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ABSTRACT

North America's quail population trends are often linked to regional climate. Extreme climate events such as severe drought, hard freezes, or excessive winter precipitation can reduce quail populations by as much as 84%. Above-average spring and summer temperatures coincident with drought can reduce the laying season for quail by ≤60 days. Exposure of quail eggs to high temperatures during preincubation can initiate and alter embryonic development. Here, we review the impacts of extreme climate events and a changing climate on the survival, reproduction, and population trends of 6 North American quail species: California quail (*Callipepla californica*), Gambel's quail (*Callipepla gambelii*), Montezuma quail (*Cyrtonix montezumae*), mountain quail (*Oreortyx pictus*), northern bobwhite (*Colinus virginianu*s), and scaled quail (*Callipepla squamata*). Climate change scenarios are especially troubling when considered in conjunction with the heat stress hypothesis, which suggests that reproduction is reduced during heat and drought events by elevated corticosterone levels due to heat stress. Global climate change is predicted to increase the west-to-east precipitation gradient across North America. While eastern North America will see more frequent heavy precipitation events, western North America will experience more frequent and severe spring heat waves, droughts, and wildfires. These will further imperil western quail populations in the near term by decreasing the frequency of successful reproductive events. Over the long term, we expect both an elevational increase and southwest-to-northeast shift in species ranges, and concordant extirpation of local populations. Of North American quail species, California quail may see its range contract the most, approximately 50% under a 3° C global temperature increase scenario. Conversely, milder winters may increase the area over which climate is favorable to bobwhites by approximately 25%. However, these gains will largely be contiguous with regions where bobwhite populations are rapidly declining, or have been extirpated, due to intensive agriculture and other land use changes. Extirpation of local populations may not be reversible, as there are few examples of successfully reestablished populations. There is a critical need for a national recovery plan that incorporates the impacts of future climate change on quail populations. We recommend that incorporating quail and other grassland birds into agricultural enterprises become standard practice. Long-term solutions will require increasing habitat quantity and connectivity. We also recommend research to further test and expand upon the heat stress hypothesis, and we recommend land management practices to mitigate the negative consequences of climate change.

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