Latvijas Universitātes 69. zinātniskā konference
Bioloģijas sekcija, Zooloģijas un dzīvnieku ekoloģijas apakšsekcija, 2011. gada 3.-4. februāris

IMMUNO-ECOLOGY OF WINTERING BIRDS

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Animals living in temporally dynamic environments experience variation in resource availability, climate and threat of infection over the course of the year. To survive and reproduce successfully, these organisms must allocate resources among competing physiological systems in such a way as to maximize fitness in changing environments. Climate conditions, shorter activity day and less availability of food resources may make survival difficult in winter (Nelson 2002). Energy stress and predation (Ekman 1986; Lima and Dill 1990) are probably the main factors responsible for winter mortality of wintering birds.

Immune function contributes to host survival by limiting infection and by performing self maintenance duties such as clearing apoptotic cells. Theory of immunological defense assumes that immune responses have not only fitness benefits, but they may also have costs (e.g. Behnke, Barnard et al. 1992; Frank 1993). These physiological costs are sufficiently large to affect fitness (e.g. reproductive output, growth or survival) when resources are limited and these costs involved in life-history trade-offs are based on constraints of energy use (Sheldon and Verhulst 1996).

Immune system can be divided in the following parts: innate constitutive (energetically low costs and non specific first line immune response) and adaptive or acquired (energetically costly and specific to particular antigens). Under limited resources in winter conditions immune defense may often be suppressed because of the shortage in an organism’s energy resources. Recent evidence suggests a possible trade-off between the use of the different arms of immune system (Horak, 2006), which is compatible with the general logic of ecological immunology (e.g. Sheldon and Verhulst, 1996; Zuk and Stoehr, 2002). Costs of mounting the immune response, whether to a benign or potentially deadly infection, may push the animal beyond the minimal levels of bodily reserves to survive (Lochmiller and Deerenberg 2000).

The aim of our study was to test whether birds with higher physiological stress would have lower immune responsiveness against *Brucella abortus* antigen during extreme environmental conditions. We challenged immunity of great tits with *Brucella abortus* antigen and recorded the immune responsiveness. To assess physiological stress of the birds (Davis et al. 2008), we calculated H/L (hetrophil/lymphocyte) ratio. We tested whether there is a trade-off between humoral responses to *Brucella abortus* antigen and cellular H/L ratio, belonging to different arms of immune system.

Immune challenge with *Brucella abortus* antigen changed concentration of heterophils and lymphocytes in peripheral blood. There was significant increase of the H/L ratio of immune challenged birds indicating that mounting immune response increases physiological stress level. Birds with higher physiological stress at the time of capture had lower immune responsivenesss against *Brucella abortus* antigen during extreme environmental conditions. Only birds in good health condition were able to acquire new immunity by producing more antibodies against *Brucella abortus*. These results suggest a link between physiological stress and winter survival, indicating that H/L ratio may serve a reliable indicator of birds’ abilities to adapt to their environment.

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