

Identification of molecular growth signatures in skeletal muscle of juvenile Pacific halibut (*Hippoglossus stenolepis*) for monitoring population growth patterns

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INTRODUCTION

The International Pacific Halibut Commission has reported changes in the size-at-age (SAA) of Pacific halibut (*Hippoglossus stenolepis*) caught in the commercial fishery as well as in its own survey research for almost 100 years. Although an increase in SAA was observed between the 1930's until the 1980's, SAA has significantly declined since the 1990's until today, as evidenced by a 50% reduction in body weight for a typical 12-year old female during this period (Figure 1). However, our understanding of the potential causes for the long-term variability in SAA is still rather scarce. Although a number of factors could be contributing to this variability, recent analyses have suggested that temperature variation may have been a contributing factor to the observed changes in SAA in the Pacific halibut. Therefore, there is an urgent need to better understand the physiological effects of temperature on growth in this species.

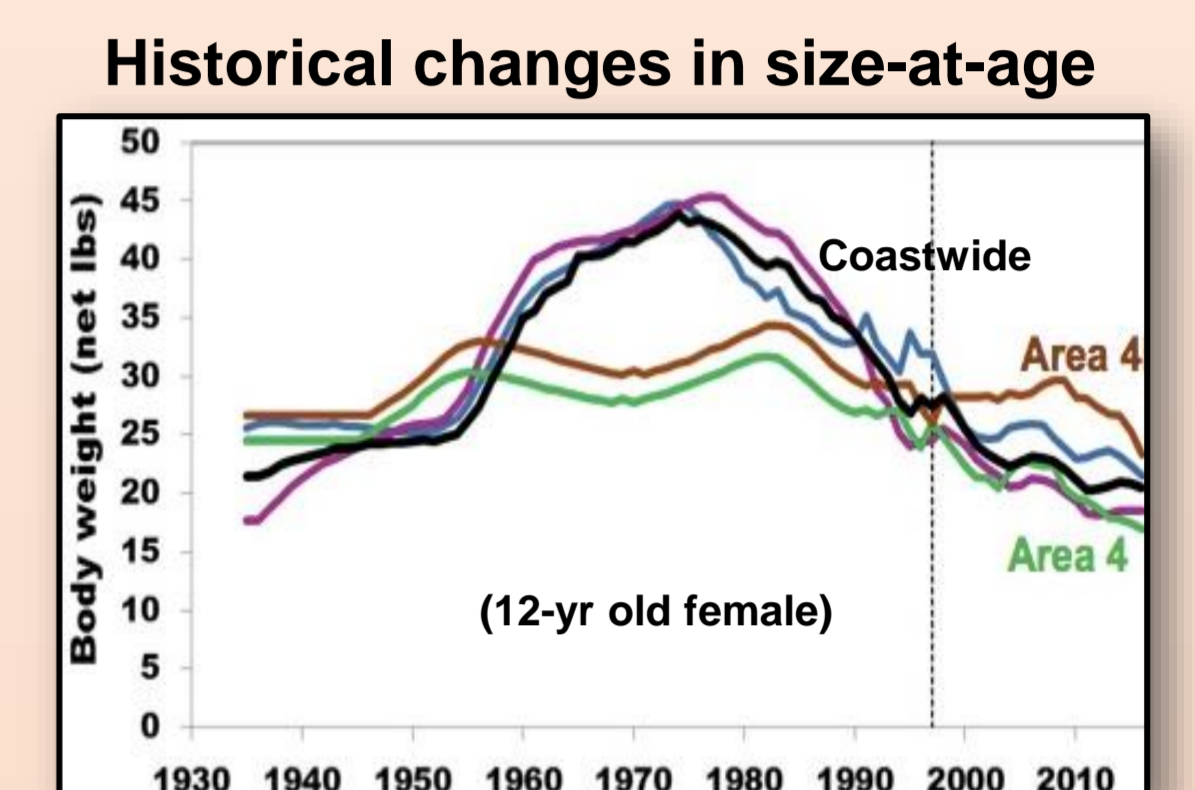
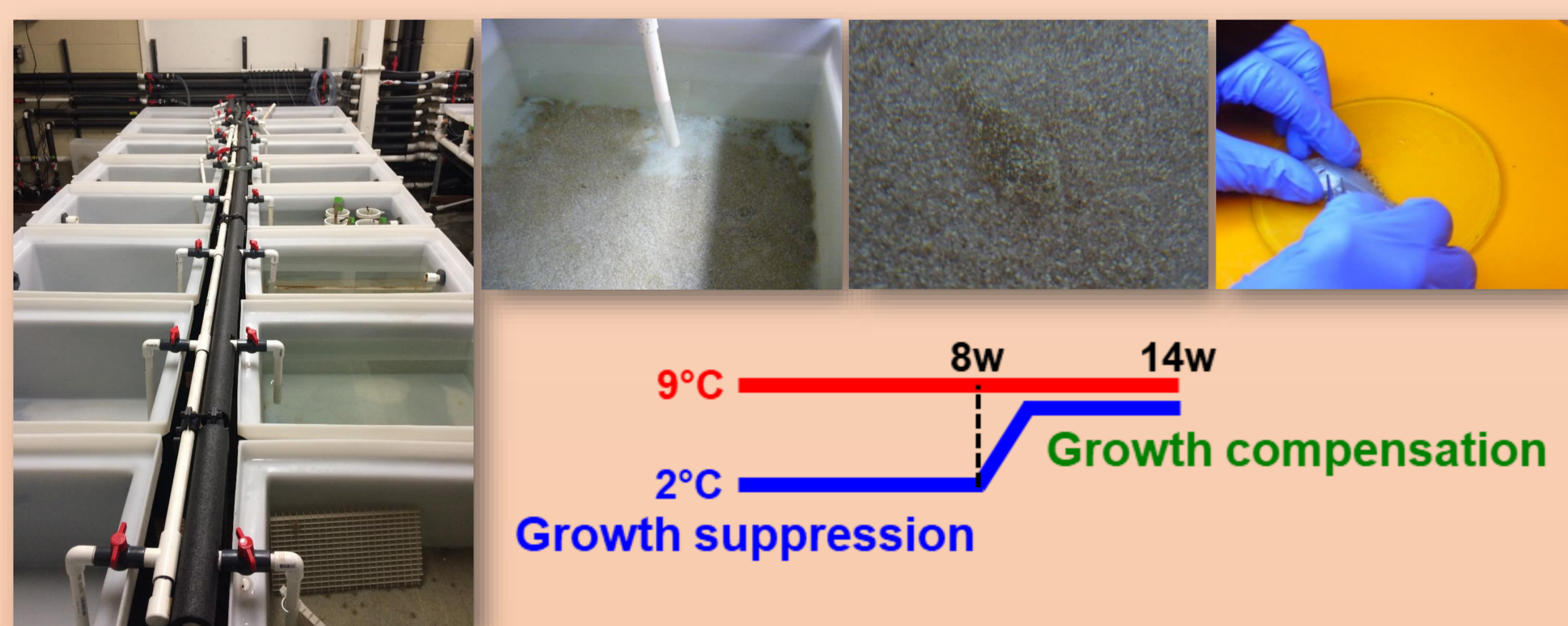


Figure 1. Coastwide changes in the average body weight of a 12-yr old female Pacific halibut (black line).

MATERIALS AND METHODS

Juvenile Pacific halibut of approximately 6 month of age were collected off the coast of Kodiak, Alaska, US and transferred to the aquatic facilities of the Hatfield Marine Science Center in Newport, Oregon, US. Individually pit-tagged fish were acclimated for 8 weeks to 2°C and 9°C in duplicate tanks (N = 5) prior to sampling. Subsequently, half of the fish previously acclimated at 2°C were gradually brought up to 9°C and held at 9°C for 6 additional weeks prior to sampling. The transcriptomic responses of white skeletal muscle from fish experiencing temperature-induced growth suppression and growth compensation were analyzed by RNA sequencing (Illumina).



RNA sequencing
White muscle

Molecular signatures of temperature-induced growth alterations

Molecular growth markers

RESULTS

- Temperature modulates the specific growth rate (SGR)

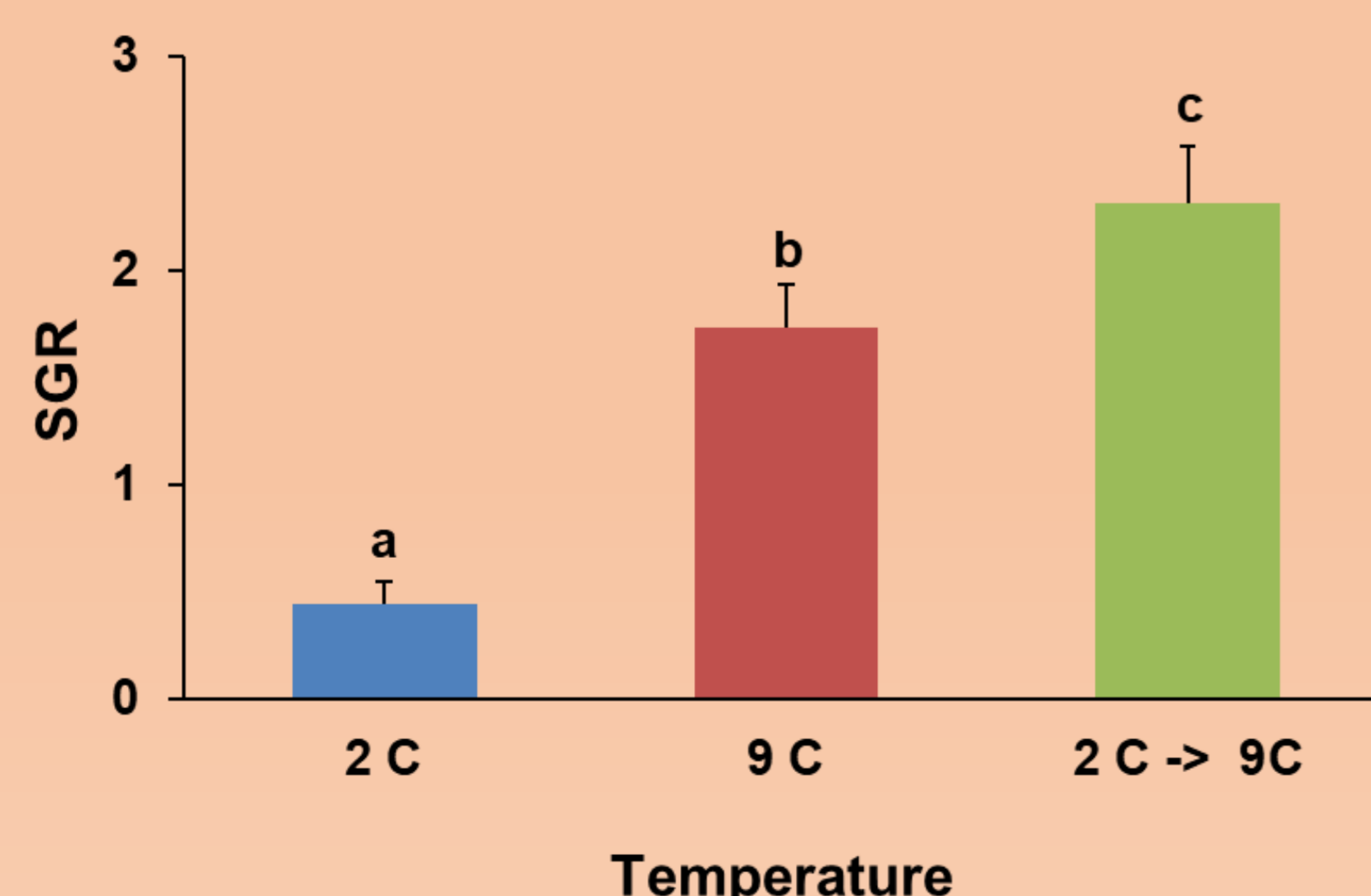


Figure 2. Effects of temperature on the specific growth rate in juvenile Pacific halibut. Different letters indicate statistically significant differences among the groups (N = 10).

- Transcriptomic responses to temperature-induced growth suppression

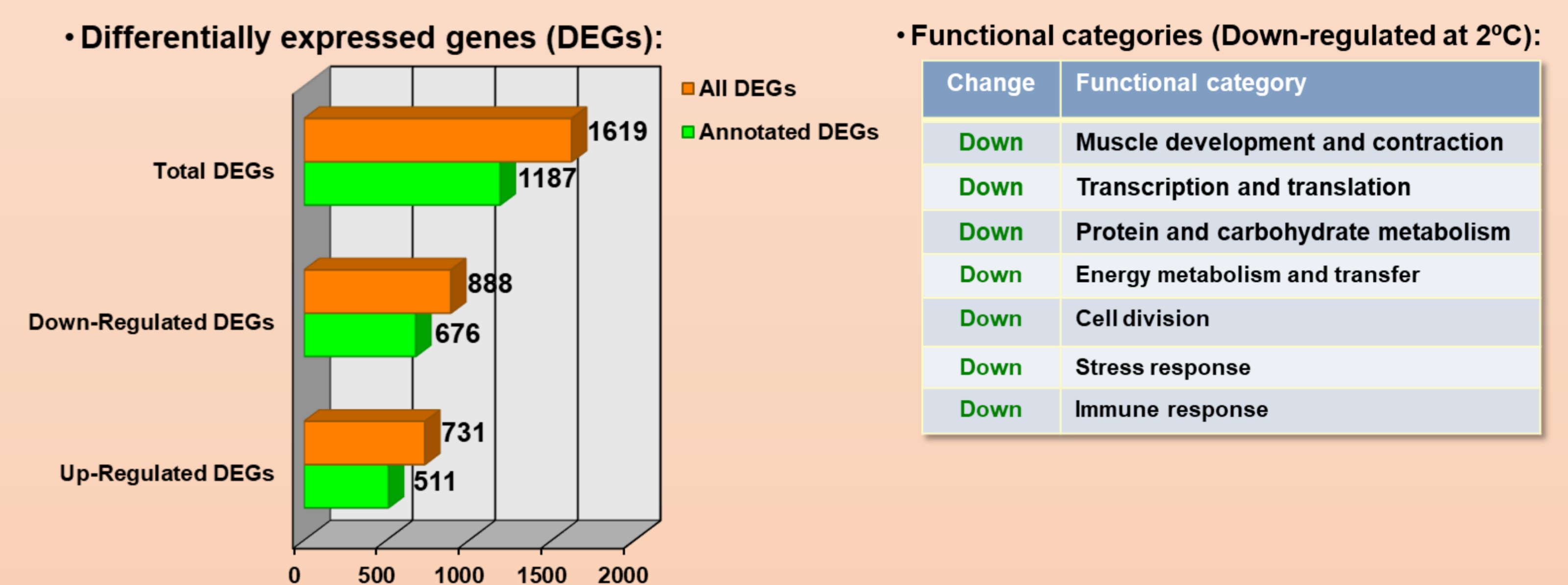


Figure 3. Left: Number of differentially expressed genes. Right: Functional categories of genes significantly down-regulated under growth suppression.

- Transcriptomic responses to temperature-induced growth stimulation

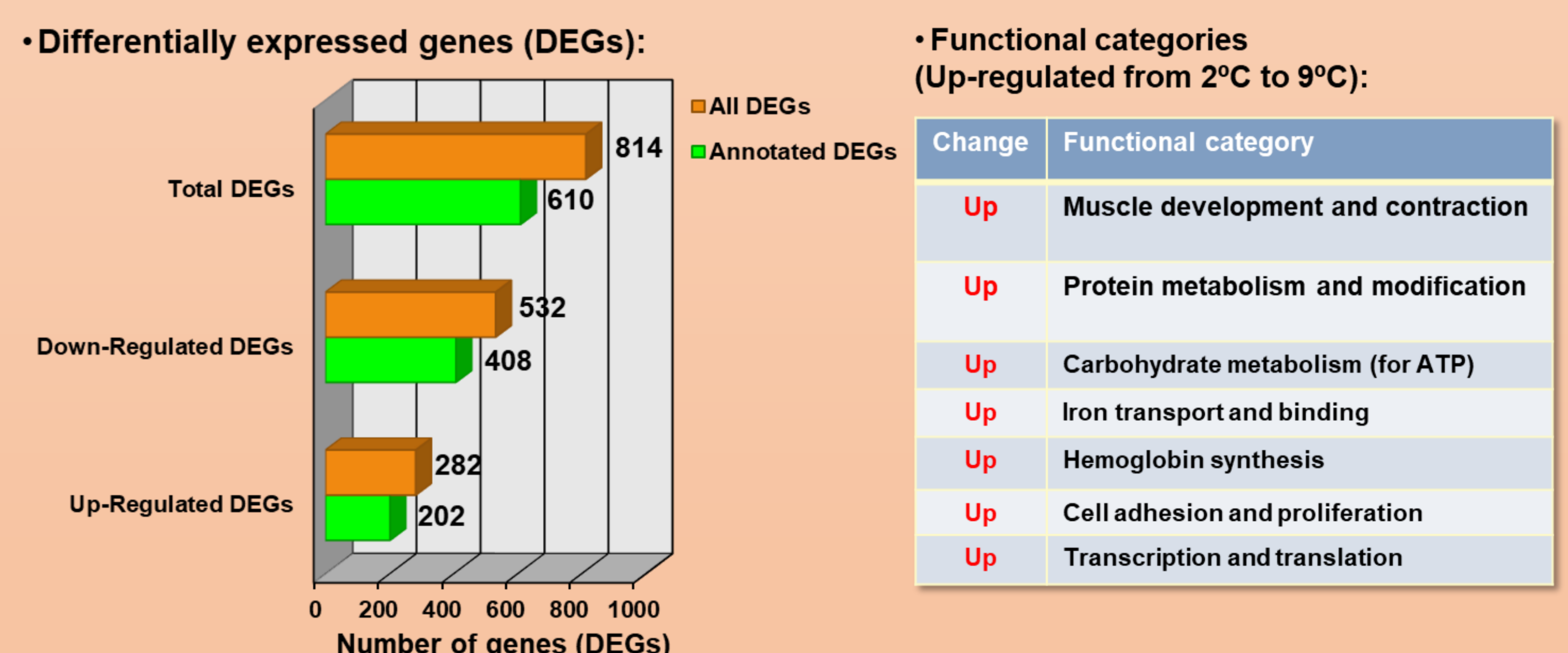


Figure 4. Left: Number of differentially expressed genes. Right: Functional categories of genes significantly up-regulated under growth stimulation.

CONCLUSIONS

- Acclimation at 2°C resulted in a significant reduction in the specific growth rate (SGR) whereas a significant increase in SGR was observed as a result of temperature-induced growth compensation.
- Growth suppression by low temperature acclimation is associated with a decrease in the expression of genes involved primarily in muscle function, protein synthesis, transcription and stress and immune response.
- Growth stimulation by temperature-induced compensation is associated with an increase in the expression of genes involved primarily in muscle structure and function and metabolic activation.
- The resulting molecular growth signatures will be useful to investigate potential changes in growth patterns in Pacific halibut.

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