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An Age-structured Model of Bird Migration

An approach to modelling bird migration is proposed, in which there is a region where birds do not move but spend time breeding. Birds leave this breeding region and enter a migration flyway which is effectively a one-way corridor starting and ending at the breeding location. Mathematically, the flyway is a curve parametrised by arc-length. Flight speed depends on position along the flyway, to take account of factors such as wind and the pausing of birds at various locations for wintering or stopovers. Per-capita mortality along the flyway is both position and age-dependent, allowing for increased risks at stopover locations due to predation, and increased risks to immature birds. A reaction-advection age-structured equation models population dynamics along the flyway and, using a Laplace transform technique, the model is reduced to a scalar delay differential equation for the number of adult birds at the breeding location. Extinction and persistence criteria are obtained for the bird population and the results of computer simulations are presented.