The alternative splicing landscape of a coral reef fish during a marine heatwave

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Abstract

Alternative splicing is a molecular mechanism that enables a single gene to encode multiple transcripts and proteins by post-transcriptional modification of pre-RNA molecules. Changes in the splicing scheme of genes can lead to modifications of the transcriptome and the proteome. This mechanism can enable organisms to respond to environmental fluctuations. In this study, we investigated patterns of alternative splicing in the liver of the coral reef fish Acanthochromis polyacanthus in response to the 2016 marine heatwave on the Great Barrier Reef. The differentially spliced (DS; n=40) genes during the onset of the heatwave (i.e. 29.49°C or +1°C from average) were related to essential cellular functions such as the MAPK signaling system, Ca(2+) binding and homeostasis. With the persistence of the heatwave for a period of one month (February to March), 21 DS genes were detected, suggesting that acute warming during the onset of the heatwave is more influential on alternative splicing than the continued exposure to elevated temperatures. After the heatwave, the water temperature cooled to ~24.96°C, and fish showed differential splicing of genes related to cyto-protection and post-damage recovery (n=26). Two-thirds of the DS genes detected across the heatwave were also differentially expressed, revealing that the two molecular mechanisms act together in A. polyacanthus to cope with the acute thermal change. This study exemplifies how splicing patterns of a coral reef fish can be modified by marine heatwaves. Alternative splicing could therefore be a potential mechanism to adjust cellular physiological states under thermal stress and aid coral reef fishes in their response to more frequent acute thermal fluctuations in upcoming decades.

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