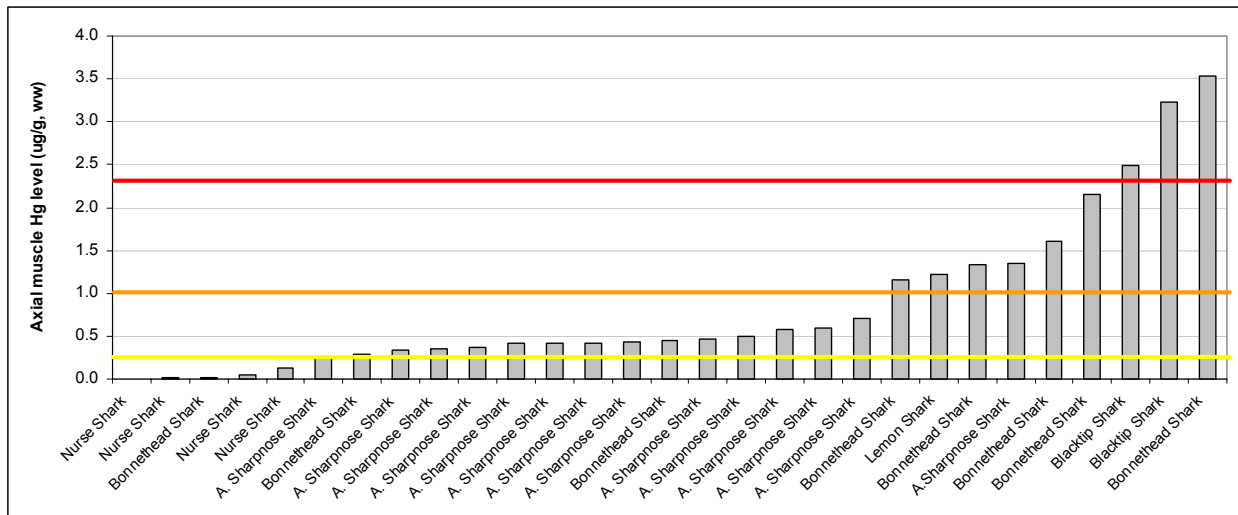


Figure 2. Individual mercury levels of sharks sampled during the 2006 pilot study².

Age, size, sex, forage habits, location and time of year are factors that may affect the levels of mercury in shark muscle. These and potentially other parameters need to be collected to best interpret shark mercury levels. Size-adjusted mercury levels in shark muscle were determined for our data set and while there is a strong relationship with total length and mercury level within a species.

Conclusions:

² The yellow line is the U.S. EPA action level (0.30 ug/g, ww). The orange line is the Federal Drug Administration Action Level (1.0 ug/g, ww). The red line is the adverse effects level for freshwater fish (2.37 ug/g, ww).

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