Influence of Fish Load on Nitrifying Community Succession in Aquarium Biofilters

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Within freshwater aquarium systems, ammonia accumulation from metabolic waste or organic matter decay can become toxic for aquatic organisms. Ammonia is removed from aquaria through nitrification, a microbially mediated process that oxidizes ammonia (NH3) to less-toxic nitrate (NO3-) via a nitrite (NO2-) intermediate, facilitated by ammonia-oxidizing bacteria (AOB), archaea (AOA), and comammox *Nitrospira* (CMX). Newly established aquaria that lack a nitrifying community are susceptible to ammonia toxicity and loss of aquatic life. However, nitrifier community succession and niche occupation within freshwater aquarium biofilters is poorly characterized. To investigate microbial community succession in response to fish loads, aquaria containing varying numbers of zebrafish (i.e., *Danio rerio*) were established and maintained for 240 days. Whole-community 16S rRNA gene sequencing and nitrifier-targeted *amoA* qPCR analyses were used to profile aquarium communities and abundances, respectively. Microbial community profiles from aquaria with high fish loads differentiated rapidly from low-fish-load aquaria, within the first two weeks of aquarium operation, and remained differentiated throughout the experiment. Nearly all aquaria were consistently dominated by *Nitrospira*-associated ASVs*,* regardless of fish load or aquarium operation time; AOB were less dominant, but present. In contrast to previous aquarium studies, AOA were nearly entirely absent.