ABSTRACT

The increase in the production of plastic has caused a growing environmental issue in wildlife habitats, especially in marine ecosystems. As UV radiation, wave action, and other agents break down the larger plastics into smaller pieces, new threat emerge now referred to as microplastics and nanoplastics. Oysters, mussels, and microscopic crustaceans ingest micron-sized plastics because they are similar in size to the organism’s usual diet. However, less information is known regarding nanoplastic accumulation and sublethal toxicity to cellular and physiological processes. Some evidence suggests their toxicity in aquatic biota, but there are many unanswered questions, such as are there differences in toxicity between micron and nano-sized particles. There is currently no published report using the ecologically important and abundant species, *Palaemonetes pugio*. The estuary crustacean, *Palaemonetes pugio*, also known as the grass shrimp is an appropriate indicator for aquatic toxicity.

As the one of the five major plastics in use, polystyrene (makes up Styrofoam for example) is commonly found in the marine environment, therefore, this plastic will be used during this investigation. Polystyrene nanoparticles have shown to increase harmful reactive oxygen species (ROS) in distinct organisms such as algae and rats (Bhattacharya et al., 2010; Brown et al., 2001) and may also induce this effect in grass shrimp. We will measure the amount of oxidative damage using a lipid peroxidation test.

It is not known whether plastic NPs are capable of affecting neurological process in crustaceans. However, because organic NPs are capable of crossing the blood brain barrier (Lockman et al., 2002) in mammals, accumulation of polystyrene nanoparticles in crustaceans may cause an interaction with the nervous system. We will investigate the potential for neurotoxicity by measuring the activity of the enzyme, acetylcholinesterase. Acetylcholine is an excitatory neurotransmitter that is conserved across higher organisms. At the synapse, acetylcholinesterase binds to acetylcholine and removes it. If Acetylcholine accumulates at the synapse, it can causes excessive synaptic NT activity.

Microplastics have displayed a potential to bind organic pollutants (Frias et al., 2010; Teuten et al., 2007; Mato et al., 2001. Because the smaller size of nanoplastics provides a greater surface area to volume ratio, they may also possess a potential to adsorb organic pollutants. The plastics that adsorb contaminants may serve as a “Trojan horse” for the transfer of pollutants from the environment into the organisms that ingest the contaminated plastic. We will investigate this Trojan horse effect using two organic pesticides, malathion and fipronil. The mode of action of many pesticides is neurotoxicity. Acetylcholinesterase activity and lipid peroxidation will also be used to compare the toxicity of two pesticides alone and with polystyrene particles.

The results from these investigations will provide new information concerning the cellular responses of crustaceans to nanoplastics and their potential toxicity. Both direct toxicity of the particles and the combination of adsorbed pesticides and particles will be investigated. These kinds of studies are essential for characterizing and understanding the potential impacts of plastic debris in coastal and estuary ecosystems.