RFC stats

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November 2017

1 Introduction

Signals that collide are problematic with the current proposed solution to this problem. In this section, we will explore the probability that signals will collide in a few different cases. Assumptions for this section are as follows:

- The number of crabs transmitting in the entire study is 500
- The target listening radius is 10 meters with an area of $314m^2$
- The estimated density of tagged crabs is 0.00012 tagged crabs/m2 (that's 1 tagged crab per 8500 square meters)
- The conservative estimate of tagged crabs is 0.001 crabs/m2 (1 tagged crab per 1000 square meters). The average distance between crabs will be about 32 m if they're all evenly spaced.
- For the sake of simplicity, a signal is defined as the total time between the beginning of a signal and the end of the signal, including the encoded silence. The time for this is conservatively estimated to be 2 seconds
- The signal space is defined as the time between the end of one signal and the start of the next. This will be between 0 and 5 seconds.
- The total signal time will then be between 2 and 7 seconds (signal + signal space). On average, that's 20 signals per minute
- A conservative estimate for the percentage of crabs tagged is .5%
- The probability of finding more than one crab within a meter (tagged or untagged) during the season when research will occur is $3 - 5\%$

First, we use a Poisson distribution. For one minute, a signal crab will produce an average of 20 signals, and $\lambda = 3$. For a period of 5 seconds, the probability of one signal occurring is $P(s) = \int_0^{.2} 3 * e^{-3t} dt = 0.45$. Assuming a uniform distribution, the probability of any two crabs signaling in the same 5 second time frame is $P(two\_signals) = P(s) * P(s) = 0.2025$.

Next, we explore how likely finding two crabs within the listening radius (10 meters). For this section, we will use the conservative estimate of one tagged crab in $1000m^2$. The probability of finding one tagged crab within the listening area of $314m^2$ is $P(crab) = 0.314$. The probability of finding two tagged crabs in that same area is $P(two\_crabs) = 0.099$. The probability that there are two tagged crabs withing the listening radius that transmit at the same time is $P(two\_signals) * P(two\_crabs) = 0.02$.