Model Phytoplankton Population by Branching Processes

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Phytoplankton are one of the most ancient inhabitants of our planet, playing the key role at the base of the ocean and marine food chains. They are microscopic species, photosynthetic organisms in aquatic systems, mostly unicellular and between animals and plants. Data on the amount of chlorophyll-A (chl-A) may be obtained by sampling, but also by means of satellite. A unit weight phytoplankton contains $0,505 \pm 0,197$ chl-A, therefore chl-A concentration can be a measure of this of the phytoplankton. We can consider as a single particle in our process, not the whole cell phytoplankton, but only the contained therein quantity of chl-A, say chl-unit. Let us define the random variables τ_i; $i = 1, 2, 3$ over the probability space $(\Omega, \Im, P)$ and consider the branching process $\{\mathbf{Z(t)}, t \geq 0\}$, $\mathbf{Z(t)} = (Z_1(t), Z_2(t), Z_3(t))$. With probability ρ at the end of his life any particle T_i splits into two particles T_{i+l} and T_{i-l} according to the law p_{ij}; $i, j = 1, 2, 3$. For $\mathbf{Z(t)}$ are derived renewal type equations and asymptotic behaviour of the means. Discuss the case where T_i stop dividing due to grain refining. The deviation in the birth magnitude of every daughter-particle regarding to this of the parent we signify by $\Lambda r \in \bar{N}(0, \sigma^2)$, where $\bar{N}$ denoted the truncated normally distribution. The proposed models would be applicable in cases of unequal splitting of the particles. Under some conditions $\mathbf{Z}(t)$ is reduced to 3 in number single type Galton-Watson processes with immigration.

References

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