Bioaccumulation Factors

Stakeholder Group Meeting

PFOS & PFOA Surface Water Criteria

23 March 2020

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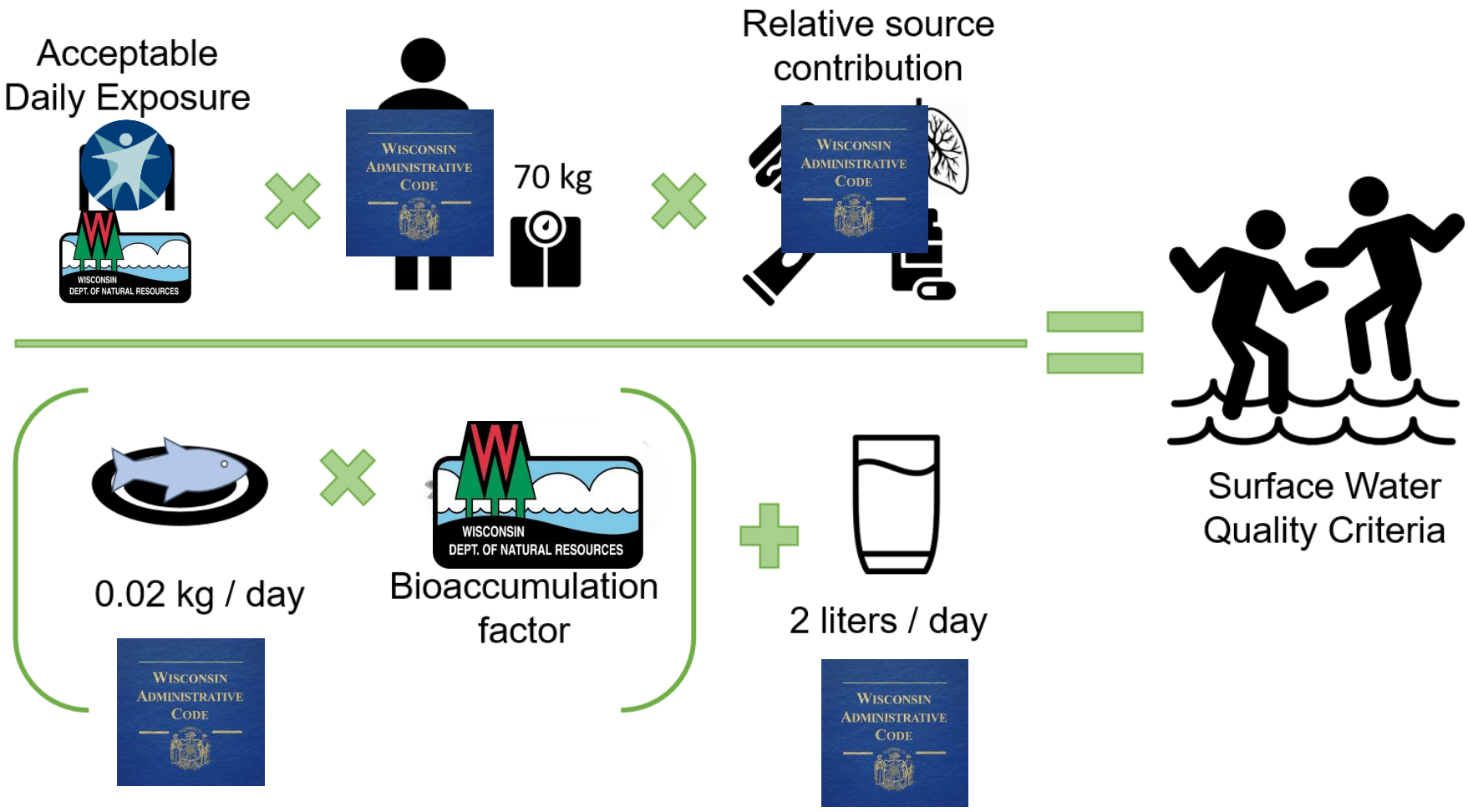
Today's presentation

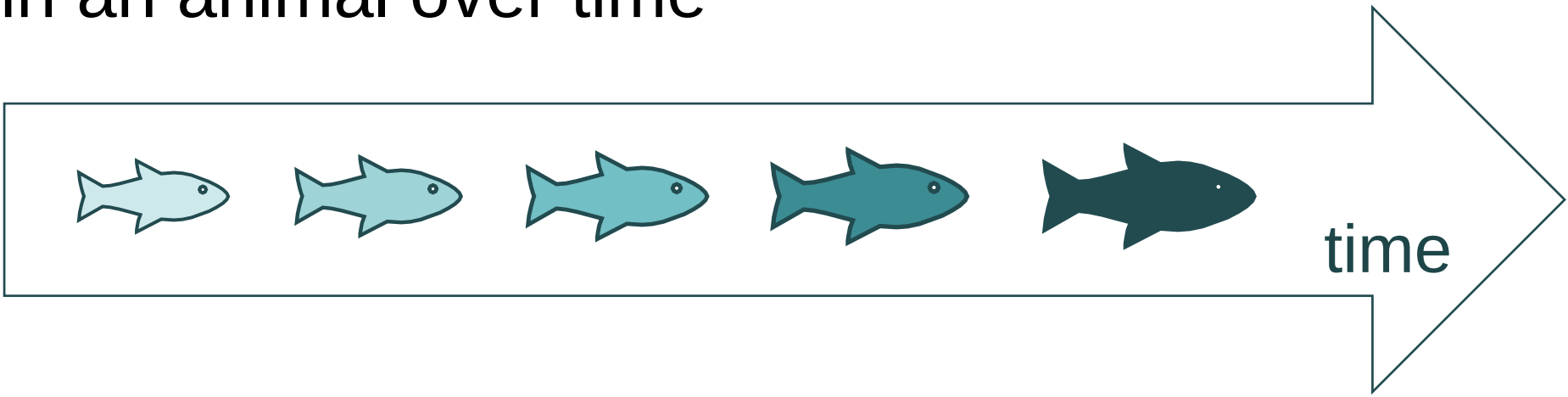
- **What is bioaccumulation?**
- What does NR105 say about BAFs?
- How is are BAFs calculated?
- What BAF data is available for PFOS and PFOA?
- Likely range of PFOS and PFOA surface WQC to protect human health

Human Health Threshold Criteria

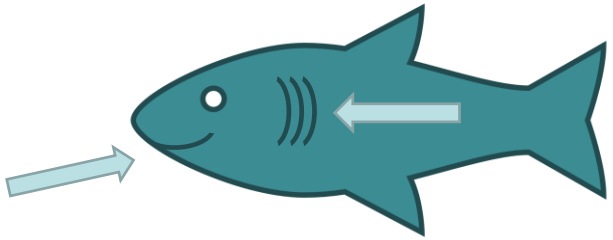


What is bioaccumulation?

Increase in the concentration of a contaminant in an animal over time

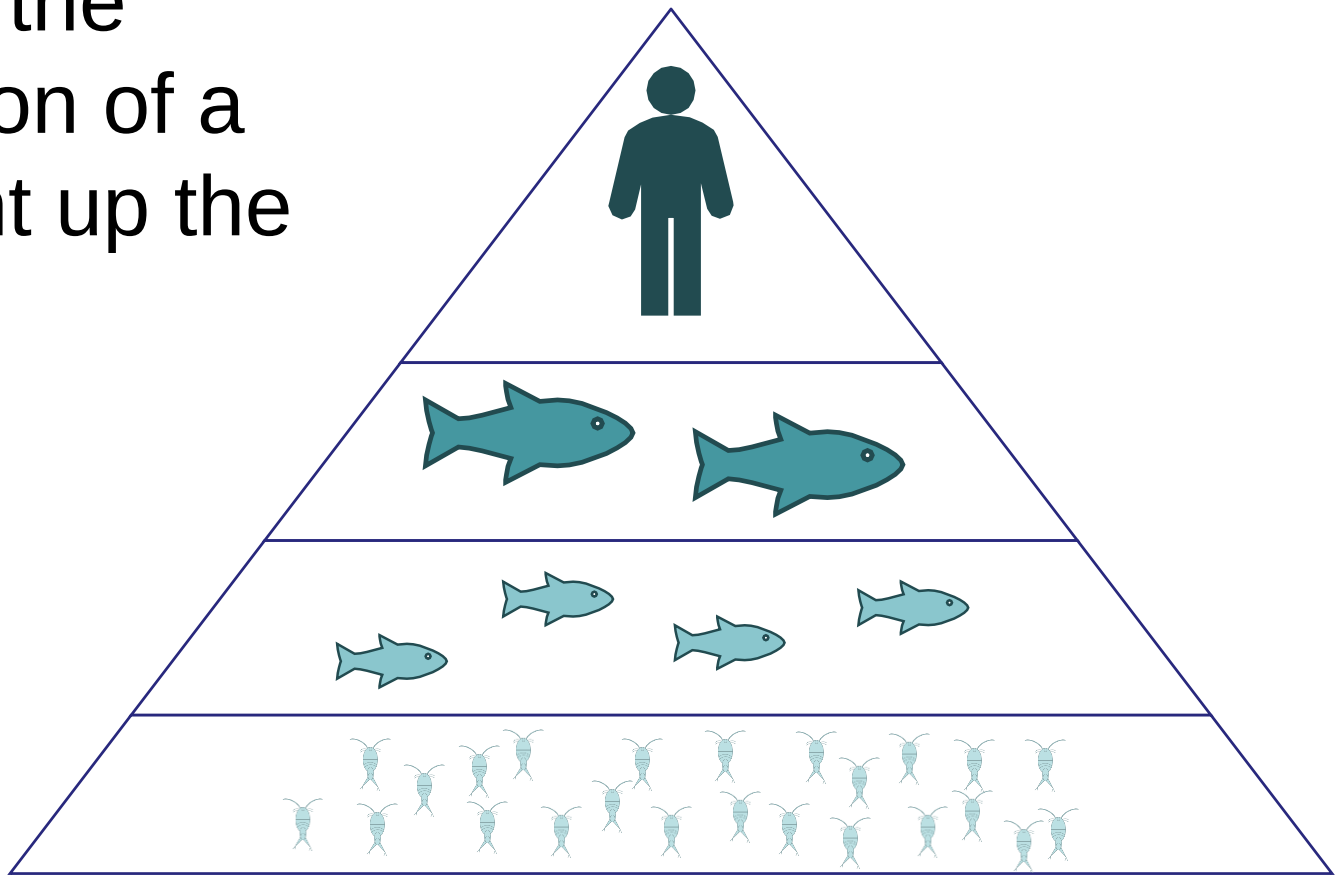


Incorporates uptake from diet and through gills



Bioaccumulation vs. biomagnification

Increase in the concentration of a contaminant up the food chain



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What does NR105 say about bioaccumulation factors?

105.10(1): The BAF used to derive surface water criteria is determined using the methodology in 40 CFR part 132, Appendix B

105.10(3): Measured BAFs shall be obtained from available sources, including: EPA Ambient Water Quality Criteria documents, published scientific literature, reports issued by EPA or other reliable sources, or unpublished data

What does NR105 say about bioaccumulation factors?

105.10(5): BAFs for **inorganic** substances

BAFs for organic substances are calculated by incorporating the lipid content of fish.

However…PFAS do not accumulate in fats like other organic compounds, so the procedures to calculate BAFs for inorganic compounds are more appropriate.

This is the same rationale also used by Michigan and Florida when deriving SWQC.

What does NR105 say about bioaccumulation factors?

105.10(5): BAFs for inorganic substances

Measured BAFs shall be based on **edible tissue** (e.g., muscle) of freshwater fish.

BAFs based on measurements of aquatic plants and invertebrates may not be used.

If >1 field measured BAFs are available from studies in the Great Lakes system, the **geometric mean of the species mean BAFs** shall be used as the human health BAF for that substance.

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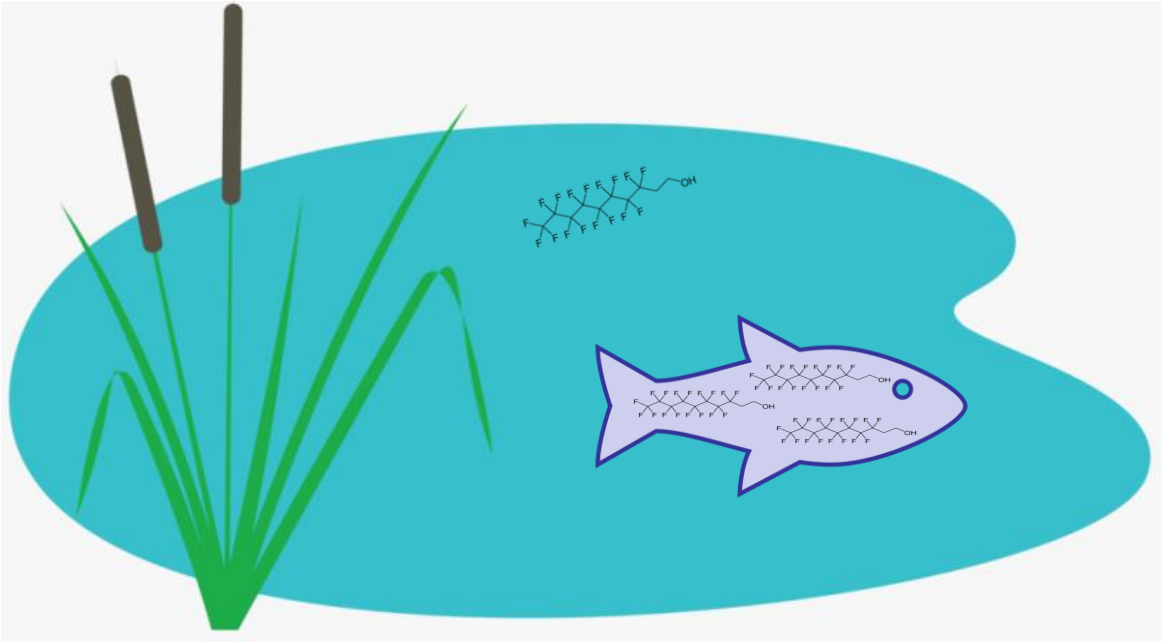
How are bioaccumulation factors calculated?

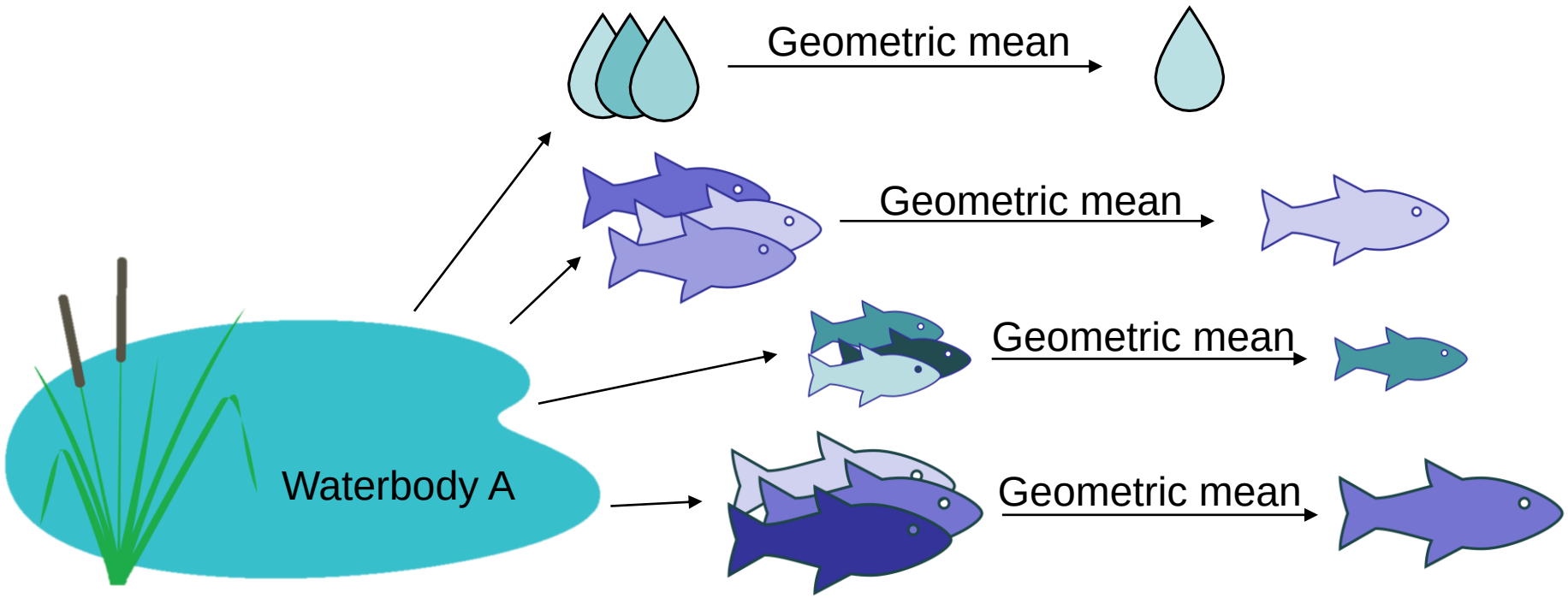
Ratio of the concentration of a substance in fish tissue to its concentration in the ambient water



https://www.clipartwiki.com/clipimg/detail/25-253290_pond-clipart-pond-water-clipart.png

How are bioaccumulation factors calculated?

For each waterbody, calculate geometric mean concentration in water samples and in fillets of each species



How are bioaccumulation factors calculated?

Water and fillet concentrations used to calculate BAFs for each species from each waterbody

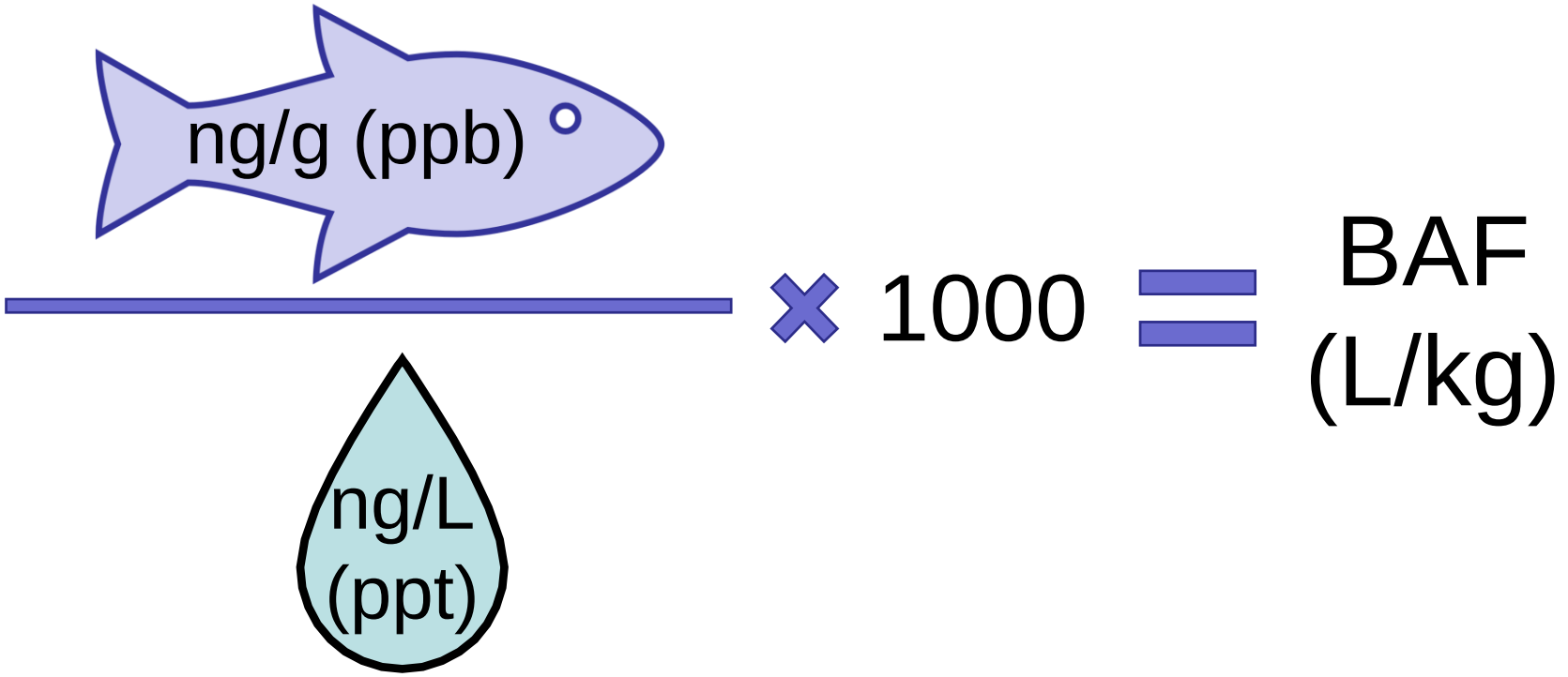
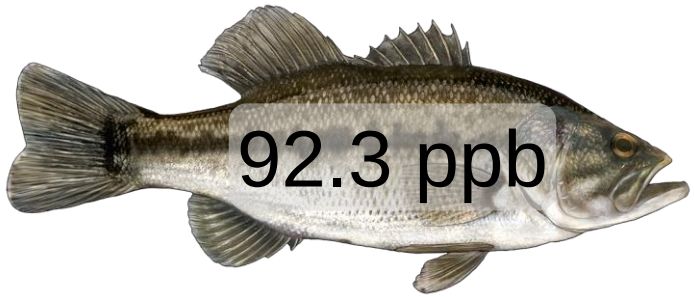


Photo credit: UW Geology Museum

How are bioaccumulation factors calculated?

Calculate BAFs for each species from each waterbody: Example

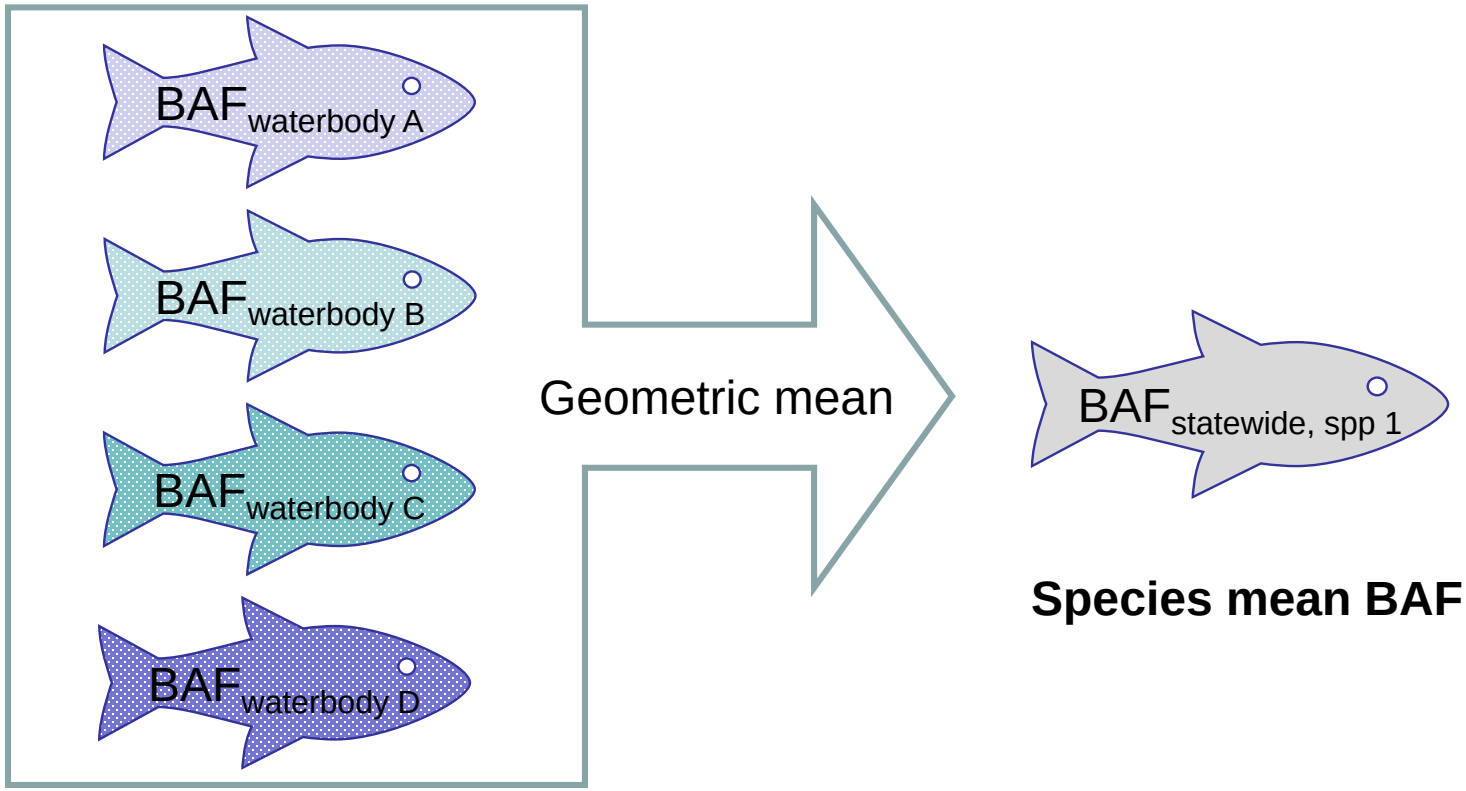


$$\frac{92.3\ \text{ppb}}{53.3\ \text{ppt}} \times 1000 = 1732.7\ \text{L/kg}$$

$$BAF_{LMB,Starkweather} = 1733\ \text{L/kg}$$

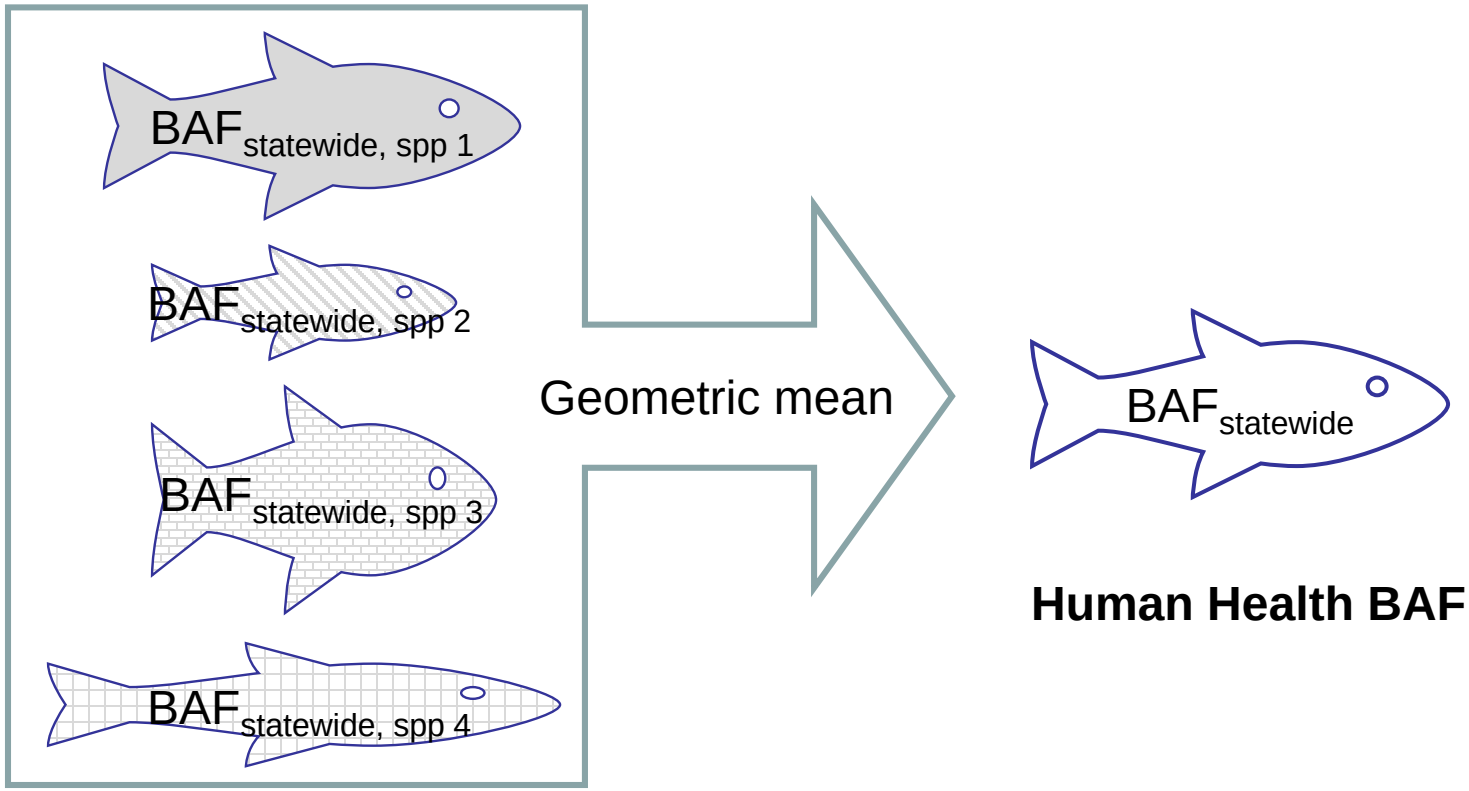
How are bioaccumulation factors calculated?

Calculate the statewide BAF for each species (from all waterbodies)



How are bioaccumulation factors calculated?

Calculate the statewide BAF (all species from all waterbodies)



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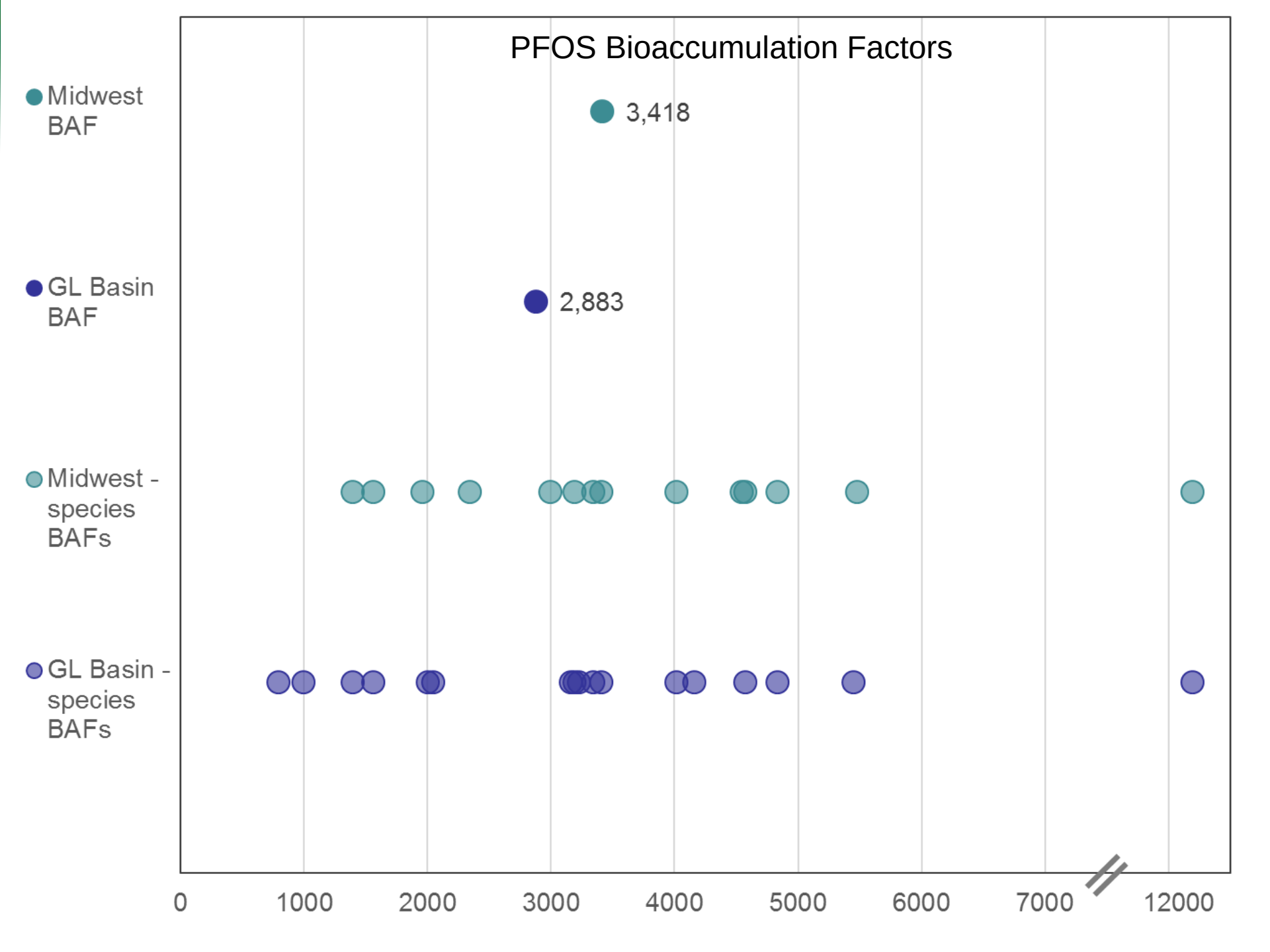
- **What BAF data is available for PFOS and PFOA?**
- Likely range of PFOS and PFOA surface WQC to protect human health

Data availability: PFOS

Location	Years	# Waters	# Species
Wisconsin	2019-20	2*	7*
Minnesota	2006-18	27	12
Michigan	2010-13	8	6
Ontario, Canada	2009-12	1	10

*additional data forthcoming

Great Lakes basin BAF **Midwest BAF**

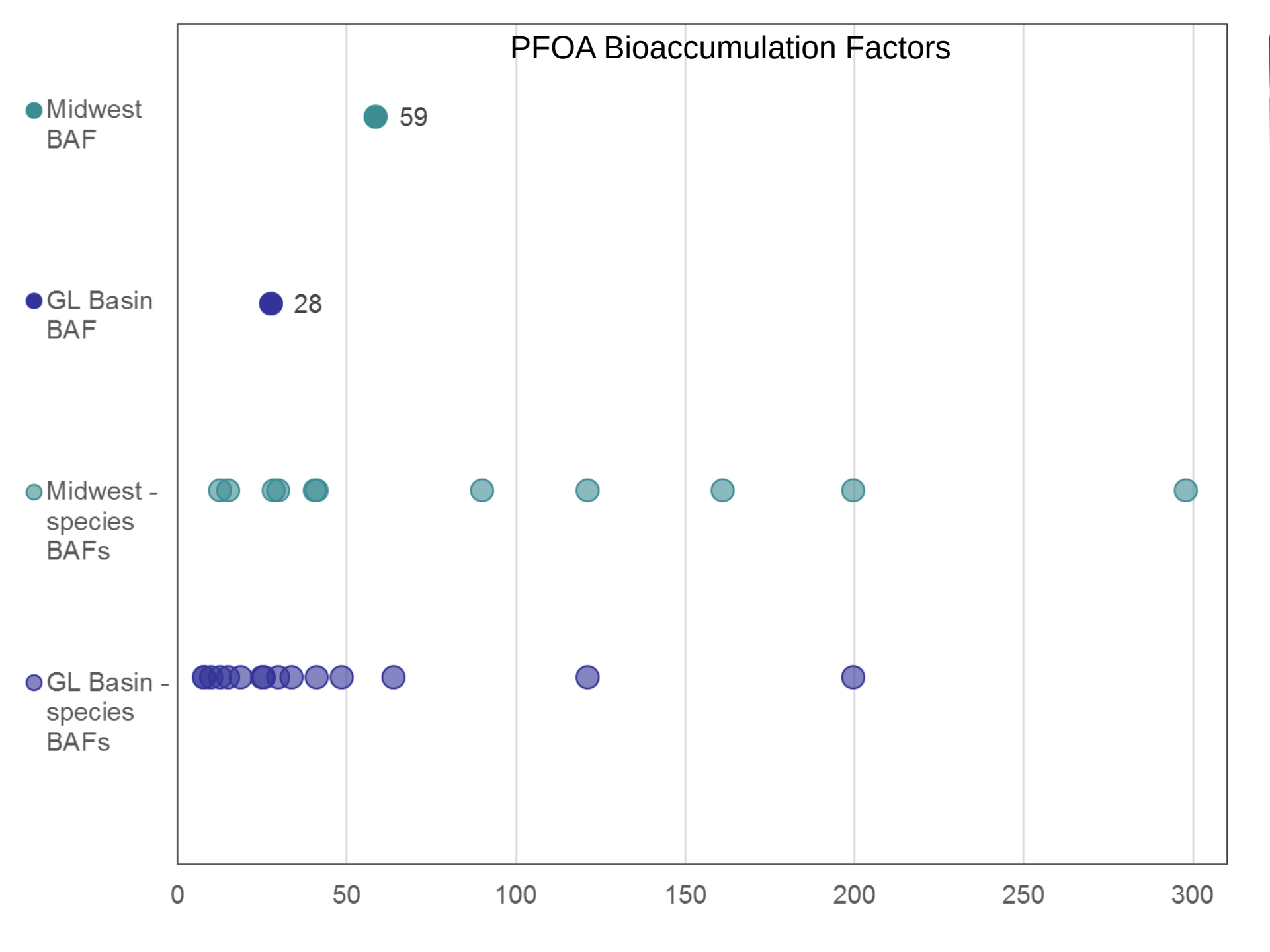

PFOS Bioaccumulation Factors
Midwest BAF
GL Basin BAF
Midwest - species BAFs
GL Basin - species BAFs
3,418
2,883
0
1000
2000
3000
4000
5000
6000
7000
12000

Data availability: PFOA

Location	Years	# Waters	# Species
Wisconsin	2019-20	1*	4*
Minnesota	2006-16	4	7
Ontario, Canada	2009-12	1	10

*additional data forthcoming

Great Lakes basin BAF **Midwest BAF**


PFOA Bioaccumulation Factors
Midwest BAF
59
GL Basin BAF
28
Midwest - species BAFs
GL Basin - species BAFs
0
50
100
150
200
250
300

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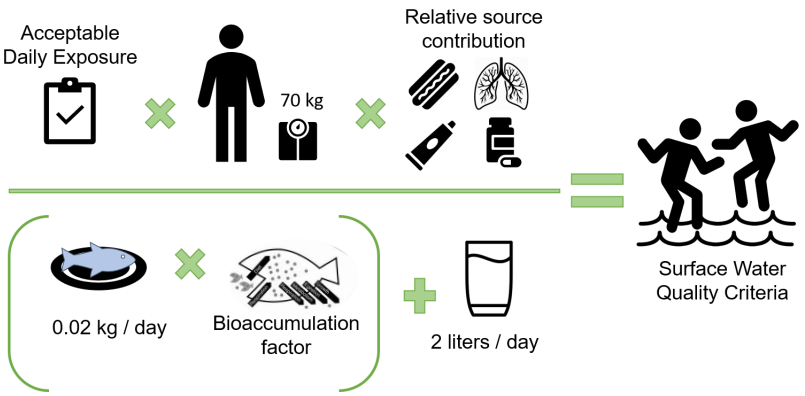
- What BAF data is available for PFOS and PFOA?
- **Likely range of PFOS and PFOA surface WQC to protect human health**

Derivation of PFOS Surface WQC

GL Basin BAF: $$\frac{(2 \times 10^{-6}) \times 70 \times 0.8}{(0.02 \times 2883) + 2} = 1.88\ ng/L$$

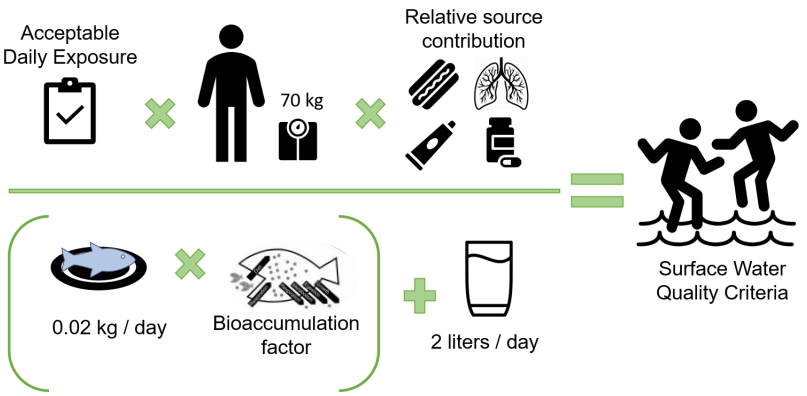
Midwest BAF: $$\frac{(2 \times 10^{-6}) \times 70 \times 0.8}{(0.02 \times 3418) + 2} = 1.59\ ng/L$$



Derivation of PFOA Surface WQC

GL Basin BAF: $$\frac{(2 \times 10^{-6}) \times 70 \times 0.8}{(0.02 \times 28) + 2} = 43.8\ ng/L$$

Midwest BAF: $$\frac{(2 \times 10^{-6}) \times 70 \times 0.8}{(0.02 \times 59) + 2} = 35.2\ ng/L$$



Likely range of surface WQC to protect Human Health

PFOS: ≤ 2 ng/L

PFOA: 35 – 45 ng/L

Photo credits: Flickr users ktgeek, lesterpubliclibrary; https://www.kitchenfrau.com/wp-content/uploads/2015/03/IMG_1394a-fish-sticks-682x1024.jpg

Next steps

Spring-Fall 2020

Stakeholder input and feedback

Stakeholder group meetings focusing on NR106 implementation

Winter 2020-21

Economic Impact Analysis

Questions?

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