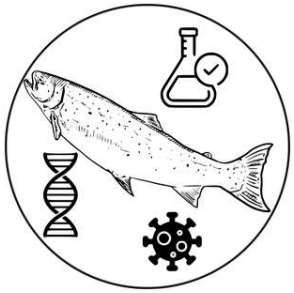
Measurement of stress hormones in scales and its application for the identification of conditions causing chronic stress in Pacific Salmon



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In salmon, cortisol is the predominant glucocorticoid released as part of the primary stress response, and is critical for mediating adaptive metabolic, physiological, and behavioral adjustments. However, prolonged elevation of cortisol, due to extended or repeated exposure to stressors, can negatively affect fish behavior, growth, reproduction and immune functions. To understand chronic stress, the past cortisol history of individuals needs to be understood.

Fish scales have been recently recognized as a biomaterial that accumulates cortisol, and other physiologically important hormones including cortisone, over long periods of time. Moreover, scale cortisol levels are not generally affected by stress associated with capture. This project measures stress hormones (cortisol, cortisone) levels in scales as a tool for routine monitoring of chronic stress in different life history stages of Pacific salmon.

As an example, this tool could be used to examine individual and population effects of external stressors encountered during migration on cortisol dynamics, which has implications with respect to population resilience to stressors such as climate change. The use of scales is minimally invasive and therefore suitable for use in populations of conservation concern. However, to interpret values obtained from scales, researchers need to understand the temporal profile of stress hormone accumulation and rates of clearance in scales under different environmental conditions for the different species of Pacific Salmon.

Take-aways

- Chronic stress, which is difficult to measure, impacts fish health, behavior, growth and reproduction.
- Measurement of stress hormone (cortisol and cortisone) levels in scales is being evaluated as a tool for routine monitoring of chronic stress in Pacific salmon.
- Methods for scale sampling and stress hormone analysis in salmon have been validated.
- To aid in the interpretation of scale stress hormone levels as a measure of chronic stress we are determining the timing and rates of cortisol/cortisone deposition and resorption in a series of controlled laboratory experiments.

This project conducts laboratory and hatchery-based studies to determine/optimize:
1) sampling methods (e.g. study spatial heterogeneity of Scale Stress Hormone Content (SSHC)),
2) effects of acute vs. chronic stress on SSHC,
3) relationship between plasma and SSHC,
4) individual, stock and temporal variability in SSHC, including changes associated with smoltification, and
5) effects of unpredictable chronic stress on plasma and SSHC.

Timeline

to March 2025: stress response lab experiments

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Project ID
2421