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RNA-seq analyses reveal environmental stress response genes in Lapland longspur

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Extreme weather events are becoming more frequent because of climate change. Understanding how organisms respond to adverse environmental conditions is a prerequisite to coping with environmental challenges. We studied a unique set of samples collected from free-living Lapland longspurs(Calcarius laponnicus) during their arrival and incubation. Birds were sampled at an extreme arrival period, a typical arrival period, and incubation before and during a severe snowstorm. To understand how climate change influences the biological systems of wild birds, we performed RNA-seq on the liver, hypothalamus, heart, and gonad. Plasma levels of glucocorticoids were elevated in response to stress handling during the extreme spring and during the snowstorm. We identified storm-associated differentially expressed genes (DEGs). In particular, the gene encoding FKBP5 was up-significantly regulated in hypothalamus, suggesting that FKBP5 is functionally important for the response to inclement weather. FKBP5 is a regulator of the Hypothalamic-Pituitary-Adrenal (HPA) axis stress-response, and it acts to modulate glucocorticoid receptor sensitivity. FKBP5 acts as a co-chaperone, negatively regulating the glucocorticoid signalling pathway and provides a mechanism by which an individual can adjust to environmental perturbations. Such findings will build on our understanding of endocrine mediated stress and resilience in freely living animals in a changing world. Extreme weather events are becoming more frequent because of climate change. Understanding how organisms respond to adverse environmental conditions is a prerequisite to coping with environmental challenges. Wild animals are an excellent proxy, so we studied a unique set of samples collected from wild Lapland longspur (*Calcarius laponnicus*) breeding in Alaska, representing different tissues under exposure to different environmental conditions, including a severe snowstorm. To understand how climate change influences the biological systems of wild birds, we performed RNA-seq on different tissues including liver, hypothalamus, heart, and gonad, with the presence and absence of storm condition. We identified many storm-associated differentially expressed genes (DEGs). In particular, when comparing the differentially expressed genes in hypothalamus, the gene encoding FKBP5 is significantly up-regulated, which suggests FKBP5 is functionally important in response to storm conditions. FKBP5 is a regulator of the Hypothalamic-Pituitary-Adrenal axis 45 and stress-response, and in response to stress FKBP5 modulates glucocorticoid receptor sensitivity. FKBP5 acts as a co-chaperone, negatively regulating the glucocorticoid signalling pathway and other biological functions. Such findings will provide the foundations to develop resilience strategies to mitigate potentially devastating effects in all life on earth including those of global agricultural importance.