As endotherms, mammals and birds have evolved the capacity to thermoregulate, an evolutionary achievement with profound impact on biology and ecology. Largely independent of the environmental temperature, endotherms could now occupy novel ecological niches as their activity was far less constrained in time and space. The evolution of endothermy is considered to have laid the foundation for the success and radiation of mammals and birds on one hand, and the extinction of other taxonomic groups that have not evolved the ability to thermoregulate on the other hand. Endothermy, however, does not necessarily entail a constant body temperature throughout a day, a year or a life time. Instead, many mammals are known to hibernate seasonally or enter torpor, reducing their body temperature by a few °C to several tens of °C below the normothermic level. Birds are known to also become torpid or and reduce body temperature during the night by rather a few °C with some exceptions of up to two tens of °C. These on first sight small temperature drops may, however, have profound effects on enzymatic activity. The rate of biochemical reactions in general, and enzymatic reactions in particular are highly temperature dependent, which also applies to enzymes that act as antioxidants against free radicals. They protect against the negative effects of oxidative stress through free radical scavenging and if this protective enzymatic action is reduced in its rate, free radicals may remain unchecked, which may lead to oxidative damage of biomolecules. Such oxidative damage risks functional integrity of biomolecules and is currently one of the most frequently forwarded driver of aging. This research is designed to understand how regulation of body temperature may be hampered by increasing age and how this impaired thermoregulatory capability may lead to increased oxidative stress when animals grow old.

While it is well established for mammals, including us humans, that body temperature and the capacity to thermoregulate declines with increasing age, such data are virtually absent for birds, and in addition were never linked to oxidative stress. Thus, the first goal of this research project is to provide thorough understanding how age in the context of senescence influences thermoregulation in birds. This first goal entails two main components, as we have to learn i) how age influences body temperature and a bird's thermoregulatory capability and ii) how age alters the known drop of body temperature in birds during the night time in response to environmental challenges. In order to achieve these project goals we will employ continuous measurements of energy expenditure and body temperature for zebra finches (*Taeniopygia guttata)* spanning the range of known adult ages. These birds are exposed to a broad range of ambient temperatures (Experiment I), to a a sliding cold exposure that allows us to measure the maximum physiological achievable energy expenditure (Experiment II), and to the daily routine of feeding or fasting (Experiment III).

The second goal of this research project is then to relate the detailed measurements of body temperature to our measurements of oxidative stress that will be obtained from blood samples (Experiment II and III). This will allow us to test the hypothesis that body temperature is related to the antioxidative capacity of the blood and in consequence also the rate of oxidative damage. We expect that birds which lower their body temperature in order to save energy will pay a cost through the increased risk of accumulation of oxidative damage. Finally, our research will relate the effects of ageing not only to thermoregulatory properties but also to the risk to accumulate oxidative stress. We will test the hypothesis that the older the birds get – and the more the age compromises their thermoregulatory capacity – the less efficient will be their antioxidative defense mechanisms against free radicals, resulting in increased risk for oxidative damage.

In summary our research project will provide novel results on how oxidative stress may depend on small modulations of body temperature in endotherms, how environmental challenges may translate into oxidative damage and thus aging of the organism, and if the maintenance of the antioxidative defense may have been involved in the evolution of endothermy.