The Pebble Project

Fish Resources Baseline Studies

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APC SERVICES, LLC
A subsidiary of Alaska Peninsula Corporation

HDR Alaska

Investigation	Year				
	2004	2005	2006	2007	2008
Aquatic Habitat Assessments					
Mainstem and Tributary Surveys					
USFS Tier 1 (USFS, 2001)	NFK, SFK, UT			UT	NFK, SFK, UT
USFS Tier 3 (USFS, 2001)	NFK, SFK, UT	SFK, UT		UT	NFK, SFK, UT
Fish/Habitat Associations - Anecdotal Data	NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	
Off-Channel Surveys					
USFS Tier 3 (USFS, 2001)					NFK
Fish/Habitat Associations - Anecdotal Data		SFK	SFK	SFK, UT	
Mesohabitat Mapping		NFK, SFK, UT		NFK, SFK, UT	
Fish Assemblage Surveys					
Distribution and Relative Abundance	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT
Fish Use of Off-Channel Habitats		SFK	SFK	SFK, UT	NFK
Winter Sites	KR, NFK, SFK, UT	NFK, SFK, UT	NFK, SFK, UT	SFK, UT	
Mainstem Index	NFK, SFK, UT	NFK, SFK, UT			NFK, SFK, UT
Adult Salmon	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	KR, NFK, SFK, UT	NFK, SFK, UT
Rainbow Trout Radio Telemetry [a]				UT	UT
Instream Flow Habitat Studies					
Mainstem Channel	KR, NFK, SFK, UT	KR, NFK, SFK, UT		KR, NFK, SFK, UT	NFK, SFK, UT
Off-Channel		SFK	SFK	UT	NFK
Water Temperature Modeling	NFK, SFK, UT	NFK, SFK, UT	NFK, SFK, UT	NFK, SFK, UT	NFK, SFK, UT
Fluvial Geomorphology and Spawning Gravel Quality		SFK, UT		KR, NFK, SFK, UT	NFK, SFK, UT

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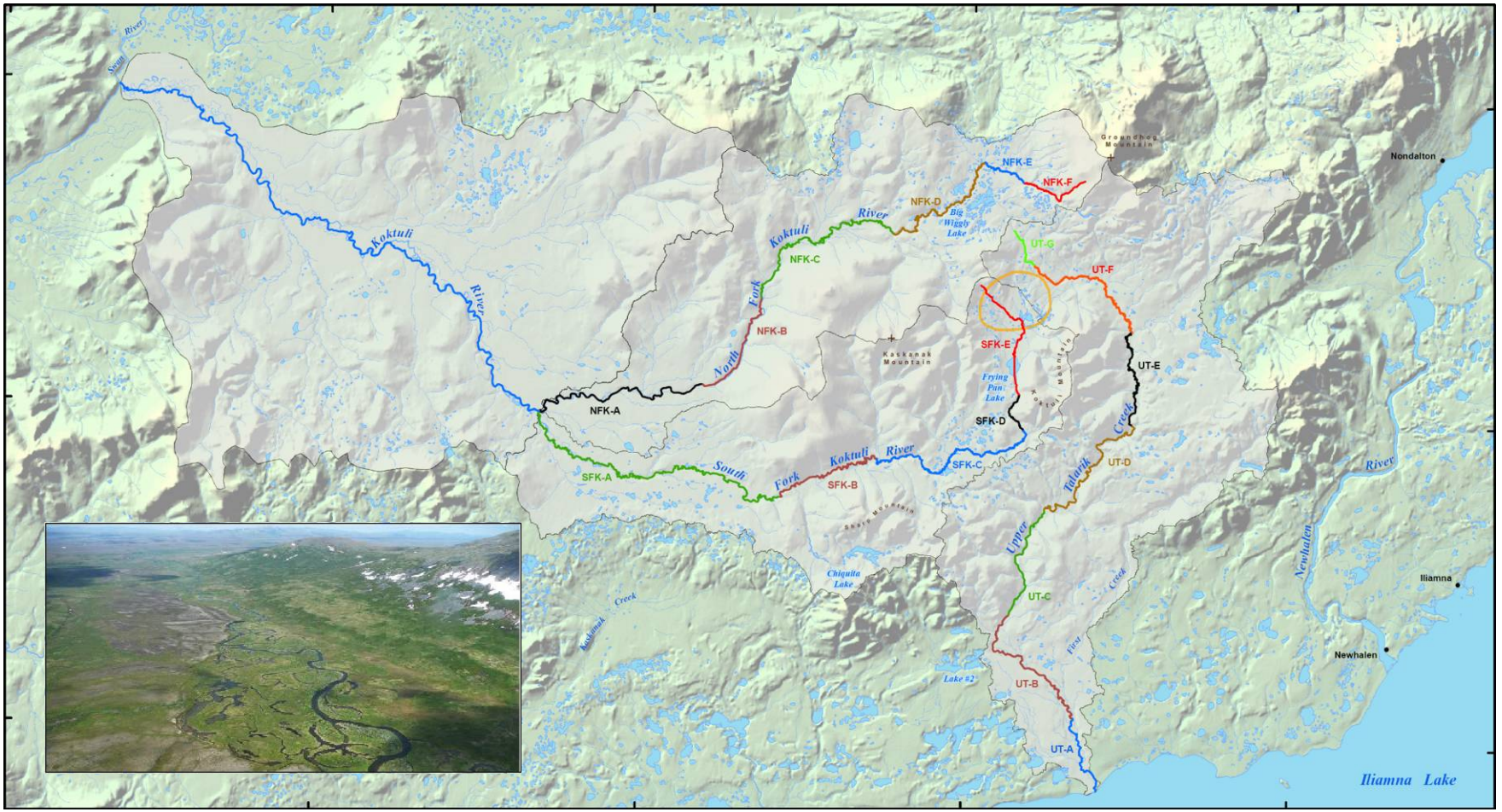
Mine Study Area



Legend

UT-A Mainstem Reach Example

Watershed Boundary

General Deposit Location

Objective 1

Document stream channel & valley form characteristics

- Largely single-thread, gravel-bedded, low gradient channels
- Influenced by glaciation: old lake deposits & glacial outwash
- High flows typically overtop stream banks
- Riparian, wetlands, & off-channel habitats extend into the valley

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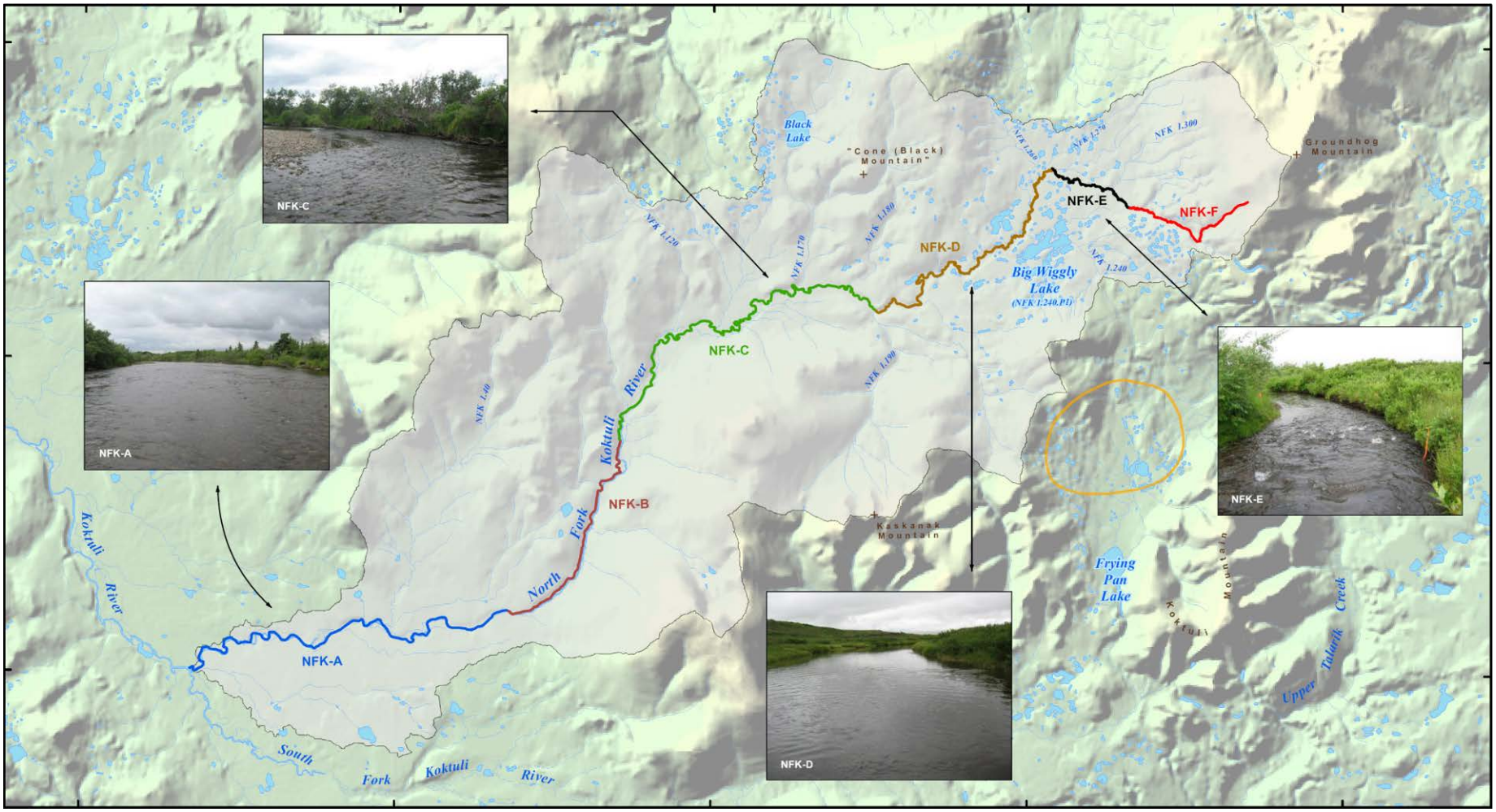
North Fork Koktuli River



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NFK-A Mainstem Reach Example

NFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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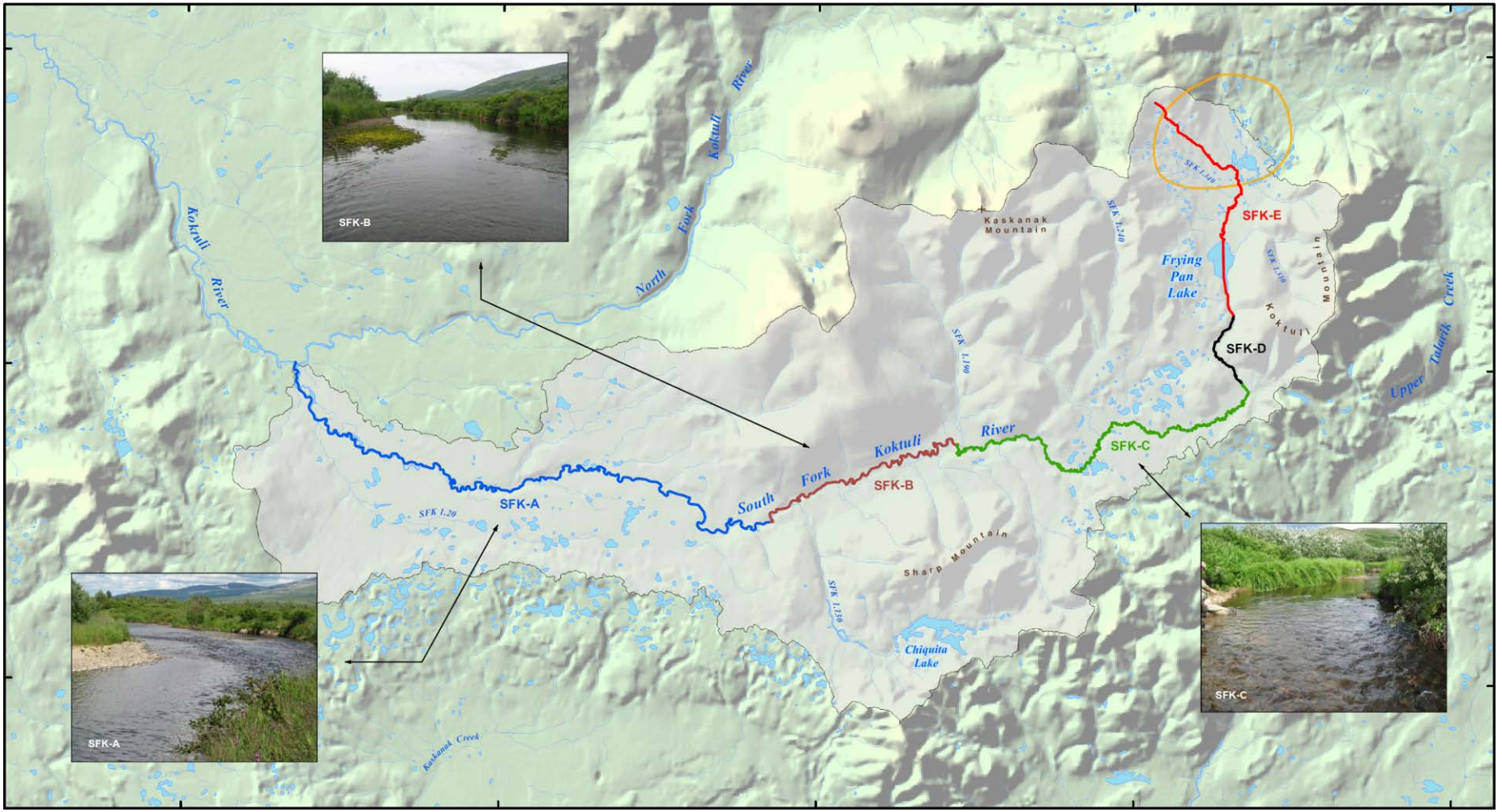
South Fork Koktuli River



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SFK-A Mainstem Reach Example

SFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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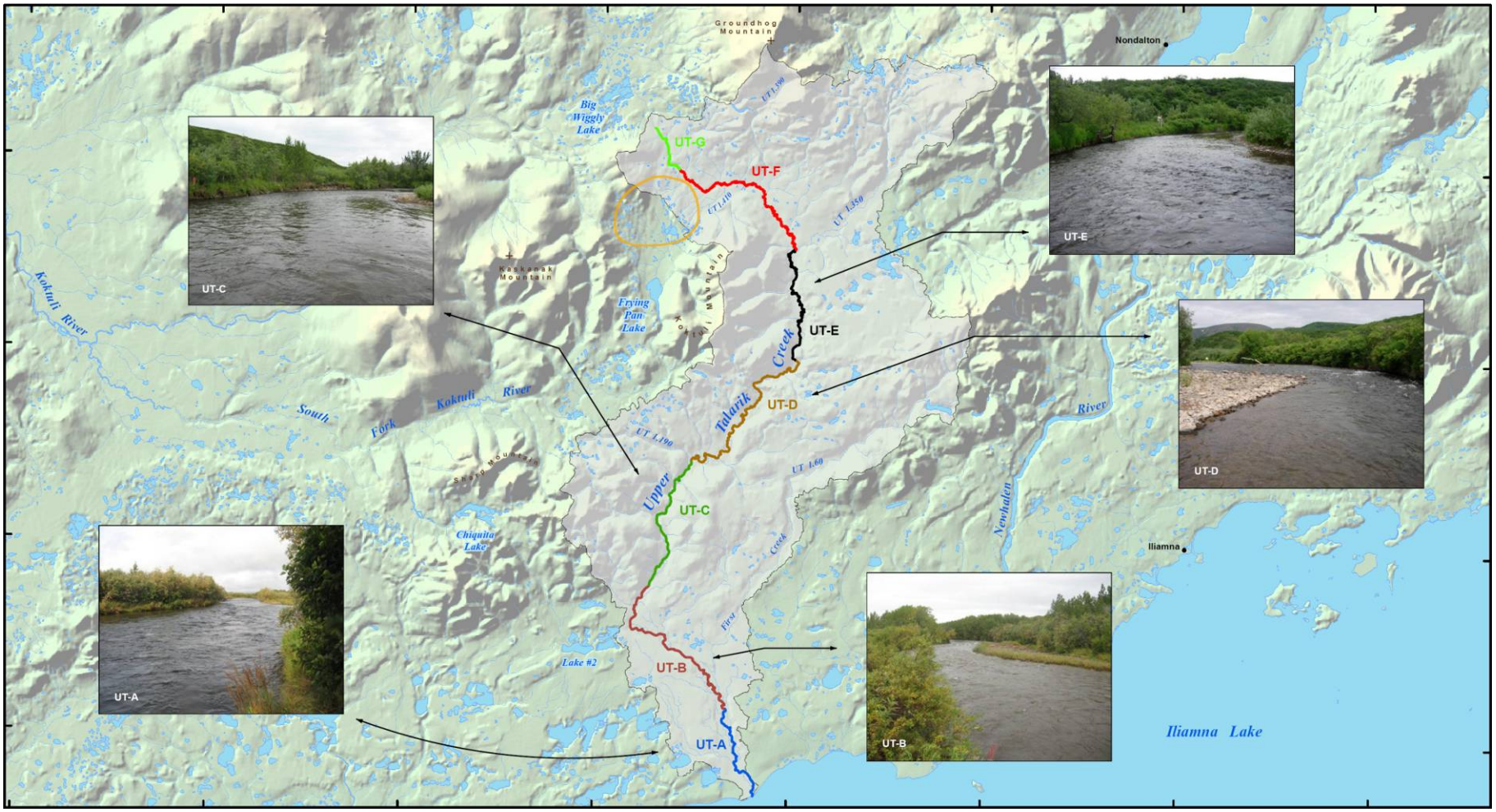
Upper Talarik Creek



Legend

UT-A Mainstem Reach Example

UT 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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Objective 2

Characterize riverine habitat types & document their distribution

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Mainstem and Tributary Habitat Surveys

- Surveys were conducted using standard USFS habitat survey protocols…with modifications.
- Continuous stream surveys were conducted on foot in smaller channels.
- In larger water, such as the lower UT, boats were used.

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Remote Habitat Mapping

- Combined aerial imagery and GIS tools to estimate the area associated with each habitat type visible.

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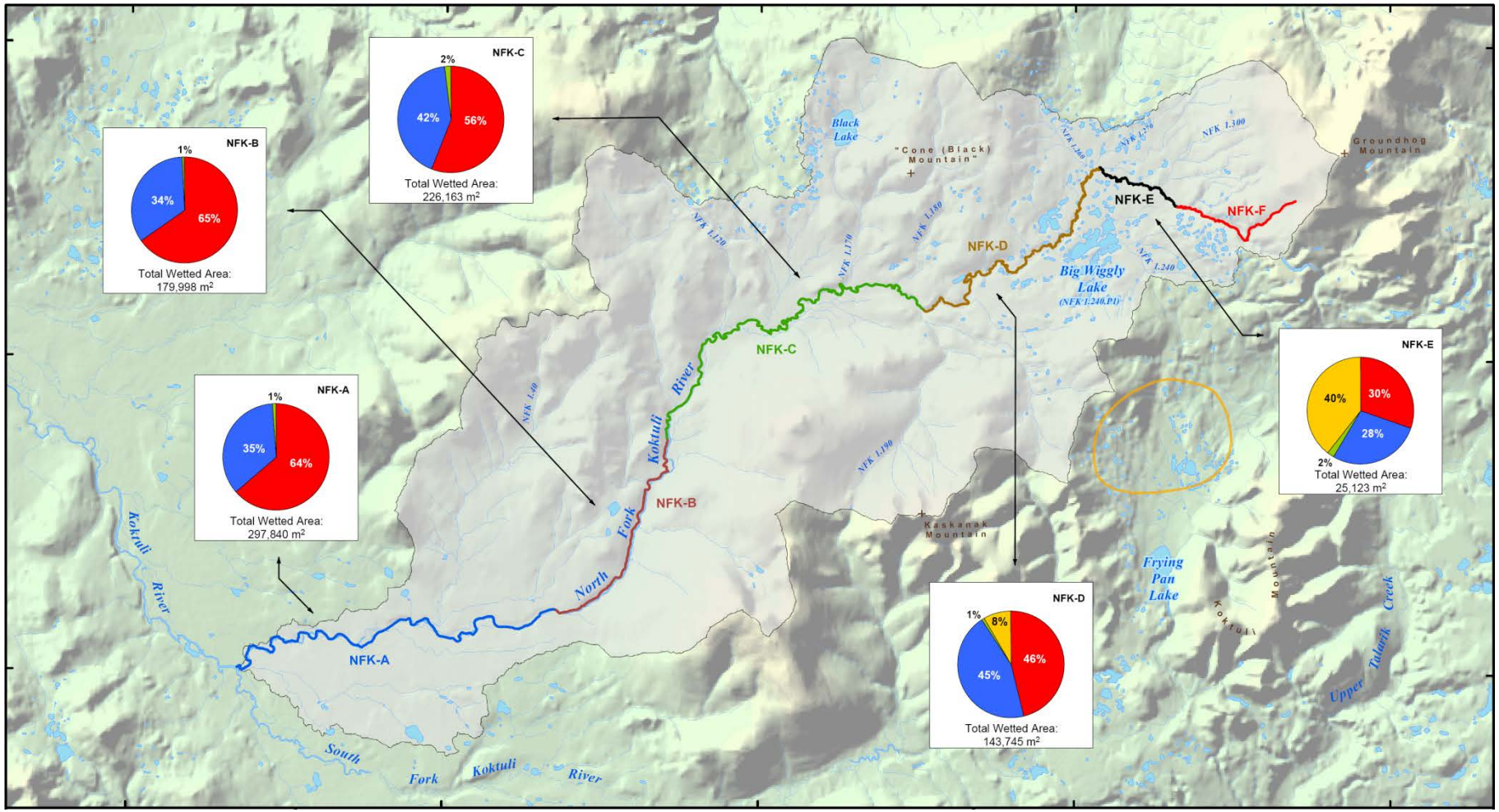
Example Mainstem Habitat Types in NFK



Legend

- Pool
- Run/Glide
- Riffle
- Beaver Pond

NFK-A Mainstem Reach Example

NFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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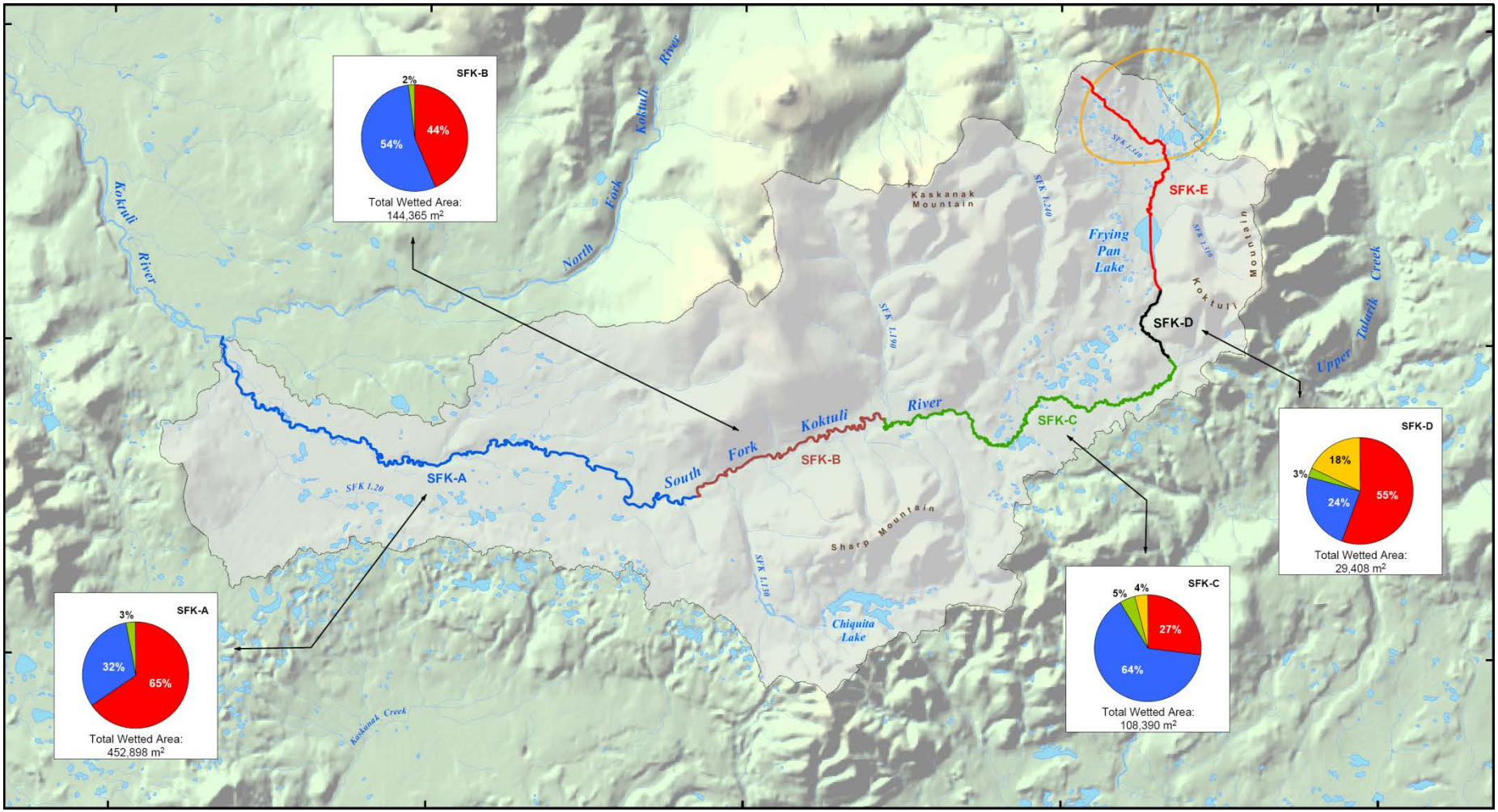
Example Mainstem Habitat Types in SFK



Legend

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- Riffle
- Beaver Pond

SFK-A Mainstem Reach Example

SFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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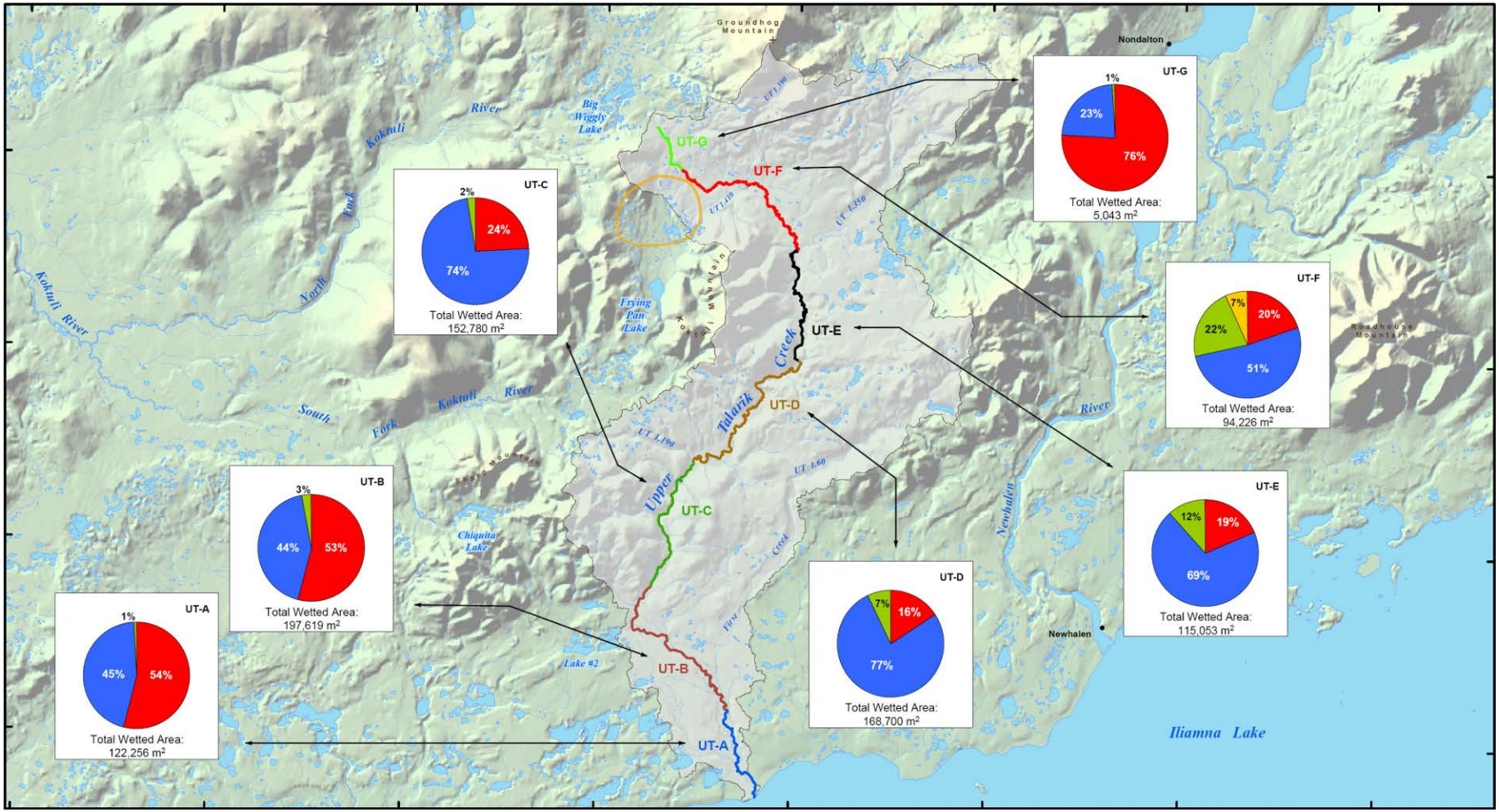
Example Mainstem Habitat Types in UT



Legend

- Pool
- Run/Glide
- Riffle
- Beaver Pond

- UT-A Mainstem Reach Example
- UT 1.190 Tributary Name Example
- Watershed Boundary
- General Deposit Location

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Objective 3

Document locations of special habitat features

- Seeps & springs
- Beaver ponds & dams
- Intermittent flow reaches
- Lakes & ponds
- Tributaries

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Special Habitat Features

NFK

- Groundwater upwelling in lower reaches
- Intermittent flow in some tributaries
- Beaver ponds were limited in mainstem to upper reaches, yet abundant in off-channel areas
- Big Wiggly Lake supports lake-spawning sockeye salmon

Special Habitat Features

SFK

- Intermittent flow observed upstream tributary 1.190
- Constant subsurface flow to UT
- Groundwater upwelling in mainstem below tributary 1.190 & in tributaries upstream of Frying Pan Lake
- Beaver ponds concentrated upstream of Frying Pan Lake & in off-channel areas
- Several ponds high in the watershed
- Two large lakes - Frying Pan & Chiquita Lakes

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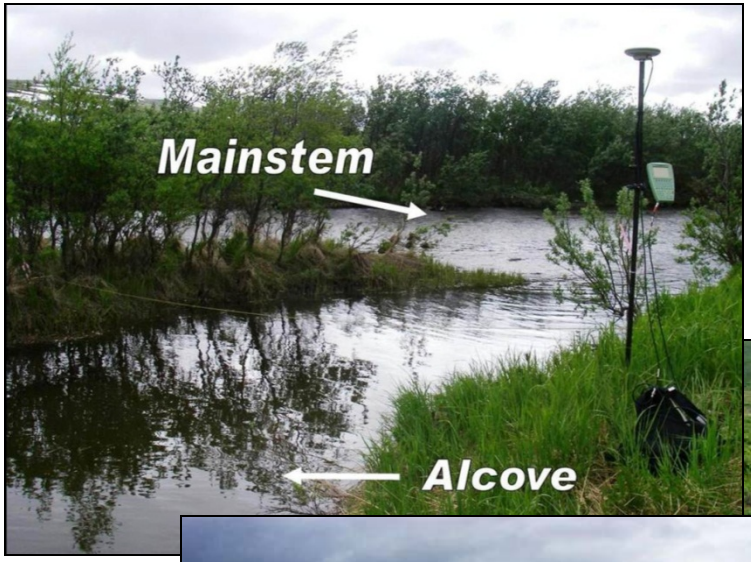
Special Habitat Features

UT

- Groundwater influence throughout mainstem
- 1.190 receives steady cross-basin flow from SFK
- Beaver ponds scarce in the mainstem, yet abundant in off-channel areas
- Lakes & ponds are prevalent, particularly on the eastern watershed boundary
- Lakes & ponds in some upper tributaries support spawning salmon

Objective 4

Describe quantity & types of off-channel habitats



- Beaver ponds & outlet channels, alcoves, isolated ponds, side channels, & percolation channels

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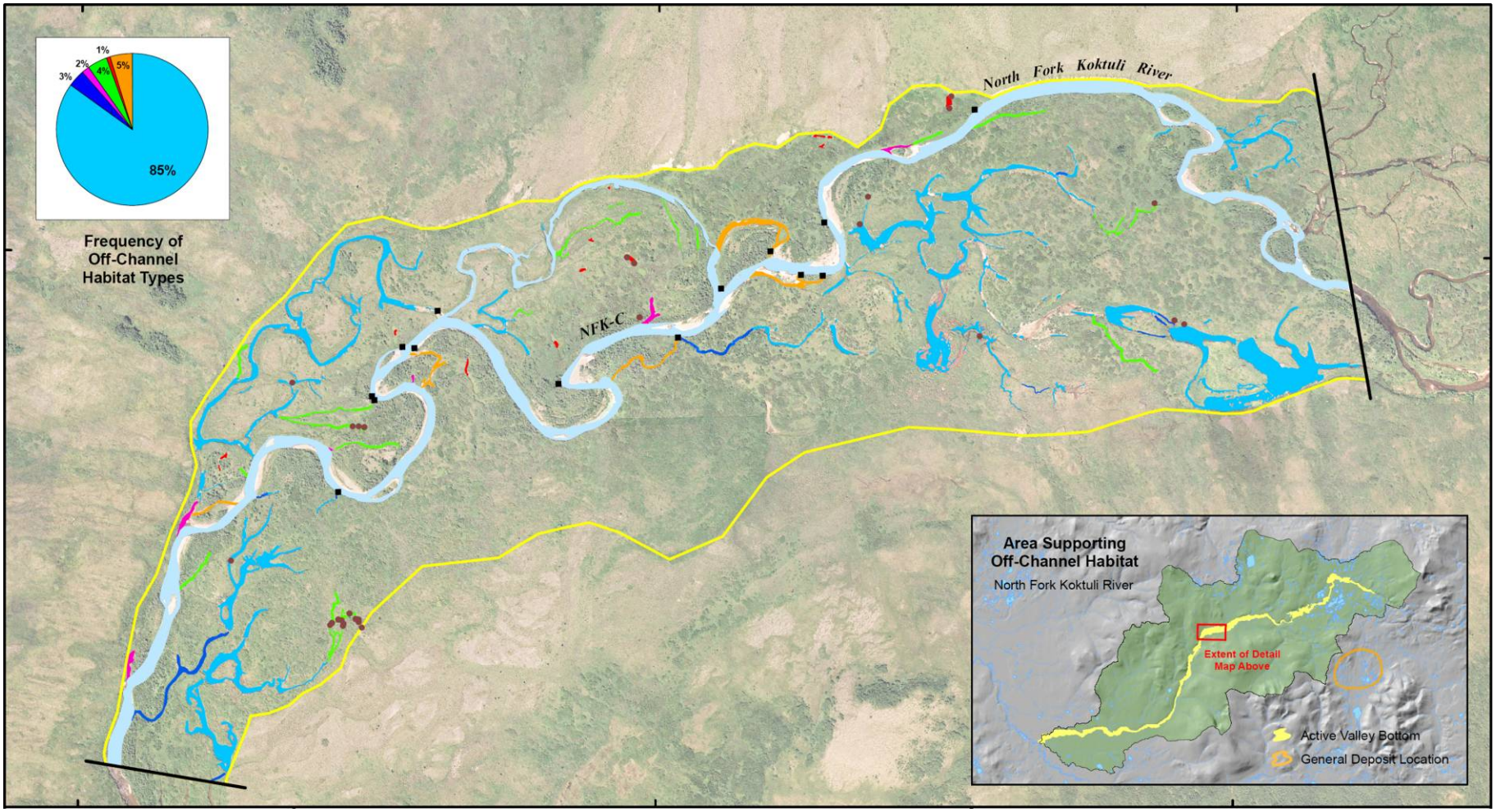
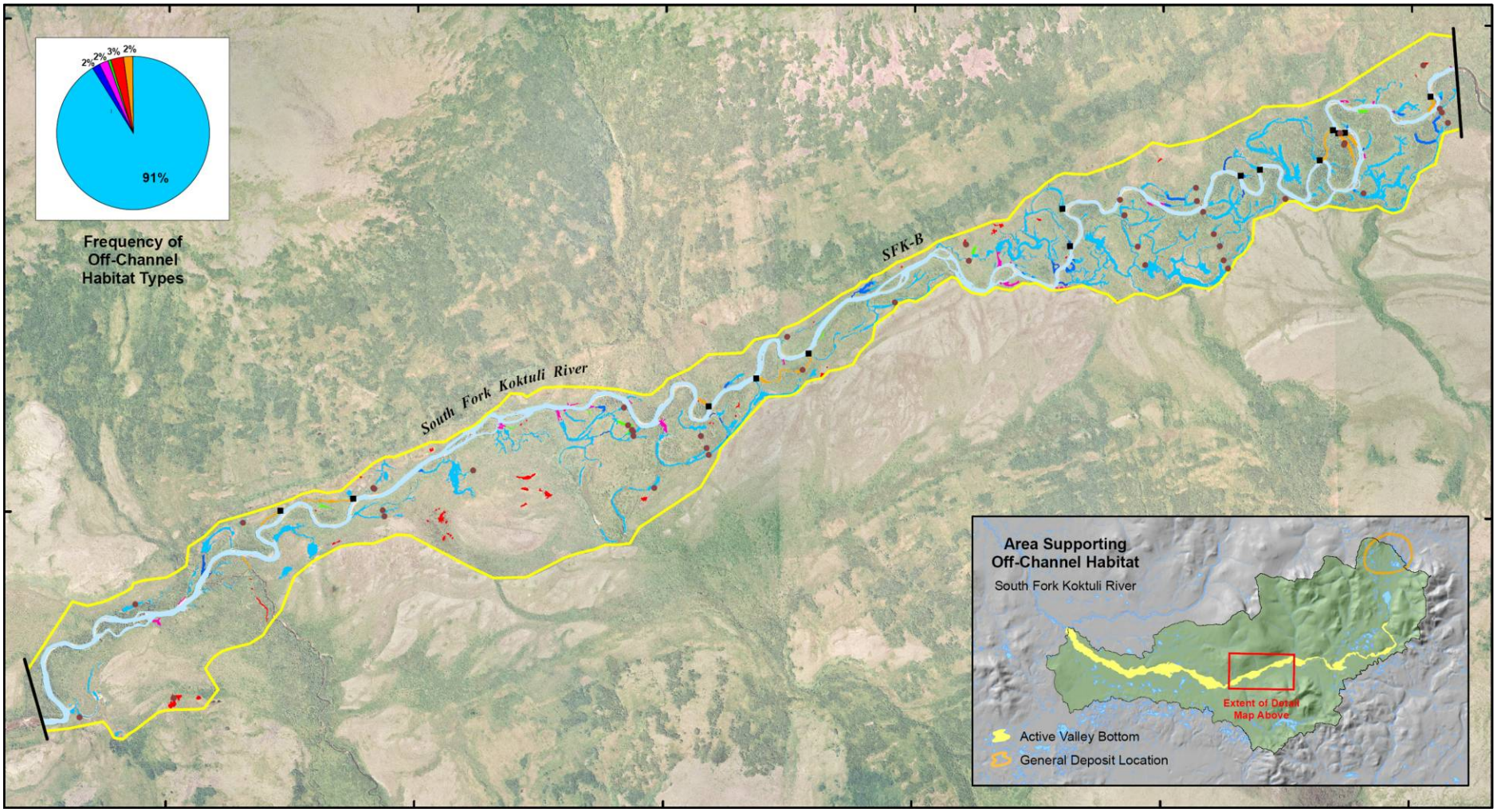
Distribution and Frequency of Off-channel Habitat Types in NFK



Legend

- Beaver Pond
- Beaver Pond Outlet Channel
- Alcove
- Isolated Pond
- Side Channel
- Percolation Channel
- Study Area Extents
- Inlets
- Fish Sampling Sites
- Mainstem
- Active Valley Bottom

Distribution and Frequency of Off-channel Habitat Types in SFK



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- Alcove
- Isolated Pond
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- Study Area Extents
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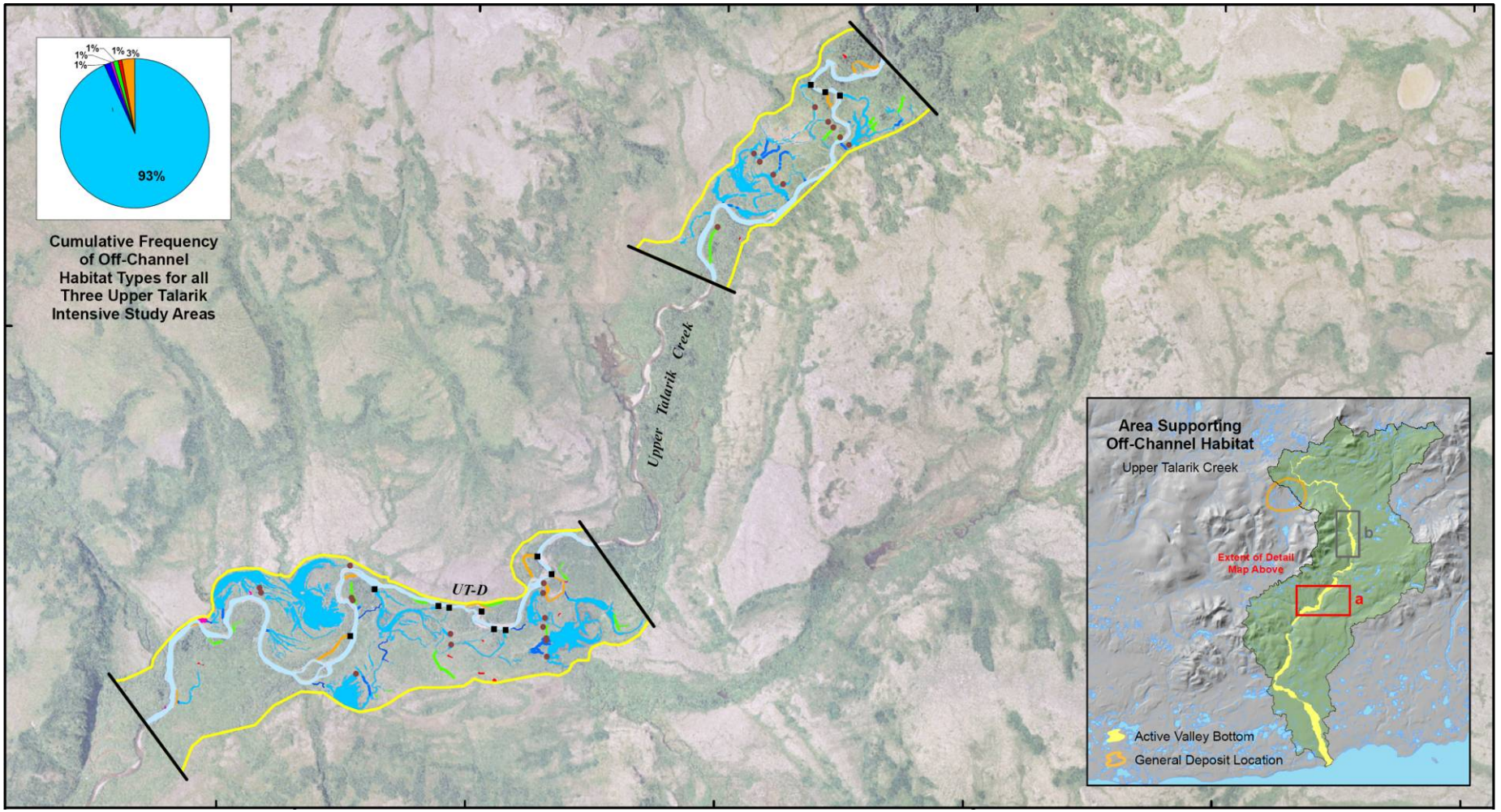
- Fish Sampling Sites
- Mainstem
- Active Valley Bottom

Distribution and Frequency of Off-channel Habitat Types in UT



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- Beaver Pond
- Beaver Pond Outlet Channel
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- Percolation Channel
- Study Area Extents
- Inlets
- Fish Sampling Sites
- Mainstem
- Active Valley Bottom

Objective 5

Describe patterns of fish distribution & abundance in mainstem, tributary, & off-channel habitats

- ~3,000 sampling locations (NFK, SFK, UT, & KR)
- Snorkeling, electrofishing, minnow trapping, seining, tangle netting, angling, and dipnetting

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- Freshwater stages and resident fish focus
- Fish identified to species and life stage
- Fork length measured or estimated

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- Document fish presence
- Compare relative fish abundance across habitat types
- Winter fish sampling (Nov-Apr)

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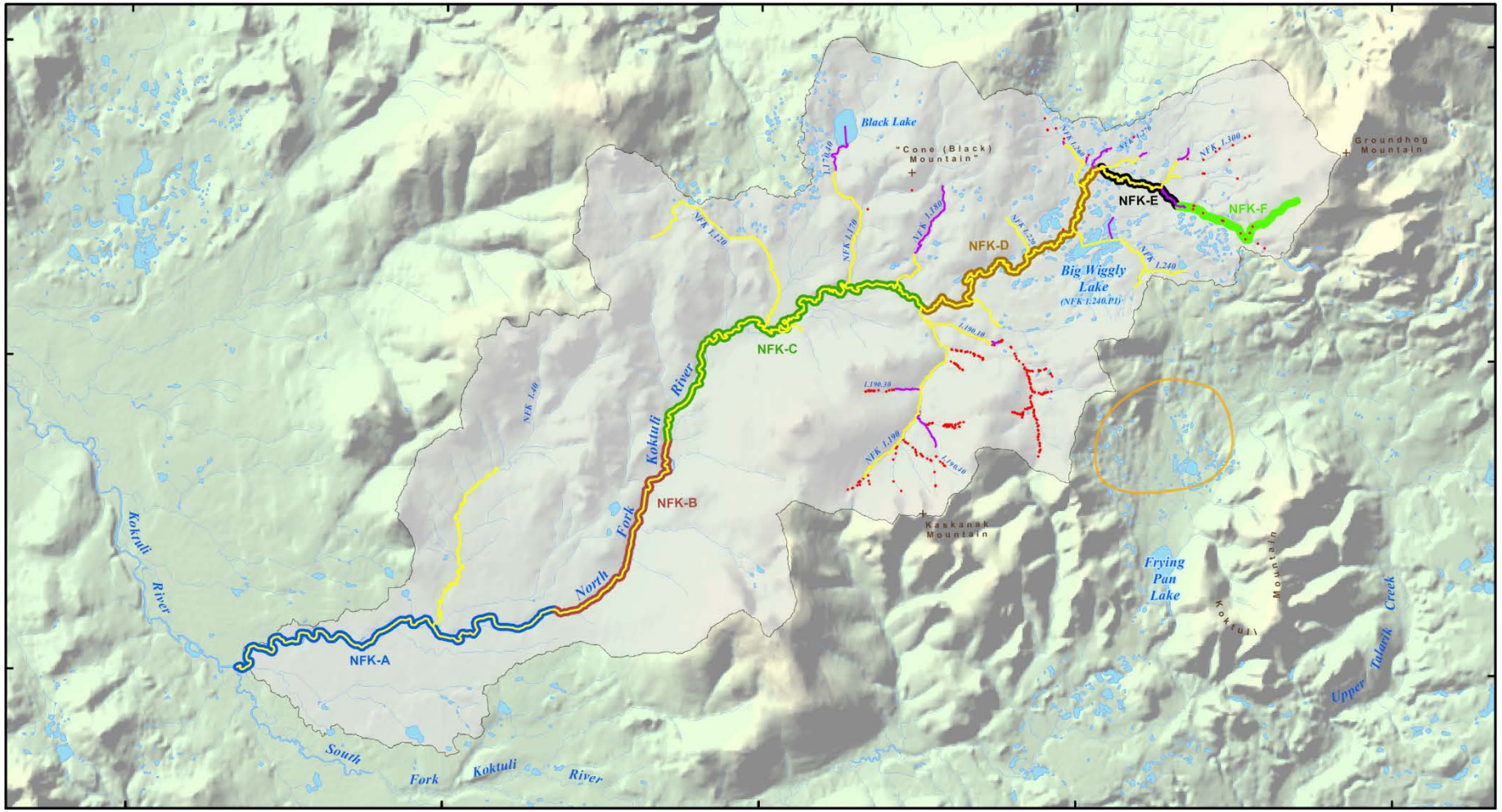
Anadromous Fish Distribution in NFK



Legend

Anadromous Fish Distribution*

- R2 Anadromous Water Catalog Nominations (2004-2008 Data)
- ADF&G Anadromous Water Catalog Stream (2009)
- Sites With No Anadromous Fish Present (2004-2008 Data)

NFK-A Mainstem Reach Example

NFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

* Species include Chinook, chum, coho, and sockeye salmon.

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NFK Fish Species

- 12 species
- Greatest abundances in NFK-C
- Number of species decreases in upstream reaches
- Chinook & coho salmon, Dolly Varden, & sculpin throughout

Common Name	NFK-A	NFK-B	NFK-C	NFK-D	NFK-E	NFK-F
Chinook salmon	X	X	X	X		X
chum salmon	X	X	X			
coho salmon	X	X	X	X	X	X
sockeye salmon	X	X	X	X		
Arctic grayling	X	X	X	X		
Dolly Varden	X	X	X	X	X	X
rainbow trout	X		X			
whitefish	X	X	X	X		
sculpin	X	X	X	X	X	X
northern pike			X	X		
ninespine stickleback	X	X	X	X		
threespine stickleback	X			X		

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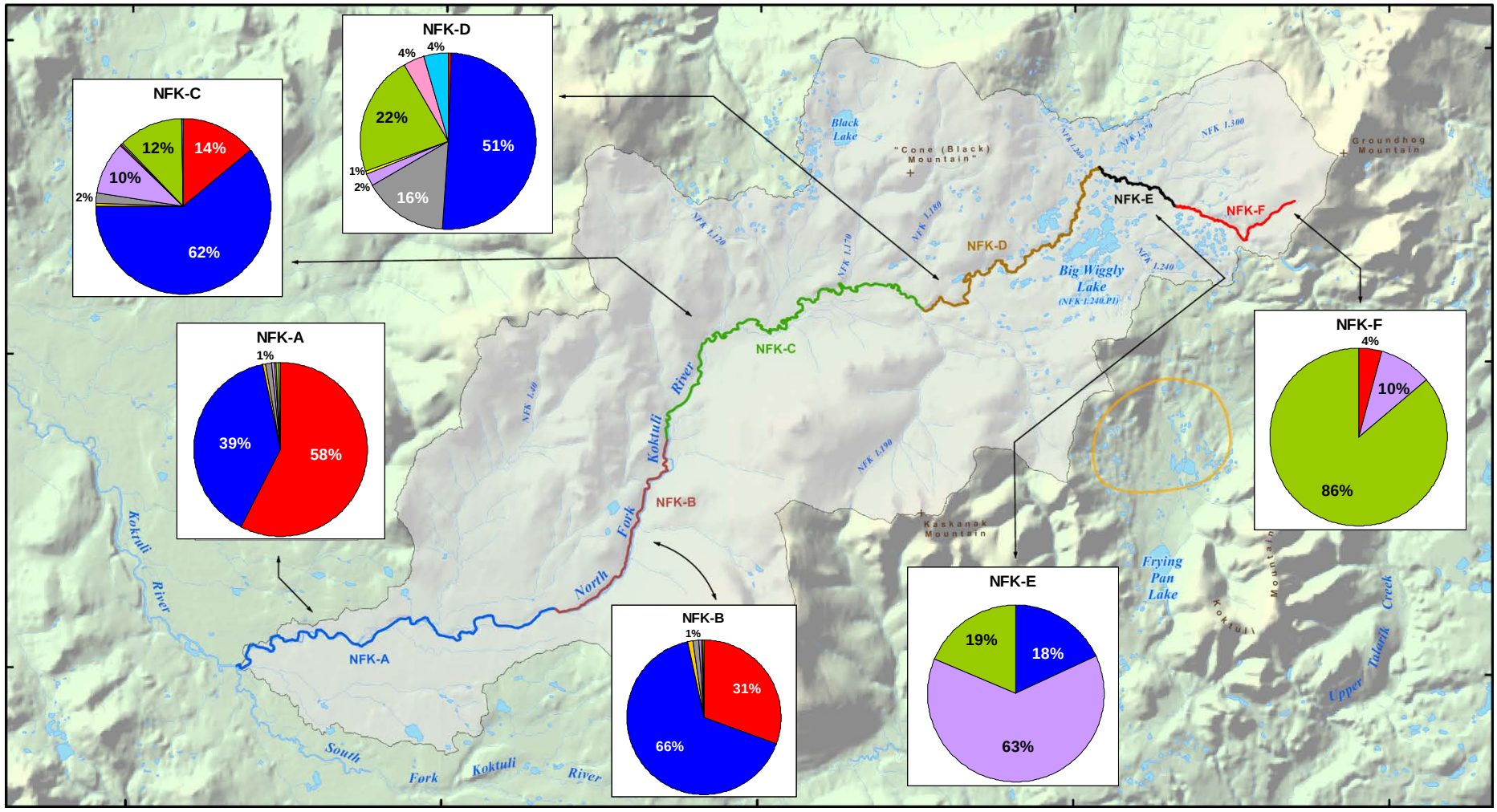
Fish Species Composition in NFK



Legend

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Sockeye Salmon
- Arctic Grayling
- Dolly Varden
- Rainbow Trout
- Whitefish
- Sculpin
- Stickleback
- Northern Pike
- Other Species
- NFK-A Mainstem Reach Example
- NFK 1.190 Tributary Name Example
- Watershed Boundary
- General Deposit Location

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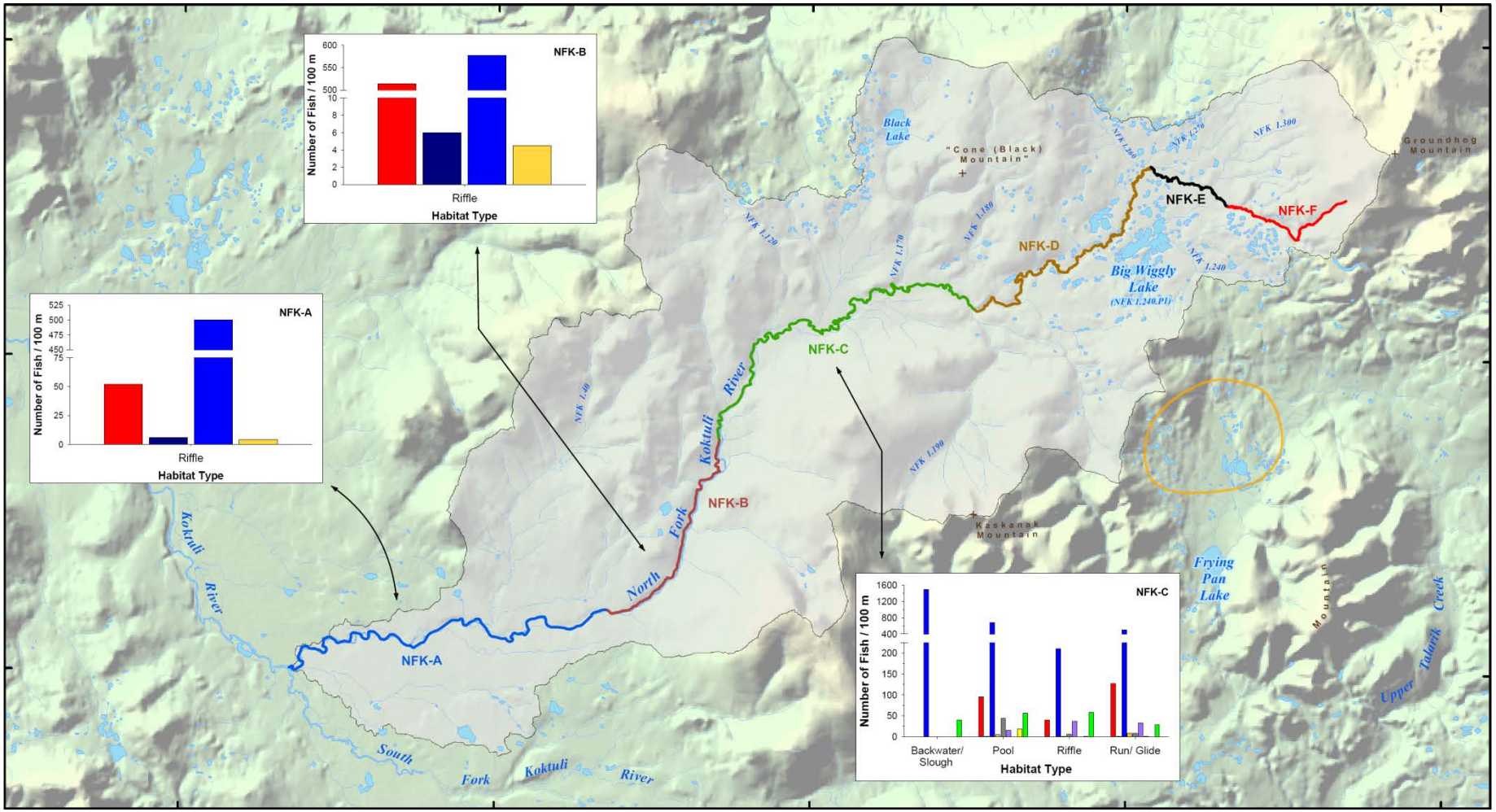
NFK Relative Fish Abundance 2004 – 2008



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- Other Species
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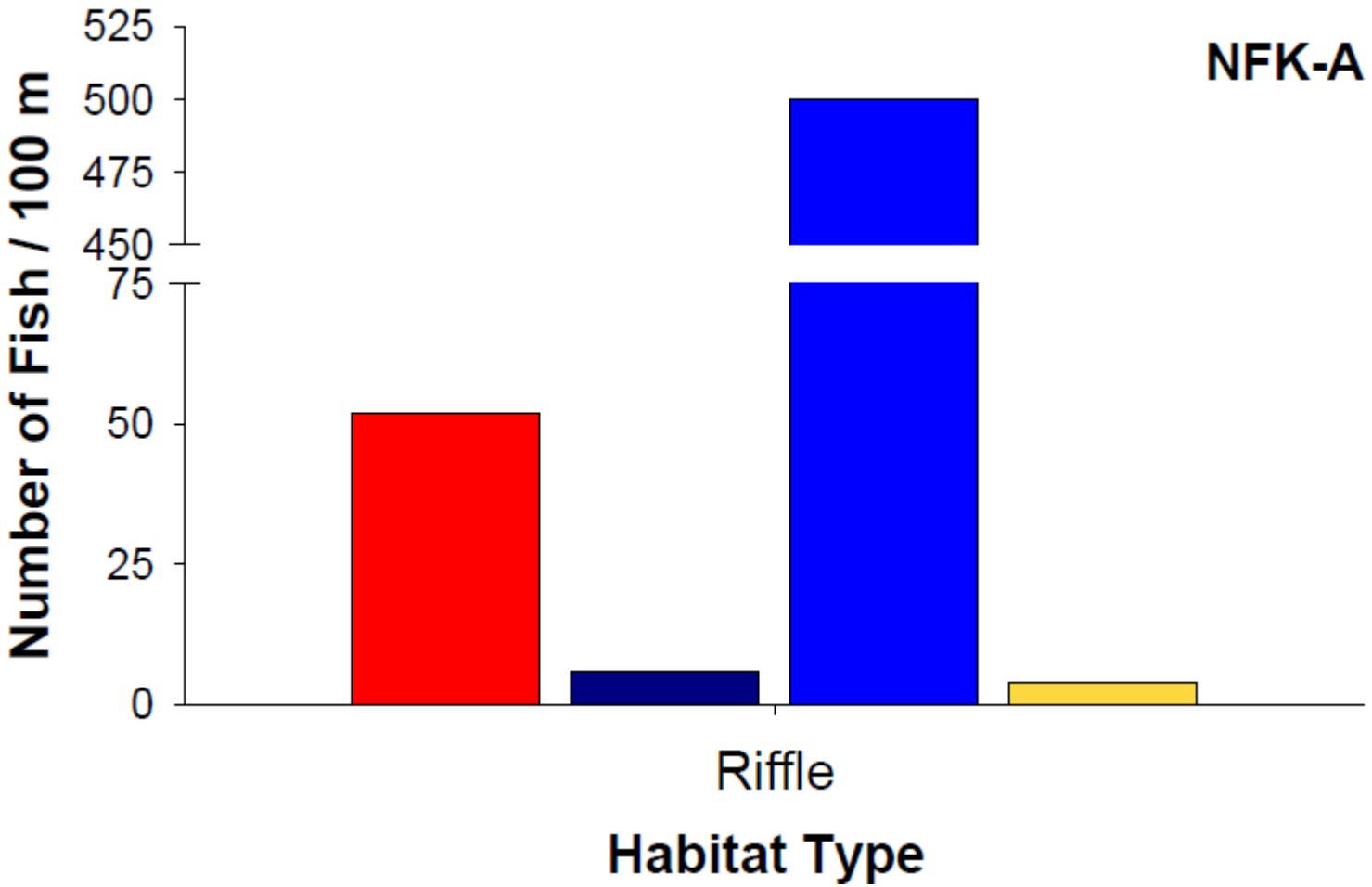
NFK Relative Fish Abundance 2004 – 2008



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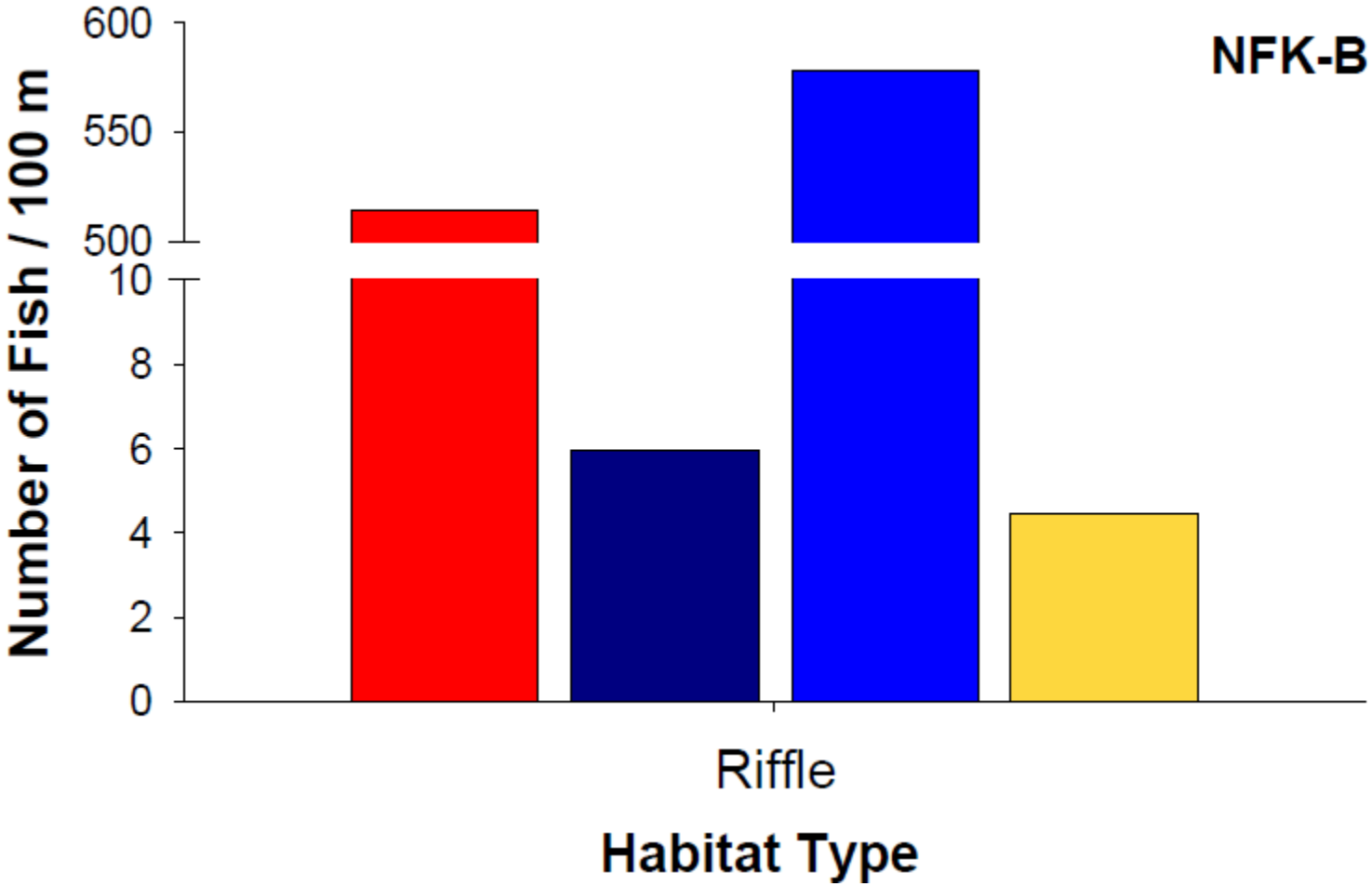
NFK Relative Fish Abundance 2004 – 2008



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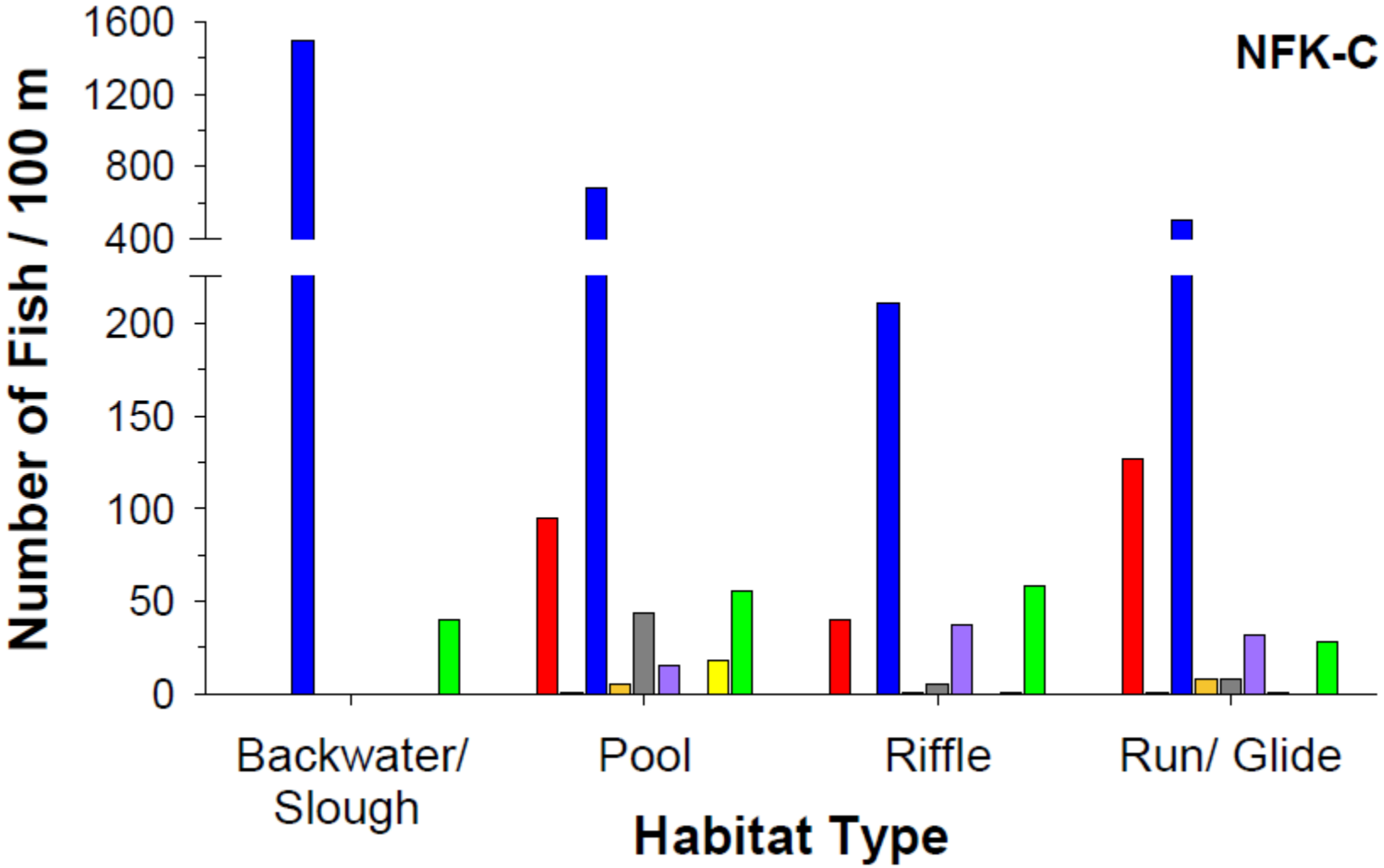
NFK Relative Fish Abundance 2004 – 2008



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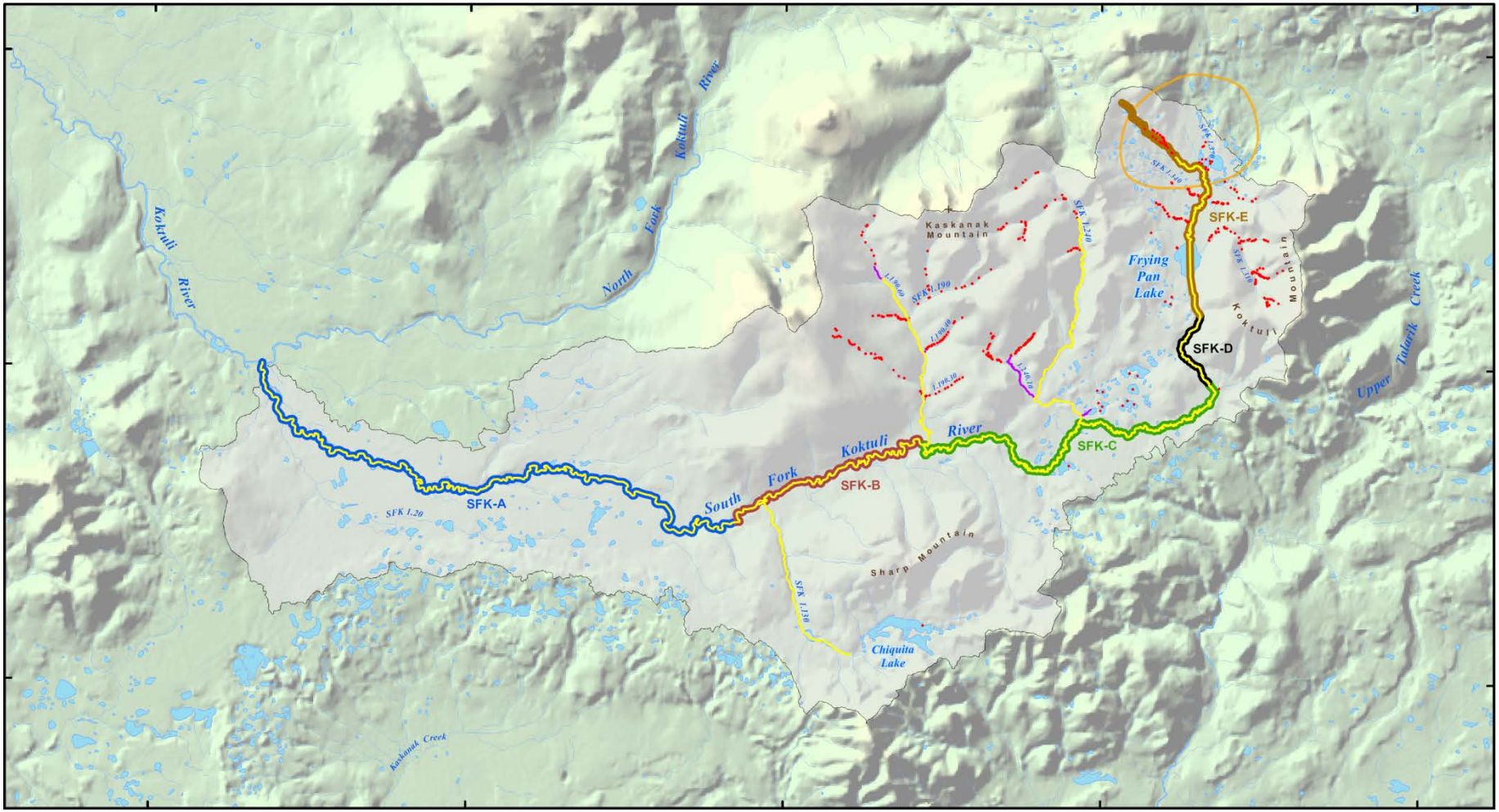
Anadromous Fish Distribution in SFK



Legend

Anadromous Fish Distribution*

- R2 Anadromous Water Catalog Nominations (2004-2008 Data)
- ADF&G Anadromous Water Catalog Stream (2009)
- Sites With No Anadromous Fish Present (2004-2008 Data)

SFK-A Mainstem Reach Example

SFK 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

* Species include Chinook, chum, coho, and sockeye salmon.

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SFK Fish Species

- 14 species
- Greatest abundances in SFK-B
- Anadromous vs resident dominance changes above intermittent reach
- Coho salmon, arctic grayling, Dolly Varden, & sculpin throughout

Common Name	SFK-A	SFK-B	SFK-C	SFK-D	SFK-E
Chinook salmon	X	X	X	X	
Chum salmon	X	X	X		
coho salmon	X	X	X	X	X
sockeye salmon	X	X	X		X
Arctic grayling	X	X	X	X	X
Dolly Varden	X	X	X	X	X
rainbow trout	X	X			X
whitefish	X	X	X		
sculpin	X	X	X	X	X
northern pike		X	X	X	X
ninespine stickleback	X	X	X		X
threespine stickleback	X	X			X
burbot		X	X		
lamprey	X	X			

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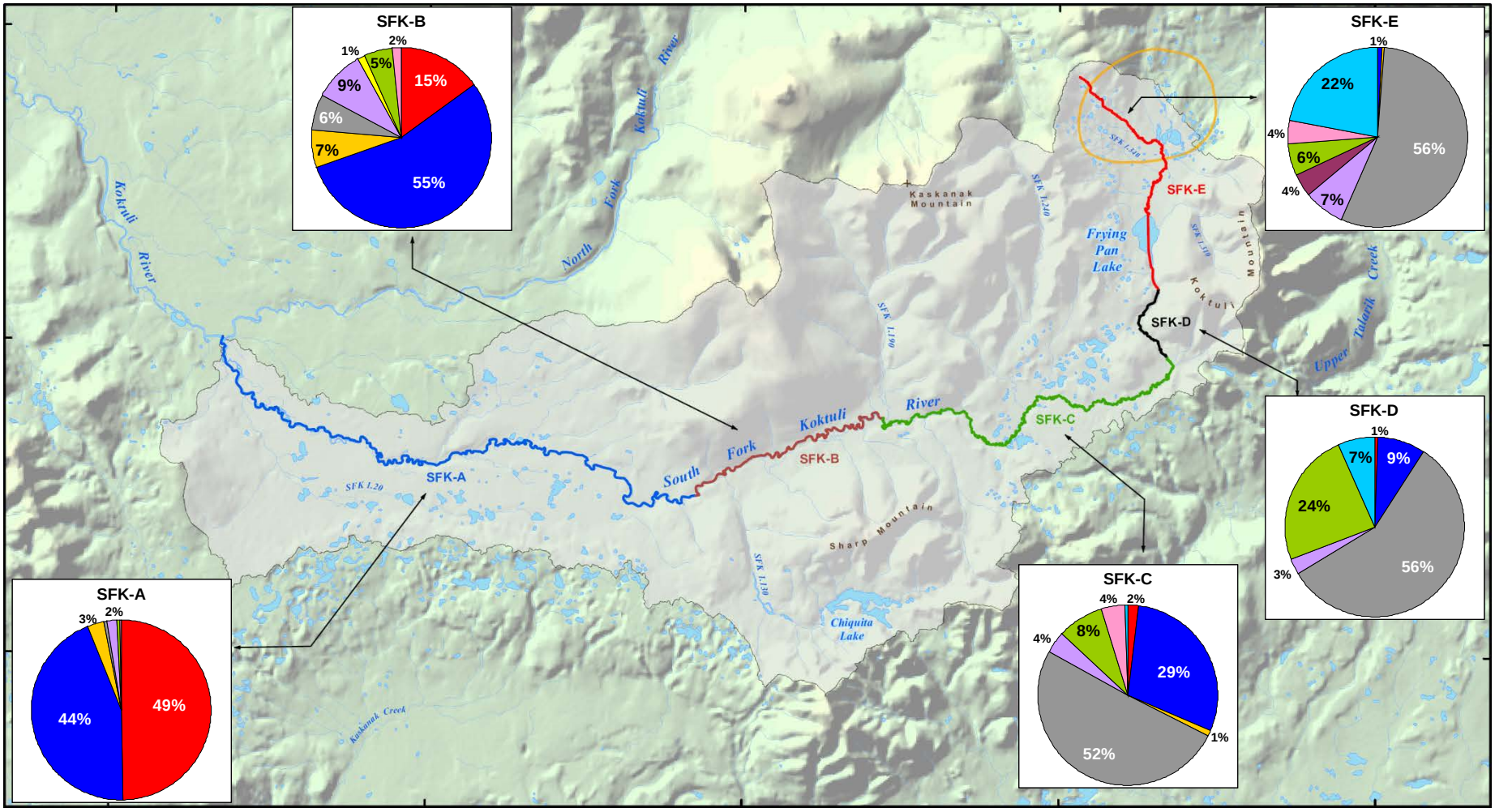
Fish Species Composition in SFK



Legend

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Sockeye Salmon
- Arctic Grayling
- Dolly Varden
- Rainbow Trout
- Whitefish
- Sculpin
- Stickleback
- Northern Pike
- Other Species
- SFK-A Mainstem Reach Example
- SFK 1.190 Tributary Name Example
- Watershed Boundary
- General Deposit Location

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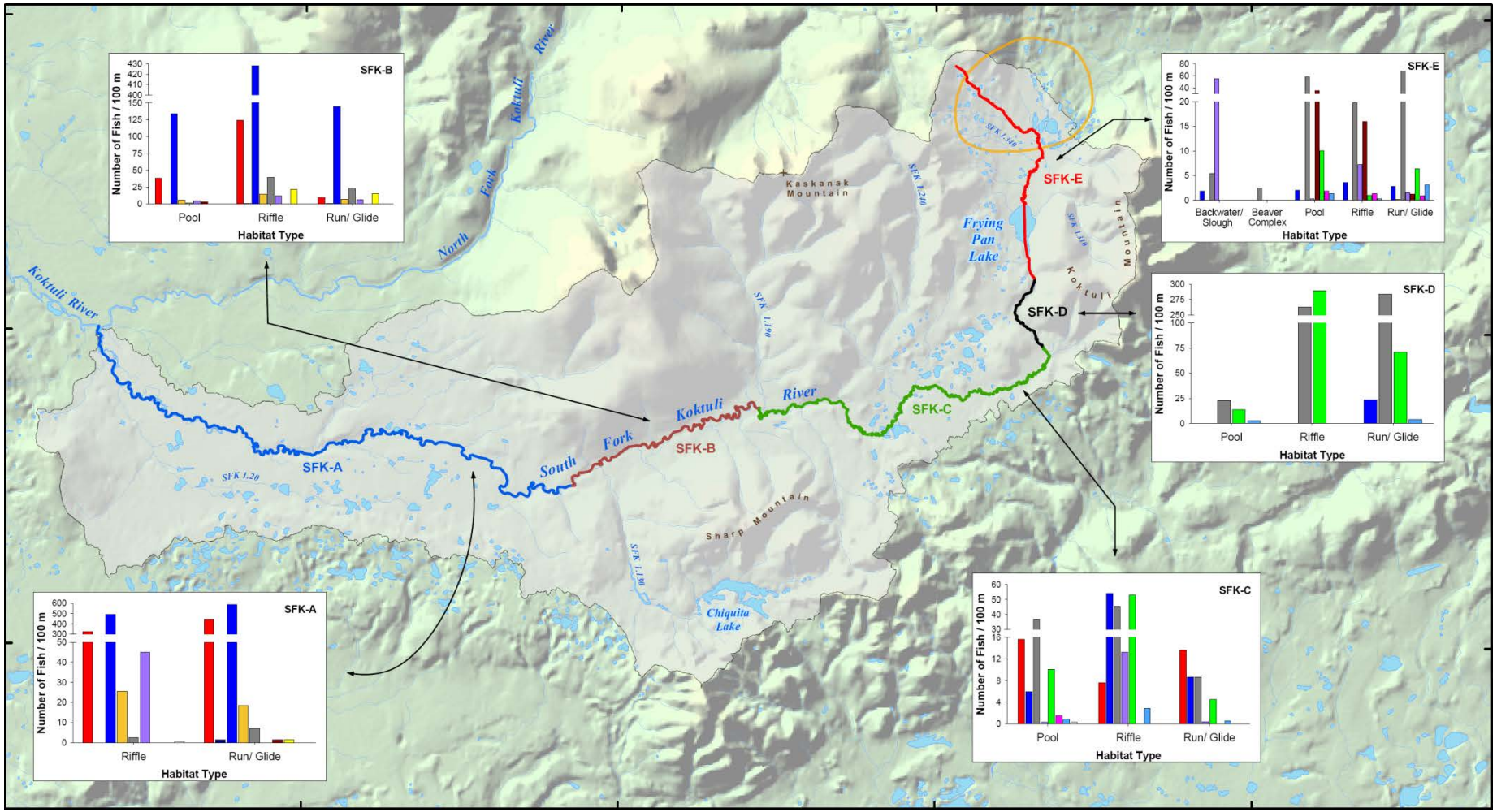
SFK Relative Fish Abundance 2004 – 2008



Legend

Chinook Salmon	Arctic Grayling	Sculpin	SFK-A	Mainstem Reach Example
Chum Salmon	Dolly Varden	Stickleback	SFK 1.190	Tributary Name Example
Coho Salmon	Rainbow Trout	Northern Pike		Watershed Boundary
Sockeye Salmon	Whitefish	Other Species		General Deposit Location

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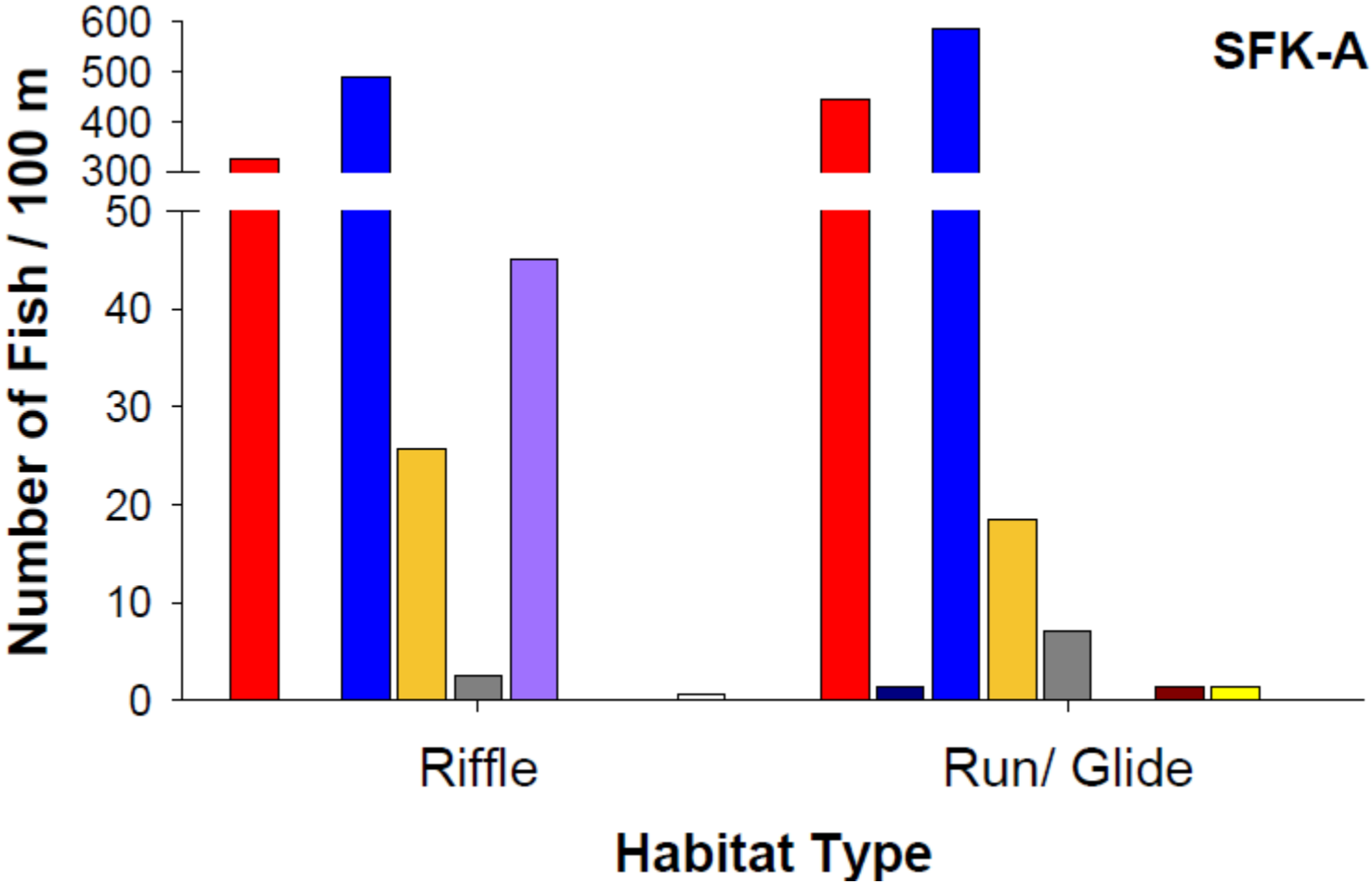
SFK Relative Fish Abundance 2004 – 2008



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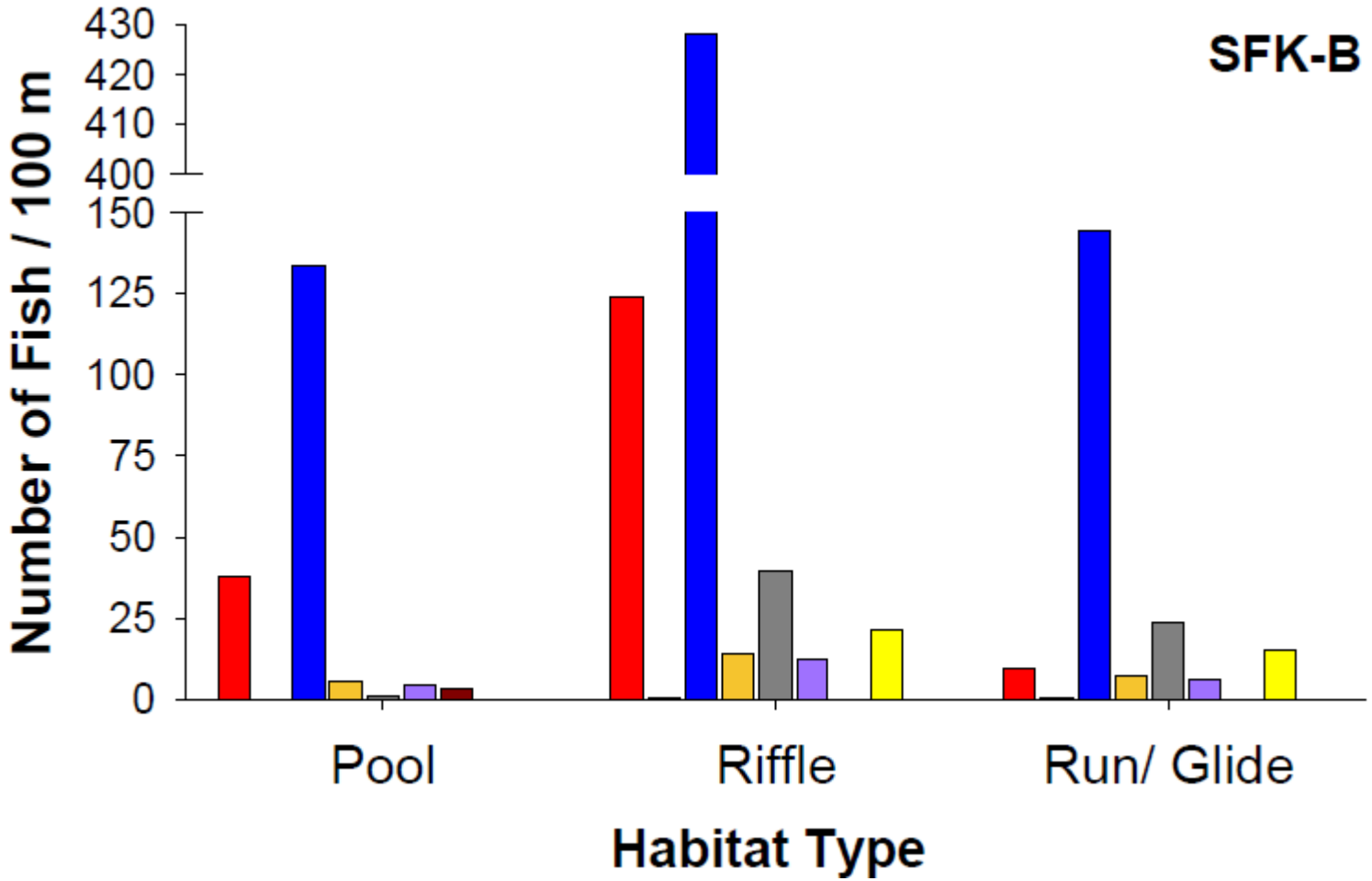

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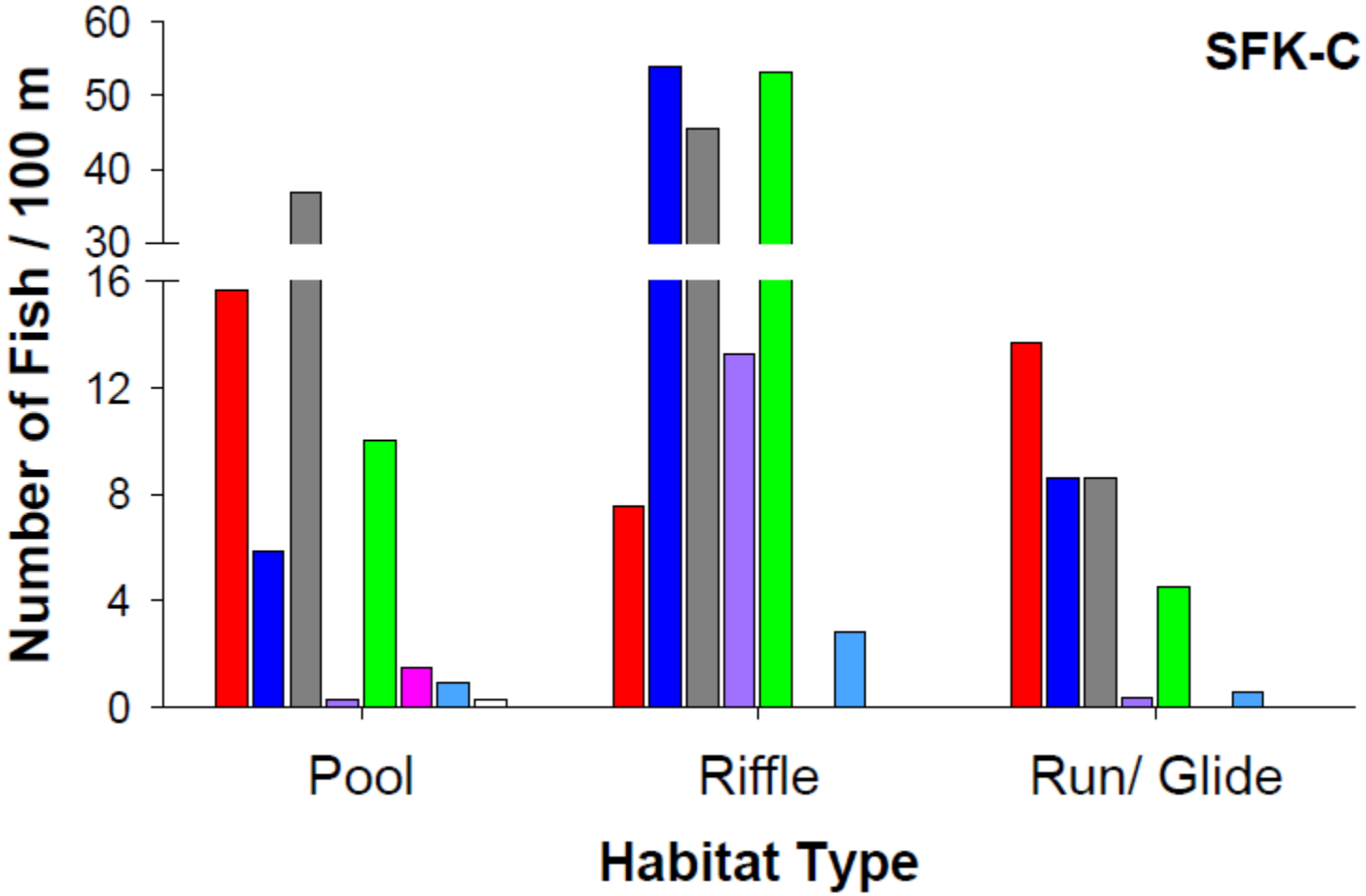

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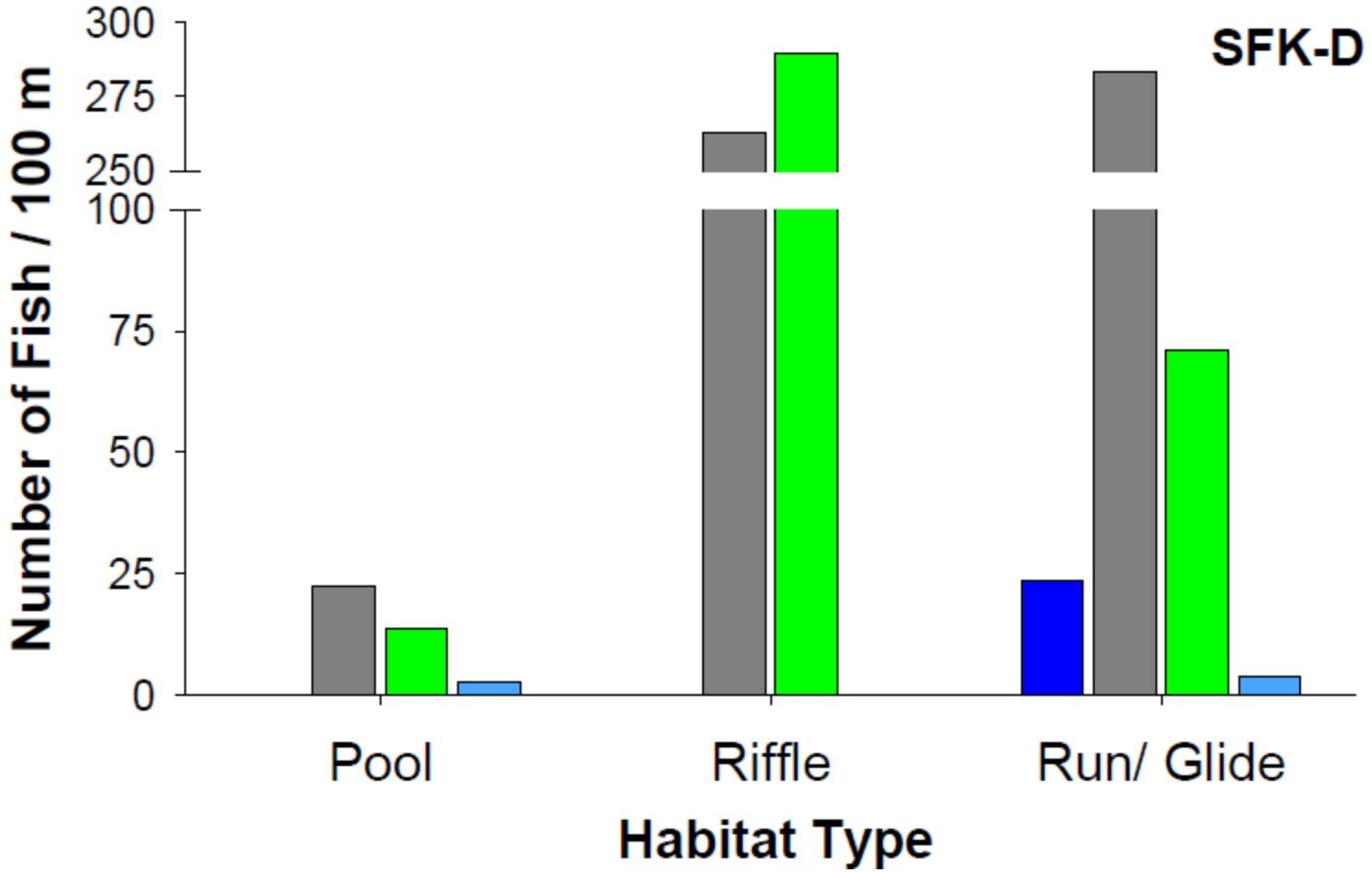
SFK Relative Fish Abundance 2004 – 2008



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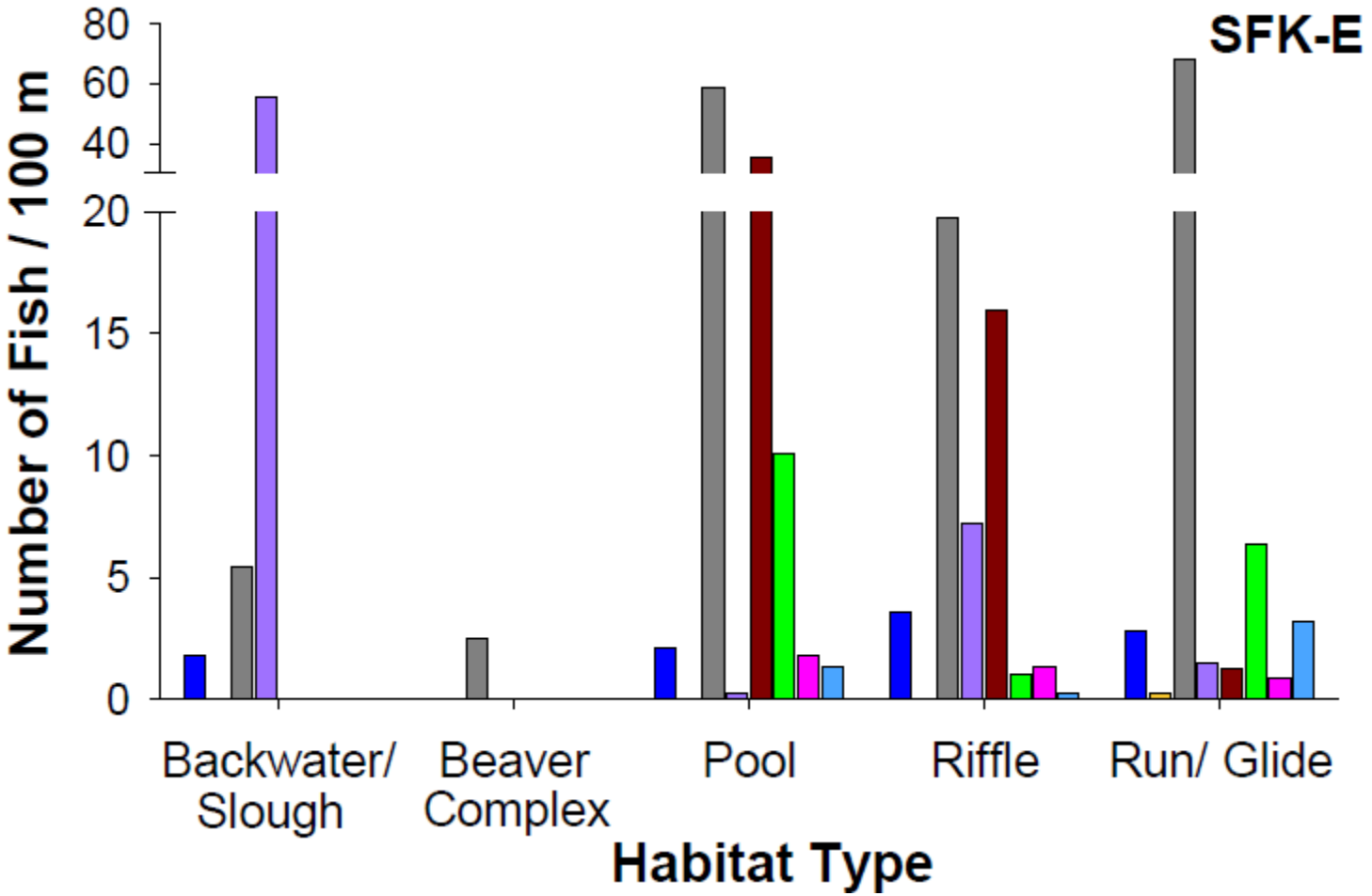
SFK Relative Fish Abundance 2004 – 2008



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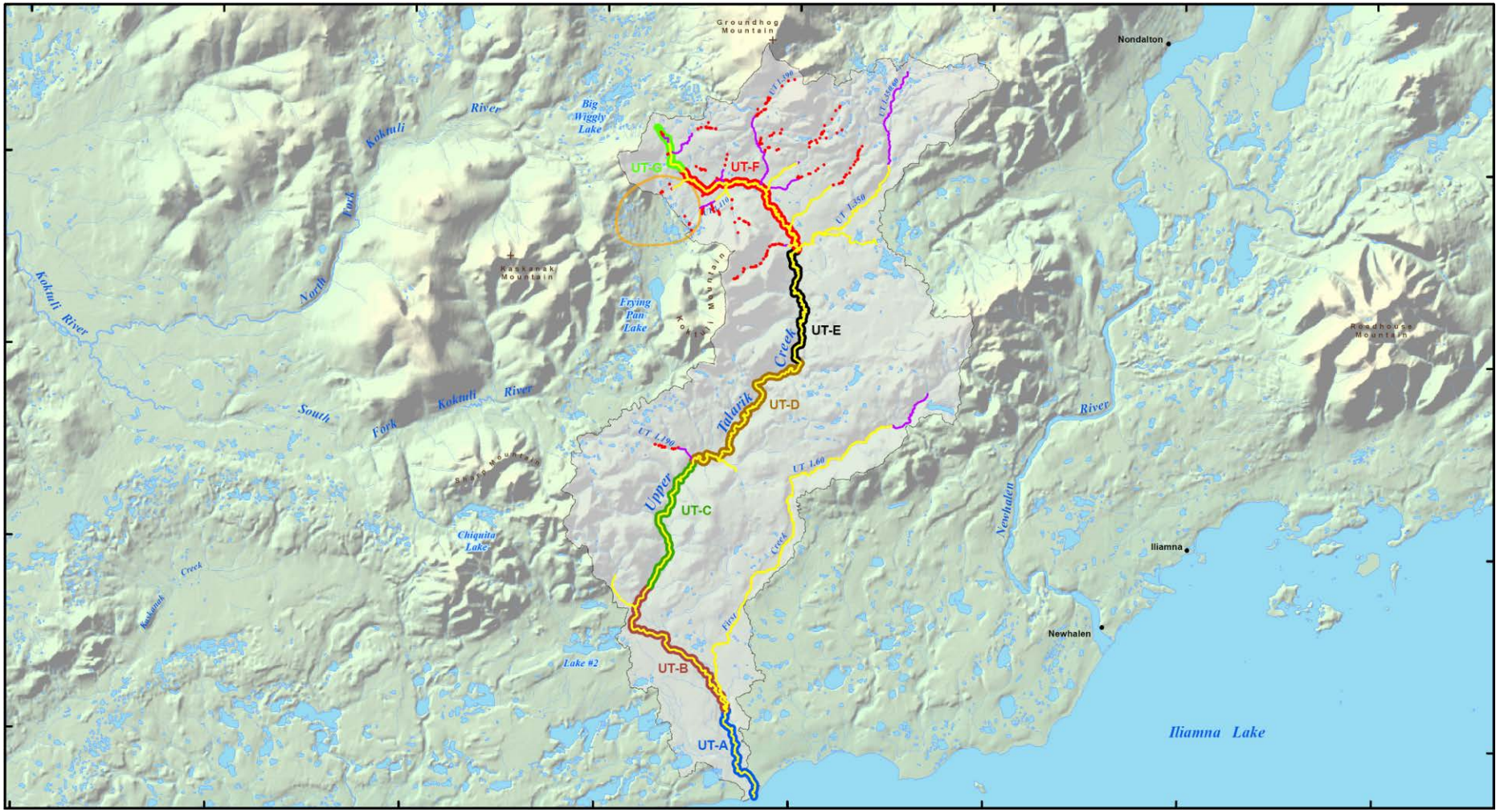
Anadromous Fish Distribution in UT



Legend

Anadromous Fish Distribution*

- R2 Anadromous Water Catalog Nominations (2004-2008 Data)
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- Sites With No Anadromous Fish Present (2004-2008 Data)

UT-A Mainstem Reach Example

UT 1.190 Tributary Name Example

Watershed Boundary

General Deposit Location

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* Species include Chinook, chum, coho, and sockeye salmon.

UT Fish Species

- 13 species
- Greatest abundances in middle reaches
- Community structure relatively consistent, until UT-G

Common Name	UT-A	UT-B	UT-C	UT-D	UT-E	UT-F	UT-G
Chinook salmon	X	X	X	X	X	X	
chum salmon	X	X	X	X	X	X	
coho salmon	X	X	X	X	X	X	X
sockeye salmon	X	X	X	X	X	X	
pink salmon	ND	ND	ND	ND	ND	ND	ND
Arctic grayling	X	X	X	X	X	X	X
Dolly Varden		X	X	X	X	X	X
rainbow trout	X	X	X	X	X	X	
whitefish	X		X	X			
sculpin	X	X	X	X	X	X	X
ninespine stickleback			X	X	X	X	
threespine stickleback			X	X	X		
stickleback	X	X	X	X	X	X	

ND = specific location not determined

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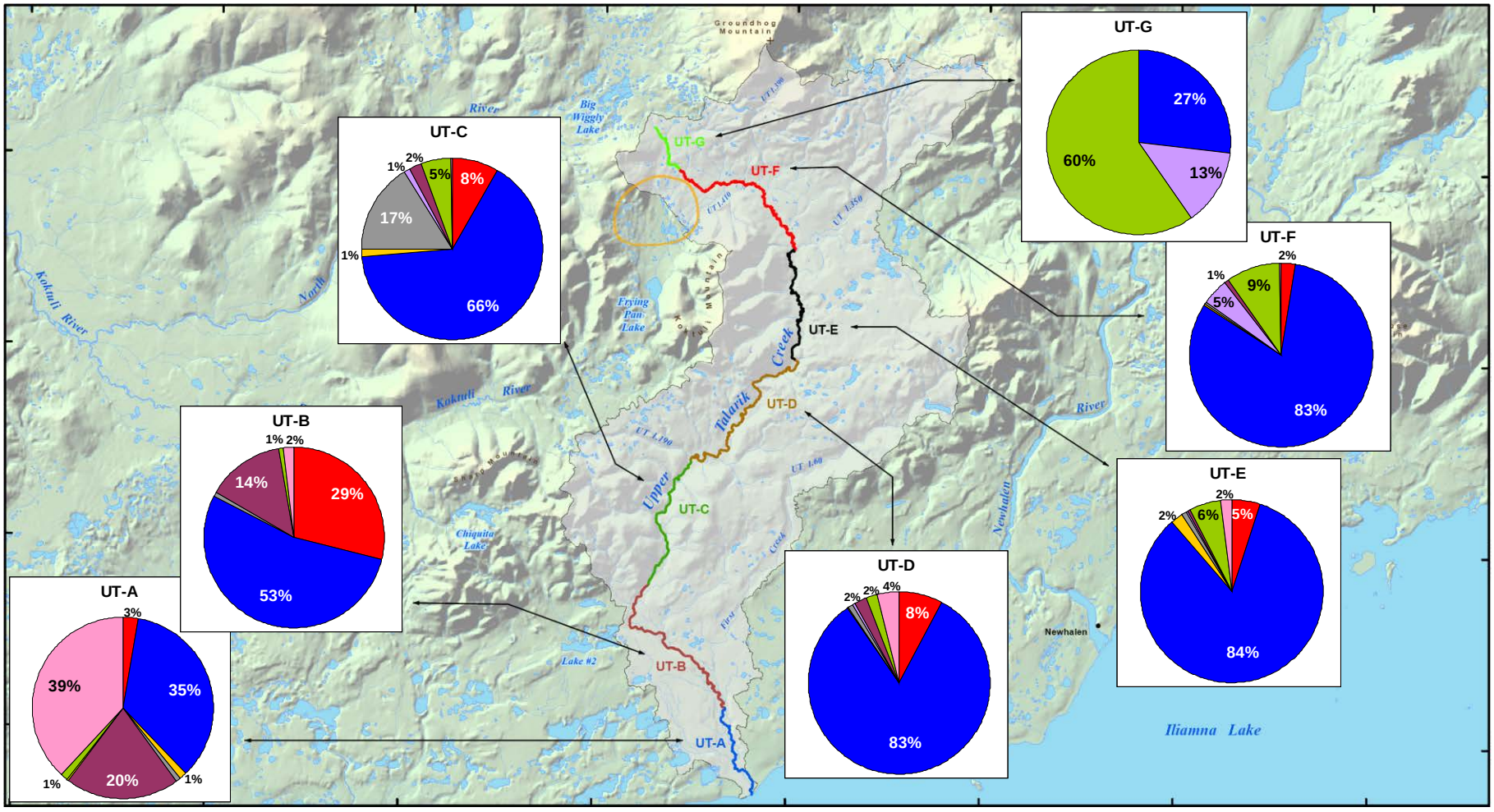
Fish Species Composition in UT



Legend

Chinook Salmon	Arctic Grayling	Sculpin	UT-A Mainstem Reach Example
Chum Salmon	Dolly Varden	Stickleback	UT 1.190 Tributary Name Example
Coho Salmon	Rainbow Trout	Northern Pike	Watershed Boundary
Sockeye Salmon	Whitefish	Other Species	General Deposit Location

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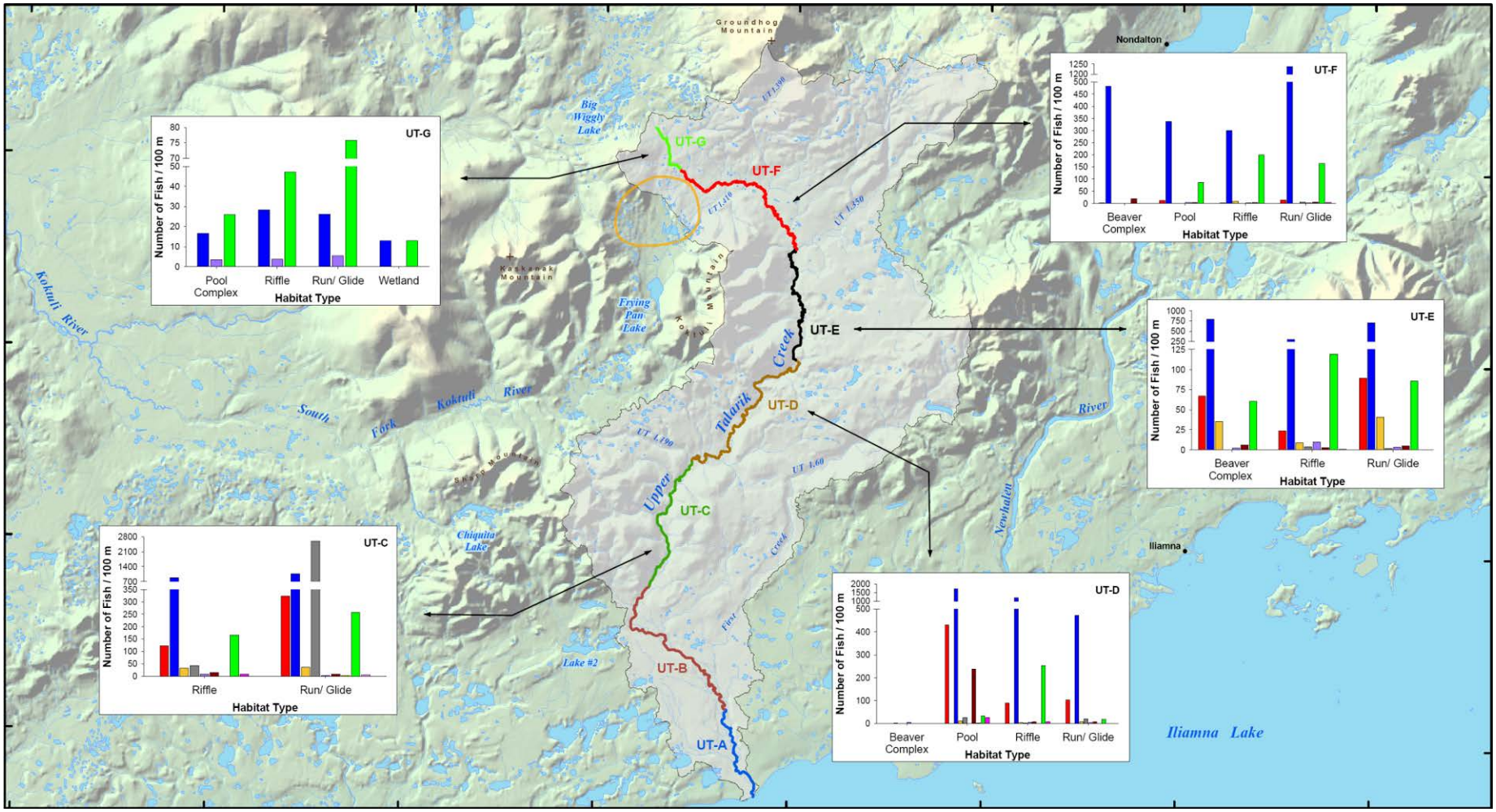
UT Relative Fish Abundance 2004 – 2008



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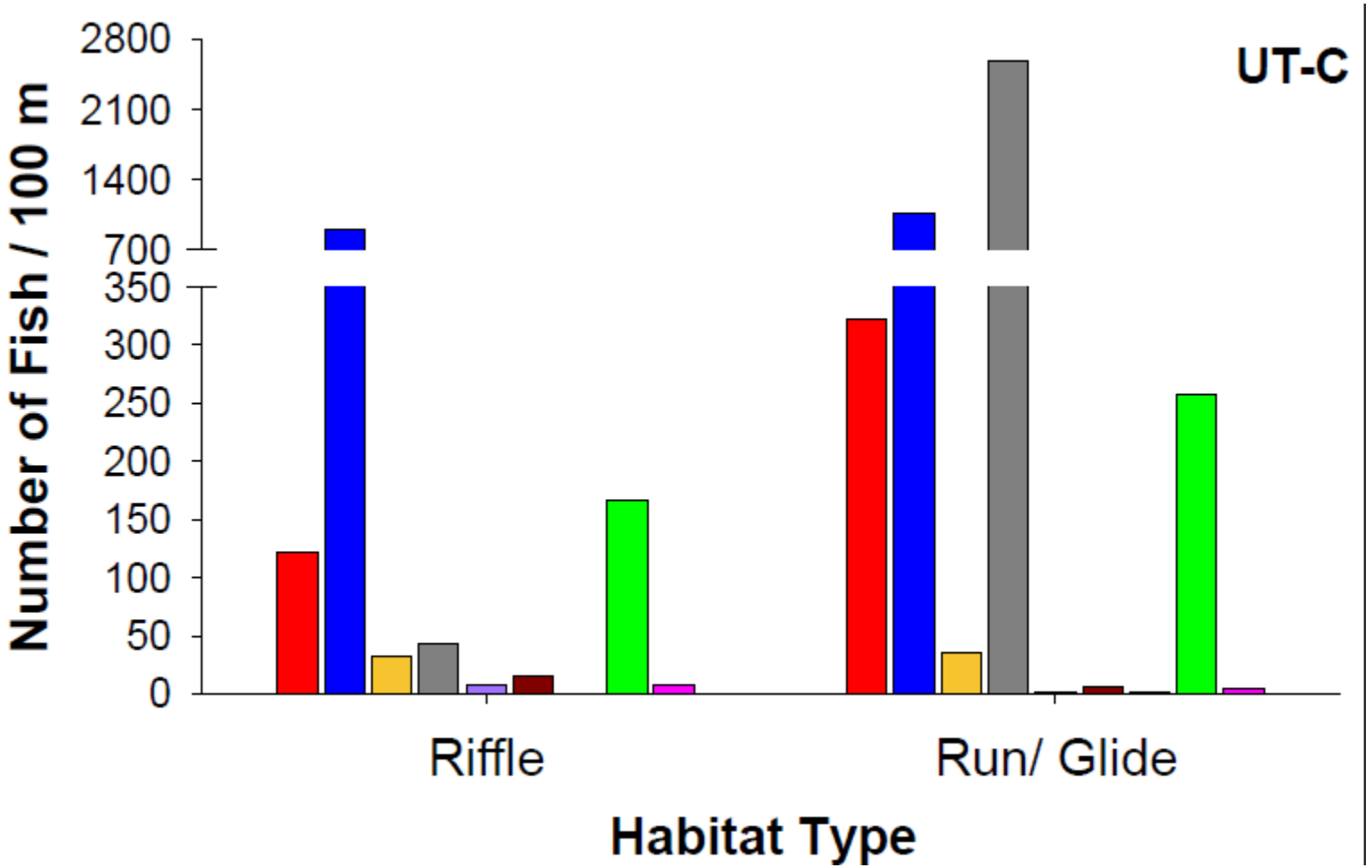
UT Relative Fish Abundance 2004 – 2008



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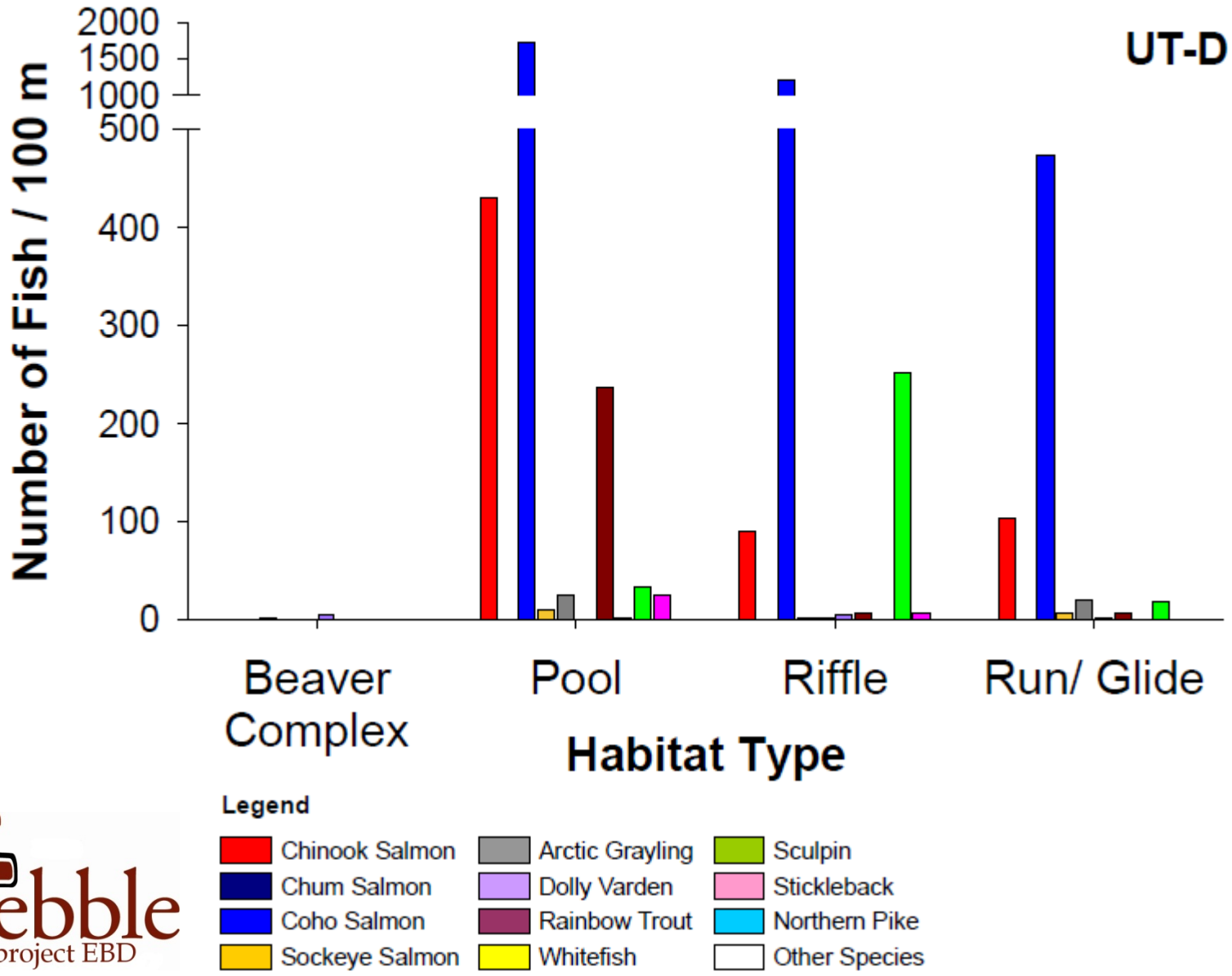
UT Relative Fish Abundance 2004 – 2008



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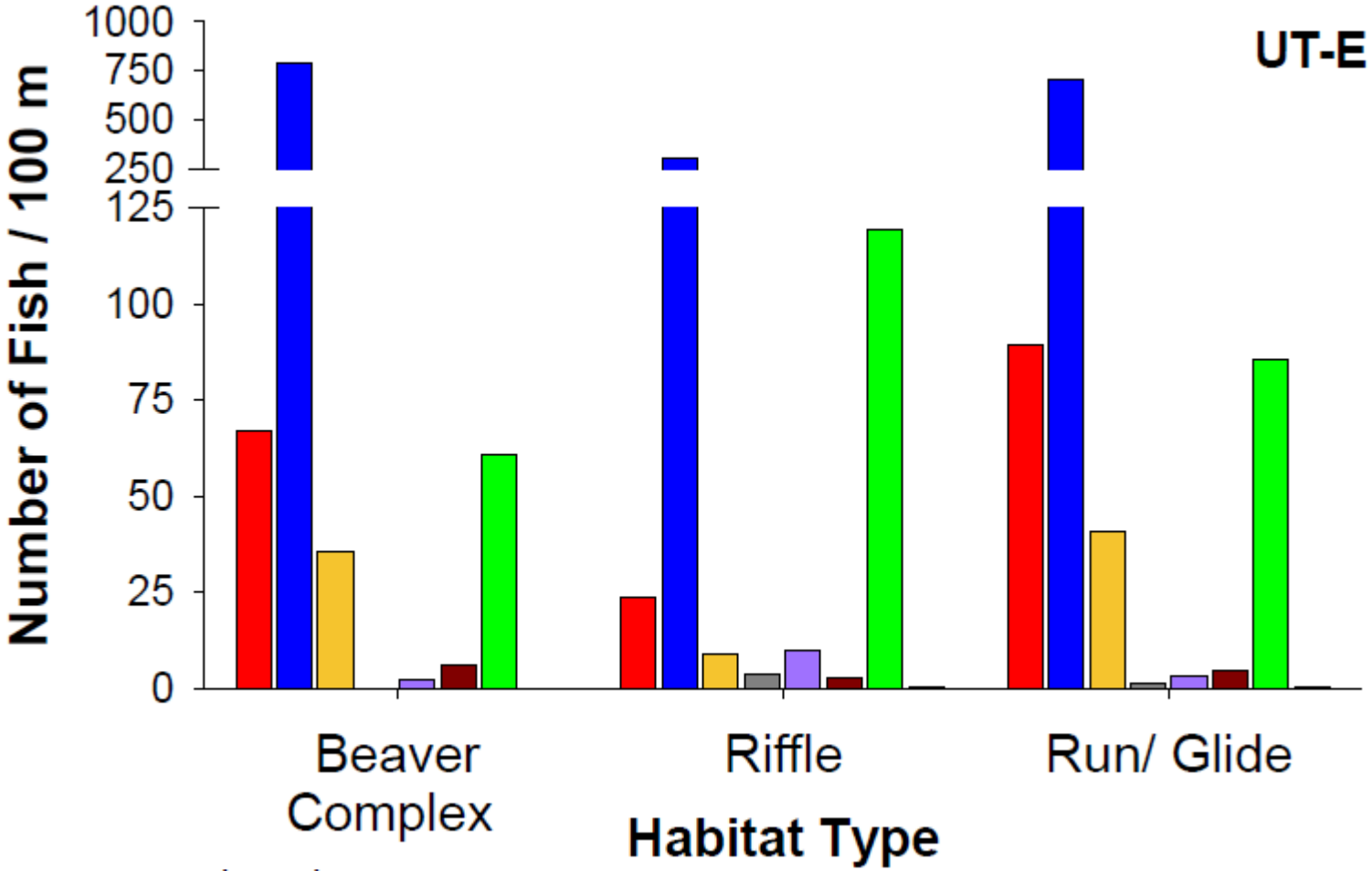
UT Relative Fish Abundance 2004 – 2008



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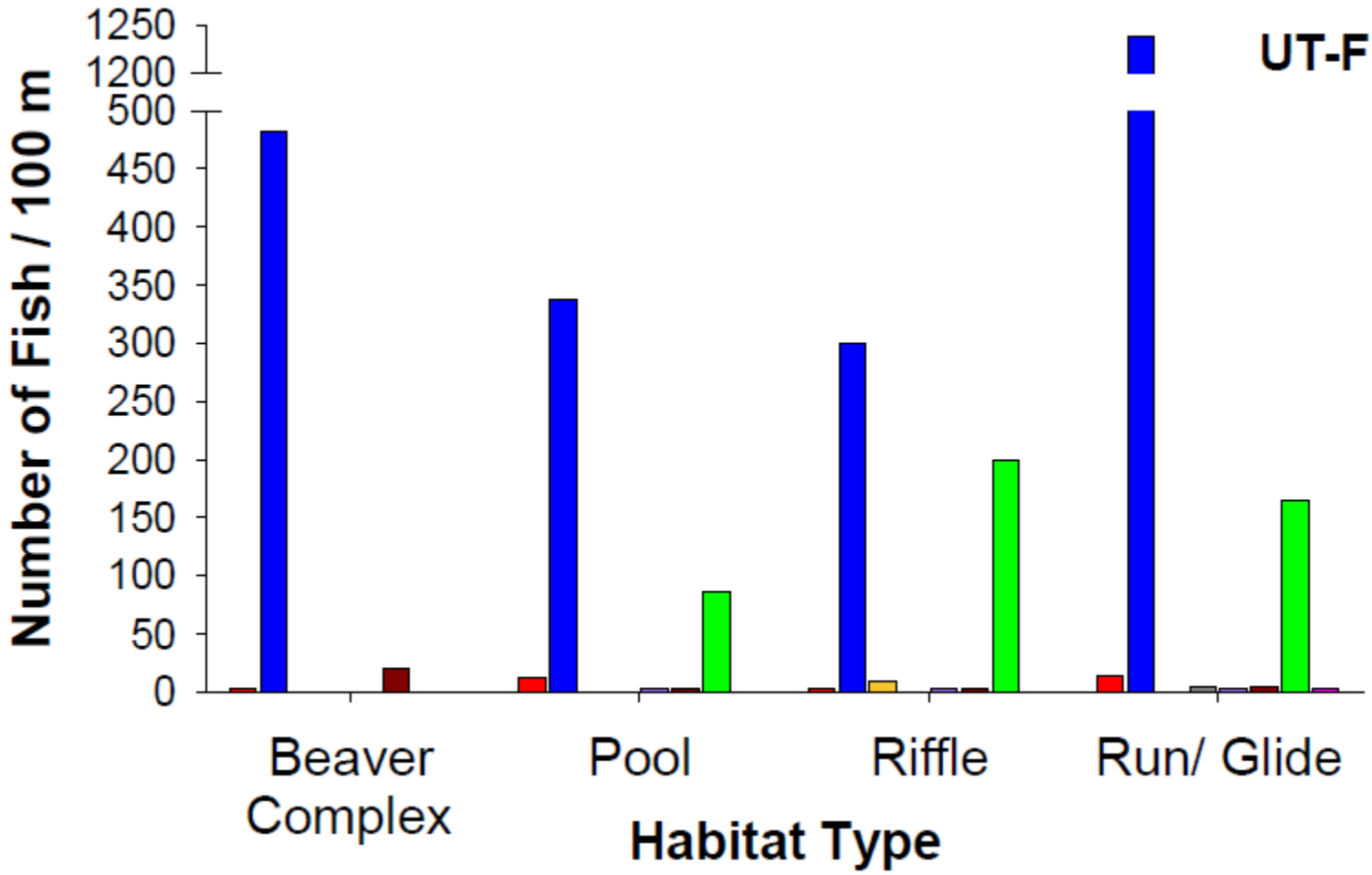
UT Relative Fish Abundance 2004 – 2008



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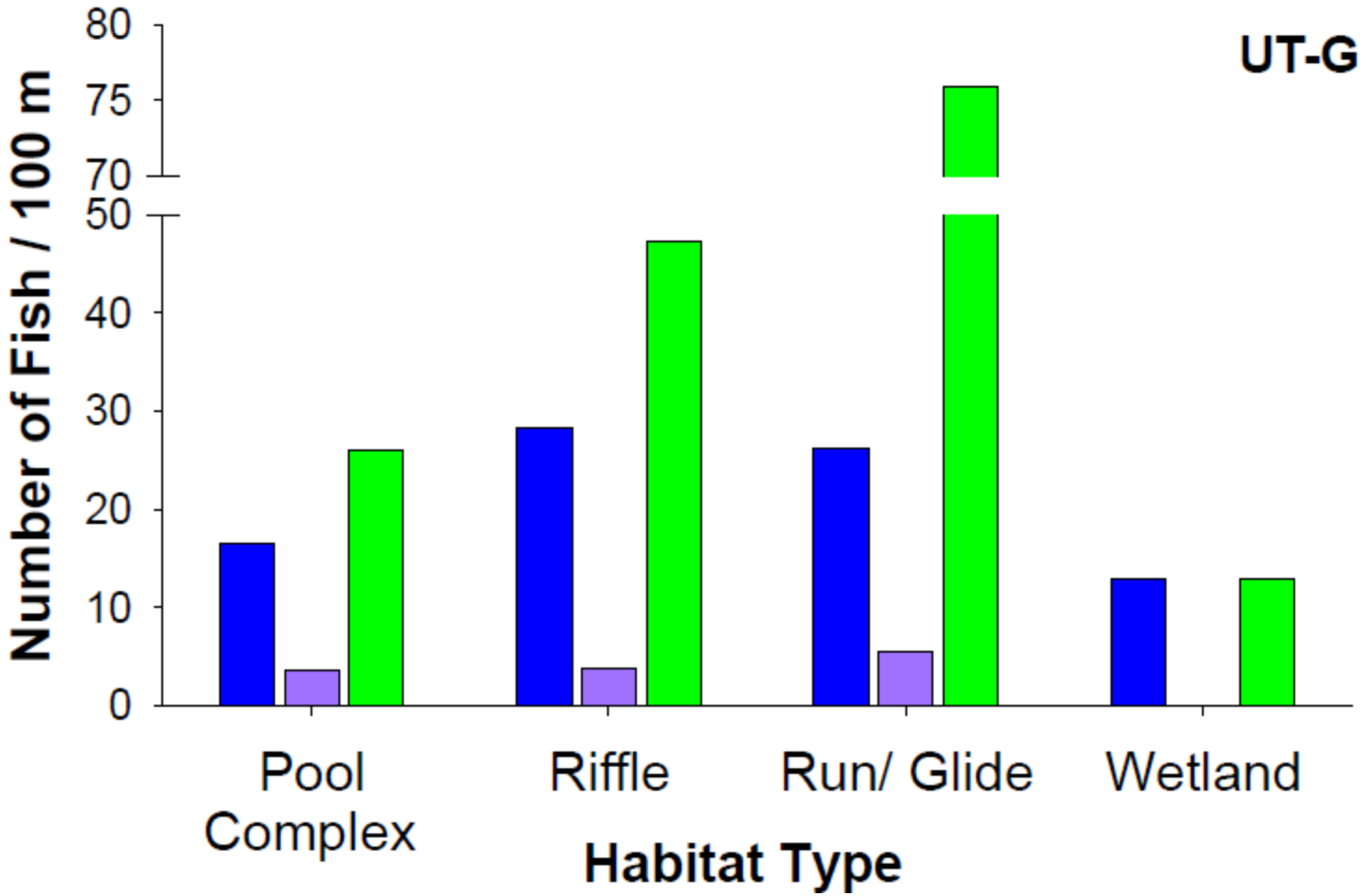
UT Relative Fish Abundance 2004 – 2008



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Fish Species Found in the Upper Koktuli River Mainstem

Common Name
Chinook salmon
chum salmon
coho salmon
sockeye salmon
arctic grayling
Dolly Varden
rainbow trout
whitefish
sculpin
stickleback

- 10+ species, all of which were also found in the NFK &/or SFK
- KR serves as a migratory corridor

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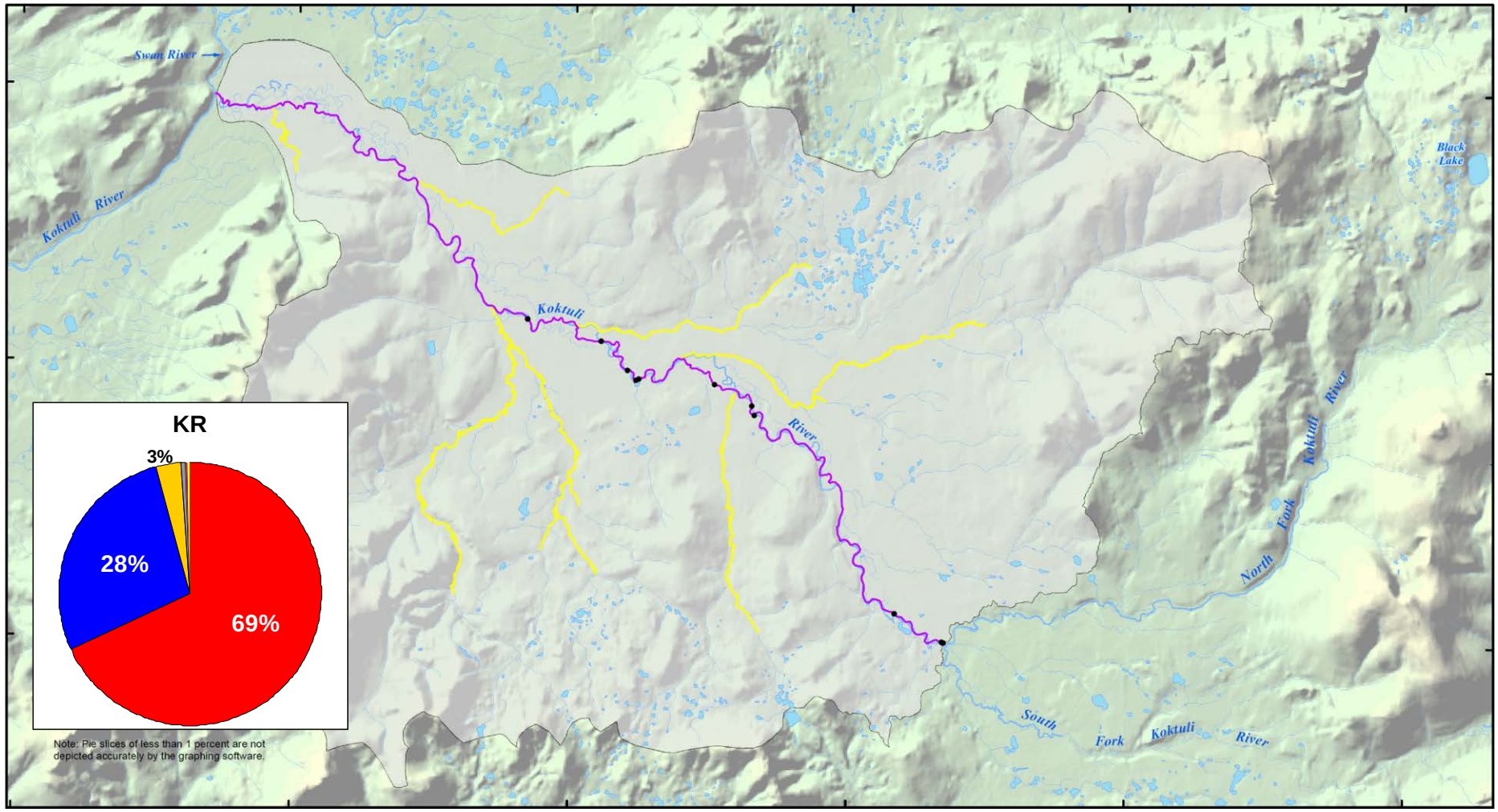
Fish Species Composition in the Upper Koktuli River Mainstem



Legend

Anadromous Fish Distribution*
- R2 Anadromous Water Catalog Nominations (2004-2008 Data)
- ADF&G Anadromous Water Catalog Stream (2009)
- Fish Sampling Sites
- Watershed Boundary

Fish Species Composition
- Chinook Salmon
- Coho Salmon
- Sockeye Salmon
- Arctic Grayling
- Dolly Varden
- Rainbow Trout
- Whitefish
- Sculpin
- Stickleback

* Species include Chinook, chum, coho, and sockeye salmon.

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Objective 6

Compare fish densities among habitat types

- Number of fish per 100 m^2

  -number of fish/ area surveyed for each species & habitat type
- Snorkeling & electrofishing
- Representative of freshwater rearing stages

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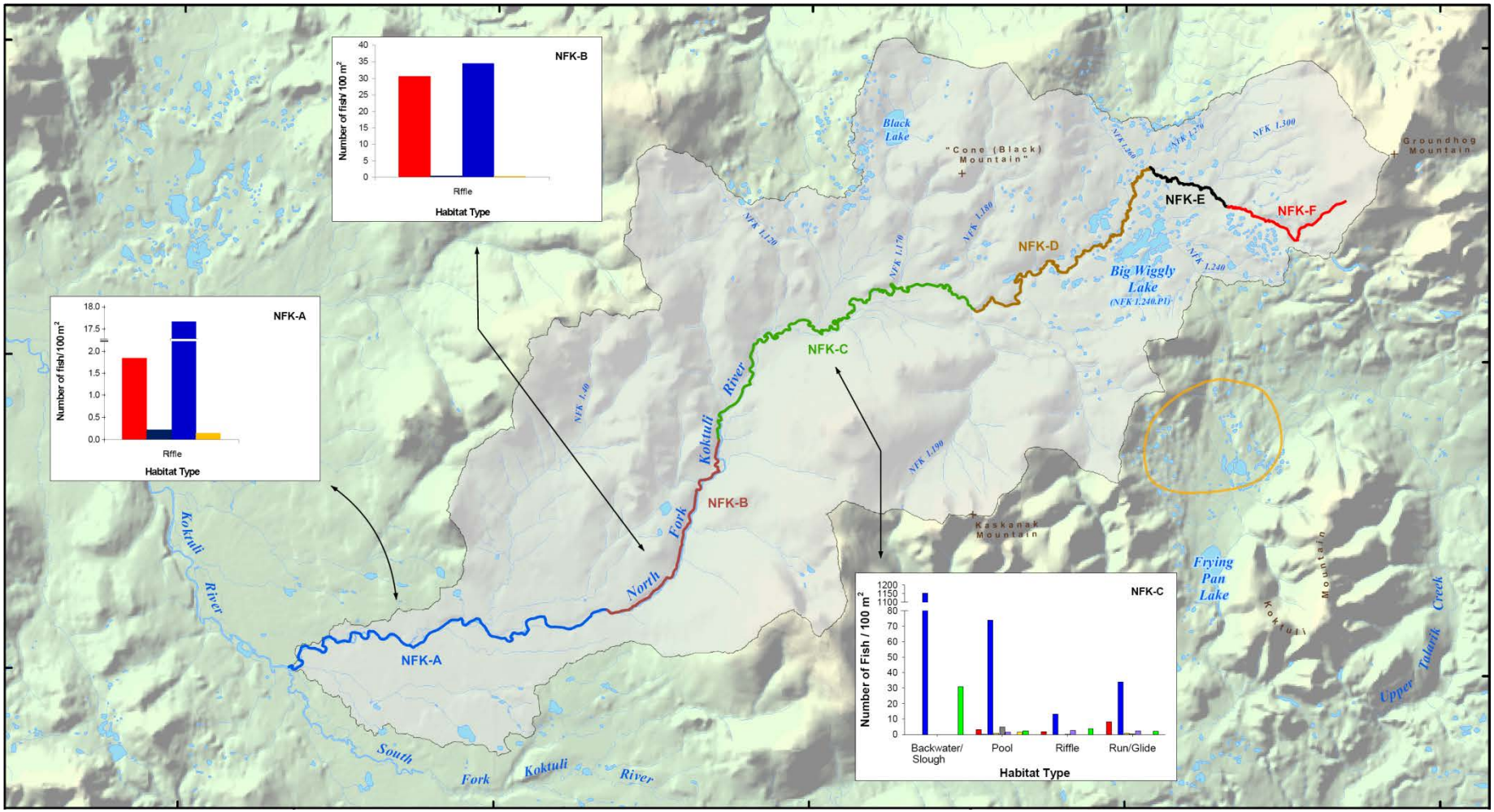
NFK Fish Density by Mainstem Habitat Type



Legend

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Sockeye Salmon
- Arctic Grayling
- Dolly Varden
- Rainbow Trout
- Whitefish
- Sculpin
- Stickleback
- Northern Pike
- Other Species
- NFK-A Mainstem Reach Example
- NFK 1.190 Tributary Name Example
- Watershed Boundary
- General Deposit Location

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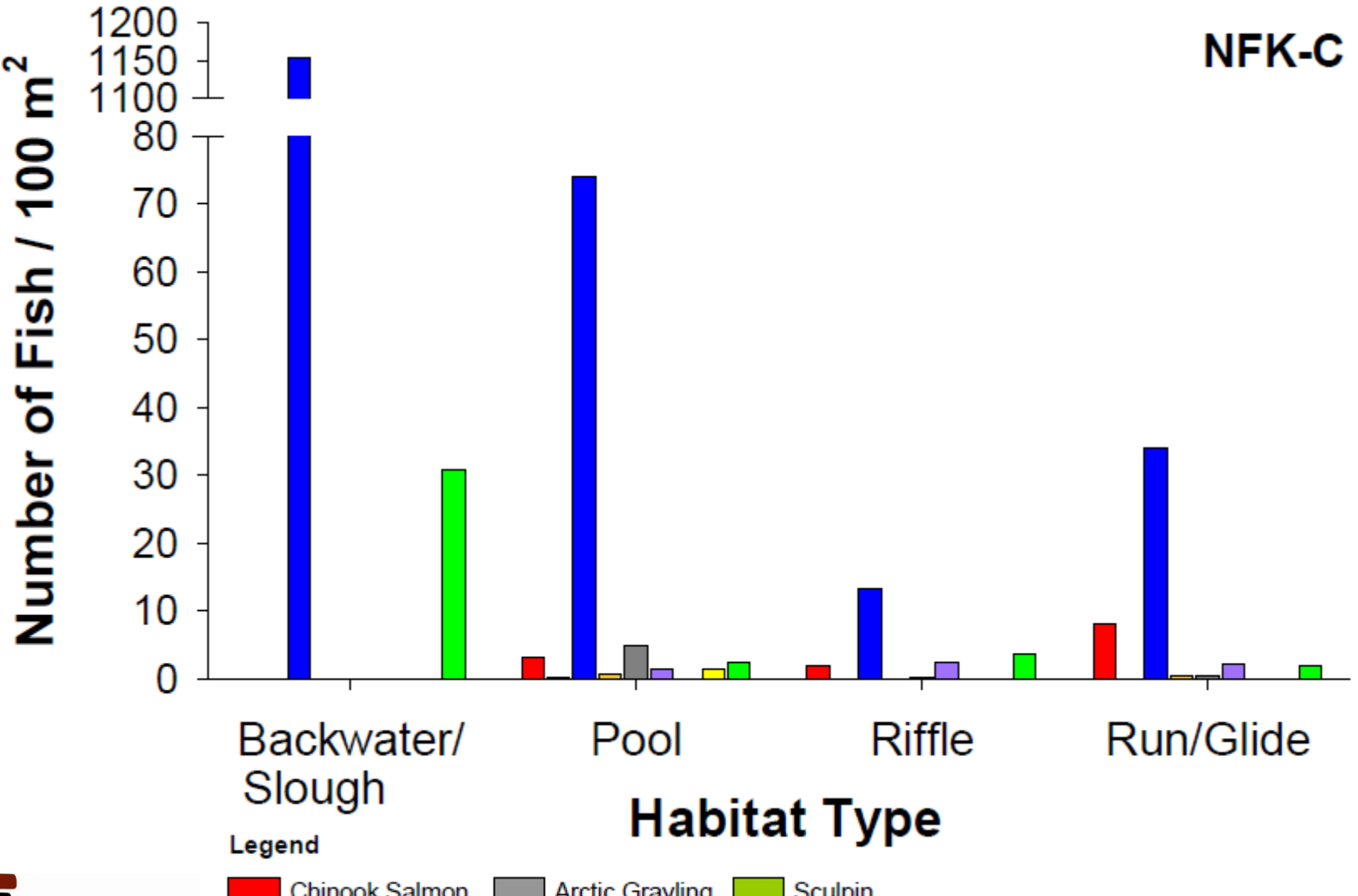
NFK Fish Density by Mainstem Habitat Type



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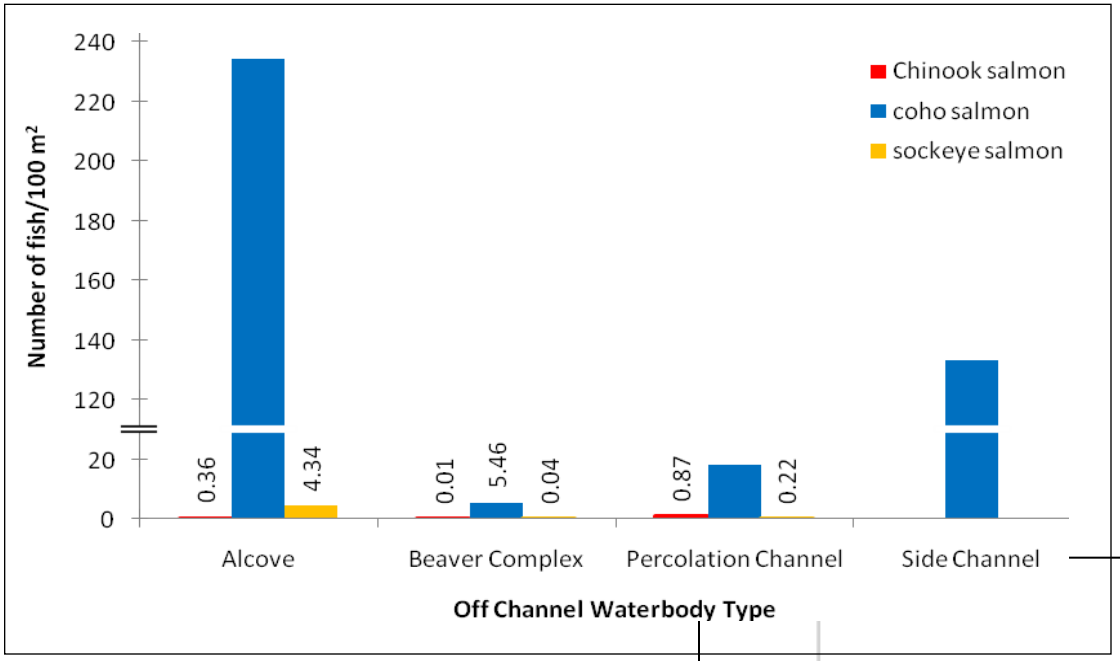
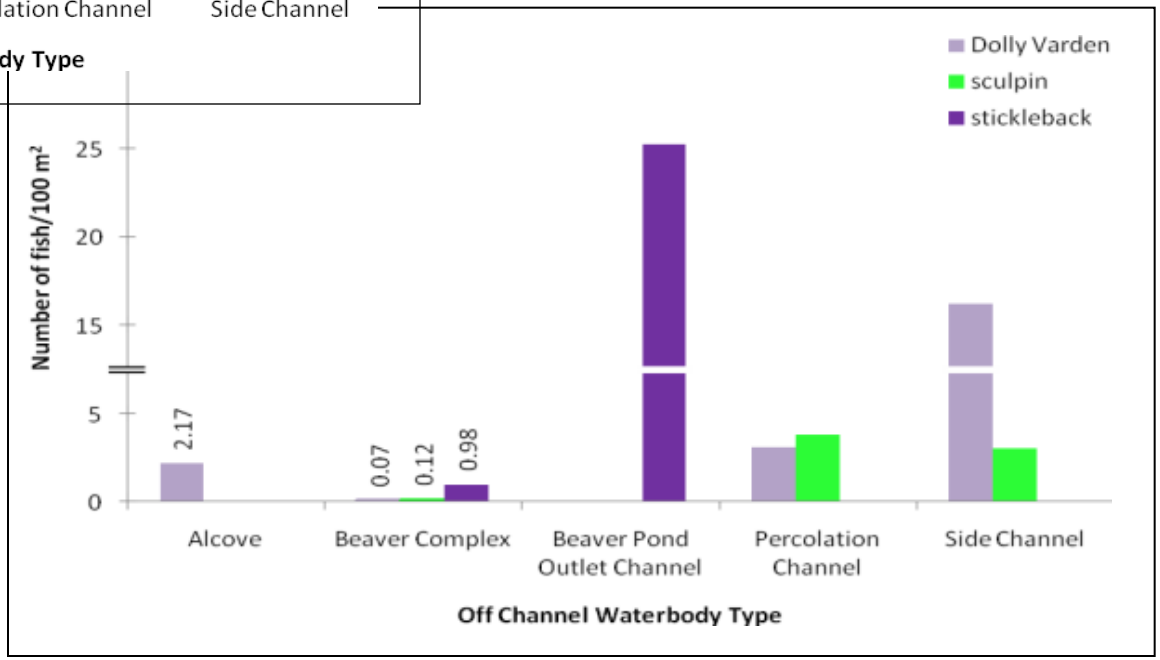
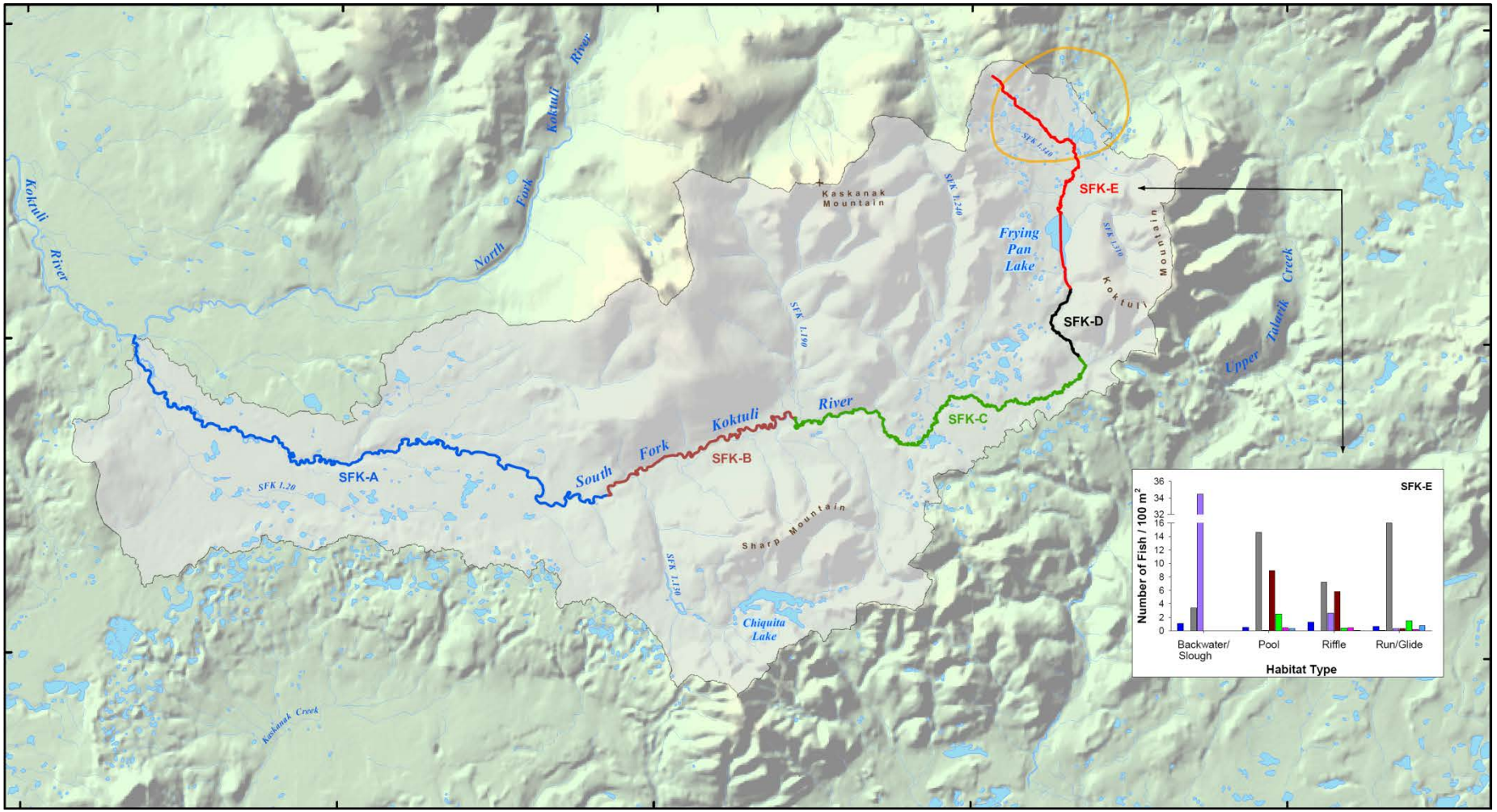
Fish Density in NFK Off-channel Habitat Types





SFK Fish Density by Mainstem Habitat Type



Legend

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Sockeye Salmon
- Arctic Grayling
- Dolly Varden
- Rainbow Trout
- Whitefish
- Sculpin
- Stickleback
- Northern Pike
- Other Species
- SFK-A Mainstem Reach Example
- SFK 1.190 Tributary Name Example
- Watershed Boundary
- General Deposit Location

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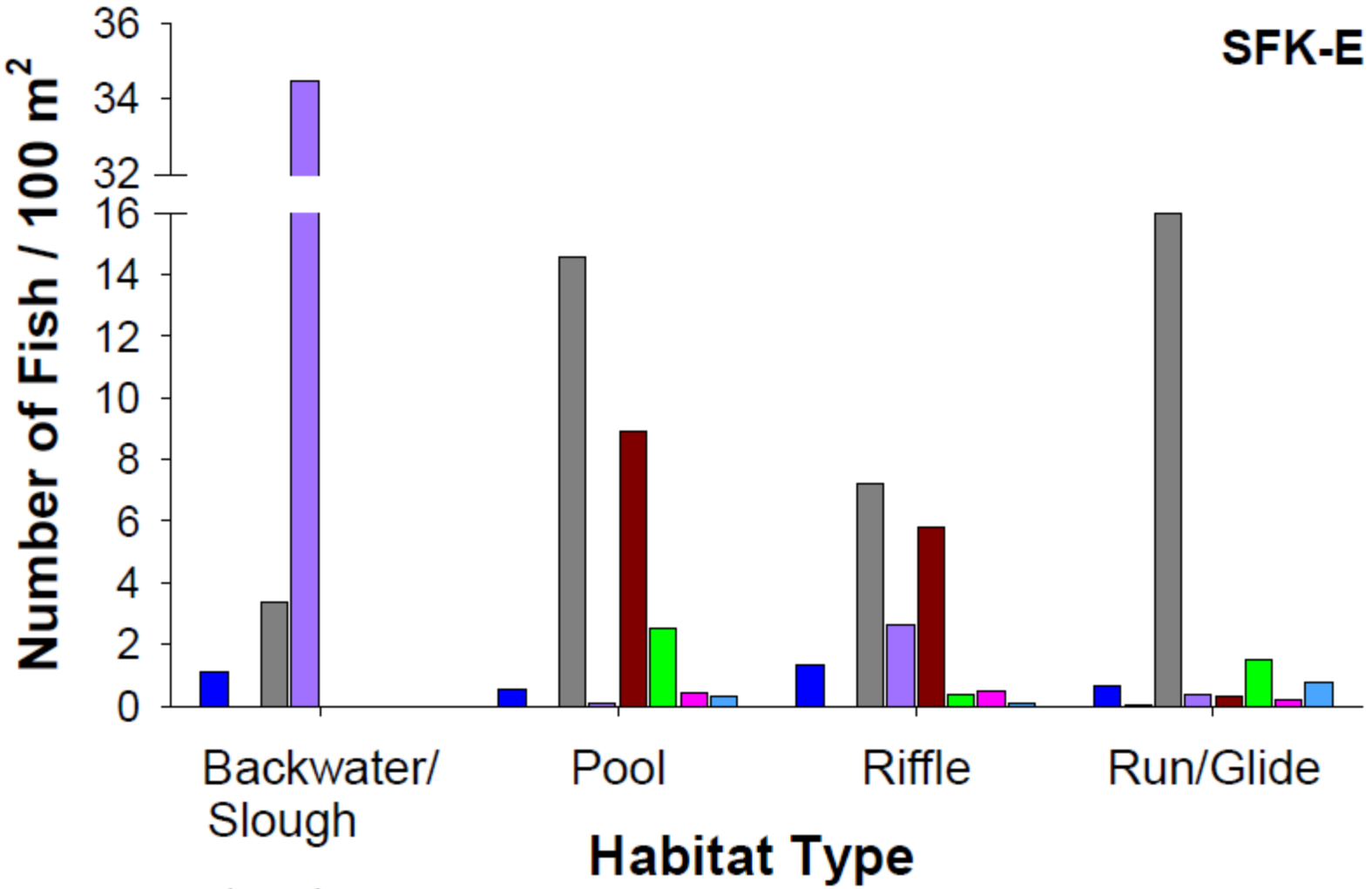
SFK Fish Density by Mainstem Habitat Type



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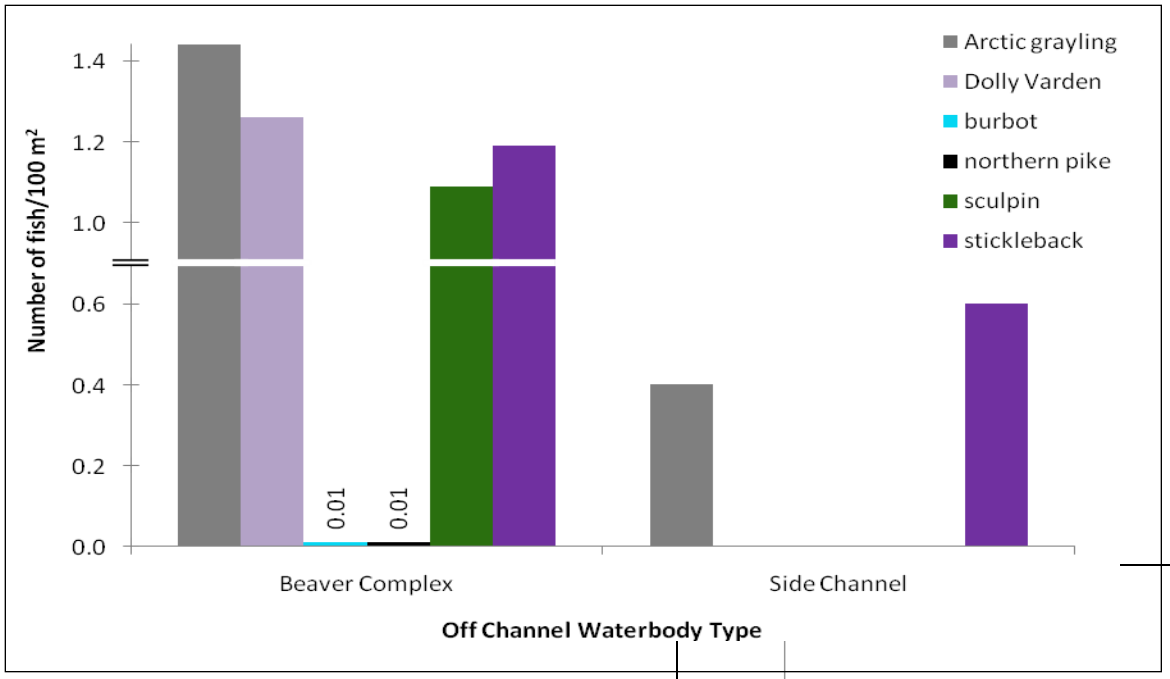
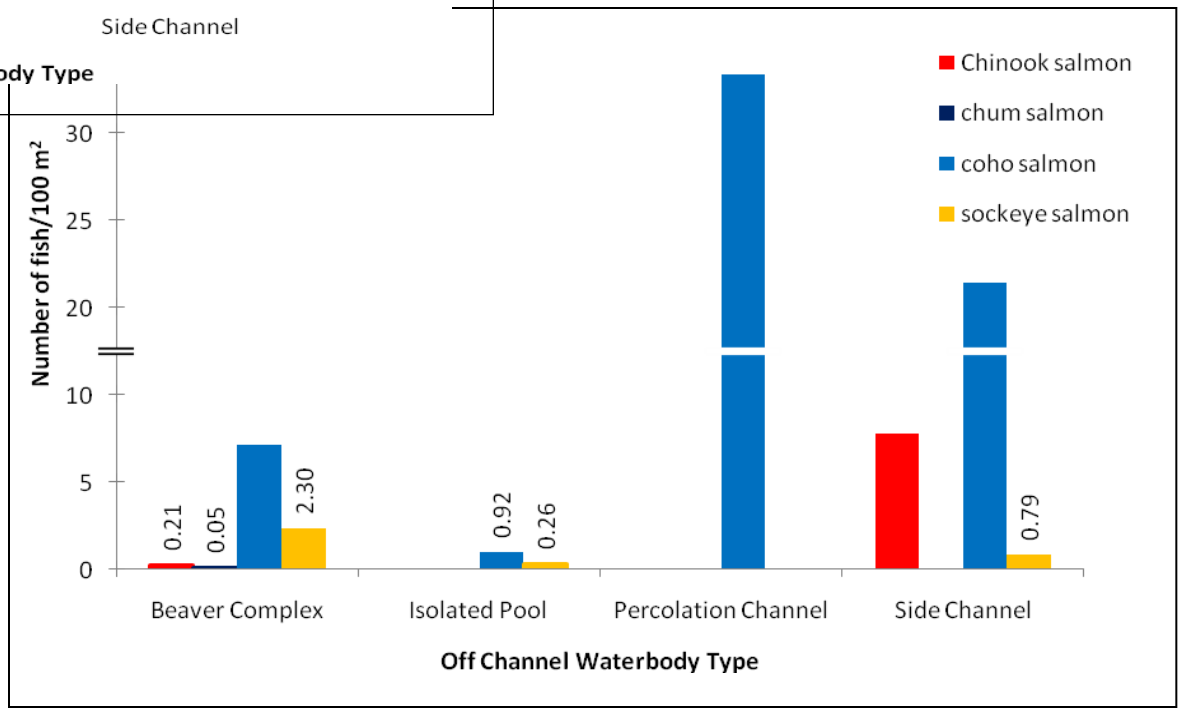
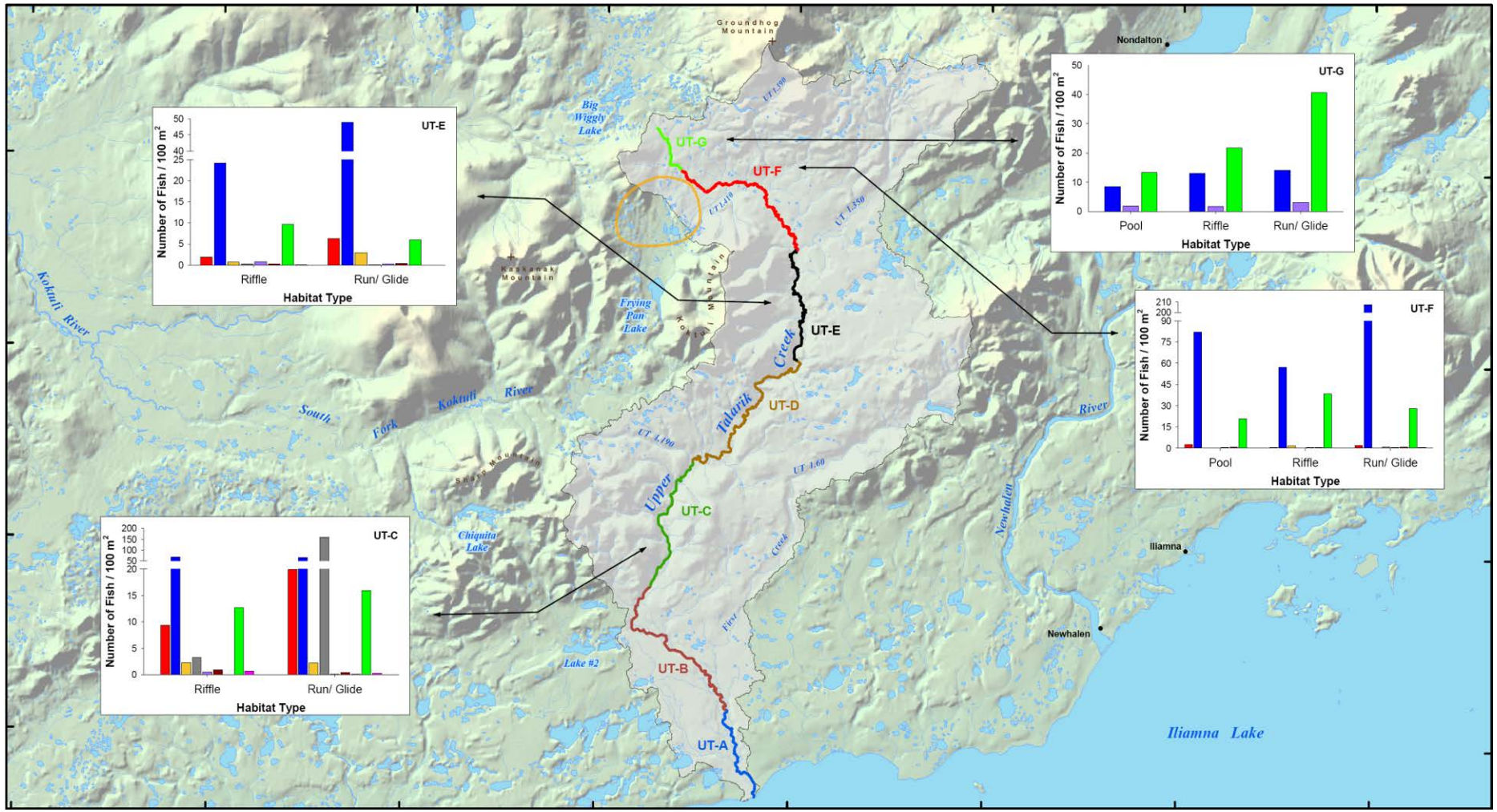
Fish Density in SFK Off-channel Habitat Types





UT Fish Density by Mainstem Habitat Type



Legend

Chinook Salmon	Arctic Grayling	Sculpin	UT-A	Mainstem Reach Example
Chum Salmon	Dolly Varden	Stickleback	UT 1.190	Tributary Name Example
Coho Salmon	Rainbow Trout	Northern Pike		Watershed Boundary
Sockeye Salmon	Whitefish	Other Species		General Deposit Location

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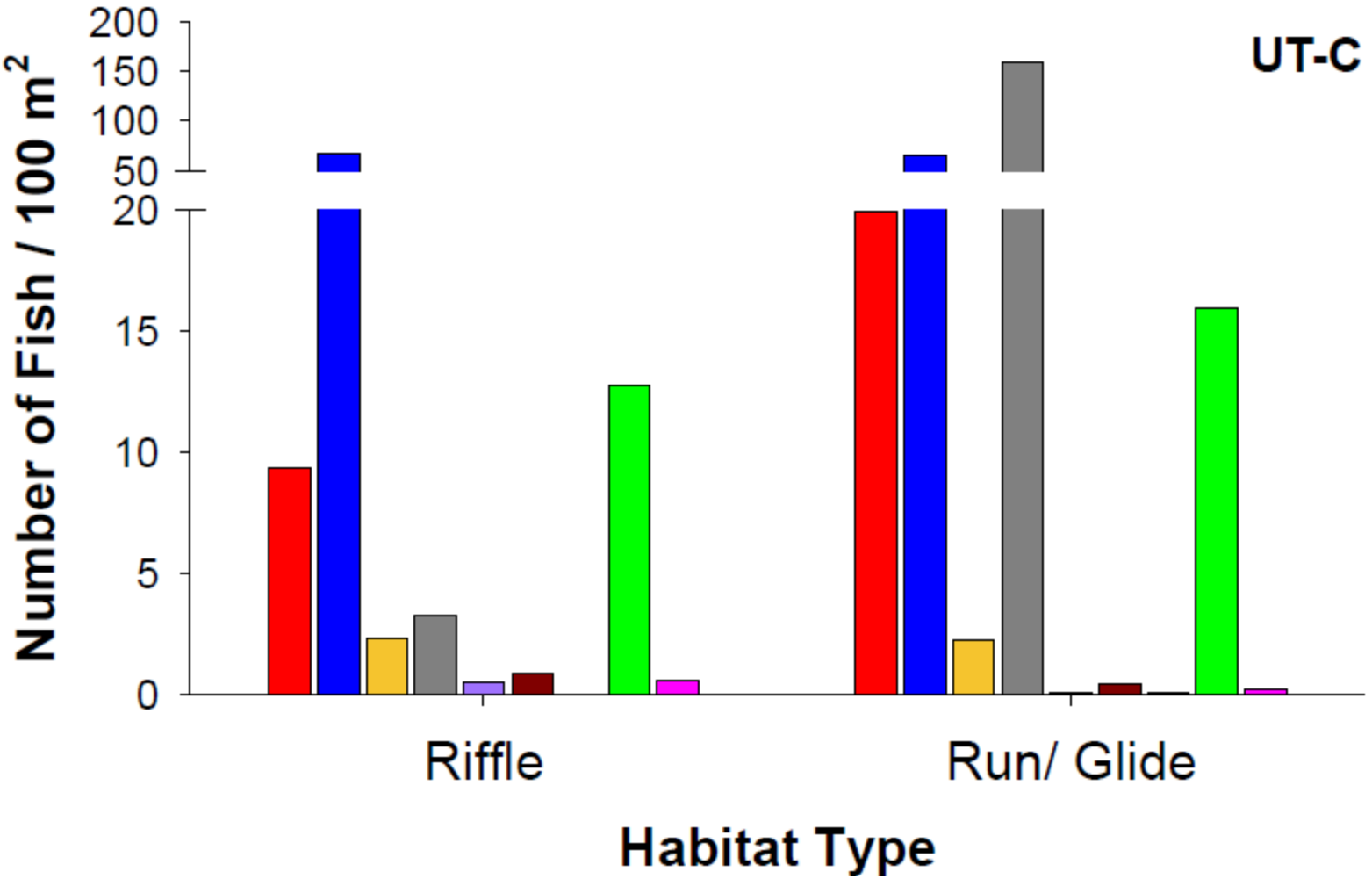
UT Fish Density by Mainstem Habitat Type



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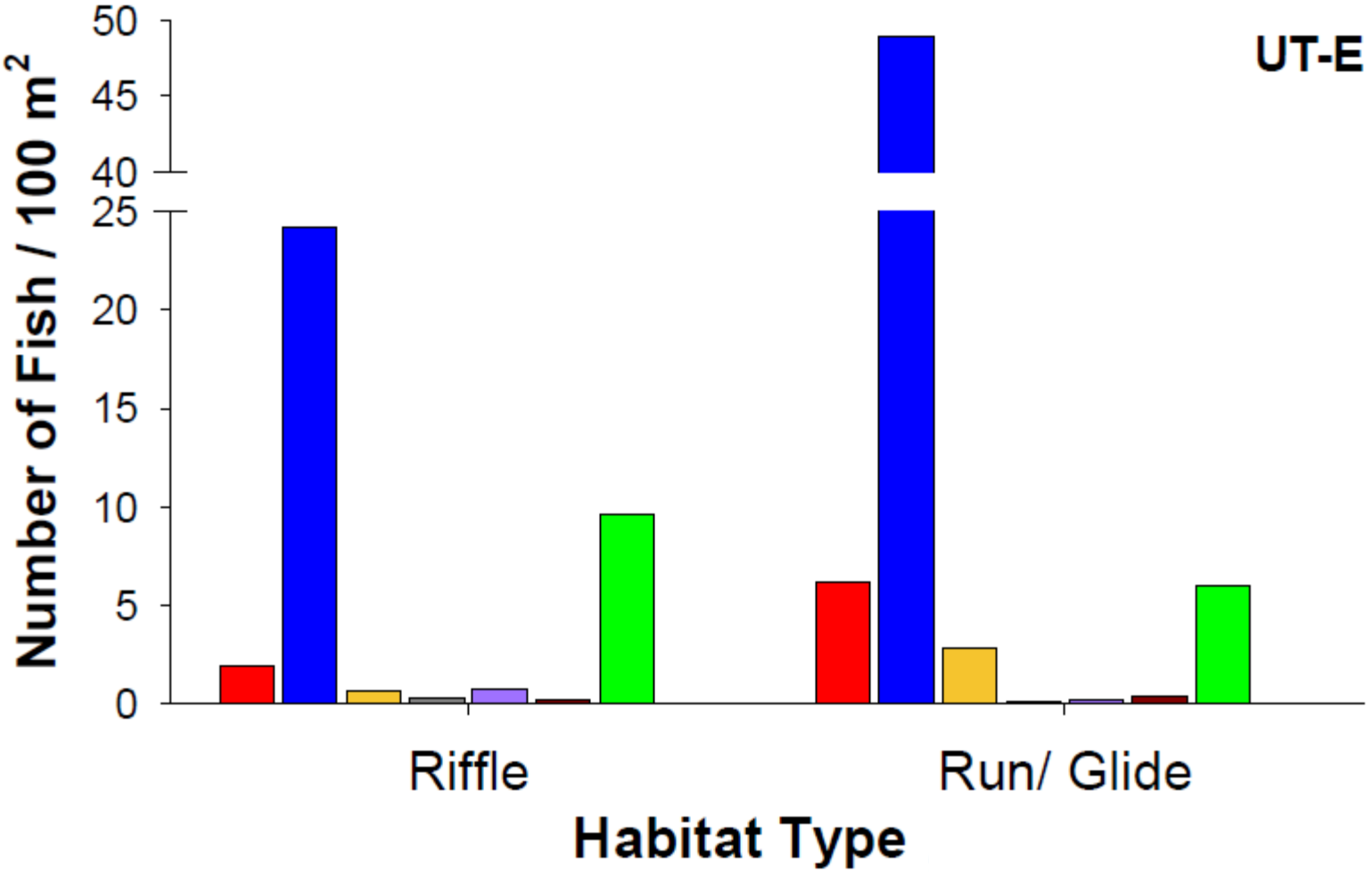
UT Fish Density by Mainstem Habitat Type



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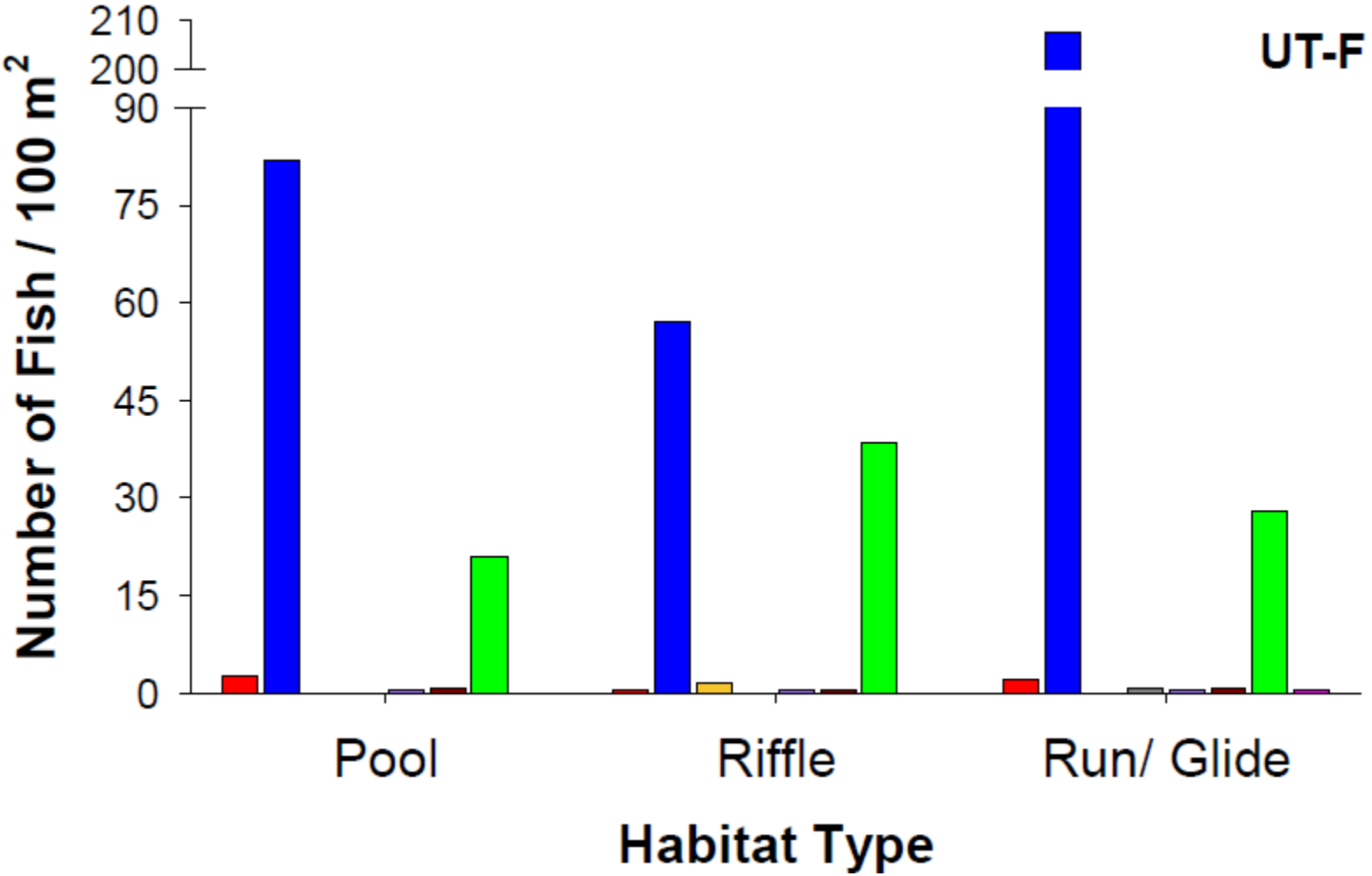
UT Fish Density by Mainstem Habitat Type



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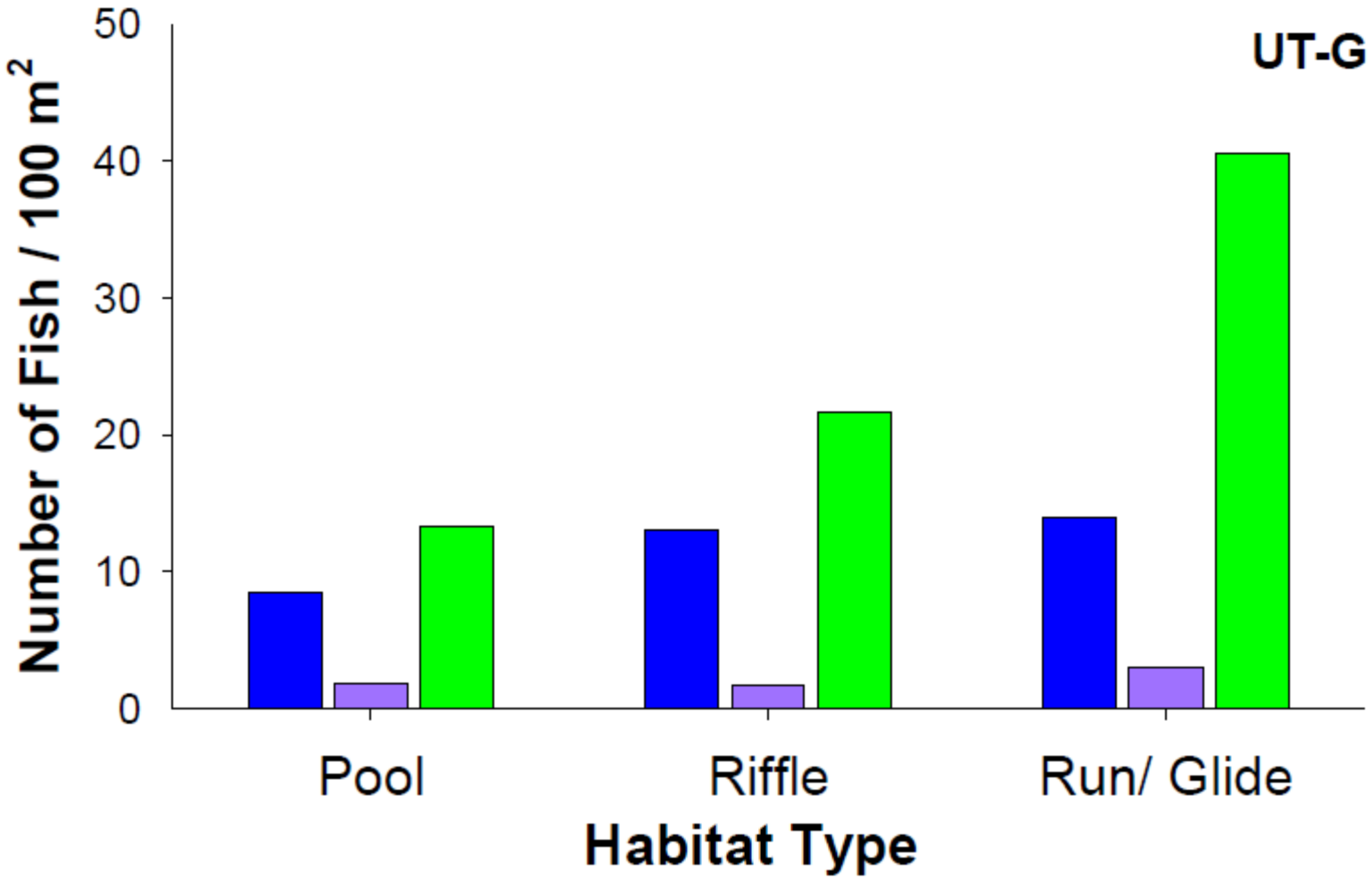
UT Fish Density by Mainstem Habitat Type



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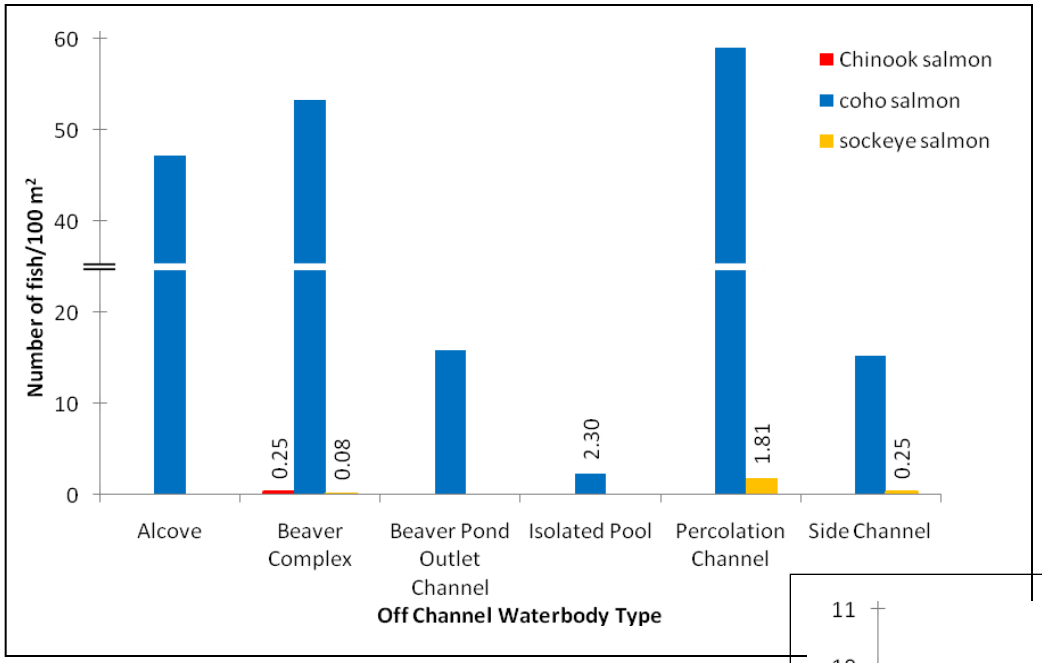
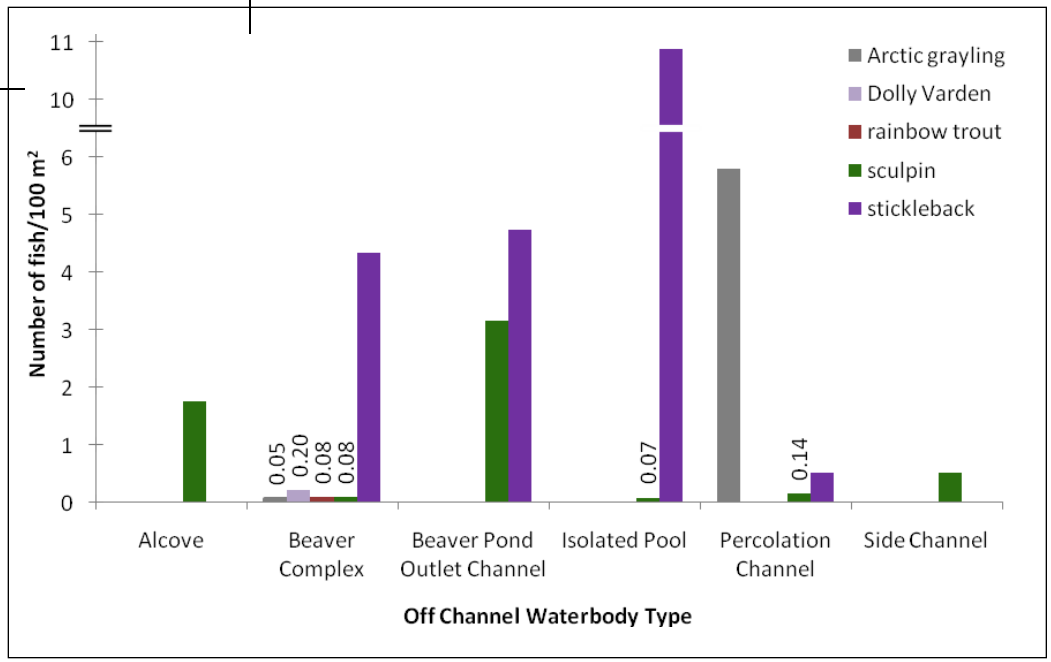
Fish Density in UT Off-channel Habitat Types





Objective 7

Describe the distribution and abundance of spawning anadromous salmon

- Chinook
- Coho
- Sockeye
- Chum

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- Aerial surveys
- July – October (November in 2008)
- Surveys repeated throughout spawning season
- Tower counts added in 2009 –Otter Creek & UT mainstem upstream of Otter Creek

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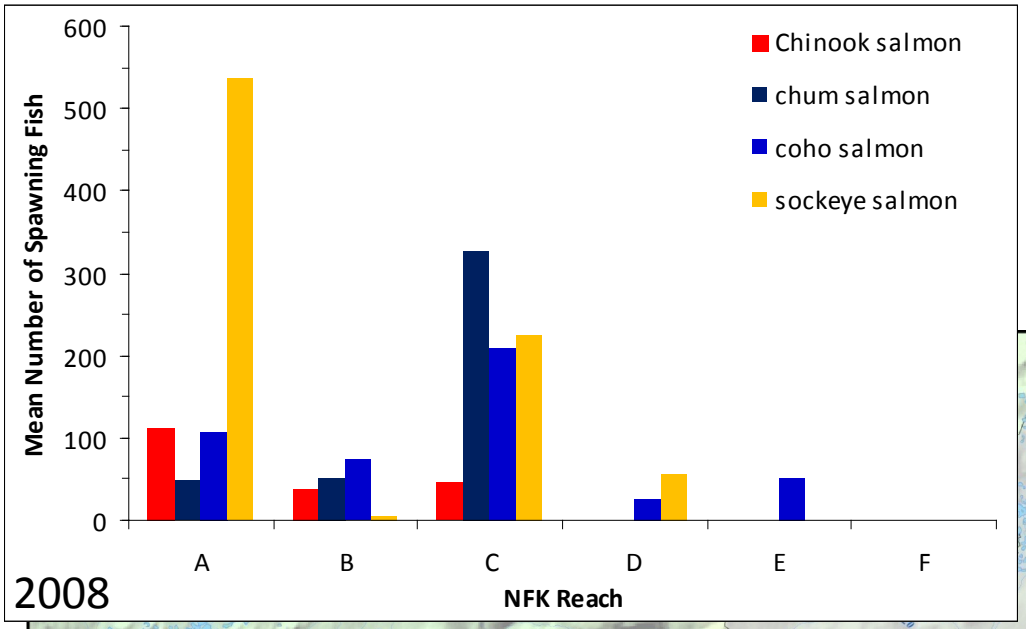
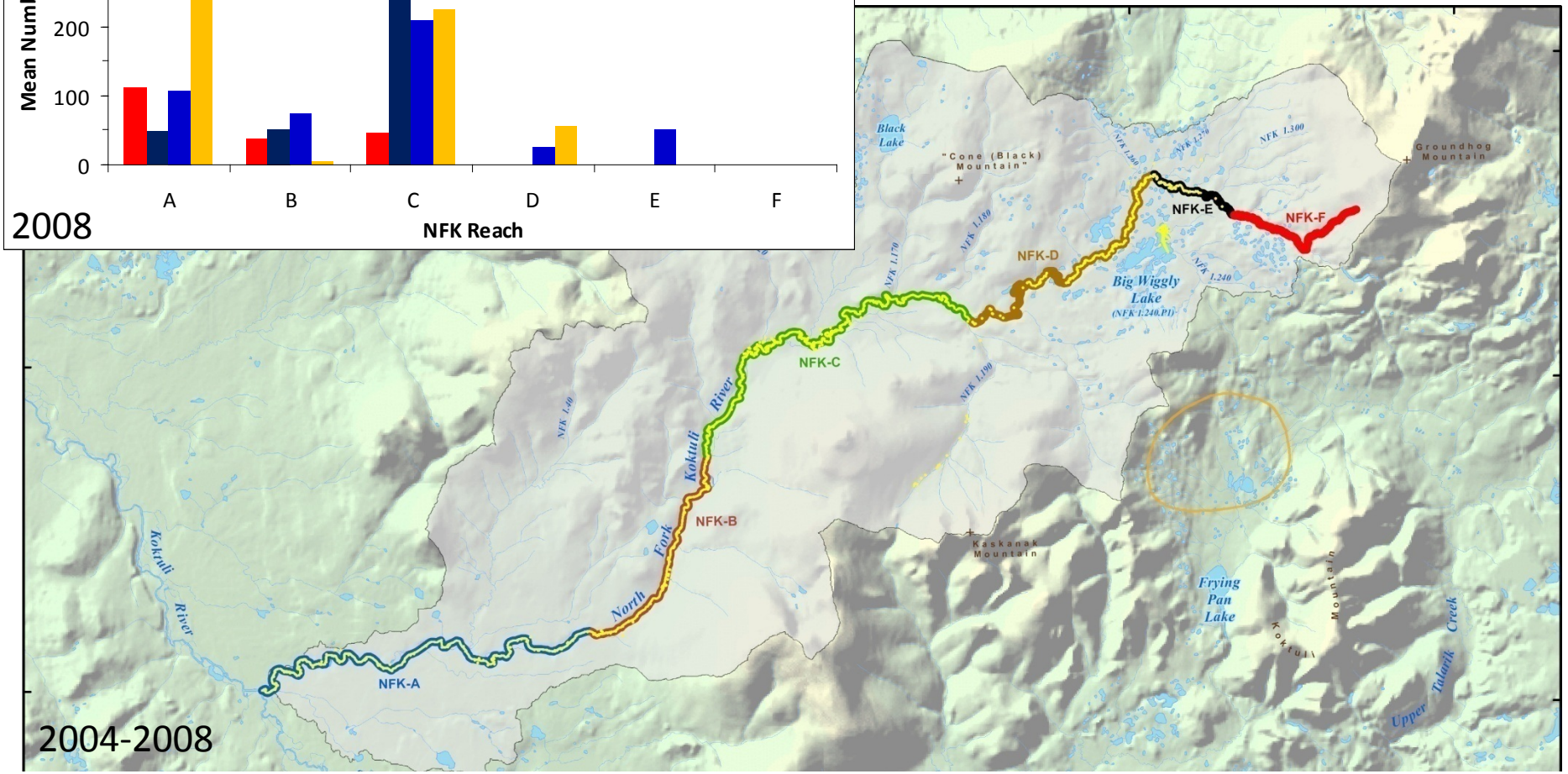
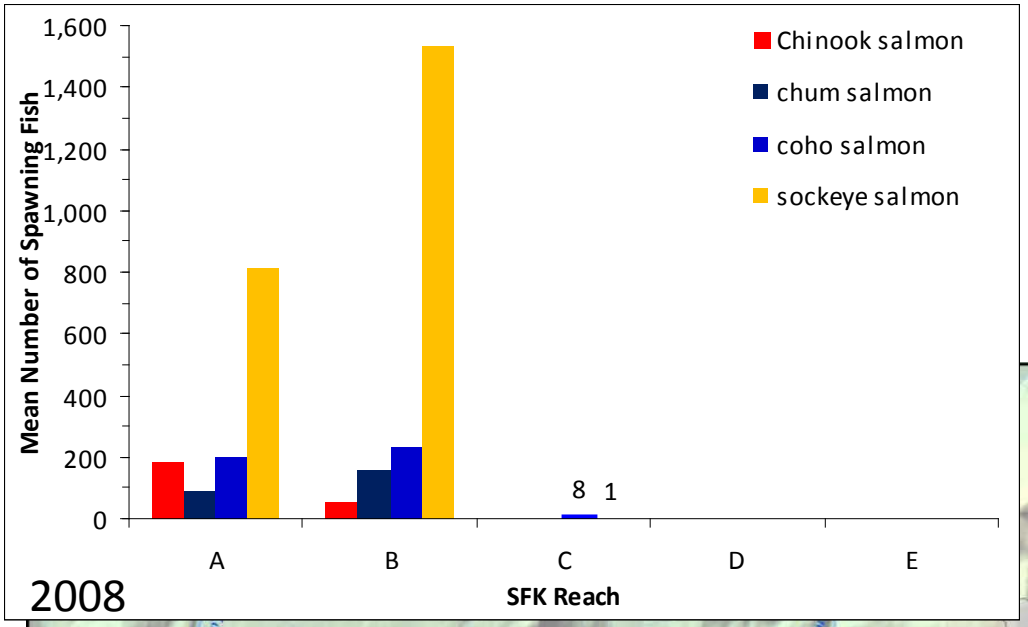
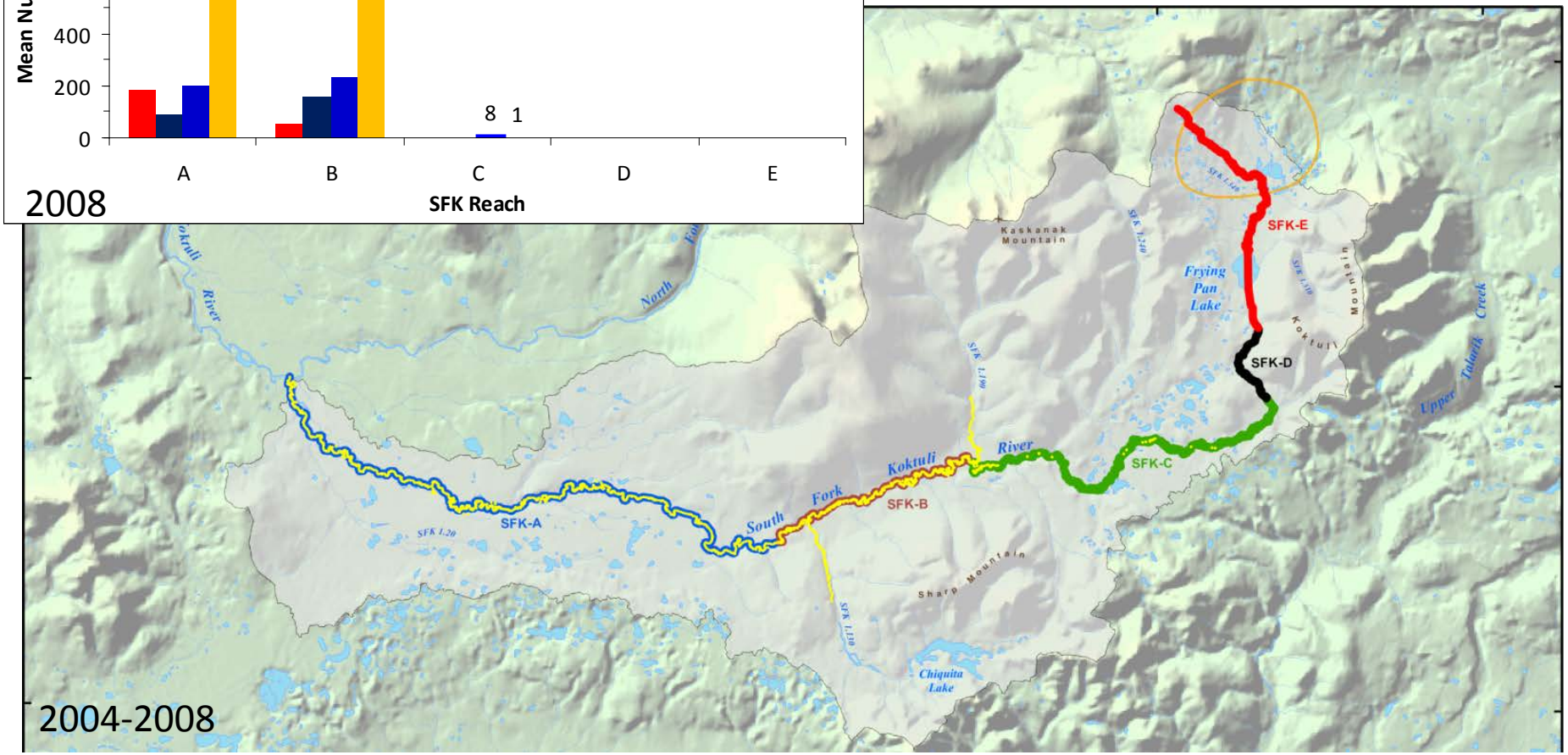
NFK Spawning Distribution



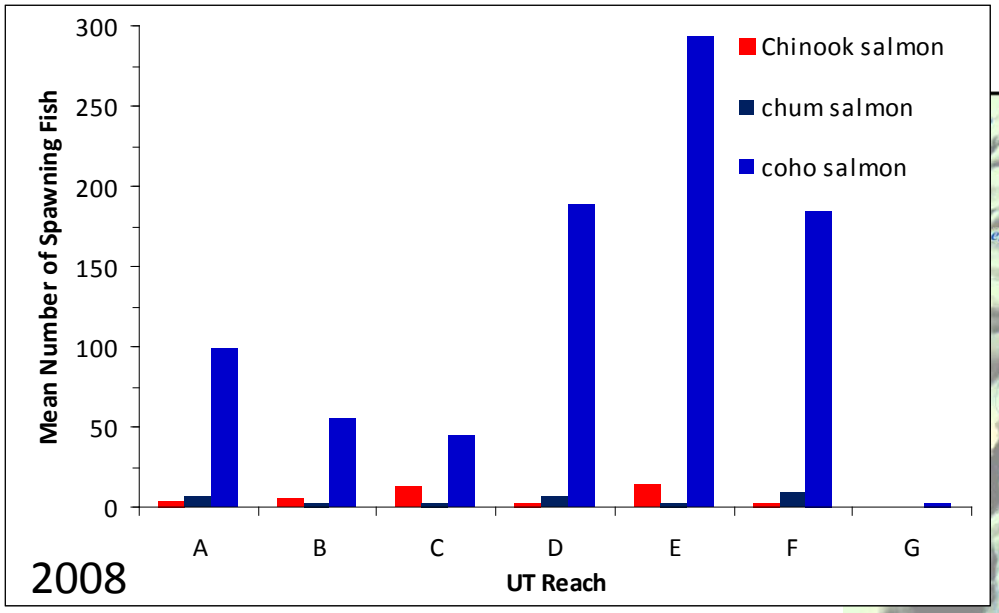


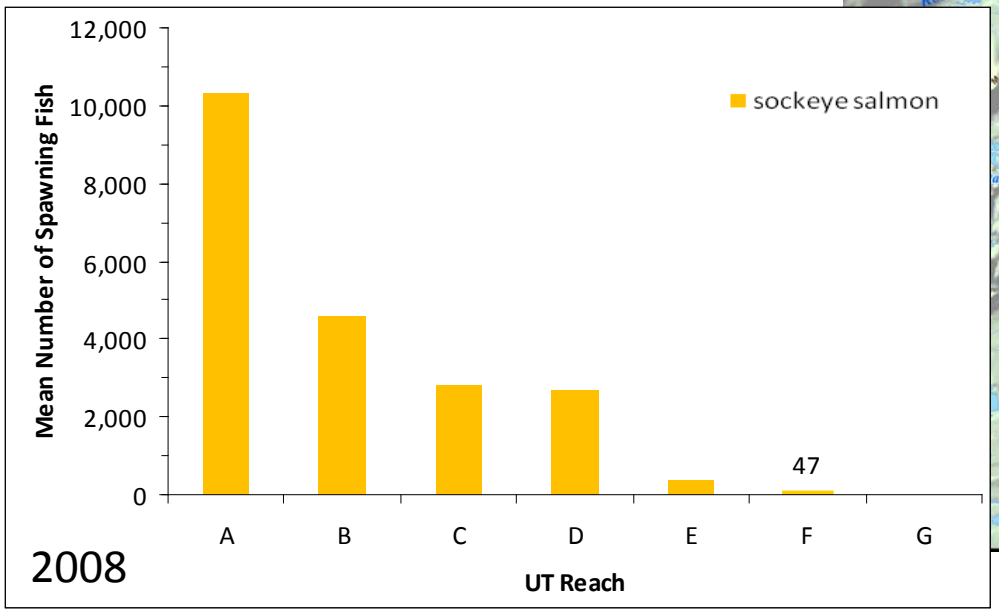
SFK Spawning Distribution

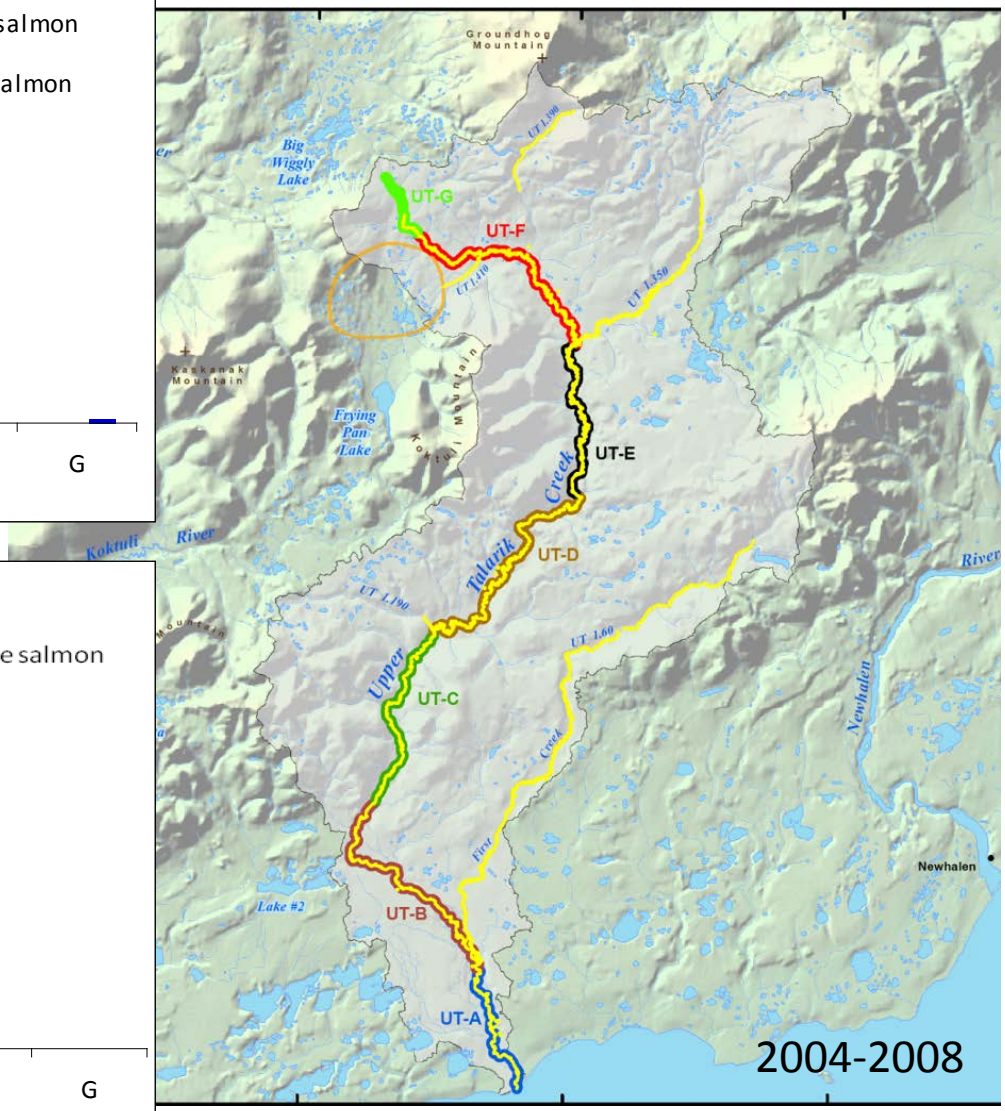




UT Spawning Distribution

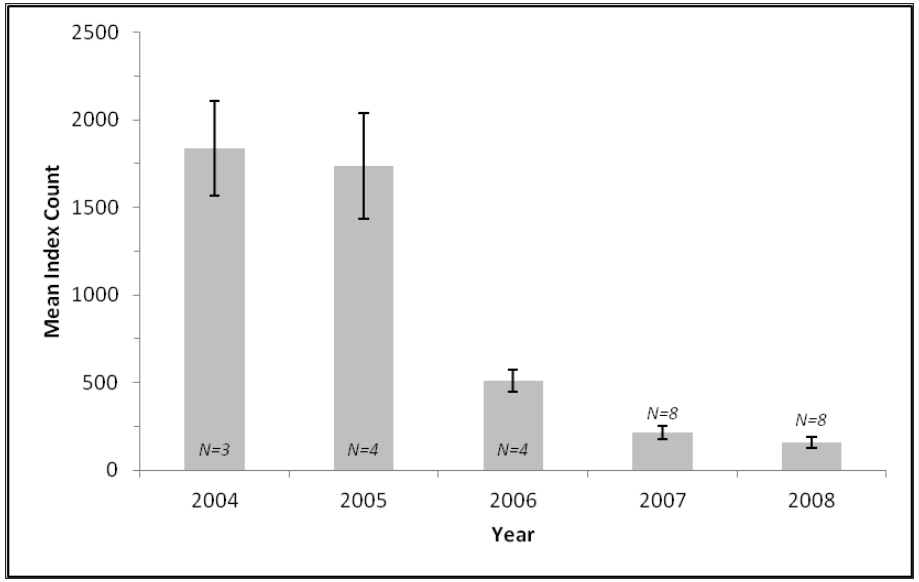




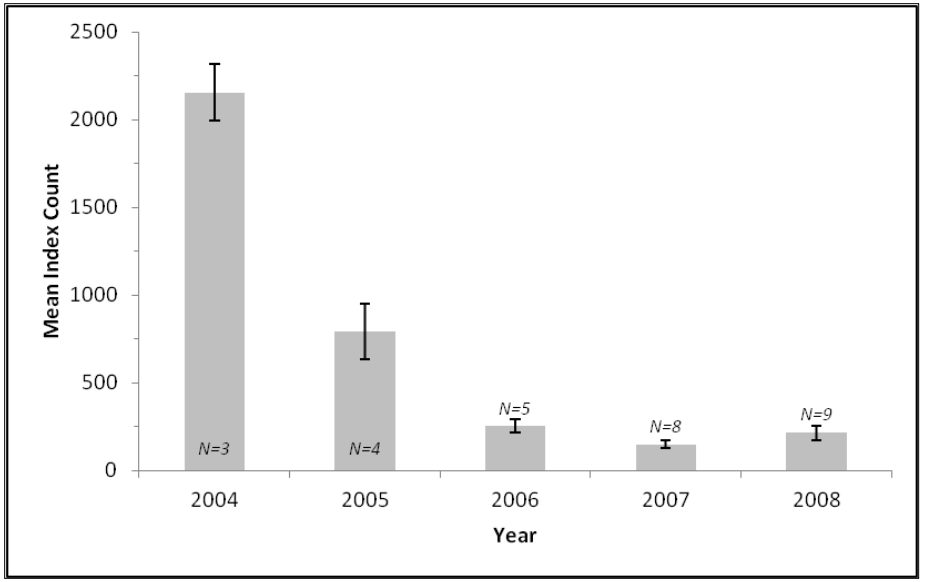


Adult Chinook Salmon Mean Index Counts

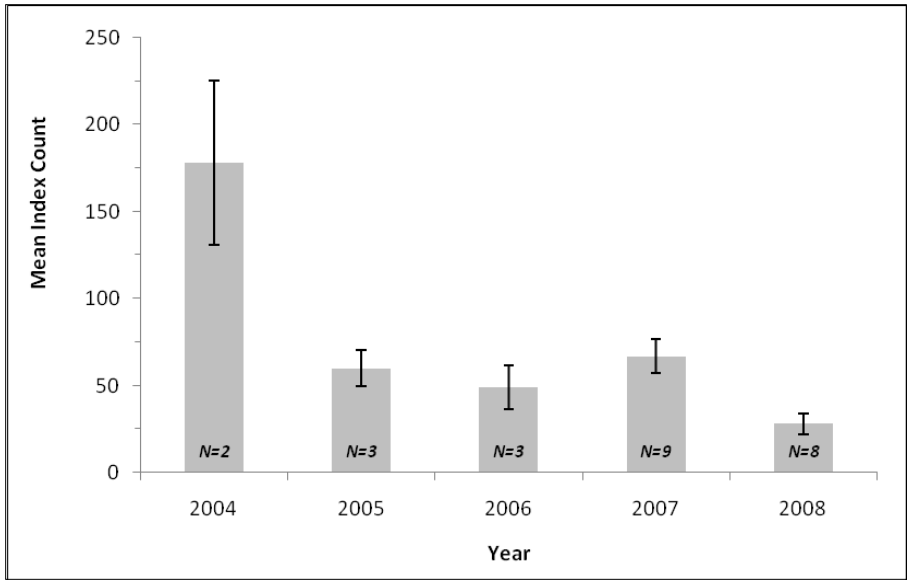
NFK



SFK



UT



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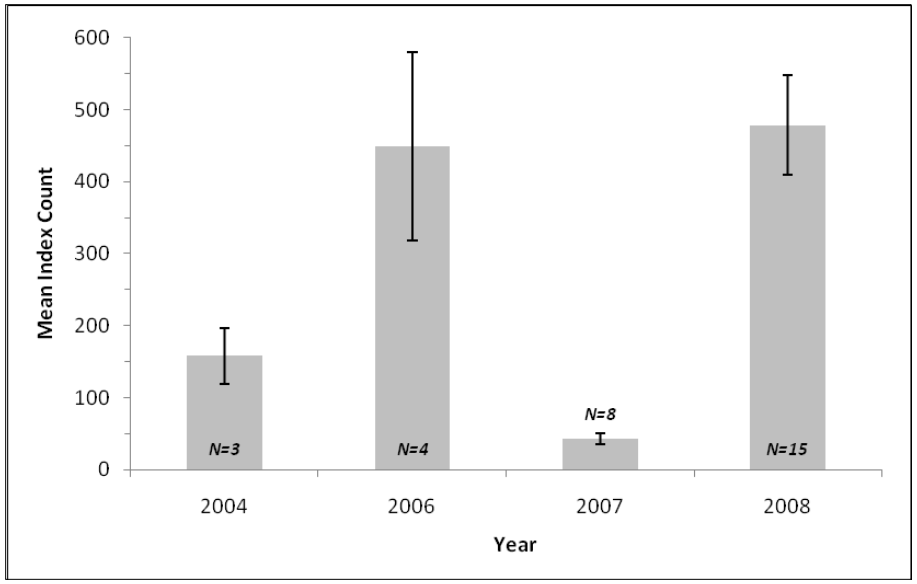
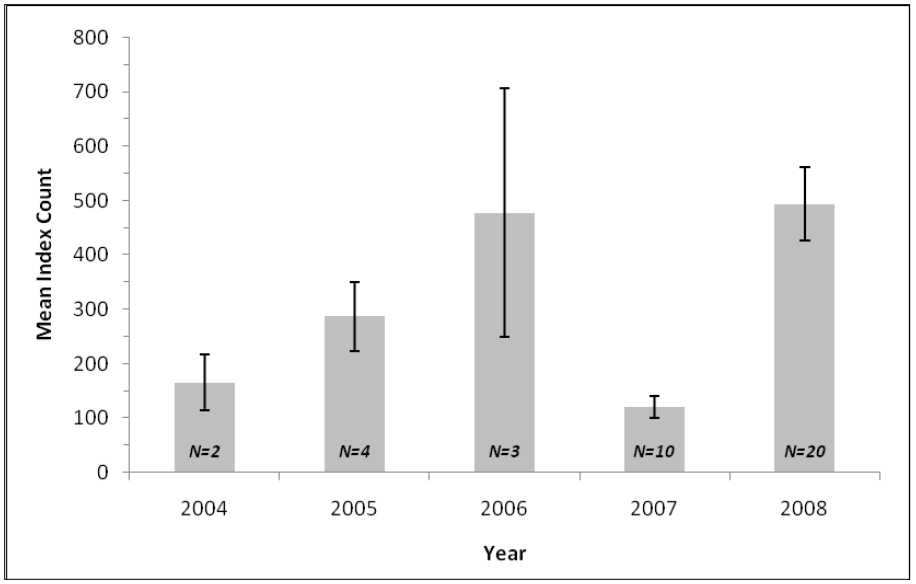
Adult Coho Salmon Mean Index Counts

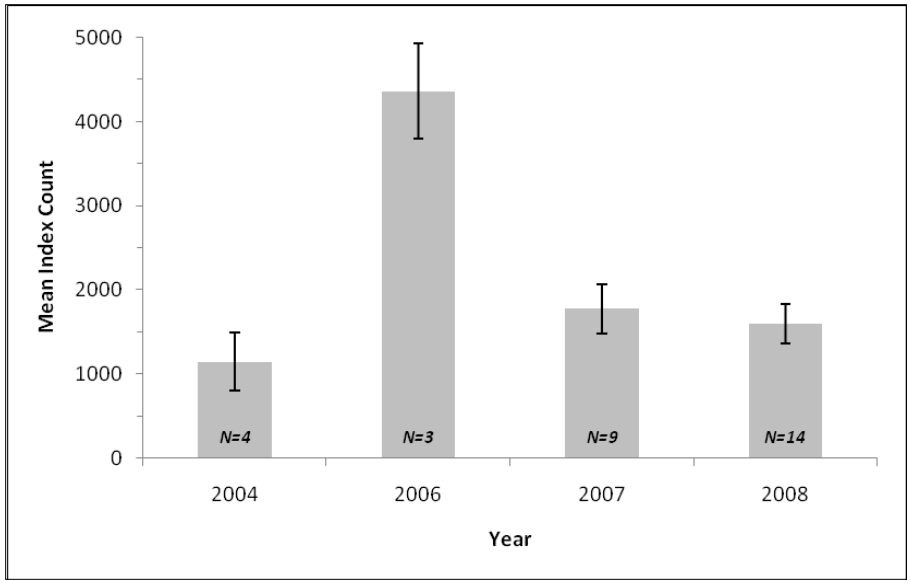
NFK



SFK



UT



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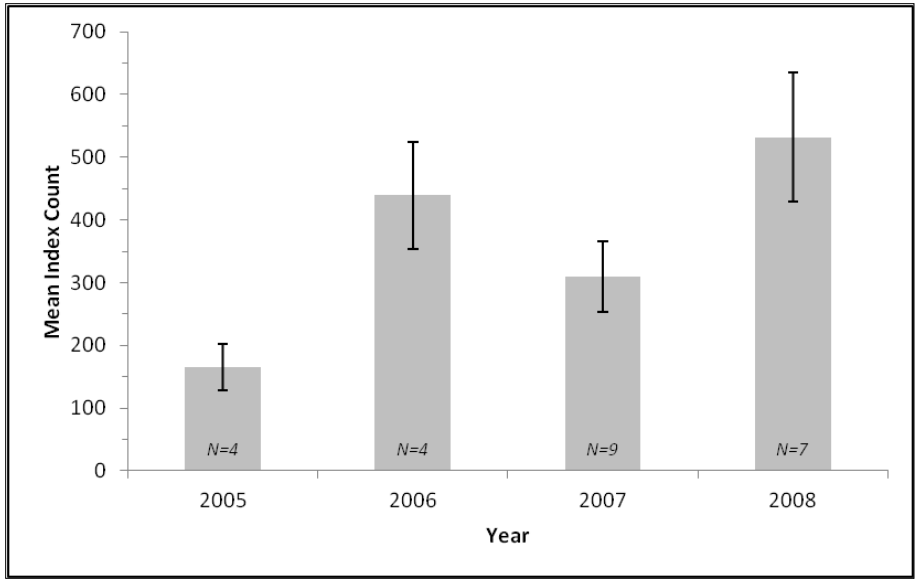
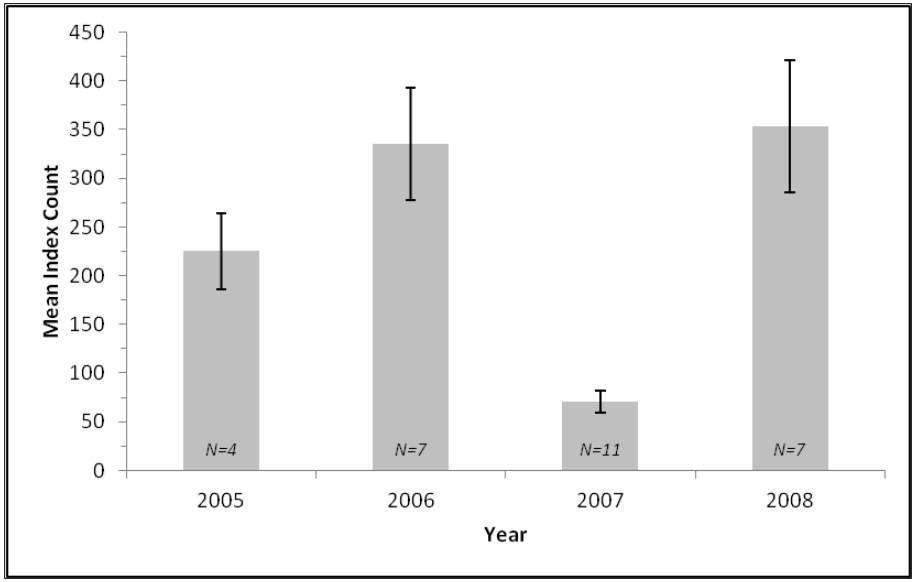
Adult Chum Salmon Mean Index Counts

NFK



SFK



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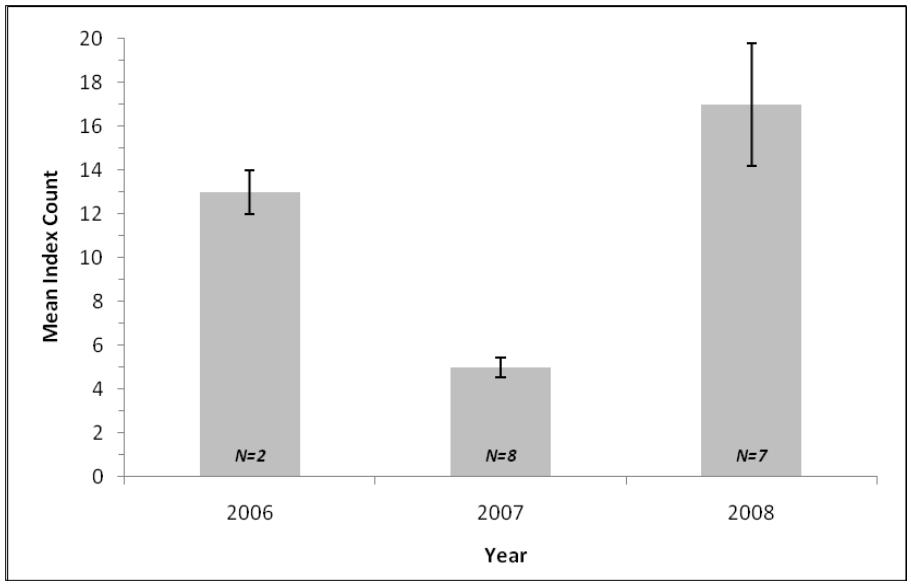

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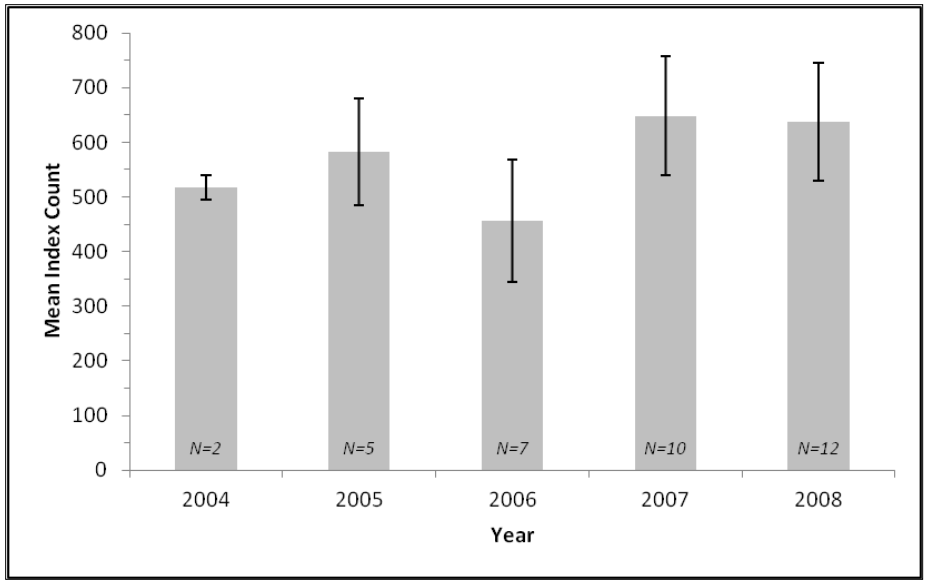
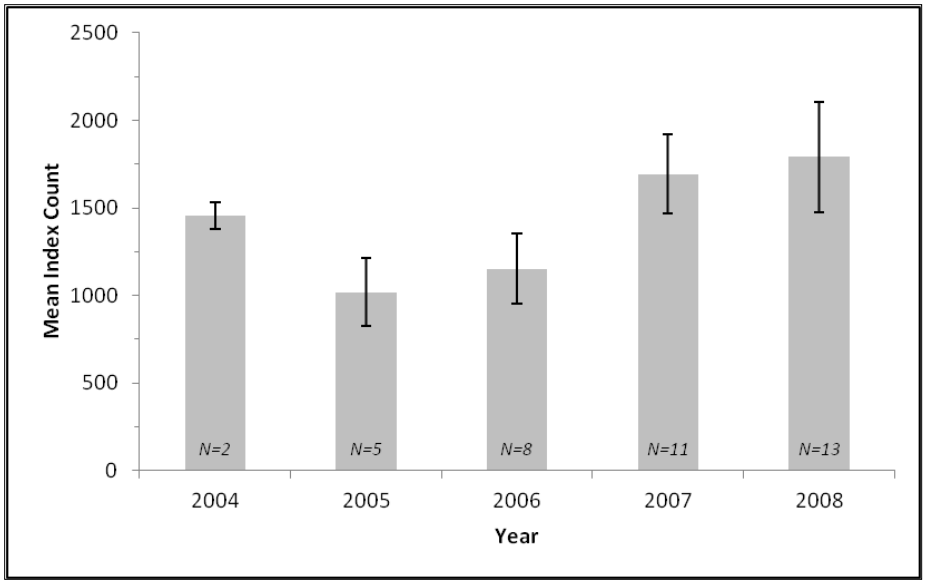
Adult Sockeye Salmon Mean Index Counts

NFK



SFK



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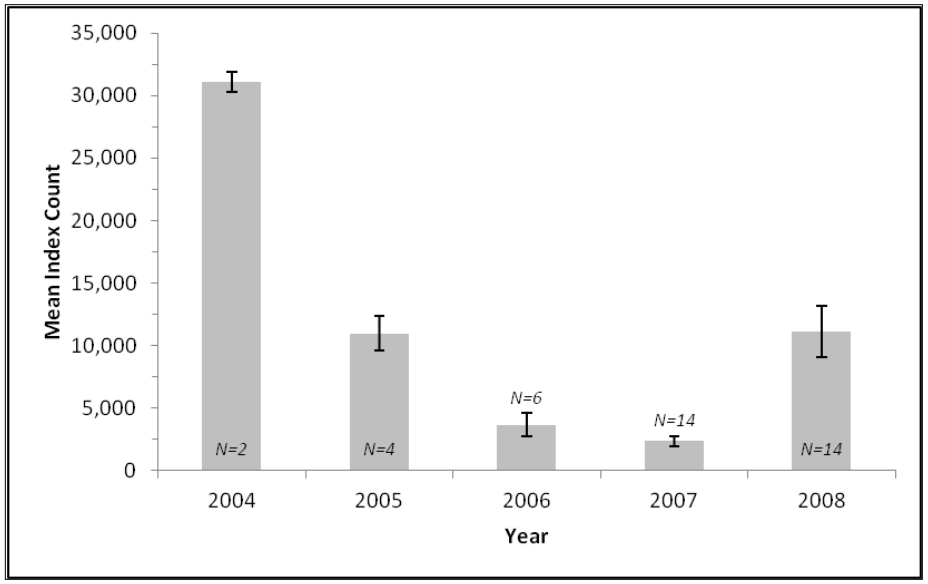

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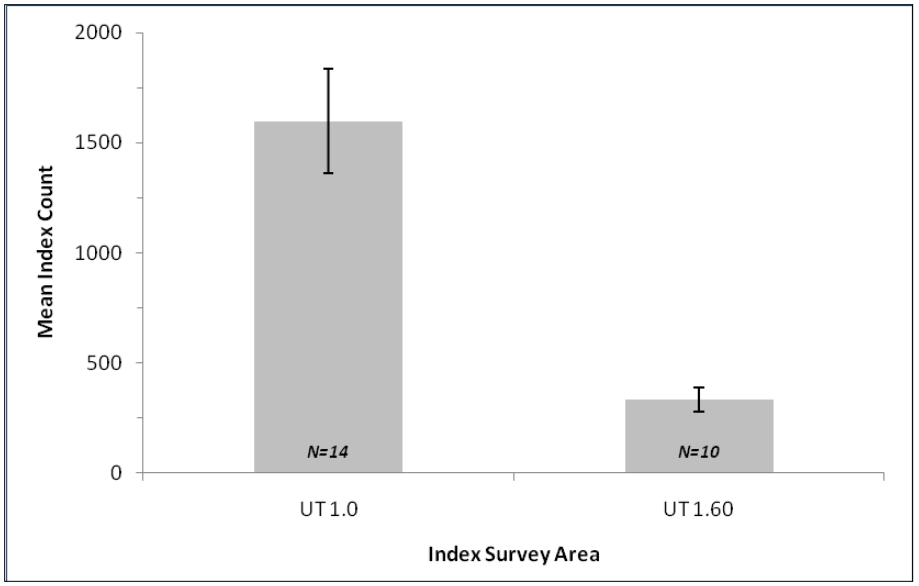
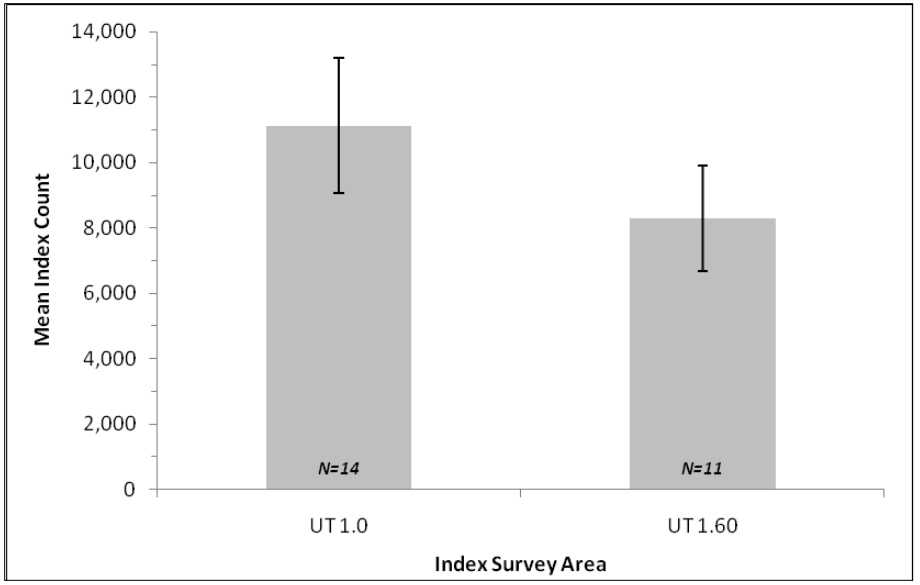
UT 1.60 Adult Salmon Mean Index Counts

Coho Salmon



The UT 1.0 index survey area includes UT Tributaries 1.190 and 1.350.

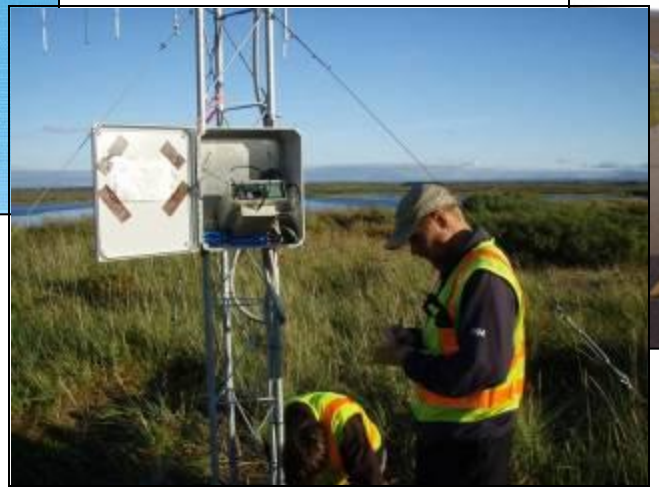
Sockeye Salmon



Objective 8

Document the seasonal distribution of UT rainbow trout

- Radio telemetry surveys
- 97 fish tagged
- Passive & active surveys
- 2-yr tracking period
- Once per month to once per week



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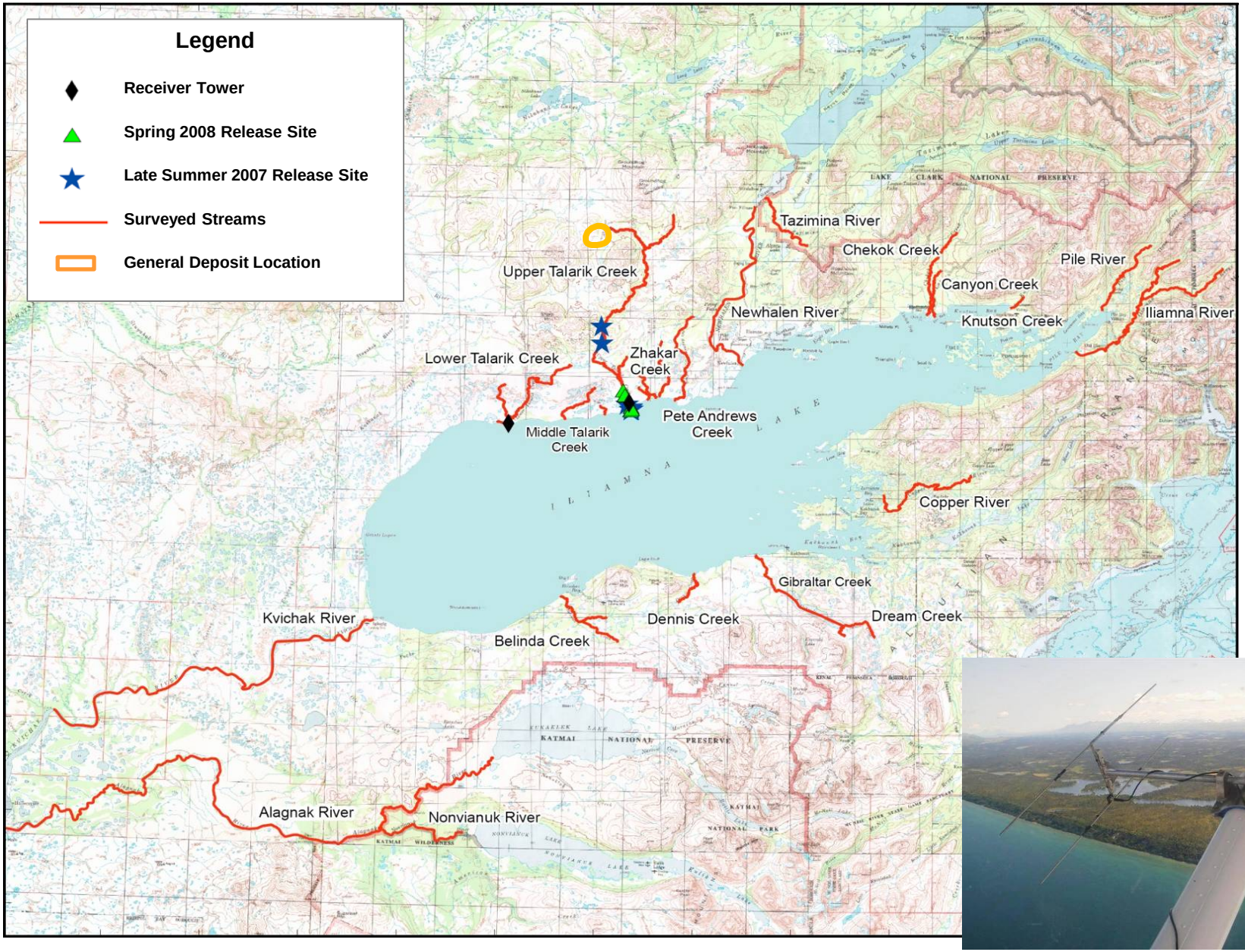
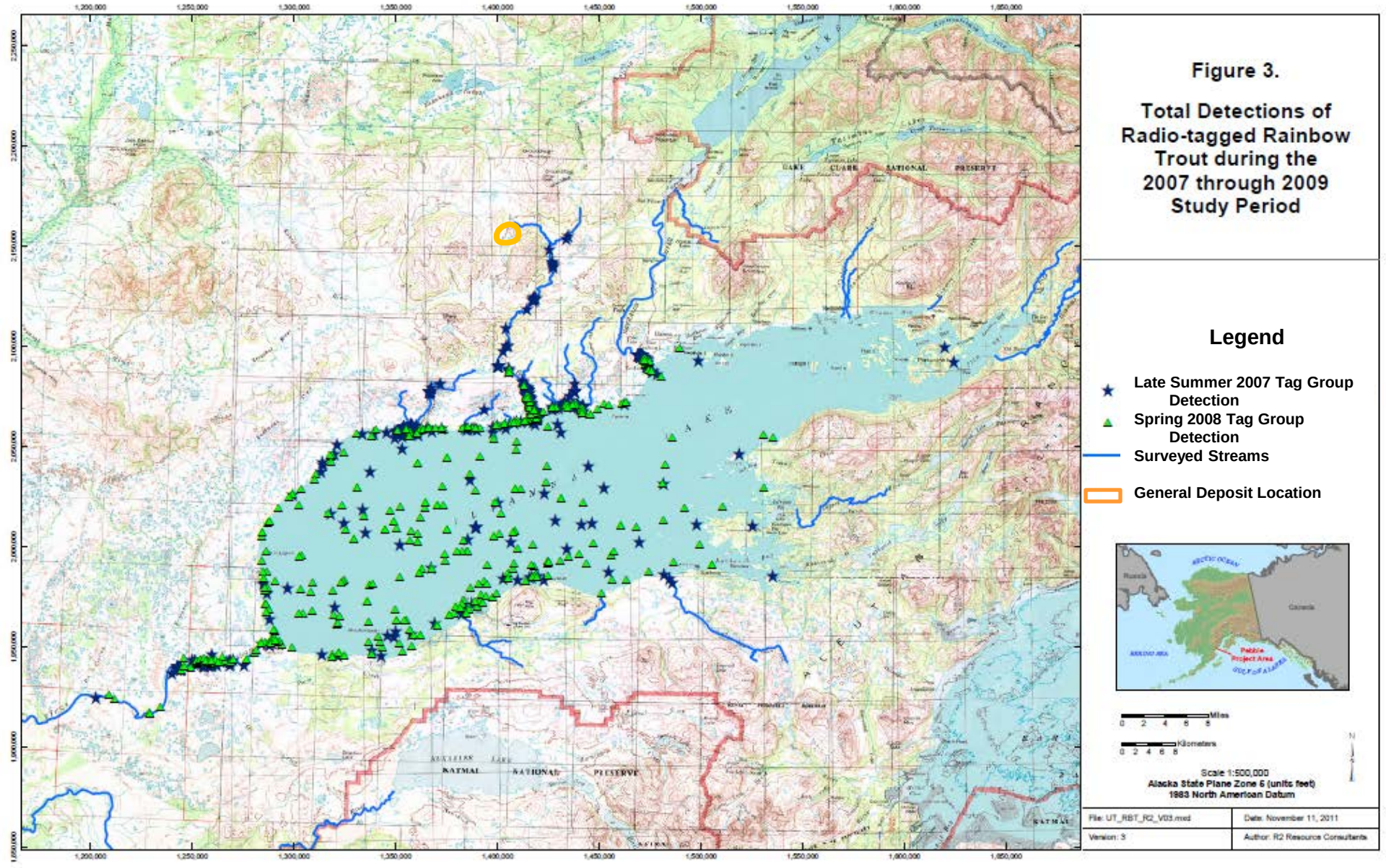
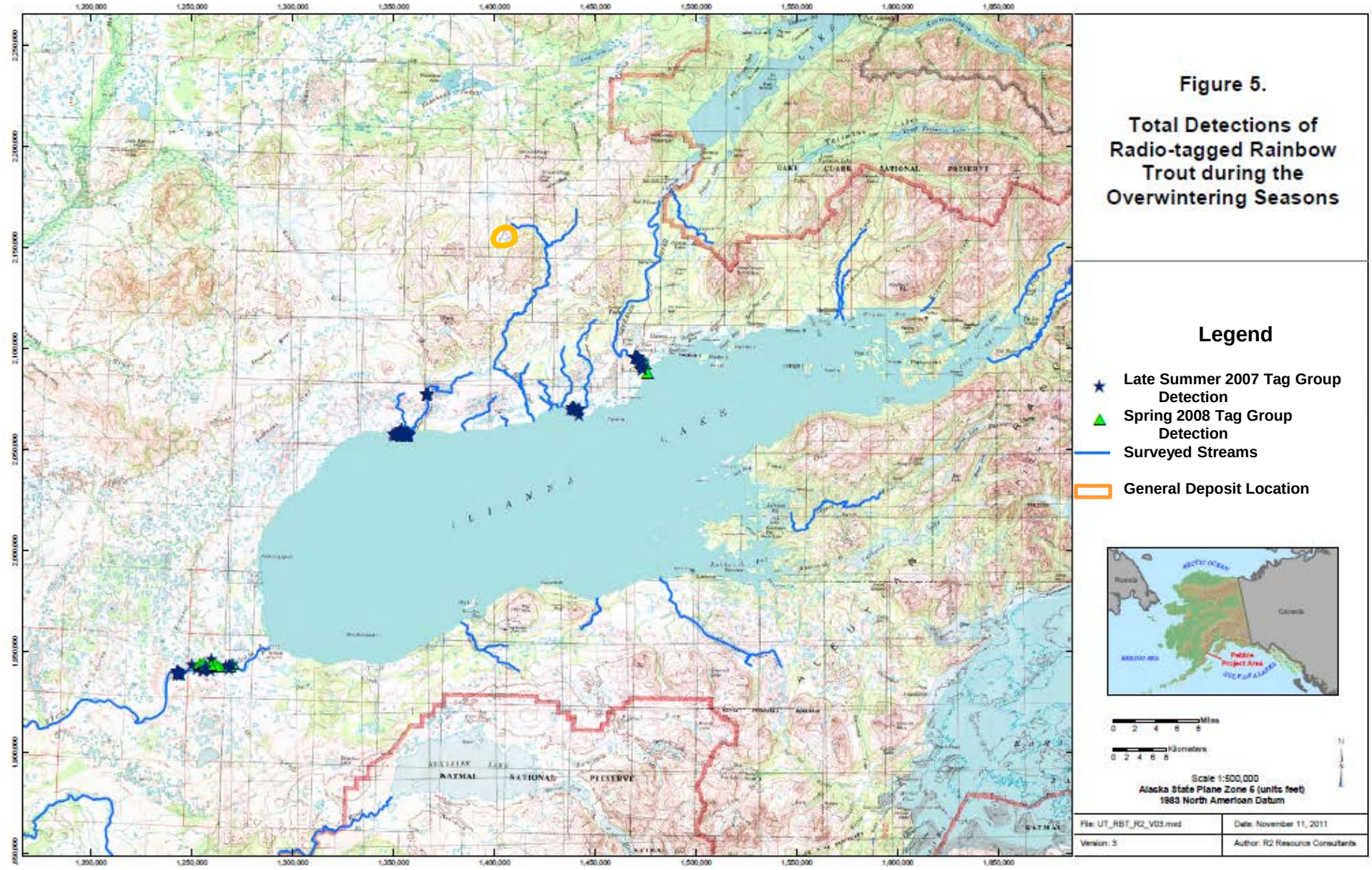
Rainbow Trout Radio Telemetry Survey Area



Overall Distribution



Overwintering Distribution



Fish Movement in Iliamna Lake & Associated Water Bodies

Tag Group	*N*	# of Water Bodies Visited per Fish	# of Incursions per Fish	Maximum Distance Traveled from Release (RKm)
Summer	28	1 - 5	1 - 16	1.1 - 75.4
Spring	42	1 - 5	1 - 8	3.3 - 90.4

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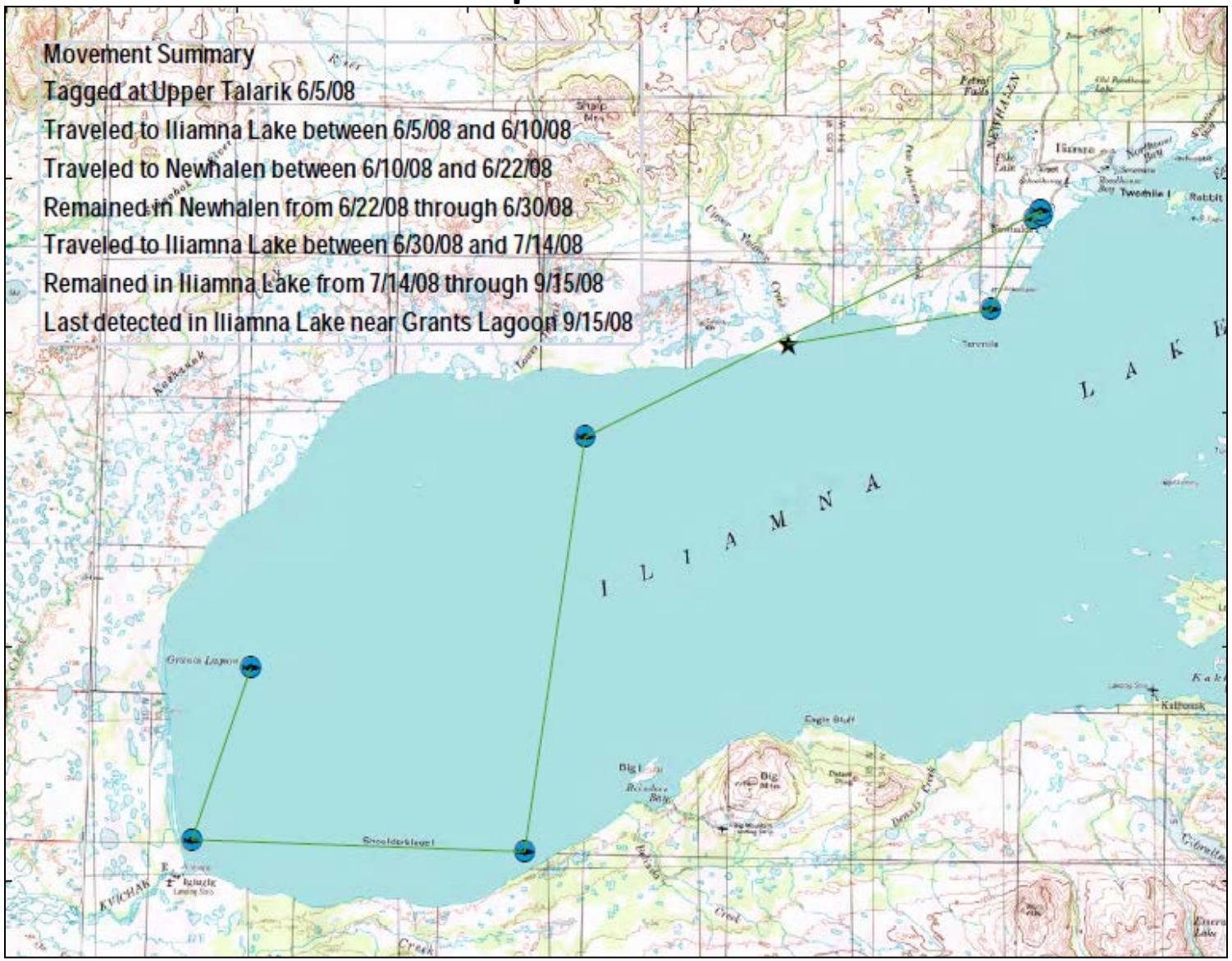
Example Fish Track



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Habitat Use in Iliamna Lake & Associated Water Bodies

Tag Group	Study Life (days)	% of Study Life (mean & range) UT	LT	LAKE	Other Streams
Returned to the UT					
Summer	376 (44-786)	14 (1-77)	39 (0-80)	7 (0-25)	25 (0-84)
Spring	308 (105-386)	5 (2-7)	<1 (0-1)	38 (23-81)	47 (0-66)
Did not return to the UT					
Summer	183 (58-398)	20 (<1-92)	23 (0-83)	2 (0-13)	37 (0-84)
Spring	76 (13-329)	13 (1-94)	3 (0-19)	60 (0-99)	3 (0-42)

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Stream Fidelity in the UT & Other Streams Associated with Iliamna Lake

Number of Fish Detected by Life Function

		Upper Talarik		Other Streams	
	Total	**One time**	**Repeats**	**One time**	**Repeats**
Spawning	56	53	7	3	0
Foraging	67	52	9	67	13*

*Lower Talarik only.

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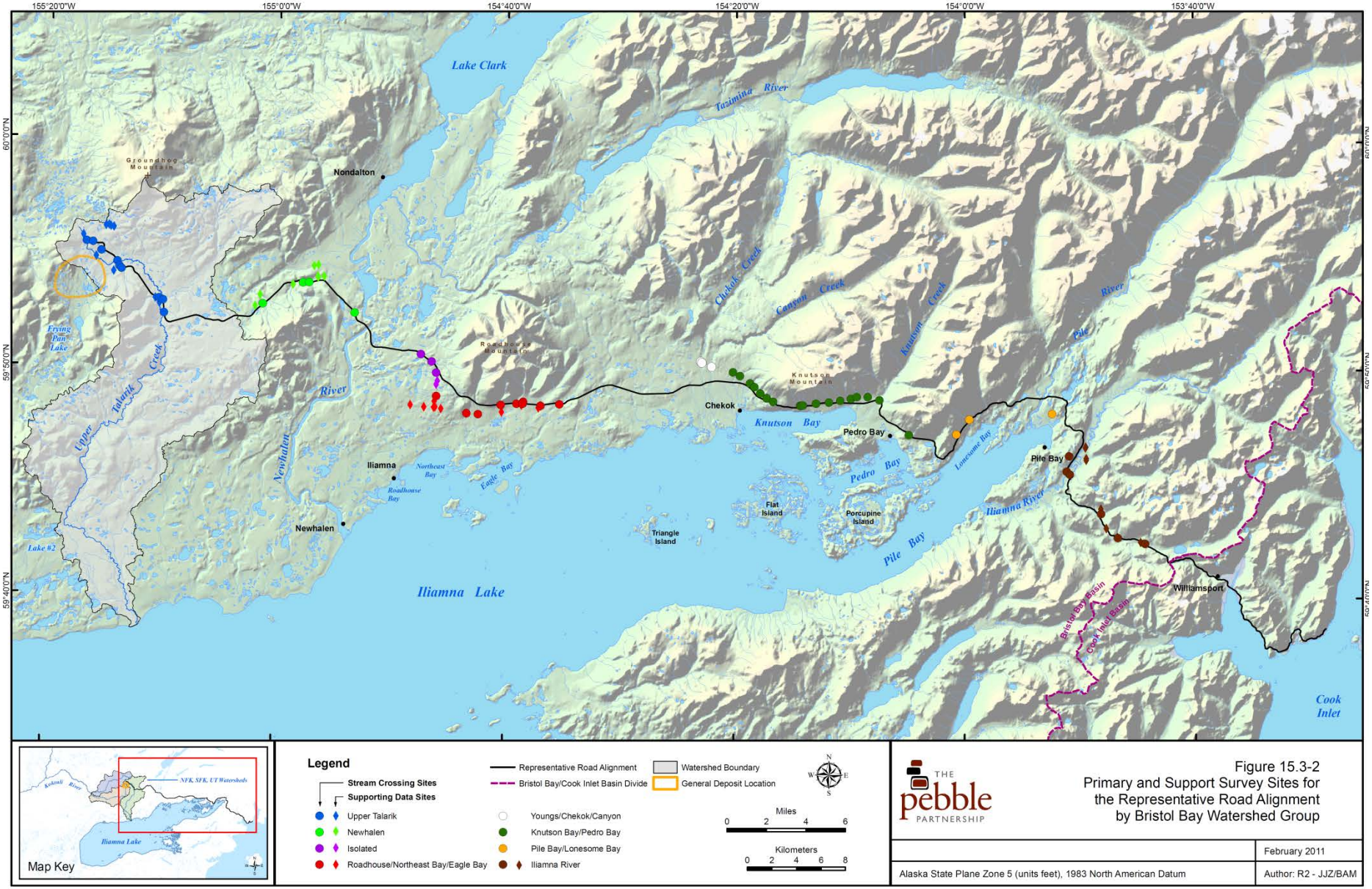
Representative Road Alignment:

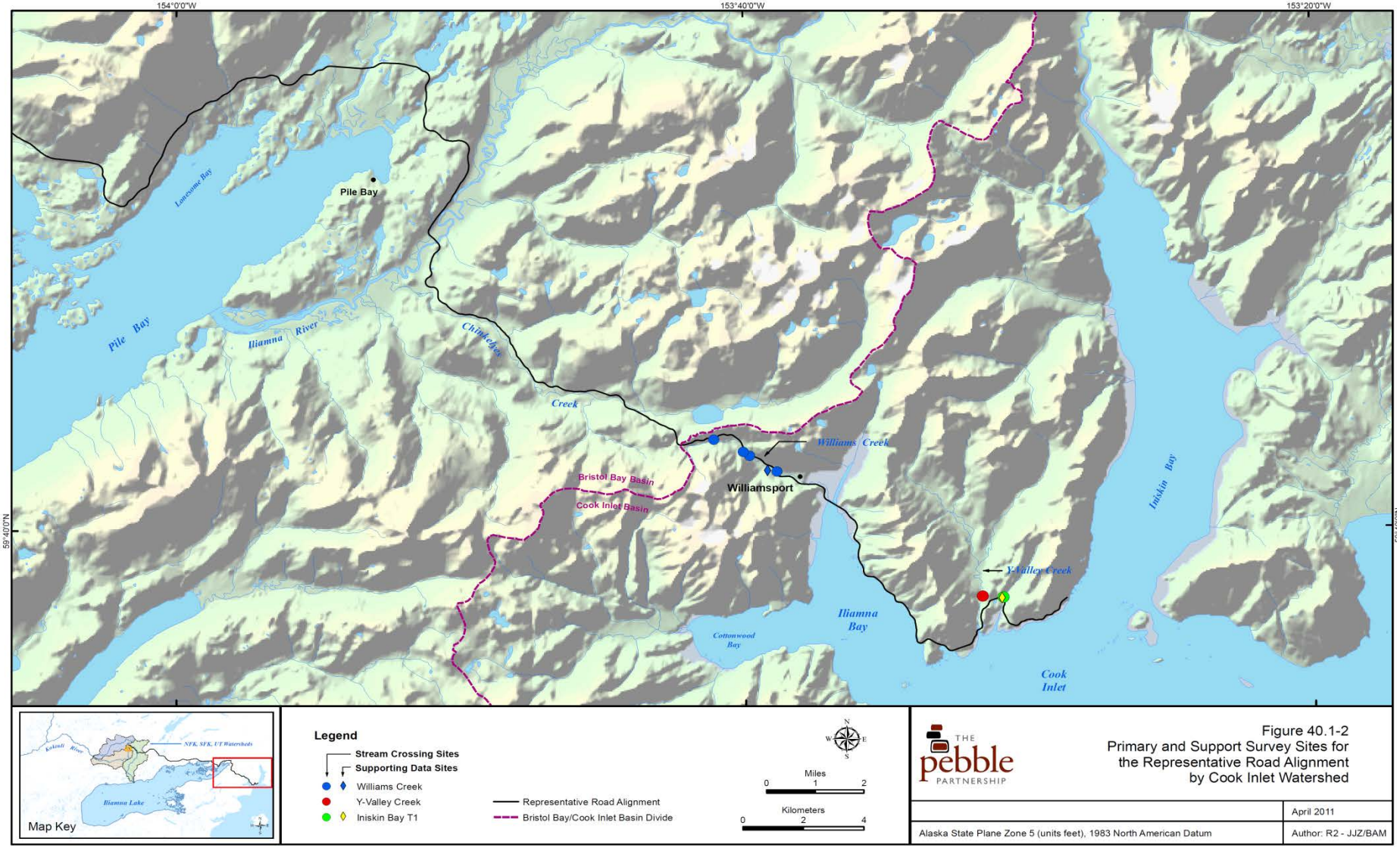
Surveys at Primary and Support Sites

- What are the baseline channel conditions?
- What types of aquatic habitats are present and how can those habitats be described?
- What are the water quality characteristics?
- What is the composition and distribution of fish species?

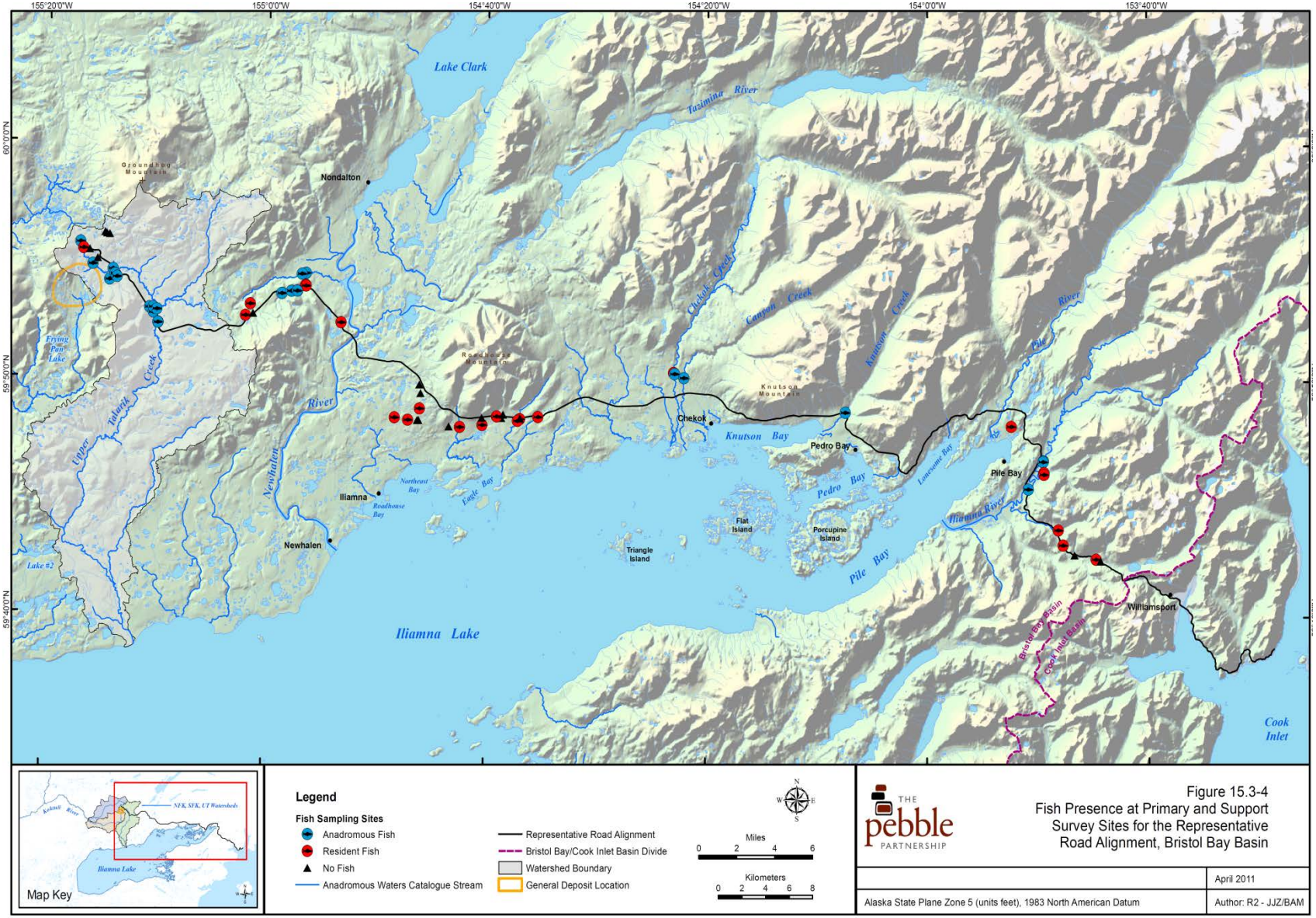
Bristol Bay Primary and Support Survey Sites



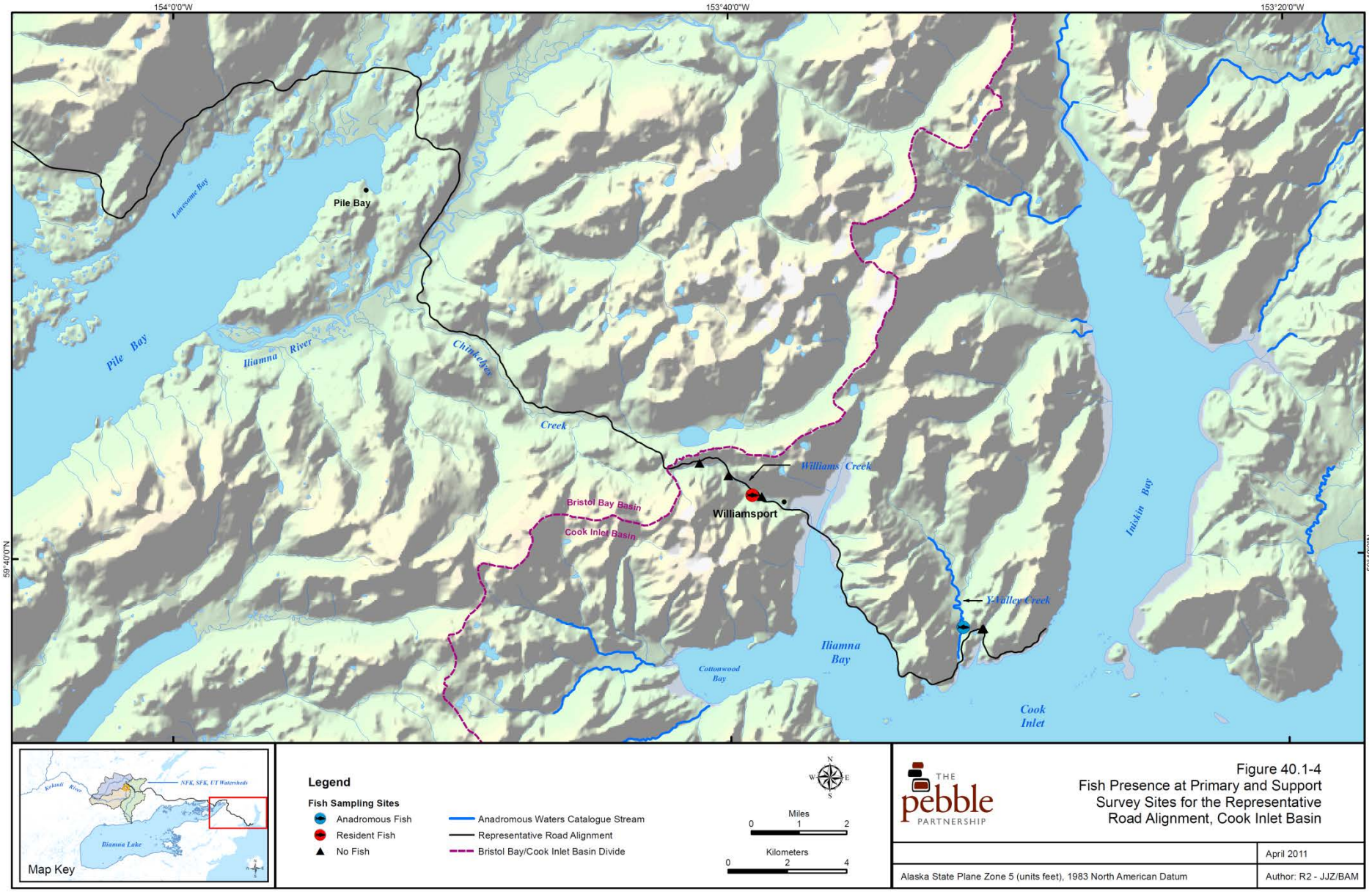
Cook Inlet Primary and Support Sites



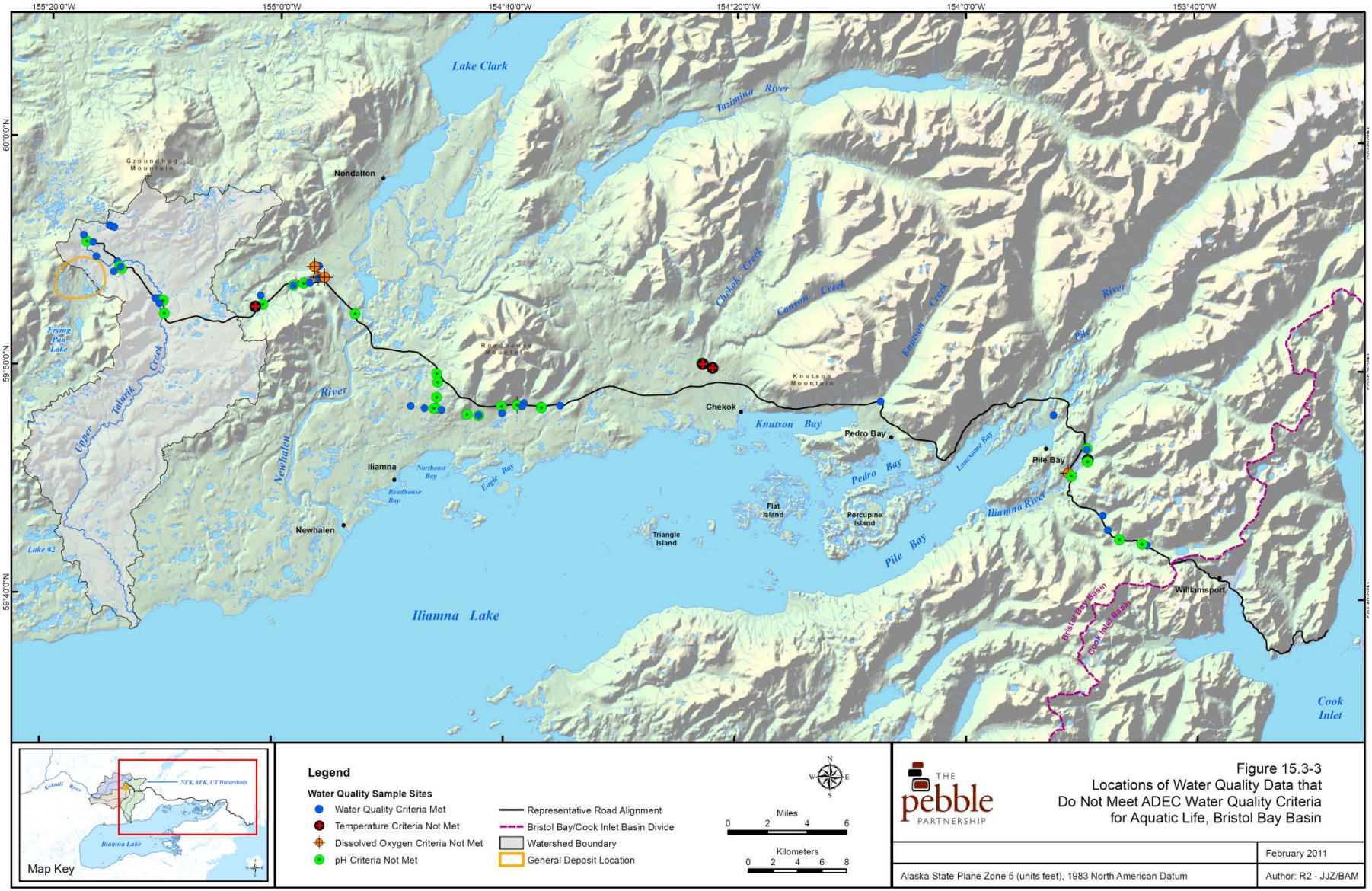
Bristol Bay Sites - Fish Presence



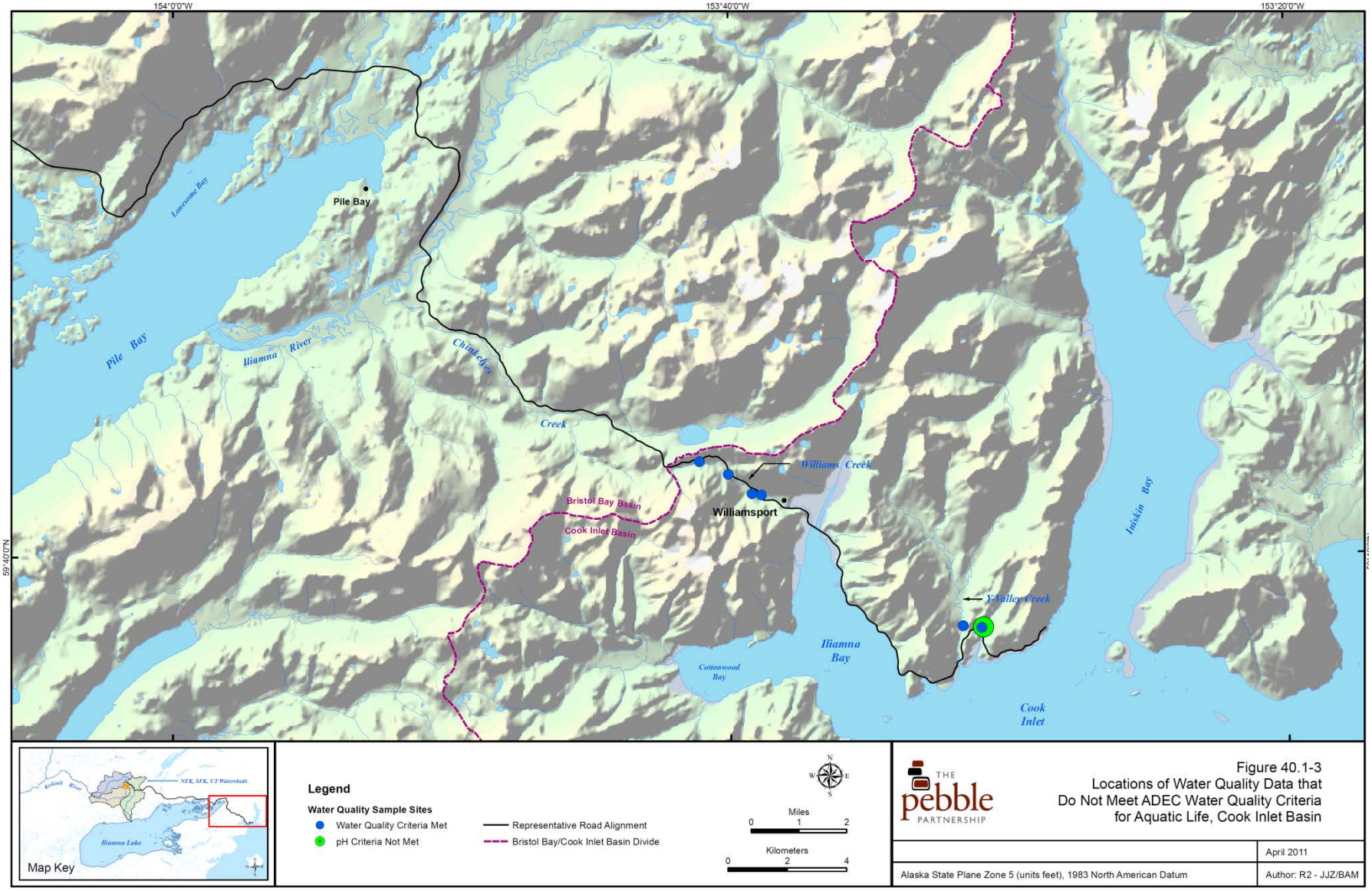
Cook Inlet – Fish Presence



Bristol Bay – Water Quality



Cook Inlet - Water Quality




Thank You!
Questions??