Next-generation sequencing offers insight into how species adapt to climate change

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Environmental scientists have a new tool for studying the responses of species to climate change. Next-generation sequencing (NGS) has made it possible to analyze enormous numbers of short pieces of DNA very quickly, and this technology is already revolutionizing the biomedical sciences. The hope is that NGS may prove similarly useful in ecological studies by providing researchers fresh insight into the way populations are adapting to a changing world.

In an article to be published in the March issue of *BioScience*, biologists Jonathon H. Stillman and Eric Armstrong, both affiliated with San Francisco State University and the University of California, Berkeley, characterize the opportunities provided by NGS: "Next-generation sequencing approaches are fundamentally changing the way in which environmental scientists undertake studies to understand how organisms are responding or may respond in the future to climate change." Further, the authors contend that NGS will allow researchers to "characterize the populations that they are studying to a higher resolution than ever before possible."

One of the important features of NGS is that allows environmental biologists to assess the presence or absence of certain gene variants within local populations, which could point to selection for certain climate-adapted traits. Alterations in gene expression are also accessible through NGS and offer further information about population responses. For instance, in an NGS study on coral, researchers found that genes associated with cellular stress responses were downregulated in a

population that had become heat adapted. The downregulation of CSR genes is "consistent with evidence suggesting that there is an evolutionary cost in maintaining elevated levels of expression in those genes," according to Stillman and Armstrong.

Despite the promise of NGS, its use in studying responses to environmental change may be stymied by a lack of funding. Compared with their counterparts in the medical and agribusiness fields, environmental biologists receive less funding, and NGS is expensive. As the authors put it, "Broad scale adoption of NGS approaches by environmental biologists will require new thinking about how to fund researchers or research consortia who are attempting to use the best available tools to tackle what may be one of the largest but most poorly funded problems facing society today—understanding and mitigating the impacts of climate change."

More information: Genomics Are Transforming Our Understanding of Responses to Climate Change, *BioScience*, 2015.

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