Mechanisms regulating seasonal reproduction in vertebrates

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Animals living outside the tropics use changes in daylength to adapt to seasonal changes in environment. The Japanese quail is a robust model for the study of these mechanisms because of its rapid and dramatic response to changes in daylength. Although recent studies revealed that central thyroid hormone (TH) activation acts within the mediobasal hypothalamus to regulate seasonal gonadal development, the mechanisms that underlie seasonal gonadal regression remain unclear. Short day/low temperature (SL) stimuli induced drastic testicular regression by apoptosis, which coincided with a decrease in serum testosterone and an increase in serum T_3. Temporal gene expression analysis revealed shut-off of the luteinizing hormone (LH)-dependent steroidogenesis pathway and activation of T_3 response genes involved in amphibian metamorphosis. Administration of T_3 mimicked effects of SL conditions on gene expression, apoptosis and testicular mass. Our study reveals that TH plays dual roles in the regulation of seasonal reproduction. That is, central action induces seasonal testicular development, while peripheral action mediates seasonal testicular regression. We conclude that birds utilize T_3 not only for adaptive thermoregulation but also for testicular regression in fall or winter.