Influences of Benzophenone-3 on the Reproductive Physiology of Yellowfin Tuna in O‘ahu Seawaters

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Background

Each year, Hawai‘i sees more than 10 million tourists. Due to the constant influx of tourists attracted to outdoor activities, such as the beaches, sunscreen usage in Hawai‘i is high. The excessive amount of human activity along shorelines and oceans raises concerns regarding chemical pollution. Active ingredients in sunscreen are an example of chemicals detected in seawater. Chemicals introduced to the ocean can have detrimental effects on aquatic ecosystems which eventually impact humans. The aim of my research is to study the impacts benzophenone-3 (BP-3), shown in Figure 1, has on the reproductive physiology of yellowfin tuna.

How does exposure to benzophenone-3 (BP-3) influence the reproductive physiology of yellowfin tuna in O‘ahu seawaters?

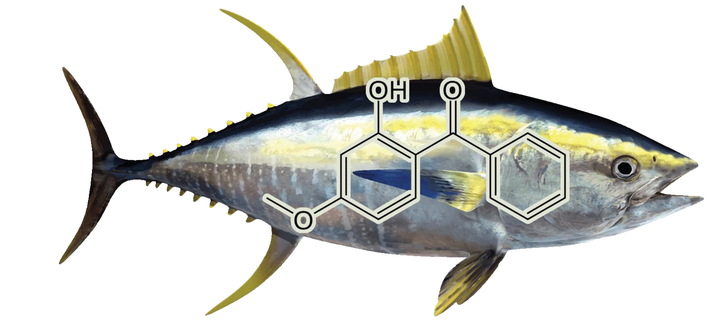

Figure 1: Chemical structure of benzophenone-3 and a yellowfin tuna.

Sunscreen

Sunscreens contain multiple chemicals whose interactions with the environment cause adverse effects, shown in Figure 2. Even biodegradable sunscreens cause harmful effects and pose a threat to ecosystems.[1] Depending on the type and concentration of the chemical, it was shown that anthropogenic chemical interactions reduced juvenile coral survival to almost 0%.[2] Loss of coral reef ecosystems cause serious impacts to both the ecology and economy of coastal communities.

Yellowfin Tuna

Yellowfin tuna are a species of fish that is locally caught, sold commercially, and consumed in many seafood dishes. Yellowfin tuna is prepared in a variety of ways such as raw, fried, steamed, and more. The species has high nutritional value and is often sought out by locals and tourists. Yellowfin tuna are caught year-round but are most abundant in the summer due to spawning season.

Benzophenone-3

Benzophenone-3 (BP-3) is a chemical that acts as an UV filter to limit degradation from UV exposure. BP-3 can easily absorb light due to its conjugated ring system. Although most commonly associated with sunscreen, BP-3 is also found in packing materials, personal care products, and wastewater plant output.[3,4] BP-3 is a non-point source contaminant found in fresh water, seawater, sediments, and biota.[5] At least 25% of sunscreen washes off during water-activity, and contamination can travel over 0.6 km from the origin of pollution.[1,6] The travel radius of BP-3 puts all aquatic organisms at risk for contamination. Hawai‘i banned BP-3 as of 2018 due to its negative effects on aquatic ecosystems.

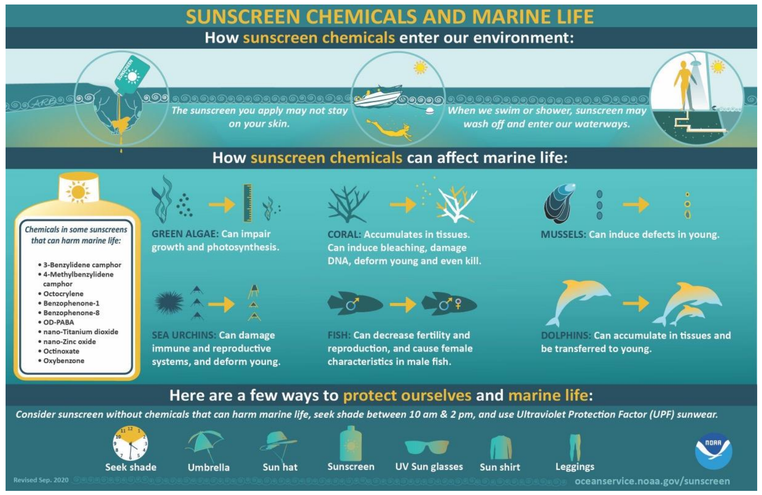

Figure 2: How the chemicals in sunscreens affect marine life/ecosystems.

Previous Research

Research shows BP-3 causes a lingering effect that can be measured. Previous scholars have done research on flatworms, crustaceans, alga, and coral species.[2,3,6] Data collection from experiments displayed results such as deformed shape of the organism, reduced population growth, and alterations of biochemical markers.[2,6,7] It is likely that BP-3 will have effects on other aquatic organisms when exposed to the chemical. My research will analyze the influence that BP-3 has on the reproductive physiology of a deep-water organism, the yellowfin tuna.

Methodology

Seawater Sampling/Chemical Analysis
Seawater from the locations in which yellowfin tuna are commonly caught by local fisherman off the shorelines of O‘ahu will be sampled appropriately. Sampled seawater will be analyzed for BP-3 concentration levels.

Yellowfin Tuna Sample/Vitellogenin Assay
Yellowfin tuna used in the study will be obtained from local fisherman who are familiar with catching this species of fish. Upon obtaining fish, blood will be collected and the resultant plasma will be frozen. Plasma concentrations of vitellogenin will be assessed by an enzyme linked immunosorbent assay (ELISA).

Future Studies

Yellowfin tuna is highly desired in the seafood industry/markets worldwide. My research will assess how BP-3 affects this organism’s reproductive activity. If BP-3 negatively affects the reproductivity of the yellowfin tuna, this raises red flags regarding the sustainability of the species.

Future studies could investigate if the ingestion of contaminated fish accumulates up the food chain. If so, this is cause for public health concern since thousands of individuals consume aquatic organisms each day.

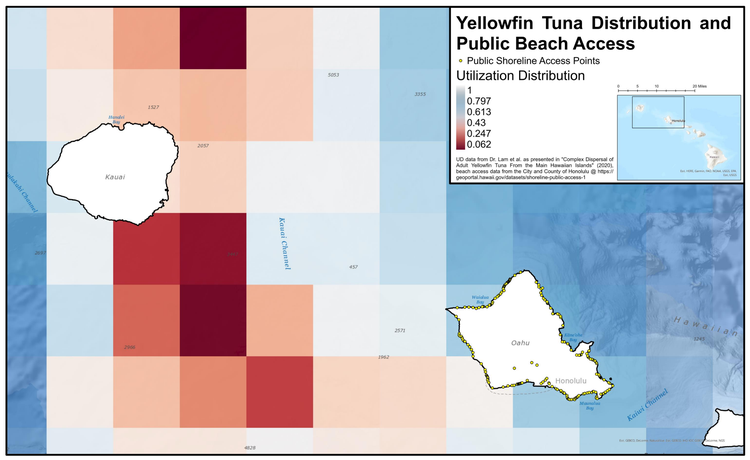

Figure 3: Reference map of yellowfin tuna distribution and public beach access points on the island of O‘ahu (map by Jim Coll).

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Acknowledgements

I would like to thank the Haskell Environmental Research Studies Institute (HERS), EPSCoR, the National Science Foundation (NSF), Haskell Indian Nations University, and the University of Kansas. I would also like to acknowledge Jim Coll, Katrina McClure, Phillip Cody Marshall, and Dr. Jay Johnson. This project was supported by KS NSF EPSCoR Award 1656006.