

A detailed illustration of a large snakehead fish, likely a Northern Snakehead, swimming in a river. The fish is shown in profile, facing right, with its mouth slightly open. It has a mottled pattern on its head and a large, fan-shaped tail. The background features a river scene with lily pads, smaller fish, and fishing boats in the distance. The entire scene is rendered in a monochromatic blue and white style.

Natal Origins and Broad-Scale Movement of Northern Snakehead in the Potomac River

Hae H. Kim, John Odenkirk, Mike Isel, Robert Willis, T. Reid Nelson, and Quinton E. Phelps



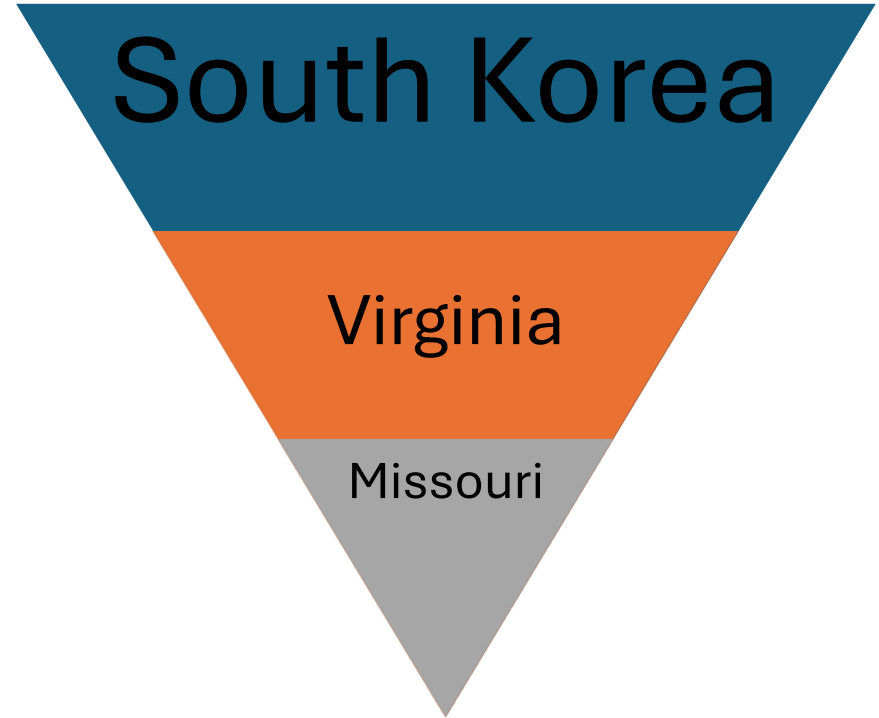
HOME



South Korea

Virginia

Missouri



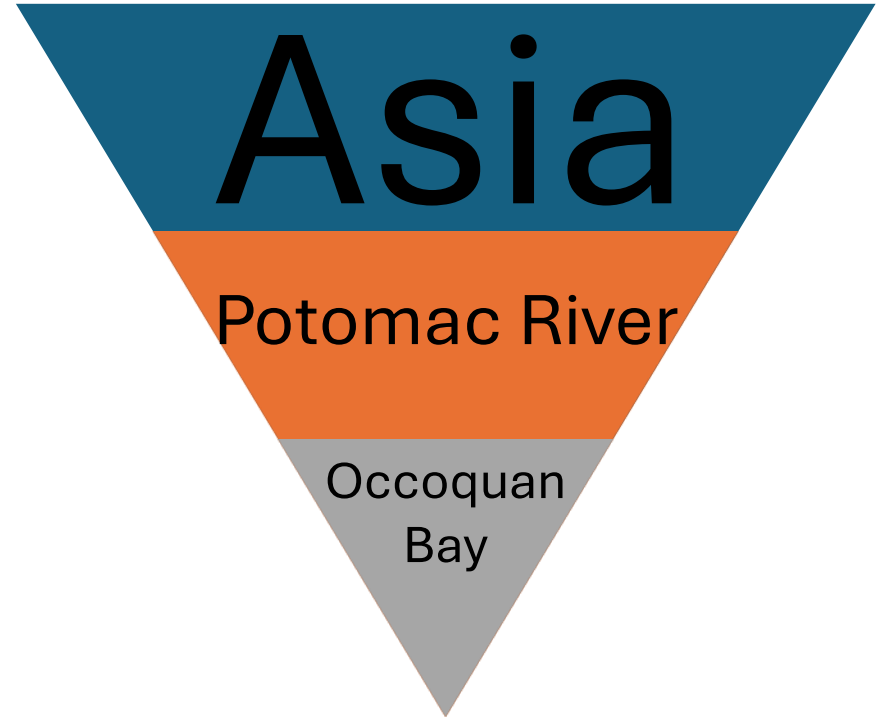
HOME



Asia

Potomac River

Occoquan
Bay





**WE'RE NOT
IN Asia
ANYMORE**

Early 2000's

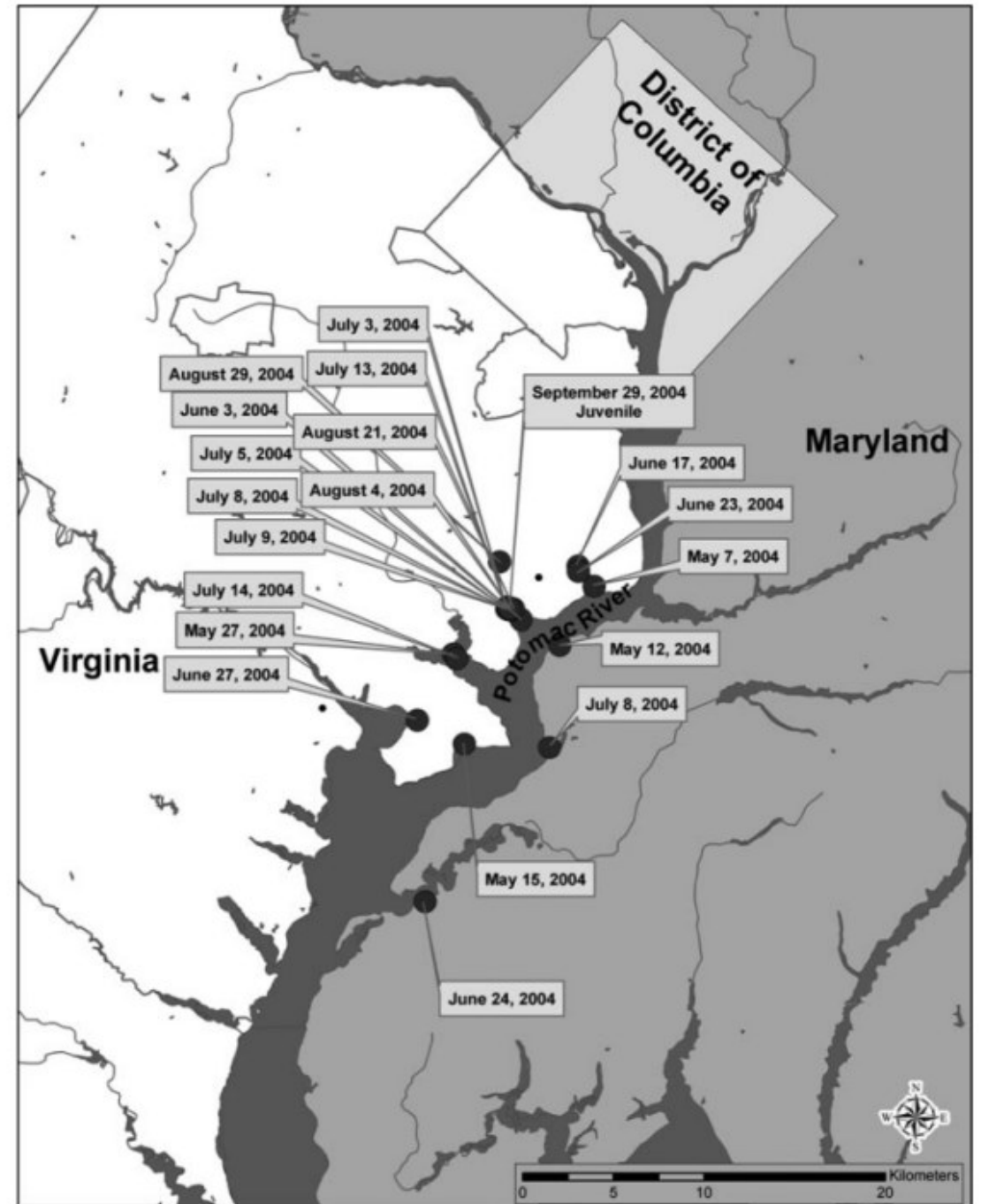
Potomac River – Mainstem and Tribs
2004

Young-of-Year (YOY; Age-0)

Adults (Ages 2-6)

(Odenkirk and Owens 2005)

Similar Patterns across newly invaded
fronts.



Evaluate and Learn

Prior Literature

Important, where native

Food Fish, Medicinal Value, etc.

Unique Traits

Parental Care

Obligate air-breathing



Evaluate and Learn

Relatively fast growing

Early maturing

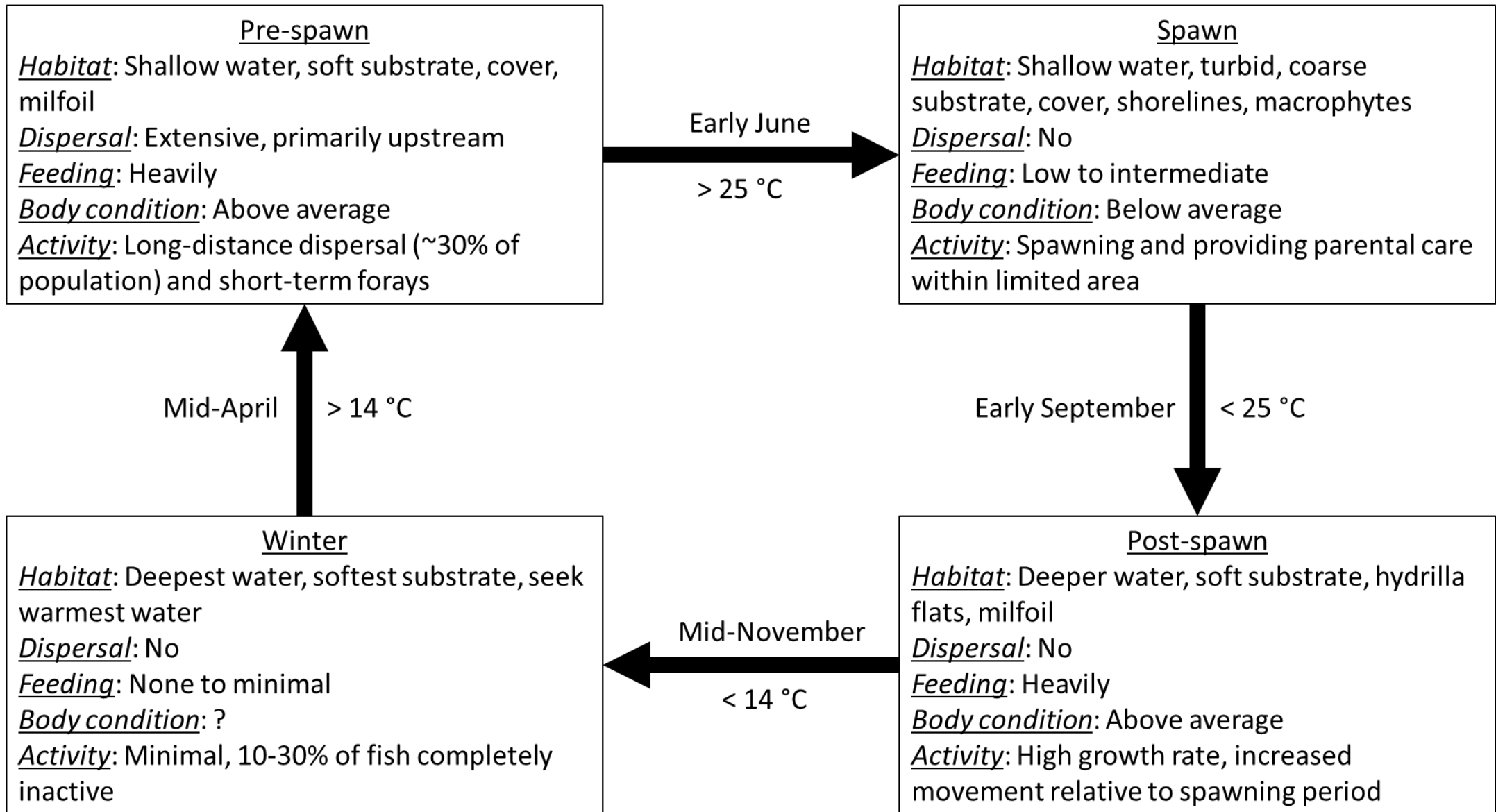
Variable recruitment patterns

Consistent and persistent overtime

Seasonal dispersal/migrations

Home-ranges





Northern Snakehead

Where did you come from,
where did you go?



Objectives

Evaluate natal origin of Northern Snakehead and tributary contribution by Virginia tributaries to the Potomac River basin population.

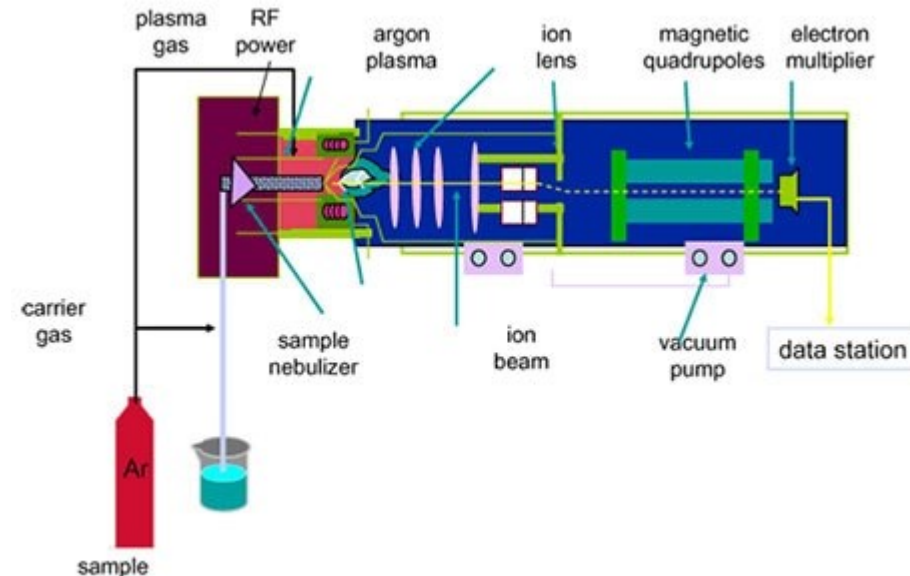


Methods

Otolith Microchemistry

Stable Isotopes – incorporation into calcium carbonate matrix

Can vary along geology, salinity, etc.



Otolith Microchemistry

Dependent on unique signatures

Signatures = Environment

Maintains a record throughout a
fishes' life



Environmental Signatures

Ambient Water Analysis

BUT, doesn't always work
Outside influences

Known Origin Fishes
Or otolith edge signatures



Collection

Boat Electrofishing

VDWR standard sampling and targeted sampling

Pentagon Basin – Potomac Creek



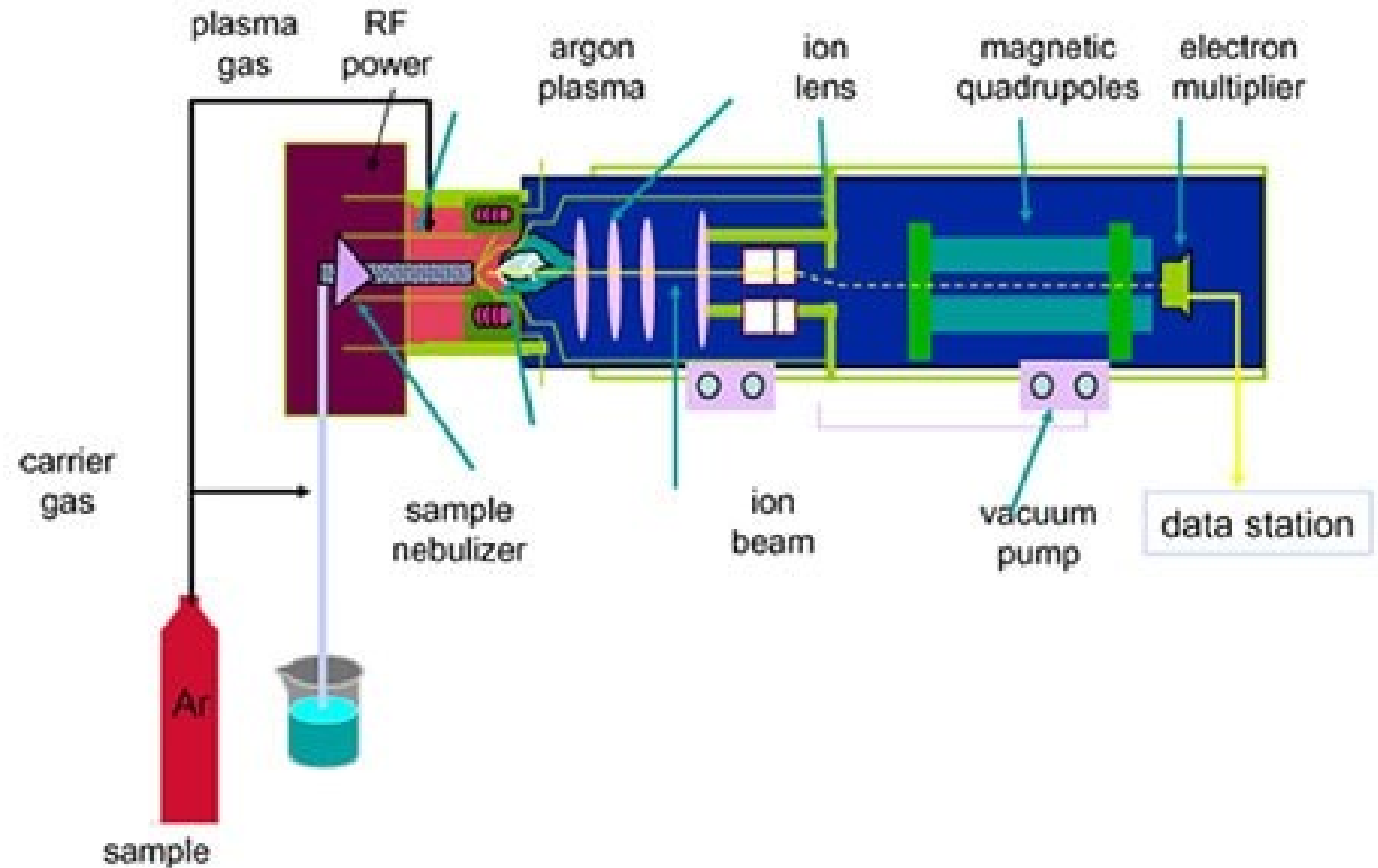
BLAST IT!

Ablation across otolith surface

Argon carrier gas -> ICPMS

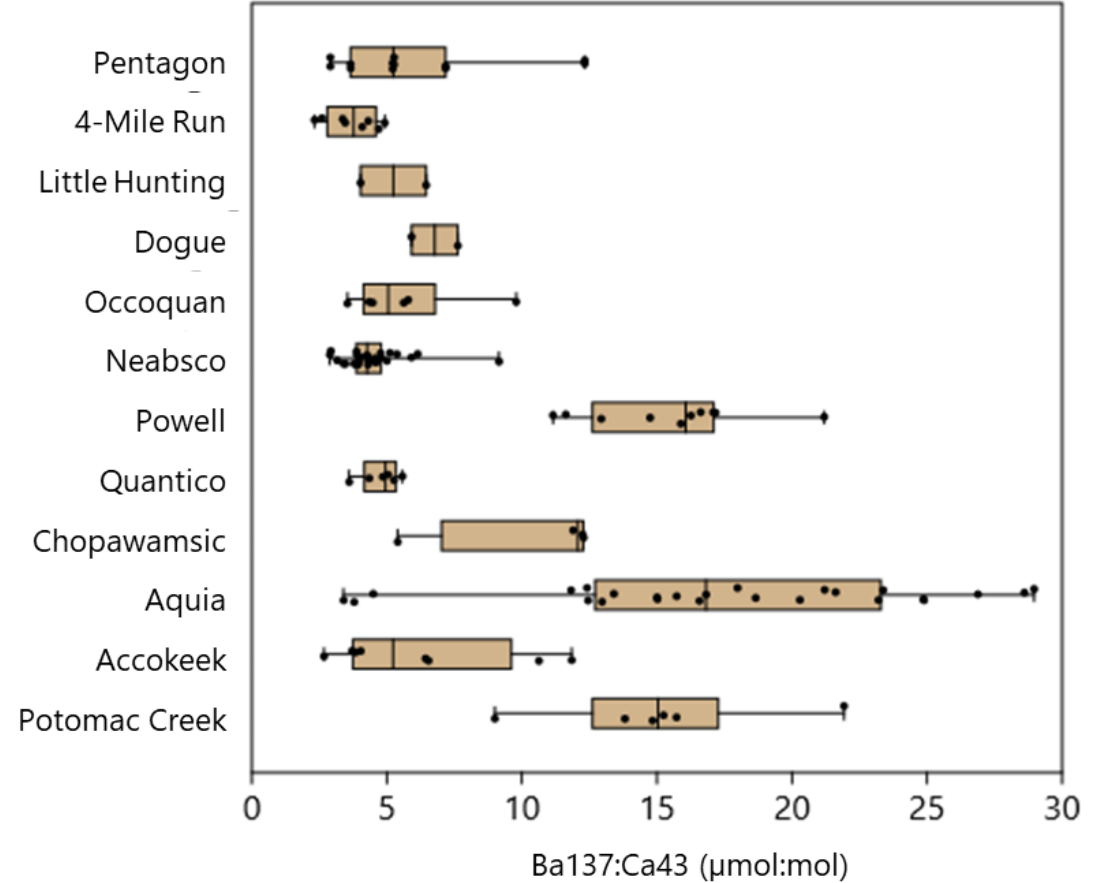
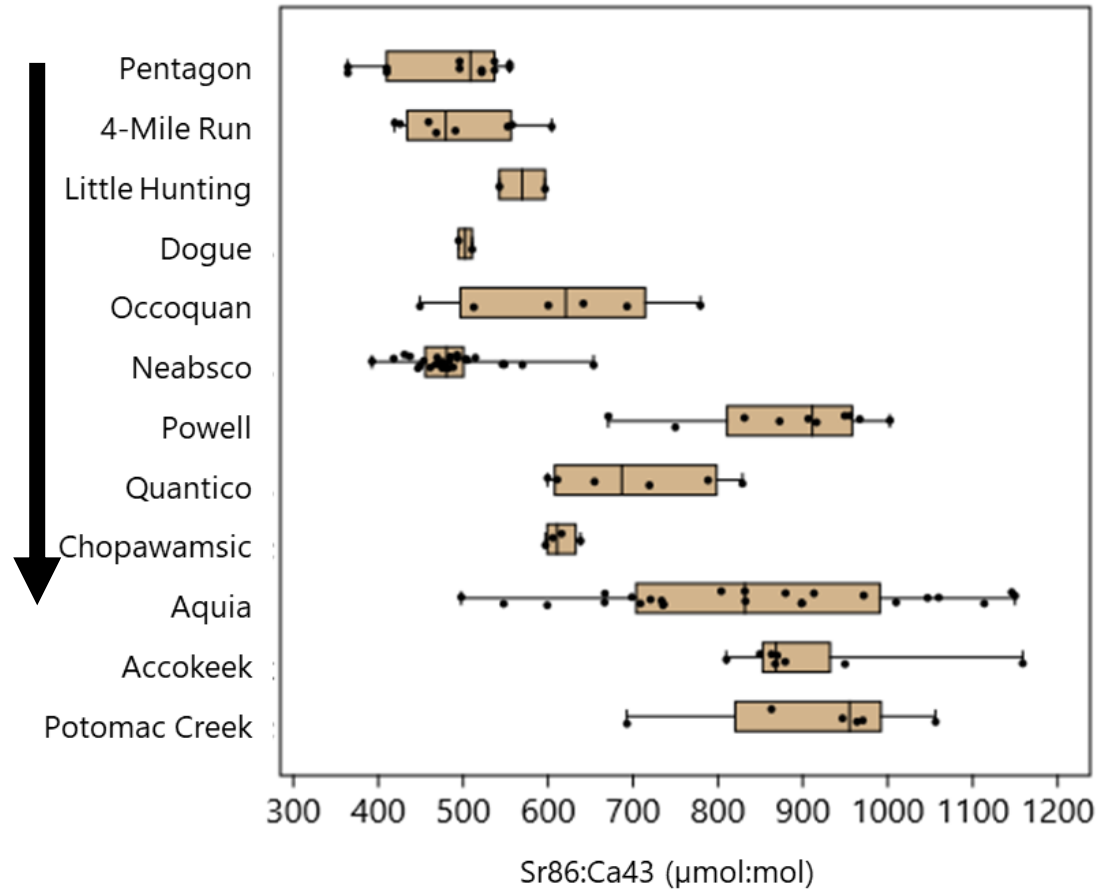
Results normalized and calibrated
using internal standards

Expressed as molar ratios of:
Sr86:Ca43 ($\mu\text{mol}:\text{mol}$)
Ba137:Ca43 ($\mu\text{mol}:\text{mol}$)



Results

FLOW



Model Development

Train a model – Cross Validate

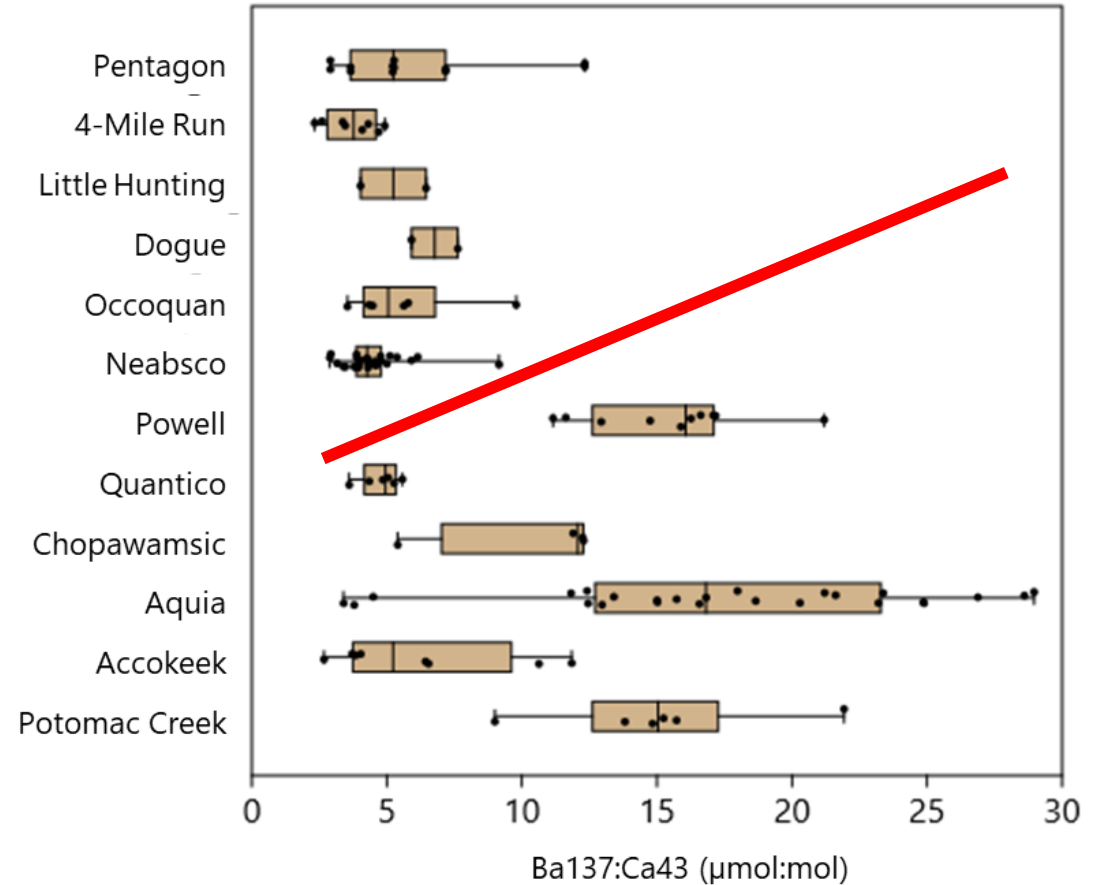
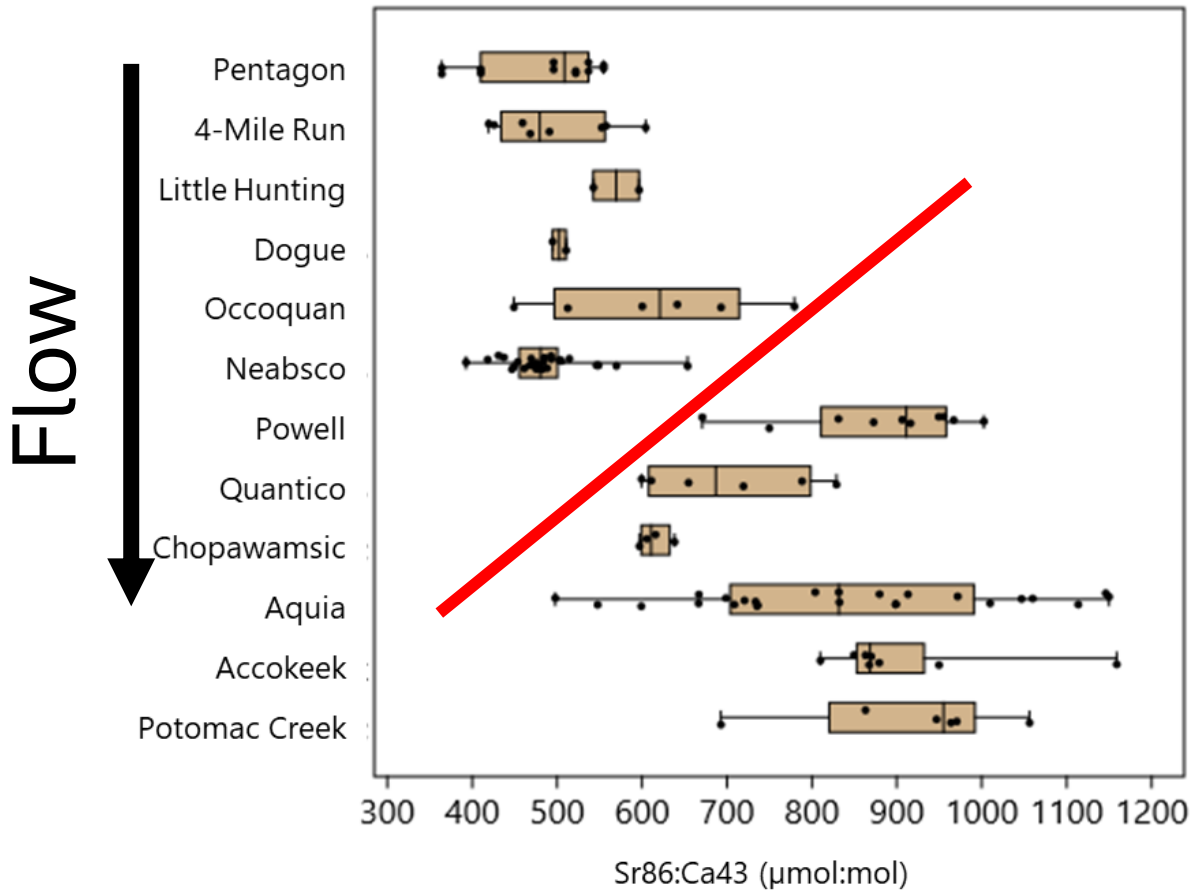
Linear Discriminant Function Analysis (LDFA)

Leave-One-Out Jackknife Procedure

Rerun model – assign core (natal signature)

Unknown Signature

Results



All-Inclusive LDFA model

Developed and trained model

All YOY and Adult Edge Signatures

a priori knowledge – Neabsco Creek

Evaluated for two geographic “regions”

Known Region	Assigned Region		% Correct
	<u>Neabsco Creek</u> Above	<u>Neabsco Creek</u> Below	
<u>Neabsco Creek</u> Above	49	10	96
<u>Neabsco Creek</u> Below	2	56	85
	Overall Accuracy		90%

All-Inclusive LDFA model

	Known Location	Assigned Region		% Correct	Average Regional Accuracy
		Actual	Assigned		
Above Neabsco Creek	Pentagon	12	12	100	97%
	4-Mile Run	8	8	100	
	Little Hunting	2	2	100	
	Dogue	2	2	100	
	Occoquan	6	4	67	
	Neabsco	28	28	100	
Below Neabsco Creek	Powell	10	10	100	83%
	Chopawamsic	4	0	0	
	Quantico	6	3	50	
	Aquia	25	22	88	
	Accokeek	8	8	100	
	Potomac	6	6	100	
Overall Accuracy				90%	

All-Inclusive LDFA model

Evaluate core signatures of all adult fish (20 μ m)

120 adult NSH core signatures

47 Above Neabsco Creek

73 Below Neabsco Creek

Captured Region	Assigned Region		% Natal Fidelity
	Above <u>Neabsco Creek</u>	Below <u>Neabsco Creek</u>	
Above <u>Neabsco Creek</u>	24	23	51%
Below <u>Neabsco Creek</u>	16	57	78%

All-Inclusive LDFA model

		Region Assignment		% Fidelity
		Above <u>Neabsco Creek</u>	Below <u>Neabsco Creek</u>	
Above <u>Neabsco Creek</u>	Collection Tributary			
		Pentagon	1	4
	4-Mile Run	1	8	11
	Little Hunting	1	2	33
	Dogue	2	1	67
	Occoquan	2	4	33
	<u>Neabsco</u>	17	4	81
Below <u>Neabsco Creek</u>	Powell	2	5	71
	Quantico	0	7	100
	<u>Chopawamsic</u>	1	4	80
	Aquia	10	25	71
	Accokeek	1	9	90
	Potomac	2	7	78

What does this all mean?

Upstream Dispersal – quite a bit

Esp. for more upstream sites

Approx. 80% of adults in Pentagon Basin did not originate there

Approx. 90% Four-Mile Run did not originate there

Higher Natal Fidelity Downstream

Relative Abundances – Higher in lower tribs.

Gradients

Observed concentrations greater on average

Tributaries generally bigger downstream

Differences along salinity gradients?



At the end of the day...

Spawning/Nursery/Recruitment habitat(s) likely better downstream

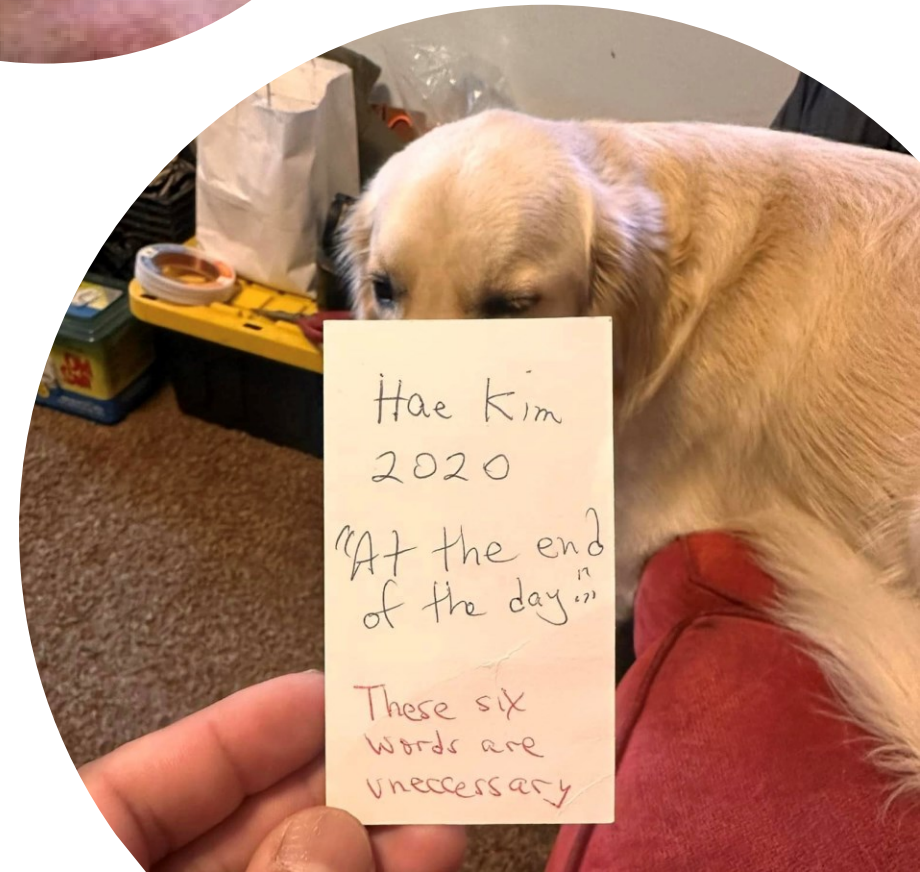
Connectivity appears to be high

Dispersal and Movement likely vary across environments

Limitations – physical barriers, abiotic gradients (e.g., salinity)

Northern Snakehead – patchy population structure supported by dispersal

Early Detection/Monitoring



Hae Kim
2020
"At the end
of the day"
These six
words are
unnecessary