Not all tuna are equals in terms of mercury: location matters

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*One of the questions I get asked quite often refers to the 'dangers' of mercury (Hg) when eating pelagic fish – particularly tuna. A lot about this issue has been mentioned in social media and the news, and it seems to be a topic that never ends. So I was interested to read an recent article that states in the title Mercury levels of yellowfin tuna (*Thunnus albacares*) are associated with capture location*[2]*.*

Before writing about the impact of mercury in human health, it is important to clear up the basics: methylmercury (MeHg – which is the form of mercury mostly found in organisms) is naturally produced in the ocean from mercury sources that can be natural (e.g., volcanism) or anthropogenic activity (e.g., industry, gold mining, coal burning, etc.).

The key issue with mercury is that it bio-accumulates when in the form of MeHg, which means that the older and the higher-up in the trophic chain (who eats who) that an organism is, the higher the potential levels of MeHg will be. Furthermore, different groups of 'fish' have different capacities to metabolise MeHg (i.e. get rid of it naturally). Sharks, for example, have a very low capacity to metabolise MeHg. Therefore, as they are also apex (at the top) predators, their Hg levels are found in higher concentrations than, for example, in tunas that have better ways of dealing with it. Finally, depth is an important parameter to take into account, as MeHg in the ocean is at its maximum at depths of about 400 m. The deeper an organism feeds, the higher the chance it will be exposed to prey that exhibits a high levels of MeHg, which impacts its own levels.

To make things more complicated, human exposure plays a big role (i.e., the quantity of fish you eat per day or week). In simple words, if a person ate a 100 kg shark, which has MeHg levels way above the recommended maximum, by themselves in one sitting, not much would happen (beyond indigestion!); yet if an individual ate 200 g of shark meat with the same very high levels of MeHg, every day for 20 years, chances are they will be in trouble.

The first confirmation and quantification of the neurological impacts of mercury were demonstrated by the Minamata case – an environmental disaster that occurred in Japan in the 1950s. Mercury in the effluent from an industrial plant was dumped into the Minamata Bay area and contaminated the aquatic environment and local people, whose diet was mostly based on seafood from these waters, which led to severe health effects.

Yet this was an extreme case and most of the tuna that we consume today is at a safe level (because many of the big – ergo older – ones have been fished already, but that is another fisheries issue) and furthermore, our diet is not just based on tuna.

Offloading a large yellowfin tuna for processing, Fiji (image: Francisco Blaha).

The demonstrated benefits of including seafood in the diet outweigh the potential risks that are associated with it. This was researched in a huge study and consultation by FAO (Food and Agriculture Organization of the United Nations)

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[2] See https://www.sciencedirect.com/science/article/pii/S0269749117308850

and WHO (World Health Organization) in 2010[3], thereby, is not a conspiracy of the seafood industry!

One of my mentors at FAO, David James, wrote a seminal book on the risks and benefits of seafood consumption[4] (it is not too big and is a 'must read'). In his conclusions section, he wrote:

> ... an analysis leaves in no doubt the conclusion that the benefits of seafood consumption vastly exceed the risks, except under extreme circumstances involving excessive consumption of a few species.

And, he added:

> When comparing the benefits of LC ω -3 PUFAs with the risks of methylmercury among women of childbearing age, maternal fish consumption lowers the risk of suboptimal neurodevelopment in their offspring compared with the offspring of women not eating fish in most circumstances evaluated.

Now, back to the paper that I was referring to at the beginning of this article, there is another reason to insist (and pay) for provenance and traceability. It looks like tuna caught in

The French Research Institute for Development (IRD) and the Pacific Community (SPC) are investigating mercury levels in tuna in deeper details in the Pacific Ocean

Working in collaboration, these two research institutions are investigating the mercury contamination in several species of tuna in the western and central Pacific Ocean (Project VACOPA funded by France through The Pacific Fund). Based on samples collected by observer programmes of the Pacific Ocean, and stored in the Tuna Tissue Bank managed by the Pacific Community (SPC), IRD has processed more than 1000 mercury analyses of yellowfin, bigeye and albacore tuna in the past few years (see Figure 1). Results of the study demonstrated that contamination varied with the species and the size of the specimens, and presented high differences according to the sampling area (e.g., central versus southwest Pacific). This work is under revision for scientific publication and detailed results cannot yet be provided; but an article in a future issue of the SPC Fisheries Newsletter will detail the findings of the study, as soon as possible.

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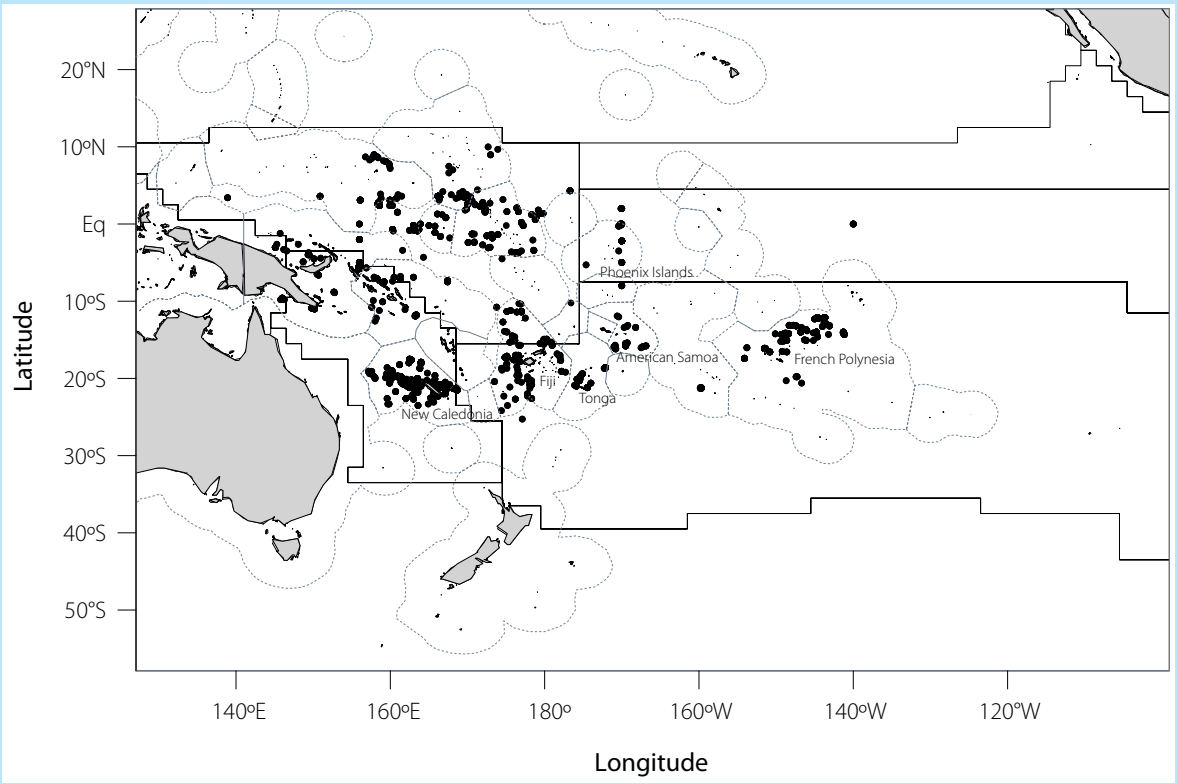

Figure 1. Map showing the 1000 tuna muscle samples analysed by the VACOPA project.

[3] See http://www.fao.org/docrep/014/ba0136e/ba0136e00.pdf
[4] See http://www.fao.org/3/a-bb211e.pdf

different parts of the world have different levels of MeHg, which in principle should not be a surprise since the main source of inorganic mercury to the ocean is through atmospheric deposition, and anthropogenic emissions are considered to be higher in the northern hemisphere.

Furthermore, as testing for mercury is expensive, regulated and needs an independently certifiable structure of determinations, it represents a huge expense for Pacific Island countries and territories since samples need to be sent to one of the following: Australia, New Zealand, Europe, Thailand or Singapore (hence think about the logistics of sending frozen samples!). The lab capacity was available at the University of the South Pacific in Fiji, but certification costs were outrageous for the level of samples required.

This paper is good news, as it gives us, in the Pacific region, the chance to confirm something we knew: our yellowfin tuna has low levels of mercury. And, more importantly, this could argue for a possible reduction in the frequency of sampling and therefore the costs for the battled seafood safety Competent Authorities in the region.

The paper highlights are as follows:

- Mercury levels of 117 wild yellowfin tuna, a commercially important species caught worldwide, were measured.
- Fish were captured from 12 known locations around the globe, representing four major yellowfin stocks.
- Geographic origin is an important factor that determines mercury levels in yellowfin of similar size.
- Low mercury fish clusters were found and argue for traceability as a tool to reduce human mercury exposure.

And the abstract says the following:

> Current fish consumption advisories focus on minimizing the risk posed by the species that are most likely to have high levels of mercury. Less accounted for is the variation within species and the potential role of the geographic origin of a fish in determining its mercury level. Here we surveyed the mercury levels in 117 yellowfin tuna caught from 12 different locations worldwide. Our results indicated significant variation in yellowfin tuna methylmercury load, with levels that ranged from 0.03 to 0.82 μg/g wet weight across individual fish. Mean mercury levels were only weakly associated with fish size ($R^2 < 0.1461$) or lipid content ($R^2 < 0.00007$) but varied significantly, by a factor of 8, between sites. The results indicate that the geographic origin of fish can govern mercury load, and argue for better traceability of fish to improve the accuracy of exposure risk predictions.