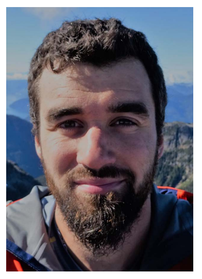
How change in ocean productivity can affect salmon fitness: a stable isotope approach



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INTRODUCTION

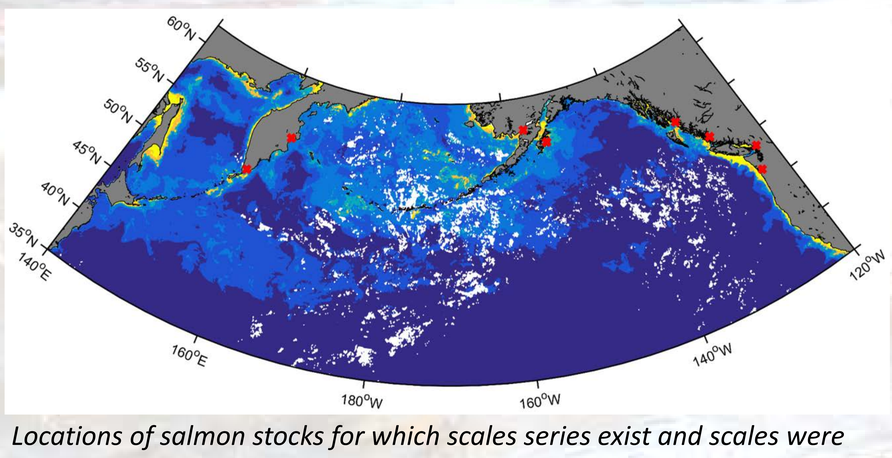
Decline in Pacific salmon stocks, including sockeye and to a lesser extent chum and pink, have been observed in the south part of the NE Pacific over the last two decades. The reasons for this decline still remain unclear, particularly with respect to the high seas "black box" life phase, the costs and logistical difficulties of working on the high seas and of tagging/recovering fish operations having limited the data available. Stable isotopes (SI) of returning adult tissues contain information that can be used to describe conditions experienced by fish during their pelagic phase.

OBJECTIVES

Combining SI based approaches for determining the high seas ocean conditions experienced by salmon stocks, and a means to assess how these conditions can affect salmon fitness (e.g., condition factor, spawning success, juvenile survival rate).

Methods

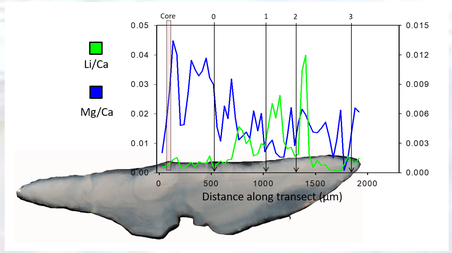
- Salmon scales of Rivers Inlet sockeye stock (BC, Canada) were retrieved from archives.
- The scales covering 1915-2016 were run for SI analysis.
- Corrections were applied to $\delta^{13}C$ considering Suess effect.
- The whole scale was used but comparison with muscles signatures show an offset rather consistent.



Locations of salmon stocks for which scales series exist and scales were requested. Most of the scales are already processed and will provide a spatial coverage across the whole North Pacific.

NEXT STEPS

- Estimation of feeding area can be refined using other source of information such as microelement ratio in otolith or Oxygen SI.

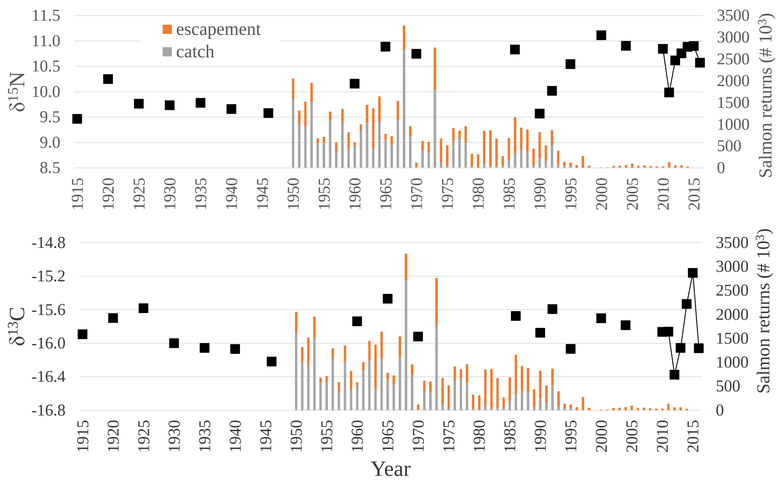


- Methodology can be applied to other salmon species.

- Get data from different stocks is important to develop further and validate the different methodologies. We encourage institutes in charge to open up scale archive as access to these dormant scales could give vital information in understanding stock variation.

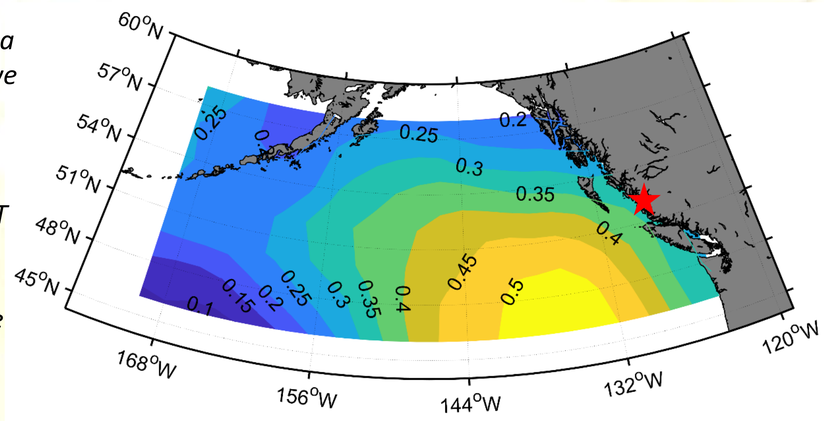
USING $\delta^{13}C$/SST RELATIONSHIP

Pilot study based on Rivers Inlet stock



Long term distribution of $\delta^{15}N$ (top) and $\delta^{13}C$ (bottom) mean, based on salmon scales for the period 1915-2016. Escapement (open bar) and catch (black bar) data are displayed.

Proposed feeding area for Rivers Inlet sockeye salmon based on the strength of the correlation between $\delta^{13}C$ and modeled SST averaged 9 months before salmon migration back to the river.



Espinasse et al., In press CJFAS

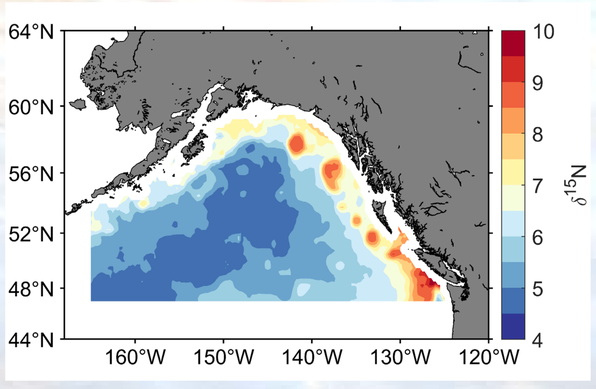
FIRST RESULTS

- Scale SI time series showed enhanced variability post-1950 probably linked to more dynamic high seas environmental conditions.
- Climate indices did not explain the SI variability.
- A strong correlation between SST and $\delta^{13}C$ enabled us to define the area of potential salmon distribution.

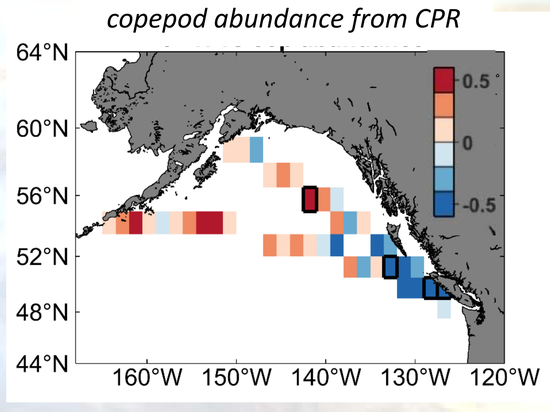
However, information such SI baseline and prey dynamic are needed to exploit thoroughly this type of time series ⇩

COMPARING WITH SI PREY DISTRIBUTION (ONGOING)

Modelled Nitrogen isoscape for 2017



Correlation between $\delta^{15}N$ and copepod abundance from CPR



- SI baseline is used to determine salmon trophic level position.
- Correlation was found between zooplankton SI and zooplankton abundance over 1998-2017 period.
- Opening possibilities to assess conditions experienced by fish in the open ocean.

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