Restoring Wild Oyster Reefs: Optimization of Population Sustainability Through Mathematical Modeling of Fertilization Dynamics

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Restoration efforts of wild oysters are often unsuccessful, in that they do not produce a robust population of oysters that are able to successfully reproduce. Furthermore, the dynamics of wild oyster fertilization is not well understood. As stochastic as the mating process may seem, a correlation has been made between the resulting oyster populations' fertilization rates, the age of the sperm, and the sperm concentration (Weissberg, 2016). These are some of the factors which can affect the success rate. To contextually model the oyster sustainability, in probabilistic terms, is to analyze its respective features and their corresponding levels of influence. It is imperative that scientists and biologists recognize not only the factors involved with the reintroduction/revival of wild oyster populations but also the most effective, optimization methods. Therefore, improvements were focused on mathematically defining a procedure which simulated a concentration distribution of a single sperm and egg release where there existed conditions necessary for breeding to take place. This could be used as a foundation for developing a flexible model for fertilization based on placement, initial seawater conditions, and size of the starting population. The results of this research could be implemented into a user-friendly program which would accept multiple variables as inputs and output the probability of fertilization given arbitrary values. By accounting for environmental deviations, this generalization would increase its compatibility with the public and actualize the project's intended purpose: enhance the planning of oyster reef restoration projects. It was found that as distance between oysters increased, the expected percentage of zygotes formed decreased exponentially.

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