Description for the general public

One of the elementary theories on which the assumptions of evolutionary ecology are based is the Life-history theory. It predicts that in adult mammals, limited energy resources are distributed on basis of trade-off between two main processes: maintenance of basic life functions (such as thermoregulation, fighting infection, etc.) and reproduction. This means that the investment of resources in reproduction takes place at the expense of deterioration of the body's condition, and thus negatively affect its survival and, consequently, lifespan. Therefore, reproduction is considered to be associated with significant and inescapable physiological costs. Despite many studies documenting the existence of the costs of reproduction in animals and even humans, to this day the physiological mechanisms responsible for their existence have not been precisely identified. In recent years, there has been considerable interest in the possibility that this mechanism is oxidative stress, which arise from the imbalance between reactive oxygen species (ROS) produced in the cell and the effectiveness of processes that repair damage caused by ROS. Reproduction is associated with an increased demand for energy and nutrients, which contributes to an increase in the metabolic rate and increased production of ROS. However, experimental support for the significance of ROS-incurred damages during reproduction remains ambiguous.

We believe that the major reason behind the inconsistency of the previous results is an effect of the choice of inappropriate animal model. The vast majority of such studies utilized short-lived species (mostly small rodents or birds), whose life-histories are geared towards high, sustained rates of reproduction. Those animals are characterized by high mortality rate caused by environmental factors (e.g., predation), and therefore more profitable for them is to invest energy in early reproduction and passing on their genes, than in repairing damage caused during reproduction. Also laboratory experiments can contribute to the inconsistency of the results. Many studies suggest that controlled conditions in which animals have unrestricted access to food and no additional expenses on e.g. thermoregulation do not force the allocation of resources between competing goals and allow to maintain all body functions at the same time.

Following the August Krogh principle, which assumes that any research problem can be solved by using an adequate animal model, we plan to conduct an experiment on females of edible dormice, a species with a unique set of features, making it an extremely suitable object for studying the costs of reproduction. The lifespan of dormice is up to 12-13 years, thus several times longer than e.g. a home mouse. That is why dormice breed many times during their lives, and each litter is only a small fraction of their lifetime reproductive success. We therefore predict that these animals should invest in repair mechanisms to increase their chances of survival to future reproduction. Moreover, edible dormouse is a hibernating animal. This means that during periods when access to food is limited and the climate is unfavorable, the dormice fall into a state of torpor and remain inactive in underground burrows. This species is one of the record-holders in terms of hibernation, which can remain inactive for up to 11 months a year. Thus, these animals, during a very short activity season (2-4 months) must regenerate energy resources after hibernation, initiate the reproduction and prepare for another winter. Most importantly, hibernation itself is also associated with oxidative stress and decreased immunocompetence, which results in additional energy expenditures on regeneration at the beginning of activity season. This is probably the reason why dormice in the years of limited food availability completely skip the reproduction. Therefore, we assume that conducting an experiment on a long-lived animal, which at the same time will be forced to spend energy for other purposes, such as regeneration after hibernation, will allow us to unambiguously detect the physiological costs of reproduction.