Hanson, Floyd B.; **Tuckwell, Henry C.**
Population growth with randomly distributed jumps. (English) Zbl 0891.92022
J. Math. Biol. 36, No. 2, 169-187 (1997).

Summary: The growth of populations with continuous deterministic and random jump components is treated. Three special models in which random jumps occur at the time of events of a Poisson process and admit formal explicit solutions are considered:

A) Logistic growth with random disasters having exponentially distributed amplitudes; B) Logistic growth with random disasters causing the removal of a uniformly distributed fraction of the population size; and C) Exponential decay with sudden increases (bonanzas) in the population and with each increase being an exponentially distributed fraction of the current population.

Asymptotic and numerical methods are employed to determine the mean extinction time for the population, qualitatively and quantitatively. For Model A, this time becomes exponentially large as the carrying capacity becomes much larger than the mean disaster size. Implications for colonizing species for Model A are discussed. For Models B and C, the practical notion of a small, but positive, effective extinction level is chosen, and in these cases the expected extinction time rises rapidly with population size, yet at less than an exponentially large order.

MSC:

92D25 Population dynamics (general)
60H10 Stochastic ordinary differential equations (aspects of stochastic analysis)

Keywords:

population extinction; randomly distributed jumps; bonanzas; logistic growth; exponential decay; disasters; Poisson process; mean extinction time

Full Text: DOI