<u>PhD Project:</u> Functional relationships between telomere dynamics, physiology and life history traits in a small passerine bird, the House sparrow (*Passer domesticus*)

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Understanding the drivers of selective trade-offs between life history traits is a fundamental goal within evolutionary biology. The underlying principle is that since resources are limited then individuals have to optimally allocate any investment in growth versus survival versus reproduction. Thus, the differences we observe in individual variation in resource allocation and acquisition is presumed to be governed by optimal allocation among these trade-offs through natural selection. One important trade-off that has been documented within species is the negative relationship between lifespan and growth and/or body size within species. One trait that has been demonstrated to play a central role in mediating the trade-off between body size and lifespan in animals is the length of the chromosomal ends called telomeres. Variation in telomere length has been shown to be partly heritable. It is now well established that the telomere length at early age is predictive of lifespan and it is well established that the length of the telomeres is reduced during lifetime. One reason for this is because at each somatic cellular division the DNA sequence of the telomere is not fully replicated, which results in telomere shortening during lifetime, and when critically short this contributes to ageing and utimately individual death. Other sources are factors that increase the level of oxidative stress, which has been shown to accelerate telomere loss. For instance, metabolically expensive activities, such as catch-up growth at early age, may increase levels of free oxidative radicals compared to the level of antioxidant defenses, and this likely increases telomere shortening via oxidativce stress.

The PhD project will involve two empirical elements: (1) an artificial selection study on body size in house sparrows conducted at the islands Leka and Vega in 2002-2005 and (2) empirical field studies of house sparrows at Helgeland in Northern Norway during the PhD project. The aim of the PhD project will be to investigate central questions related to the functional associations between telomere dynamics and physiological parameters and individual behaviour ("personality"), and how these are associated with trade offs between life history traits such as growth rate, body size, reproduction and lifespan. The project's milestones will be:

- In a unique artificial selection experiment on tarsus size of house sparrows, we increased body size at Leka and reduced body size at Vega, respectively. Although much of these data and their quantutative genetics have been analysed, the source of any potential life history trade-offs associated with this selection remains unexplored. Heritability of telomere length at early age will be estimated as part of this PhD project using an Animal Model based on genetically determined multi-generational pedigrees. This will make it possible to estimate both additive genetic variance for telomere length and the genetic covariances between telomere length and other morphological traits.
- Based on the Leka-Vega dataset, the PhD student will estimate the change in body size of fledglings as a consequence of the selection experiment, and how this influenced the size of telomere lengths in those fledglings during the four successive years of selection. The PhD student will also estimate whether change in telomere affected longevity and other life history traits.
- The PhD project will include a field study on House sparrows at Helgeland, where the aim is to investigate the association between body size and growth rate at an early age (i.e. pre-fledging) and how this relates to changes in telomere length as well as oxidative stress (free radical - antioxidant defence) and stress hormones (corticosterone). In addition, the PhD student will explore how these measures influence individual performance later in life in terms of behaviour ("personality"; using individual assays in captivity), longevity, and other life history traits.