From data to parameters : a preliminary DEB model for loggerhead turtles (*Caretta caretta*)

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Sea turtles have been swimming in the world oceans, and adapting to the changing environment for the last 200 million years. Despite their successful adaptation, all seven species of sea turtles are currently considered globally threatened in the IUCN classification and are protected by the CITES convention (see Turtle Taxonomy Working Group, 2012 for details).

Research and conservation of sea turtles increased in quality in quantity over the last two decades (see Hays, 2008 for review), with some of the areas gaining special attention. One of them is the development of models focusing on energetic budgets (Hays, 2008), with the goal to "combine information on their metabolic rate, energy density of prey and ingestion rates to assess energy balance over long periods" (Hays, 2008). A well defined Dynamic Energy Budget (DEB) model has the additional potential to predict growth, maturation and reproduction of individuals under different food and temperature conditions (Koojiman, 2010), and relate laboratory data to field data and predictions. Estimating the parameter values for such a model highly depends on the availability, selection and quality of data.

Loggerhead turtles (*Caretta caretta*) are one of the best studied marine turtles. Research includes studies of incubation, growth of captive reared and wild individuals, isotope studies, genetic studies, and various growth models. Studies often focus on individuals belonging to a specific life stage (embryo, juvenile, adult), or to a specific geographic region (North Atlantic, Mediterranean etc). When comparing individuals, variability is often observed in growth rates, size at the onset of reproduction (considered to be sexual maturity), and/or age at sexual maturity. There is considerable variability among individuals of the same life stage or region (e.g. Stokes *et.al.*, 2006), and even more variability among individuals of different life stages or regions (e.g. Byrd *et.al.*, 2005 ; Margaritoulis *et.al.*, 2003).

The source of variability could be different conditions in the environment (e.g. food density, temperature), or different perception of same conditions by different individuals, the latter translating into variation of individual-specific parameter values of a well designed mechanistic model. One of such mechanistic models is a DEB model, and we used it to test some possible sources of variabitlity. Ideally, data used for estimating parameter values should be obtained under standardized temperature and food density, which would remove some sources of variability. Despite the long and fruitful interest that people have in loggerhead turtles, it is hard to find examples of data describing the full life cycle, that were obtained under such standardized conditions. To estimate values of model parameters, we used data collected from the Atlantic and Mediterranean region, for wild and captive reared individuals. Chosen data sets were passed to DEBtool parameter regression routines, and different food density and temperature were accounted for. Model predictions obtained with the preliminary parameter set show a satisfactory fit with data ($FIT > 7$) .

References

Byrd, J., Murphy, S., and von Harten, A. (2005) Morphometric analysis of the northern subpopulation of *Caretta caretta* in South Carolina, *USA. Marine Turtle Newsletter*, **107**:1-4

Hays, G. C. (2008) Sea turtles: A review of some key recent discoveries and remaining questions, *Journal*