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INDIVIDUAL DEB-BASED STRUCTURED POPULATION MODELING

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In unstructured or compartmental population models the state of the population is described by one or a set of ordinary differential equations for one or a few scalar variables as a function of time. Examples are number of individuals or total biomass. In structured models time depending individual variables such as age, size, mass or energy content are taken into account [10]. The dependent variables that describe the state of the population and are not scalars but a density function of these independent of all the individuals that make up the population. They can be considered as emerging properties of the group of co-specific individuals living an a bounded spatial homogeneous well-mixed environment.

The individual model used is the DEB model described in [8, 7]. The Add-my-Pet collection [1] contains estimated parameters of over 2000 species from all larger animal phyla. Besides age, structural biovolume, energy reserves and maturation are the individuals state variables.

The population model will be formulated for the whole life-cycle consisting of three life-stages: embryo, juvenile and adult including the criteria for the transitions, like in the physiologically structured populations approach [11]. We will assume that reproduction occurs simultaneously for all individuals and periodically, for instance with fish populations as a specific short period of the year with spawning related to mating success but also by food availability for the offspring.

The resulting model is called the Cohort Projection Model (CPM) since each individual lives in one cohort as a group of individuals that are born at the same time. It is related to a projection matrix formulation, especially the Integral Projection Model (IPM) [2, 9] method which is intermediately between the continuous-time and the well known discrete matrix projection model. Recently in [12] this approach was applied based on a previous version of the DEB model.

The CPM-method was already used in [5, 6] with the DEB model for asexual microorganisms having one juvenile life stage that propagate by binary fission in [4, 3]. In a case study the results for the marbled electric ray fish *Torpedo marmorata* population are shown where all model parameter values are taken from the Add-my-Pet collection [1].

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