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Issue No 9.
Summer 2012

A story about lionfish

To successfully treat and prevent diseases, a physician must be up-to-date with both “state of the art” and the happenings in the community, society, environment... Sometimes unexpected and apparently unrelated events provide both the opportunities and the challenges to learn, teach, treat and prevent. Like the story about lionfish and SJSM students...

Currently, lionfish invasion threatens to devastate the marine ecosystem around Bonaire. Native to the West Pacific Ocean, lionfish have somehow found their way to the Caribbean waters. In the Caribbean their populations are blooming because they have no enemies - even their only threats (sharks, groupers and larger lionfish) do not recognize them as their real prey. That leaves snorkelers, divers and fishermen as the only force that keeps lionfish numbers down. To motivate that force, conservationists are promoting lionfish trade and urging people to eat lionfish. But FDA warns that lionfish have been found to harbor heavy metals and ciguater toxins thus eating them may carry a certain risk of heavy metals and/or ciguatera fish poisoning...

OKs and Buts

The American Heart Association recommends eating fish at least two times a week. But recent research finds that 84% of the world's fish tested was not safe to eat more than once per month because of mercury poisoning.

OKs and Buts

National Geographic (and many, many cooks) claim that lionfish have "moist, buttery meat that is often compared to hogfish"...and the SJSM biochemical lab finds only low levels of mercury...But other laboratories found out that mean concentrations may differ among years and locations...

To answer the question about mercury in lionfish, a group of students investigated lionfish tissue samples for the presence of mercury. Diving – pardon - sample collection - was their small contribution to the protection and hopeful recovery of the ecosystem. Duty combined with a pleasure to dive in one of the best locations for diving in the world...

What is the moral of the story? Maybe it can be found on the poster presented on Science day...



Is it safe to eat fish on Bonaire?

Quantitation of Lead and Mercury Contamination of Invasive Lionfish (*Pterois spp.*) off Bonaire

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Introduction

The lionfish (*Pterois volitans* / *Pterois miles*) was first found in the Gulf of Mexico/Caribbean region in the 1980's. Whether it had arrived via inadvertent transportation, probably in bilge water transferred from the Pacific through the Panama Canal, or from released or escaped aquarium fish was not able to be ascertained. During the next decades the species spread further south and gradually invaded the coastal waters of large parts of the region. The first lionfish was seen off the coast of Bonaire in the Dutch Caribbean in late October 2009. Since then the population has escalated dramatically and catches of around 100 per session during controlled removal exercises are common. It was not known whether the population increase was a reflection of recruitment from elsewhere, local breeding, or a combination of both. Given the availability of lionfish caught on control, it was decided to screen for heavy metal contamination, and to check specifically for the concentrations of mercury and lead. Four locally resident top predator species, wahoo (*Acanthocybium solandri*), mahi mahi (*Coryphaena hippurus*), black fin tuna (*Thunnus atlanticus*) and guachanche barracuda (*Sphyrna guachancho*) had previously been analysed and shown to exhibit only low levels of mercury. Even the tuna, which showed the greatest levels, were still at least ten times lower than the FDA advisory maximum for mercury (0.5µg/g).



References:

Evers, D.C., Turnquist, M.A., and Buck, D.G. 2012. Patterns of global seafood mercury concentrations and their relationship with human health. Biodiversity Research Institute. Gorham, Maine. BRI Science Communications. Series 2012-48
U.S. Food and Drug Administration: Food safety - Seafood; available at <http://www.fda.gov/Food/PopularTopics/ucm341987.htm>

Materials and Methods

The fish were all caught off the west coast of Bonaire during September 2011. Samples, taken from the flank muscle from 10 individual fish, were weighed and then heated in sealed containers using microwave energy for three minutes each, as per the instruction of the test kit manufacturers (Osumex). Subsequently, the fluid exuding from the samples was collected, the volume measured and the fluid then stored frozen prior to analysis. The fluid samples were analysed using semi-quantitative techniques, according to methods approved by the FDA, and using kits supplied by Osumex Natural Alternatives (Toronto, Canada). Initially, the samples were screened for a suite of possible contaminants. Only mercury and lead were detected and not definitively in all samples. The samples were then re-analysed using semi-quantitative kits, specific for mercury or lead. The mercury kits were all from the same batch of kits as used for the previous analyses of the local predatory species and those data had been corroborated by a private laboratory in South Africa (personal contact) using standard atomic absorptiometry techniques.



Results

Fish No.	Length (mm)	Wet mass (g)	Fluid (ml)	Screen	Hg (µg/g)	Pb (µg/g)
1	260	41.0	33.1	Hg~Pb~	0.025	0.020
2	300	52.4	39.8	Hg~Pb~	0.025	0.000
3	340	50.4	40.3	Hg+Pb~	0.050	0.000
4	220	27.2	20.6	Hg~Pb~	0.025	0.020
5	240	38.2	31.1	Hg~Pb~	0.000	0.000
6	220	25.3	20.4	Hg~Pb~	0.025	0.000
7	200	21.5	17.1	Hg~Pb~	0.025	0.000
8	170	14.7	10.8	Hg~Pb~	0.000	0.050
9	180	21.5	19.3	Hg~Pb~	0.025	0.020
10	200	24.8	19.8	Hg+Pb~	0.050	0.000
Mean	233	31.7	25.2		0.025	0.011

Discussion

Levels of mercury have increased 3-5 fold over the past century due to human activities. Similar to the earlier results with the mercury testing of wahoo, mahi mahi, tuna and barracuda, the mercury levels in lionfish muscle were low compared to the FDA advisory maximum of 1.0 ppm. Reports from more northerly sites within the region have indicated higher levels of mercury. Mercury is an accumulative toxin, the body absorbs about 90 to 100 percent of ingested methylmercury and once into an organism is predominantly not excreted. Thus the higher the environmental mercury levels the higher the mercury levels would be expected to be in an organism in, or coming from, that environment. It is thus reasonable to assume that the increasing population of lionfish found around Bonaire has not migrated from regions of greater mercury levels (Gulf of Mexico, Florida, Bahamas), but because the mercury levels are comparable to local fish species has resulted from in situ breeding. There were no comparable data for lead as this had not previously been tested for, however the levels were also very low and more than half of the samples were negative. However, FDA recently warns that certain lionfish contain ciguatoxins. Ciguatoxins are produced by an algae that grows in coral reefs and found most commonly in the tissues of large predatory fish in the Caribbean Sea, the South Pacific Ocean, the Indian Ocean and the Gulf of Mexico. Ciguatoxins cause more illnesses worldwide than any other marine toxin in the world, presenting with gastrointestinal and neurological symptoms that can last for decades after the exposure.

Conclusion

Heavy metals' concentrations in fish from Bonaire are low. However, using either EPA (RfD of 0.1 µg/kg body weight/day) or FDA limits (maximum allowable concentration of 1 ppm) on Hg input, a 6 ounce portion may sometimes exceed the daily limits in vulnerable population. And finally, recommendations about consumption of fish from Bonaire may also depend on the presence or absence of ciguateratoxin in muscle tissue, organs, and fat in predatory Bonairean fish.