

# Independent Project Statistical Analysis

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**Title: Bioluminescent symbioses of fish and cephalopods with bacterial symbionts.**

## **Background and Problem Statement:**

Bioluminescence is the emission of light by living organisms via biochemical including luciferin and luciferase. This feature has individually evolved several times across various taxa, which emphasizing its adaptive significance in diverse ecosystems. New details surveys have identified approximately 2,781 established bioluminescent marine species, with an extra 6,392 species from bioluminescent or prospectively luminescent genera whose luminescent status remains contradicted. This indicates that bioluminescent species constitute around 1.32% of the ~ 210,000 valid marine animal species cataloged in the World Register of Marine Species (Martini et al., 2024).

With respect to taxonomic distribution luminescent species categorized into Chordata, Arthropoda, Mollusca, cnidaria, Echinodermata and Annelida. 1,586 luminescent species are part of chordate. They are notably within Stomiiformes order. Primarily pelagic crustaceans are luminescent which encounters as 469 species. 282 luminescent species belong to Mollusca with a significant characterize from Decapodiformes such as squids. Cnidaria contains 159 luminescent species. Echinodermata encompasses 146 and Annelida 96 luminescent species (Martini et al., 2024).

Furthermore, organisms use bioluminescence for counterillumination, making their silhouettes to escape predators. Some species emit light in order to lure prey within striking distance. Organisms' communication purpose use bioluminescence which performs as a medium for intraspecific contact, for instance mating signals and territory displays. Some species produce light to blend them with ambient light conditions. As a result, hindering them less visible to predators and prey. According to Martini et al (2024) bioluminescence implied in courtship correspondence with higher species diversity that implement its role in speciation processes.

This research is a thorough review of bioluminescent symbioses between marine organisms, specifically in relation to cephalopods and fish with bacterial symbionts. In addition, the bioluminescent symbiosis plays a significant role in biomedical science. While symbiont relationships interacting between vertebrates (e.g. sharks/fishes) and invertebrates (e.g. squids) which remains understudied in response to phylogenetic analysis of cephalopods in order to understanding the food web dynamics and future climate. In order to address this problem statement, methods will be relevance systematic literature searches, and comparative analysis of luminescence mechanisms and symbiotic interactions. Therefore, it studies existing primary literatures to investigate characteristics in host-specificity, bacterial colonization such as *Vibrio sp.*, and the ecological roles of bioluminescent fish and key cephalopods species for instance ram's horn squid and vampire squid, and interaction between invertebrates, particularly crustaceans and vertebrates e.g. sharks. The study further examines the environmental and evolutionary variables influencing bioluminescent symbioses, in response to the impact of climate change and anthropogenic disturbances on these relationships (Otjacques et al., 2023). By integrating findings from these studies, the goal of this research is to identify knowledge gaps and propose future research directions. It also emphasizing in understanding the effects of environmental stressors on bioluminescent processes and their ecological significance.