

Effects of multiple stressors associated with agriculture on stream macroinvertebrate communities in a tropical catchment

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Tropical forests are declining at unprecedented rates in favour of agriculture, and streams can be severely impacted due to effects of multiple stressors that have rarely been considered together in tropical studies. We studied the effects of multiple stressors associated with agricultural practices (pesticide toxicity, nutrient enrichment and habitat alteration?quantified as TUmax, soluble reactive phosphorus concentration and sedimentation, respectively) on macroinvertebrate communities in a tropical catchment in Panama (13 stream sites sampled in 20 occasions from 2015 to 2017, with 260 samples in total). We examined how macroinvertebrate abundance, taxonomic richness, community composition and biotic indices (SPEAR and BMWP/PAN, which were specifically designed to detect pesticide toxicity and nutrient enrichment, respectively) varied depending on the studied stressors, considering their single and combined effects. Our analyses revealed significant effects of the studied stressors on macroinvertebrate communities, with two particular results that merit further attention: (1) the fact that pesticide toxicity affected BMWP/PAN, but not SPEAR, possibly because the former had been adapted for local fauna; and (2) that most stressors showed

antagonistic interactions (i.e., lower combined effects than expected from their individual effects). These results highlight the need for toxicity bioassays with tropical species that allow adaptations of biotic indices, and of observational and manipulative studies exploring the combined effects of multiple stressors on tropical macroinvertebrate communities and ecosystems, in order to predict and manage future anthropogenic impacts on tropical streams. © 2019 Cornejo et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.