Statement of Significance

**Briefly state the novelty, significance, and breadth of interest of the science presented** (1000 characters including spaces). Currently at 1,168 characters

Our paper describes biological and physical drivers of variability in animal-regenerated nutrients across three spatial scales. Among 27 reefs, ammonium varied up to 16-fold, a larger difference than previously reported. Surveys of reef associated biological communities revealed a potentially positive effect of animals on ammonium, which was mediated by tidal exchange. At a small-scale, we found higher concentrations of ammonium inside kelp forests than outside. Surveying 16 kelp forests of varying composition revealed that ammonium retention increases with kelp biomass, tidal exchange, and animal biomass to a lesser extent. Finally, by caging animals in situ, we found fine-scale enrichment on a scale of meters was possible, but only when flow was limited. Overall, we found evidence that animal-mediated nutrient cycling contributes to meso-, small-, and fine-scale variation in nutrients even in a wave exposed, temperate region. This suggests animals may contribute more to bottom-up effects through their excretion than previously considered. This work is the most extensive exploration of drives of ammonium variability in a temperate ecosystem to date.

**Describe why L&O is the best outlet for the publication of your paper** (500 characters including spaces). Currently at 558 characters

We believe that the readers of *L&O* will find value in our paper as it combines elements of ecological research with oceanography and includes not only physical but also biological considerations. This research broadens our understanding of aquatic systems by documenting a potentially overlooked driver of bottom-up effects in a wave-exposed temperate ecosystem. This discourse will appeal to biologists, governments, and the public, who may value marine conservation but have yet to consider the full suite of ecosystem functions provided by marine animals.