

## Abstract

NOAA's National Centers for Coastal Ocean Science (NCCOS) and the Auke Bay Laboratories of NOAA's Alaska Fisheries Science Center (AFSC) are working to assess per- and polyfluoroalkyl substances (PFAS) contamination across life stages and tissues in all five species of Pacific salmon: Chinook, chum, coho, pink, and sockeye. Fish are being collected at an urban site – Auke Creek Research Station (ACRS) in Juneau, AK – and a remote site – Sashin Creek at the Little Port Walter Research Station (LPW) on southern Baranof Island. A suite of 28 PFAS are being analyzed to 1) better understand the transport potential of these man-made chemicals across urban and near-pristine environments, 2) assess their bioaccumulation potential in coastal and open ocean environments, and 3) elucidate biomagnification pathways through food chain processes.

# Assess PFAS contamination across life stages and tissues in all five species of Pacific salmon

## Introduction

There are over 8,000 PFAS (per- and polyfluoroalkyl substances) chemical compounds, which have been used in a wide range of commercial applications from stain-resistant coatings to foams commonly used in firefighting exercises and incidents at airports. These “forever chemicals” are now ubiquitous environmental contaminants and have been linked to negative reproductive, developmental, and immunological effects. At least two PFAS compounds (PFOS and PFOA) appear to be carcinogenic.

Alaska salmon stocks are important ecologically, culturally, and commercially. Tribal communities and other people that rely on salmon are at a high risk of exceeding safe consumption advisories for these compounds, yet there is little information for issuing restrictions or enacting regulations to prevent over consumption. In addition, stakeholders of the North Pacific Fisheries Management Council (NPFMC) have expressed concerns about PFAS contaminated fishery stocks. Some states, such as Michigan, have proposed consumption guidelines for certain PFAS compounds in fish.

## Methods

In Year 1, AFSC and NCCOS personnel collected juvenile pink and coho salmon from Sashin Creek and Auke Creek for analysis of PFAS (Table 1).

- A total of six samples, each consisting of multiple juvenile fish, were collected and analyzed for a total of 28 PFAS compounds.

In Year 2, a total of 35 tissue samples (i.e., muscle, liver, kidney, and gonad) were collected from returning adult pink and coho salmon in Auke Creek, Sashin Creek, and also in Mist Cove located approximately 20 km north of Sashin Creek (Table 1).

- All samples were shipped to TDI-Brooks, International, a NOAA contract laboratory, and analyzed for a suite of 28 PFAS compounds.

In Years 3-4, additional samples were collected across species and tissues but those have not yet been analyzed.

Species	Year 1		Year 2		Year 3		Year 4	
	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult
Chinook					X	X	X	X
chum								X
coho	X		X		X			
pink	X		X					
sockeye							X	X

Table 1. Samples collected for each year, species, and life stage of salmon. For adult salmon, multiple tissues were collected – including muscle, liver, kidney, gonad, and blood – to assess bioaccumulation potential across different tissue types.

## Results

### Year 1

- PFOS was elevated in the juvenile coho salmon samples from Sashin Creek.
- The highest concentration of PFOS detected was 23.1 ng/g in one sample, and 19 ng/g (ppb) wet weight in a second fish sample from Sashin Creek.
- Concentrations of PFOS exceeded a Michigan PFOS guideline that would limit the consumption of adult fish to 1-2 meals per week (Figure 1).

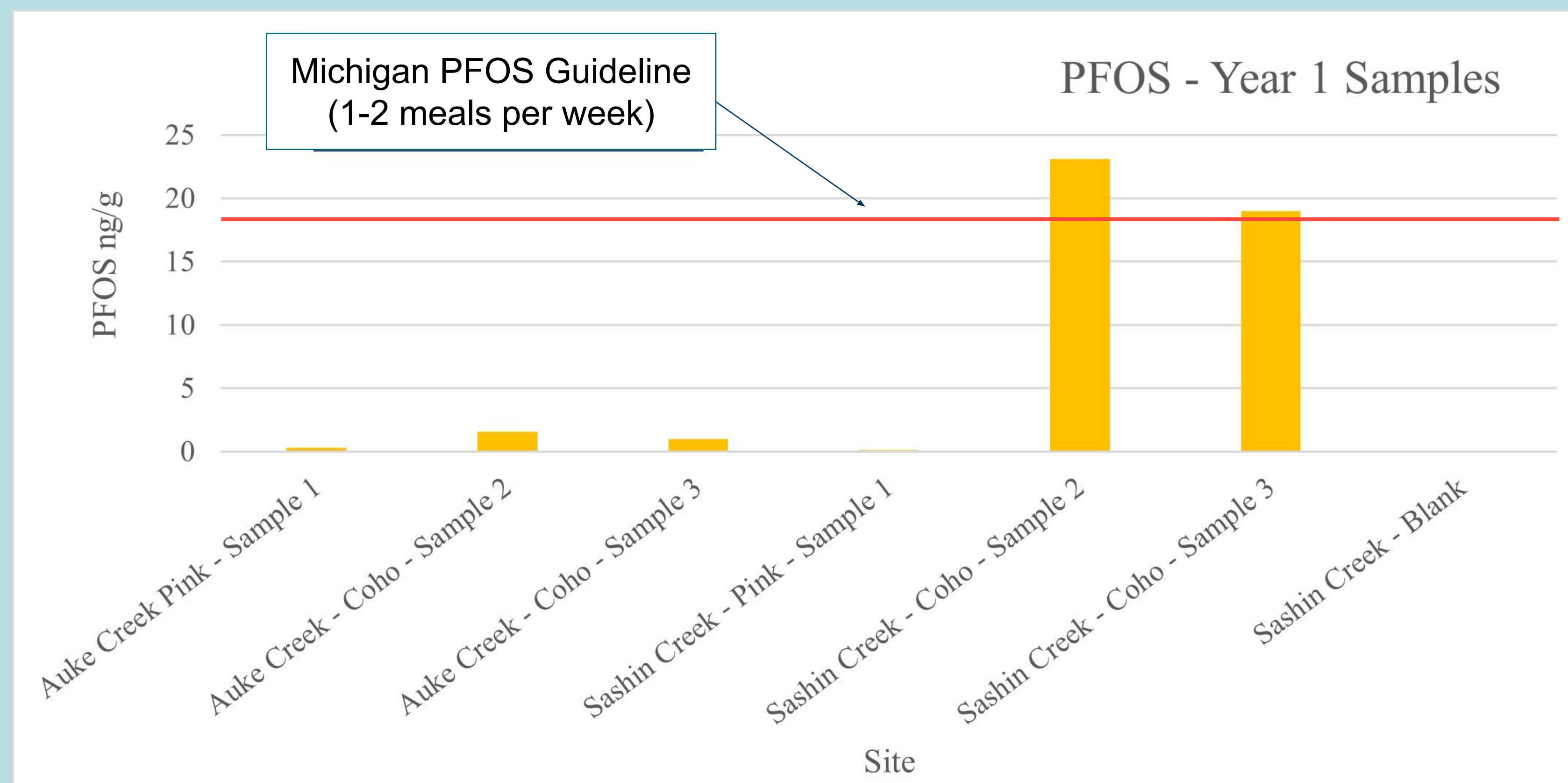


Figure 1. Concentrations of PFOS found in juvenile salmon collected in Year 1.

### Year 2

- PFOS was not prominent in Year 2 samples compared to Year 1.
- The highest concentration of PFOS in Year 2 samples was less than 1 ppb (0.724 ng/g) in an adult coho liver sample from Auke Creek.
- The highest concentration of any PFAS compound analyzed in Year 2 was 6.617 ng/g PFOSA, found in a pink salmon liver (Figure 2).
- HFPO-DA, also known as GenX, a “next generation” PFAS compound, was detected in Sashin Creek pink salmon kidney samples.
- Few differences in PFAS between fish and locations, some differences in concentrations of PFAS between organs.
- PFAS in muscle samples appeared lower than in liver or kidney, but most were not significant (Figure 3).

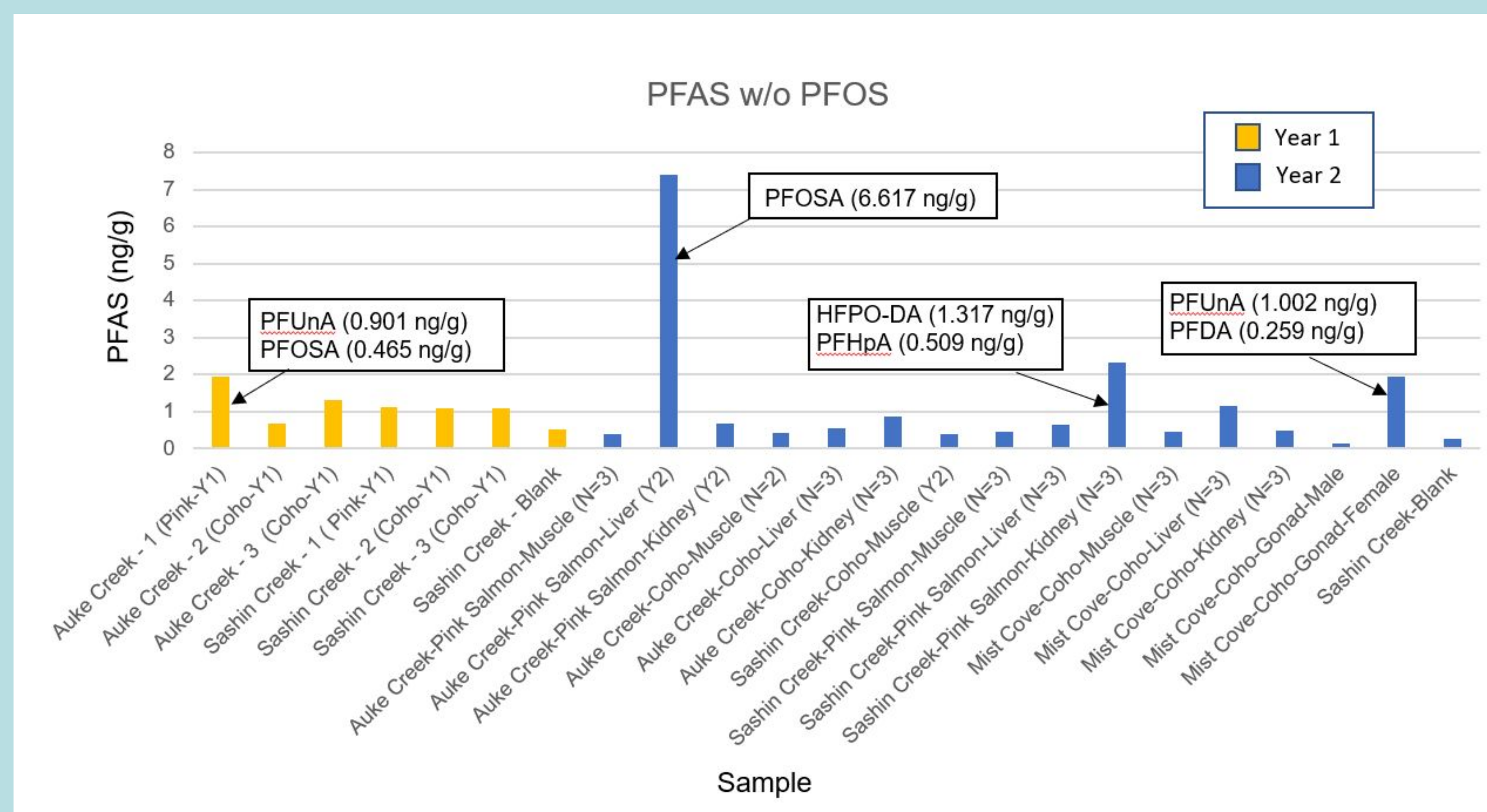


Figure 2. Concentrations of various PFAS found in adult salmon collected in Year 2.

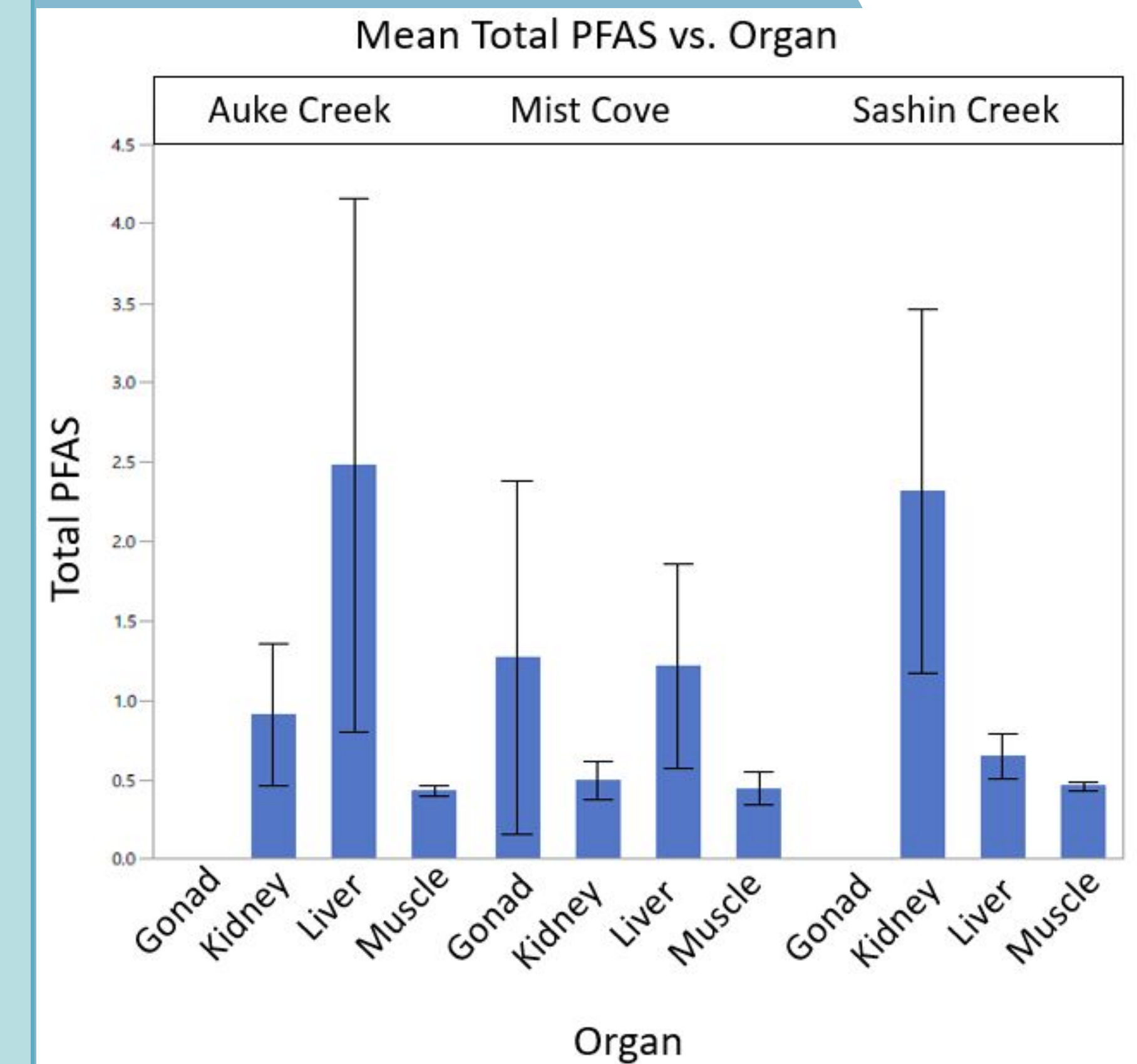


Figure 3. Concentrations of total PFAS by organ in Year 2 for adult coho and pink salmon.

## Next Steps

### Year 3:

- Collect more juvenile coho salmon to assess if PFOS is again elevated in juveniles from the relatively pristine Sashin Creek.
- Collect Chinook salmon juveniles (whole fish) and adults (muscle, liver, gonad, kidney) to assess PFAS in this species.

### Year 4:

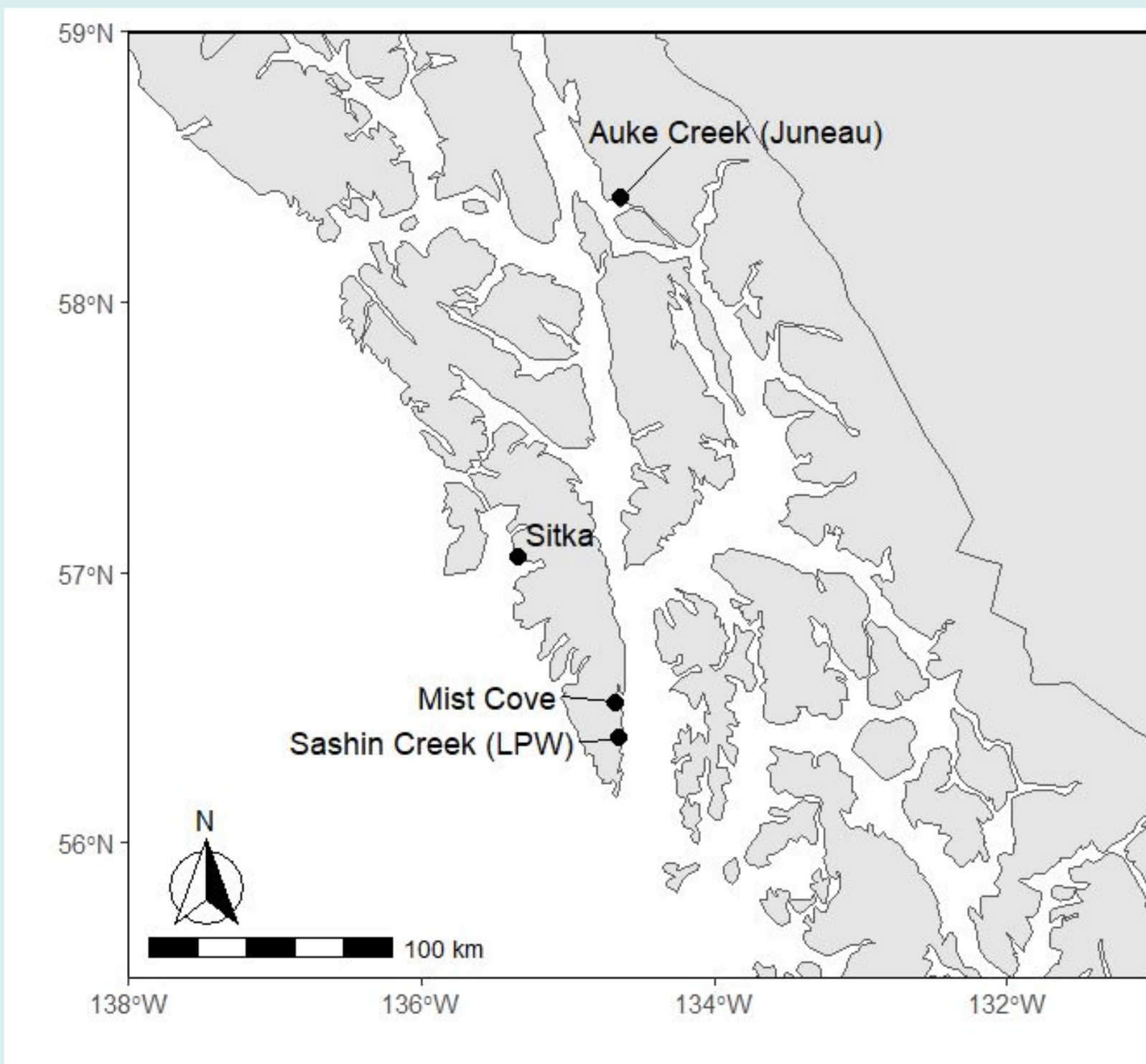
- Collect more age classes of juvenile and adult Chinook, as well as chum and sockeye, to assess total and individual PFAS. Added blood to adult Chinook salmon collections.
- Multiple year classes of adult Chinook will help understand PFAS source (land vs. sea) and bioaccumulation.
- Determine if assessing PFAS in other commercial fish species and in other areas in Alaska is warranted.

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Recent article about our work



Locations of Sashin Creek, Mist Cove, and Auke Creek in Southeast Alaska.



NCCOS researcher Felipe Arzayus draws blood from a Chinook salmon at Little Port Walter to quantify PFAS concentrations, September 2024. Credit: NOAA