You are what (and where) you eat: Comparative isotope analysis of hatchery and wild pink salmon in 2015

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Body size; a fitness related trait

e.g. size variation in males
On average, hatchery fish were shorter than wild fish in 2015
Why were hatchery and wild fish different lengths in 2015?

Body size is gained at sea
In the toolbox:
Stable isotope analysis

$^{13}\text{C} : ^{12}\text{C}$
$^{15}\text{N} : ^{14}\text{N}$
In the toolbox: Stable isotope analysis

$^{13}\text{C} : ^{12}\text{C}$

$^{15}\text{N} : ^{14}\text{N}$

You are what (and where) you eat
Comparative isotope analysis
Comparative isotope analysis

Location = Carbon

~\(-24\%\)  Offshore

~\(-16\%\)  Nearshore
Comparative isotope analysis

Location = Carbon

Trophic position = Nitrogen

Higher ~15%

Lower ~2%

Offshore ~-24‰

Nearshore ~-16‰
Comparative isotope analysis

Trophic position = Nitrogen

Ocean Caught

Stream Sampled

~15% Higher

~2% Lower

~24% Offshore

~-16% Nearshore

Location = Carbon
Were hatchery and wild fish foraging at different locations or trophic positions?

2015

~ 3,420 isotope samples from 1,140 fish
Big picture result:

Yes, hatchery and wild fish were isotopically different
Ocean fishing stations 2015
Stream sampling 2015

Pre-spawned
Post fishery
Hatchery strays
Ocean & stream sample collection represents “outside” & “inside” PWS
Tissue specific metabolic rates

Muscle: ~ 6 months
Liver: ~ 3 months
Location

~ 6 months

δ^{13}C Carbon

<table>
<thead>
<tr>
<th>Origin</th>
<th>Offshore</th>
<th>Inside PWS</th>
<th>Outside PWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatchery</td>
<td></td>
<td></td>
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<tr>
<td>Wild</td>
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</tbody>
</table>

δ^{13}C (%)
Location
~ 6 months

Ocean caught hatchery and wild foraged in similar locations

\[ \delta^{13}C \]

Carbon

- Offshore
- Nearshore

Outside PWS

Hatchery
Wild

Inside PWS

Hatchery
Wild

\[ \delta^{13}C (\%o) \]
Curious offshore signal from inside PWS

Location ~ 6 months

$\delta^{13}C$ Carbon

Offshore Nearshore

Outside PWS

Hatchery - Wild

Inside PWS

Hatchery - * Wild

$\delta^{13}C$ (%)
Hatchery and wild foraged in different locations.

Location
~ 3 months

δ\textsuperscript{13}C Carbon

Offshore
Nearshore

Outside PWS

Hatchery
Wild

Inside PWS

Hatchery
Wild

δ\textsuperscript{13}C (‰)
Foraged in different locations, opposite pattern

Location ~ 3 months

\[ \delta^{13}C \]

Carbon
Ocean currents and plankton are dynamic in space and time; possible freshwater input.
$\delta^{15}N$

Nitrogen

Trophic Level

$\sim$6 months
Trophic Level
~6 months

Hatchery and wild fish foraged on similar things.
Trophic Level

~6 months

In PWS, wild fish foraged on different prey than hatchery fish
In PWS, isotope values indicated prey shift OR starvation.
How do sex, length, or sample date influence isotope values?

δ^{15}N Nitrogen

Digging deeper
Sex influenced trophic position (diet) outside and inside PWS
Sex influenced trophic position outside and inside PWS.
Did trophic position (diet) change with size?

Lower

Higher

$\delta^{15}N$ (%)

Outside PWS

Inside PWS

Length (mm)
Size did not influence trophic position in ocean caught fish.
Size and trophic position of hatchery and wild fish had opposite trends within PWS.
Trophic position increased as season progressed.
Trophic position consistently higher for wild fish outside and inside PWS
Next steps

Isotope values depend on sex, size and time:
Include in further analyses
Next steps

Migration patterns
Preliminary results in summary

Hatchery and wild fish were foraging in different locations & eating different things within PWS, but not outside.
Thank You

Questions?
Stream sample collection 2015 represents “inside” PWS
Ocean sample collection 2015; represents “outside” of PWS