BIO 5010 Discussion 4: *Human Influence on Biogeochemical Cycles*

Prompt: Think about a local ecosystem with which you are familiar. Give a very brief description of it, then explain the effects of human activity on the cycle of your nutrient in this ecosystem. Identify the impact caused by human intervention, and describe how this change has affected this local ecosystem. What questions and issues do these effects raise in your mind?

The fringing coral reefs on Maui create diverse ecosystems that are built upon the calcium carbonate skeletons and sediments produced by corals and coralline algae (Juvik, Juvik, & Paradise, 1998). These shallow, terrace-like reefs are home to a vast array of invertebrates, reef fish and algae. However, one particular symbiotic relationship is essential to the formation of coral reefs; that is the mutualistic relationship between zooxanthellae and the coral polyp itself. A single-celled alga, called zooxanthellae, resides in the tissues of the coral. The zooxanthellae provide the coral with energy to build its skeleton through the process of photosynthesis and in turn, they receive physical protection within the hard coral skeletons that filter harmful UV light (Gulko, 1998). When invasive macroalgae blooms overgrow and physically disturb the corals, this relationship is interrupted and suffers due to competition for light, nutrients, and space (Amato, Bishop, Glenn, Dulai, & Smith, 2016).

Maui's tropical location, balmy climate, and sandy beaches have made it a popular vacation destination for a transit tourist population of 2.5 million visitors per year (Nahoopii, Chun, Chun, & Liu, 2015). The heavy pressure put on wastewater treatment facilities amounts to 3-5 Mgal/d (million gallons per day) of treated, disinfected effluent that is injected into wells along the coastline (U.S. Department of the Interior, 2009). "Once injected into the aquifer, effluent spreads out and flows to the coast, typically in a horseshoeshaped plume embedded in the regional groundwater flow from the uplands to the sea" (U.S. Department of the Interior, 2009, p.3). These effluent plumes constitute excess fluxes of nitrogen and phosphorus (in the forms of NH4, NO2, NO3, and PO4) in the coastal waters and suggested "anthropogenic nutrient loading is the dominant factor allowing for excessive [algal] biomass production" (Dailer, et al. 2012).

On Maui, coral reefs have suffered due to opportunistic macroalgal blooms of *Hypnea musciformis, Ulva lactuca*, and *Cladophora* that have cost Maui County over 20 million dollars annually in economic losses (as cited in Dailer, Smith, & Smith, 2012). These persistent blooms have been found in "coastal areas proximal to wastewater treatment facilities that use injection wells for effluent disposal" (Amato, et al., 2016). If Maui's main industry is tourism, and one of those draws is the coral reef ecosystem, why aren't these land-based nutrients intercepted before they reach the coast? Surely technologies exist that can reduce excess nitrogen in the effluent prior to injection.

References

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