STRUCTURE AND FUNCTION OF NOVEL PHEROMONES FROM SEA LAMPREY

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ABSTRACT:

The complex pheromone communication system utilized by sea lamprey is essential for its life cycle, making pheromones targets for sea lamprey control. Our overarching objective was to characterize the function of pheromones present in sea lamprey milt and their role in sea lamprey reproductive ecology. We also aimed to characterize the structure and function of these pheromone components. Due to the COVID-19 pandemic, we were unable to isolate and characterize specific pheromone components, and instead focused on understanding the behavioral function of pheromones present in sea lamprey milt. We found that pheromones present in seminal plasma allow females to discriminate among mates, and they act independently as a potent pheromone over long distances (50 and 100m) that attracts ovulated females to the odor source and retains them there for extended periods of time. Our results suggest females use chemical cues in seminal plasma during mate search to discriminate among potential mates and locate river stretches where males are actively spawning. Milt pheromones did not influence any male behaviors we measured during experiments, but we were limited in the time and scope available to test how milt pheromone influence male reproductive behavior. Our understanding how milt pheromone impact male behavior remains incomplete. We also made multiple advances in our understanding of the sea lamprey pheromone communication network. We learned that the pheromone antagonist, petromyzonol sulfate (PZS), which abates ovulated female preferences for three-keto petromyzonol sulfate (3kPZS) during mate search, does not influence the behavioral responses of migratory females to 3kZPS. This suggests PZS is likely a more effective control tool when disrupting pheromone communication of spawning populations instead of migrating individuals. We found that a male's nesting location impacts how females express their preferences for pheromone signals. Previous work has shown females prefer higher concentration pheromone signals, but we observed the effects of this preference depended on a male's nesting location at both fine (paired nesting sites) and course (across experimental sites) scales. We also found that 3kPZS released by male sea lamprey may introduce pheromone pollution that negatively impacts pheromone communication used by chestnut lamprey, a species native to the Laurentian Great Lakes. Overall, we've made multiple advances in our understanding of sea lamprey chemical ecology, and this new knowledge may provide useful insights when attempting to integrate pheromones and pheromone antagonists into the supplemental control program.