Effects of Climate Change on Ciguatera Fish Poisoning, and Social-Ecological Resilience: Case Study of French Polynesia

Lingfeng Zheng, Ph.D. Candidate, The University of Tokyo, Japan (corresponding author)
lingfeng.zheng@s.k.u-tokyo.ac.jp
Environment Bldg. 784, 5-1-5 Kashiwanoha
Kashiwa 277-8563, Japan
Clémence Gatti, Ph.D., Institut Louis Malardé, French Polynesia
Esther Garrido Gamarro, Food Safety and Quality Officer, Food and Agriculture Organization of the United Nations, Italy
Aya Suzuki, Associate Professor, The University of Tokyo, Japan
Heng Yi Teah, Ph.D. Candidate, The University of Tokyo, Japan

Ciguatera fish poisoning (CFP), arising from ciguatoxins (CTXs) produced by harmful algae blooms, is one of the most common food-borne illnesses, with annual incidences up to 500,000 worldwide. The causal toxins, the CTXs, bio-accumulate through the food chain from small herbivorous fish feeding on the coral reefs into larger-sized carnivorous fish that prey upon them. Humans get infected by consuming these contaminated fish, with symptoms such as nausea, vomiting, diarrhea, tingling, and muscle pain, lasting from several hours to several months.

Though once endemic only to small islands in tropical and subtropical areas, ciguatera has increasingly become a global human health issue. Climate change as well as its related events have been commonly hypothesized to lead to a wider presence of harmful algal blooms, hence higher risk of the disease.

Existing studies assessing the relationship between climate change and CFP are very limited. Most of them have failed to control for external factors affecting CFP incidences, such as tourism and international trade. French Polynesia is the most ideal for being selected as a case study because, (1) ciguatera is highly endemic to French Polynesia, with an average incidence rate of 16.5/10,000 people in the last decade, and despite being underreported universally, CFP cases in French Polynesia are more likely to be reported and diagnosed; (2) People consume fish caught locally. This can exclude most external factors mentioned above.

Utilizing the epidemiological data from 2007 to 2016, and climate data obtained from

Climate Data Library, we performed a time-series analysis to assess the relationships between the monthly CFP incidence and climate-related indicators including sea surface temperature (SST), precipitation, cyclones, water salinity and El Niño Southern Oscillation (ENSO) events in French Polynesia. Results reveal the significant time-lagged associations between climate variables including SST anomalies, maximum SST, precipitation anomalies and ENSO indices, and the monthly CFP incidence. If this data is confirmed, this delay will allow health authorities and the general public to take appropriate actions, to avoid/limit an epidemic risk, especially on high-risk climate scenarios.

However, the public health impact of CFP is underestimated due to under-reporting, under-diagnosis, and lack of public awareness of the disease. With the burden of climate change, CFP is projected to pose significant threats to more and more previously non-endemic communities. Efforts should be concentrated on monitoring and control at national and international levels, raising awareness about public health implications of CFP, and implementation of food safety risk assessments in affected regions. Moreover, additional long-term prospective studies, relying on complementary disciplines, are needed in order to confirm and complete our findings. They would require a detailed follow-up of meteorological, epidemiological, ecological and sociological data at a global scale.