Stock Identification of Chinook Salmon from Southeast Alaska: A review of the past and a look forward

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Bill Templin

Alaska Department of Fish and Game

SE Alaska Troll Fishery

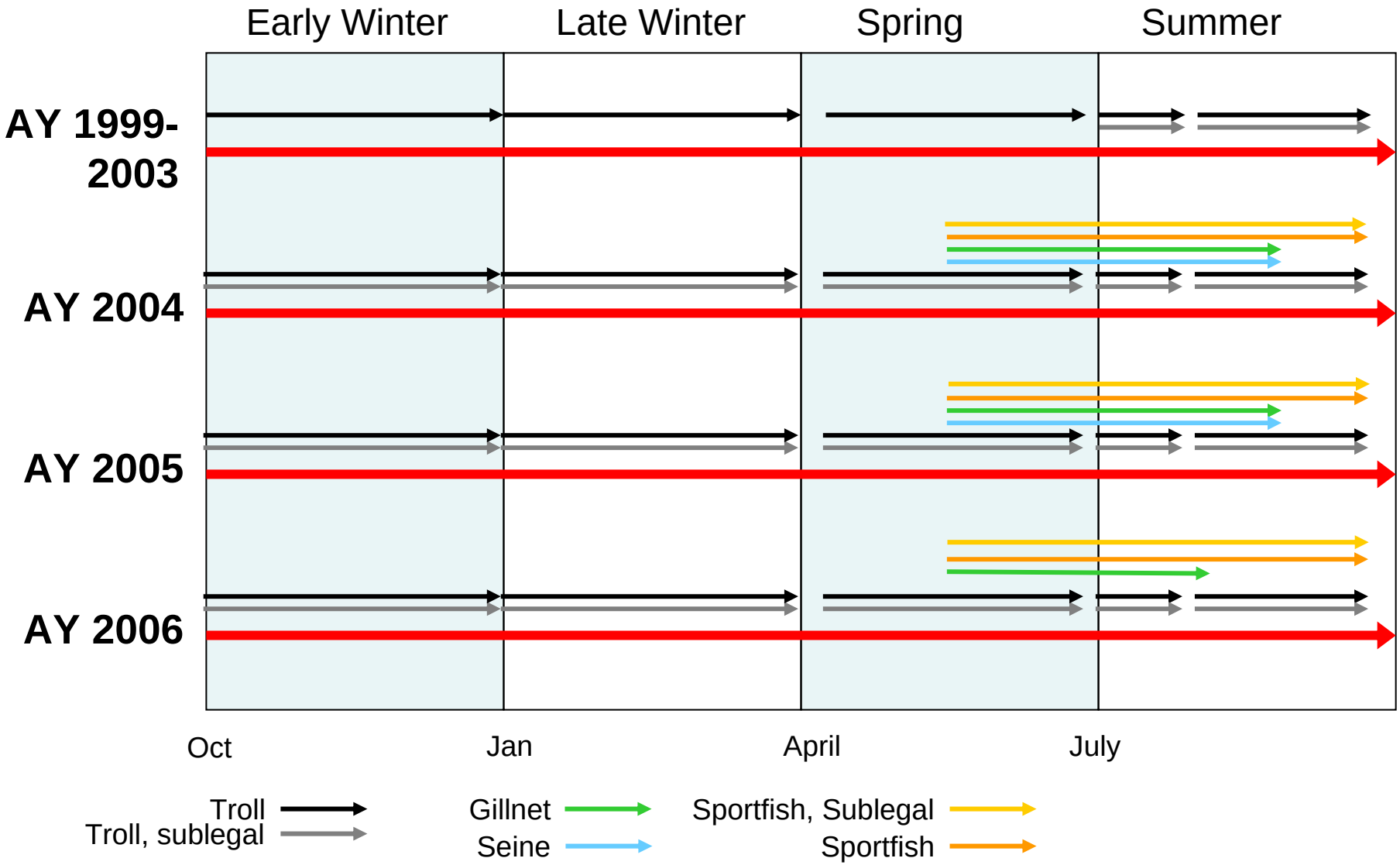
1999-2006

Fishing Seasons:

October-December
January-April 14
April 15-June
July-September

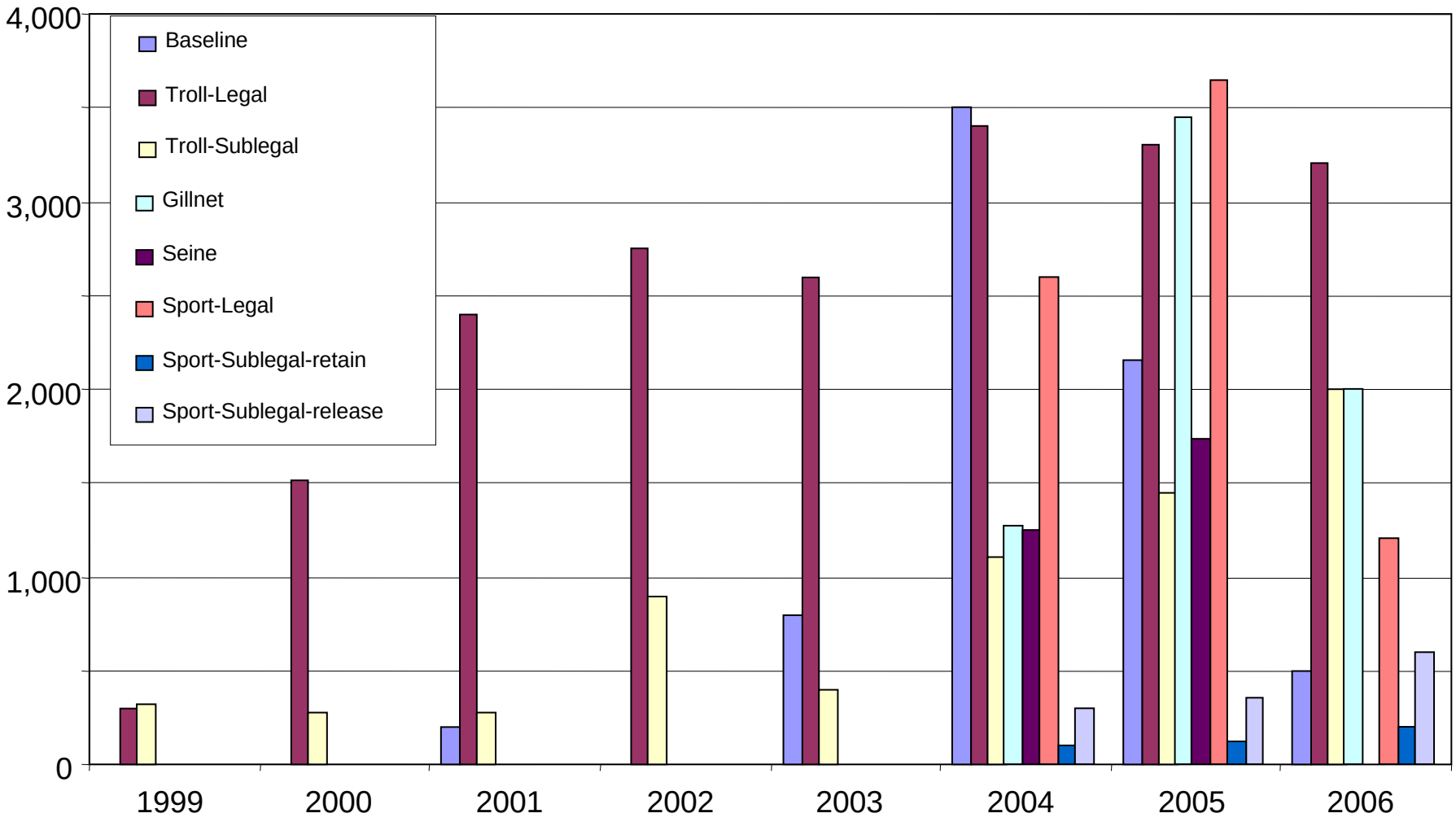
Legal-sized Chinook (>28 in)
Sublegal Chinook (<28 in)

Sampling of SE Alaska Chinook Fisheries



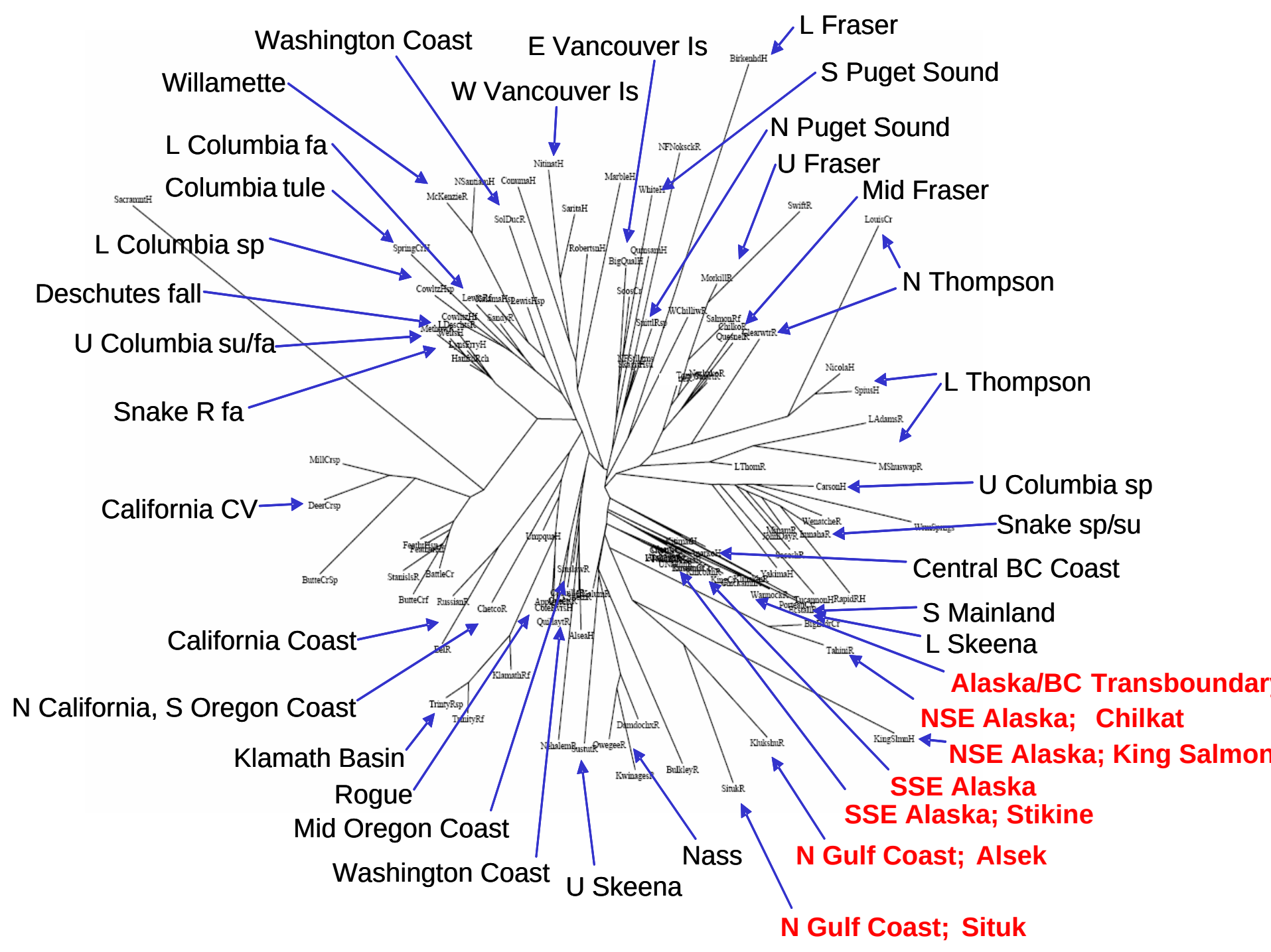
SE Alaska Chinook sampling effort

1999 - 2006



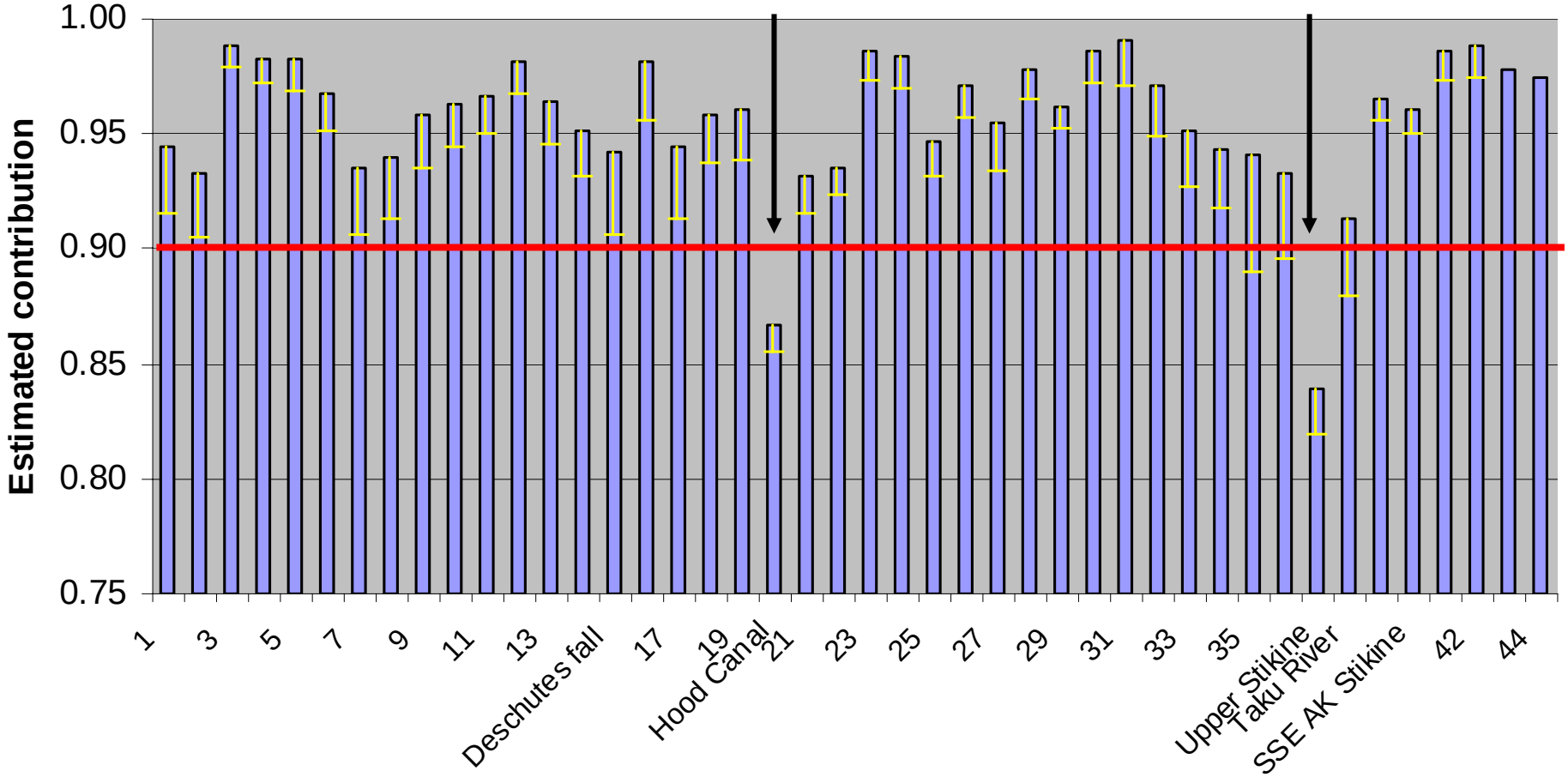
What are the questions?

- Composition of catch spatially, temporally within and among years:
  - Troll
  - Sport
  - Gillnet, seine
- Sublegal vs. legal sized


Washington Coast
E Vancouver Is
L Fraser
Willamette
W Vancouver Is
S Puget Sound
N Puget Sound
L Columbia fa
U Fraser
Columbia tule
Mid Fraser
L Columbia sp
N Thompson
Deschutes fall
U Columbia su/fa
L Thompson
Snake R fa
U Columbia sp
California CV
Snake sp/su
Central BC Coast
S Mainland
L Skeena
California Coast
Alaska/BC Transboundar
N California, S Oregon Coast
NSE Alaska; Chilkat
NSE Alaska; King Salmon
Klamath Basin
SSE Alaska
Rogue
SSE Alaska; Stikine
Mid Oregon Coast
N Gulf Coast; Alsek
Washington Coast
Nass
U Skeena
N Gulf Coast; Situk

100% sim results (SPAM)

GAPS version 2.1



Options:

1) Add more individuals and/or populations
2) Add more genetic markers
3) Combine with a genetically similar group

Challenges
Study Design

- Sampling difficulties
  - Coordinating proportional sampling in diverse and remote ports across SEAK
- Improvement of markers
  - 1999 – 2003, Allozymes
  - 2004 – present, Microsatellites

Troll Legal Sampling Design
2007

Port	Early Winter	Late Winter	Spring	Summer
	October 11 – Dec. 31	January 1 – April 14	May 1 – June 30	July 1 – September 30 1st ret./ 2nd ret.
Sitka	400	350	300	300/300
Yakutat	30	30		30/30
Juneau	30	30	200	
Port Alexander				60/60
Elfin Cove				30/30
Pelican				30/30
Hoonah			75	40/40
Wrangell			300	
Petersburg	25	40	100	60/60
Ketchikan	40	60	200	100/50
Craig	20	20		150/50
Projected totals	545	530	1175	800/650
Overall total	3975			

Troll Sampling Design
9 Ports

Size Class	Early Winter Oct 11 – Dec. 31	Late Winter Jan 1 – April 14	Spring May 1 – June 30	Summer July 1 – Sept 30
Legal	550	550	1200	1500
Sublegal	400	400	400	**Project Ended**

Overall total	Legal	3800
	Sublegal	1200

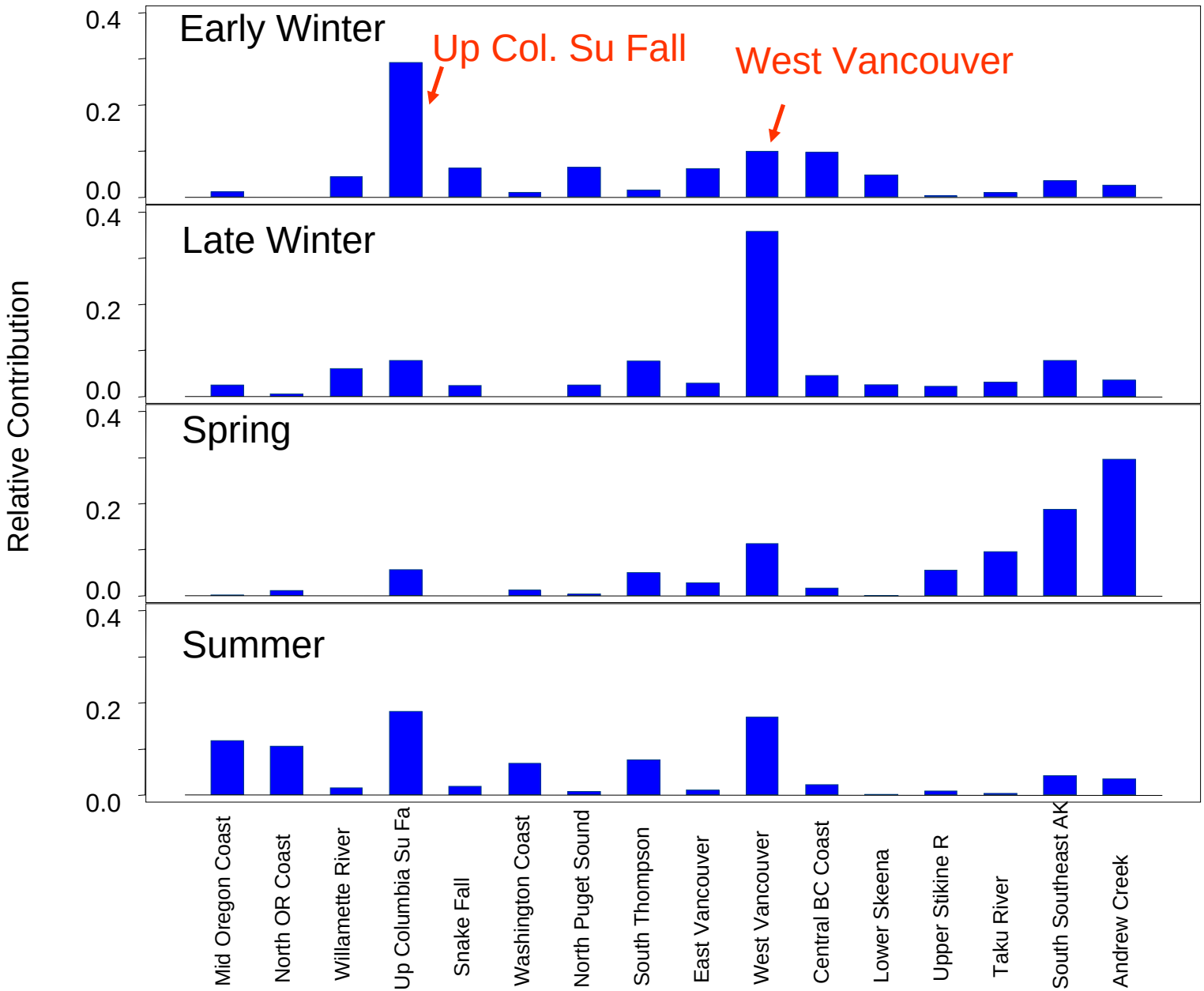
Sport Fish Sampling Design
11 Ports

Size	Northern Inside	Northern Outside	Central	South
Legal	400	500	300	300
Sublegal	110	200	80	210
Overall totals	Legal Sublegal	1500 600		

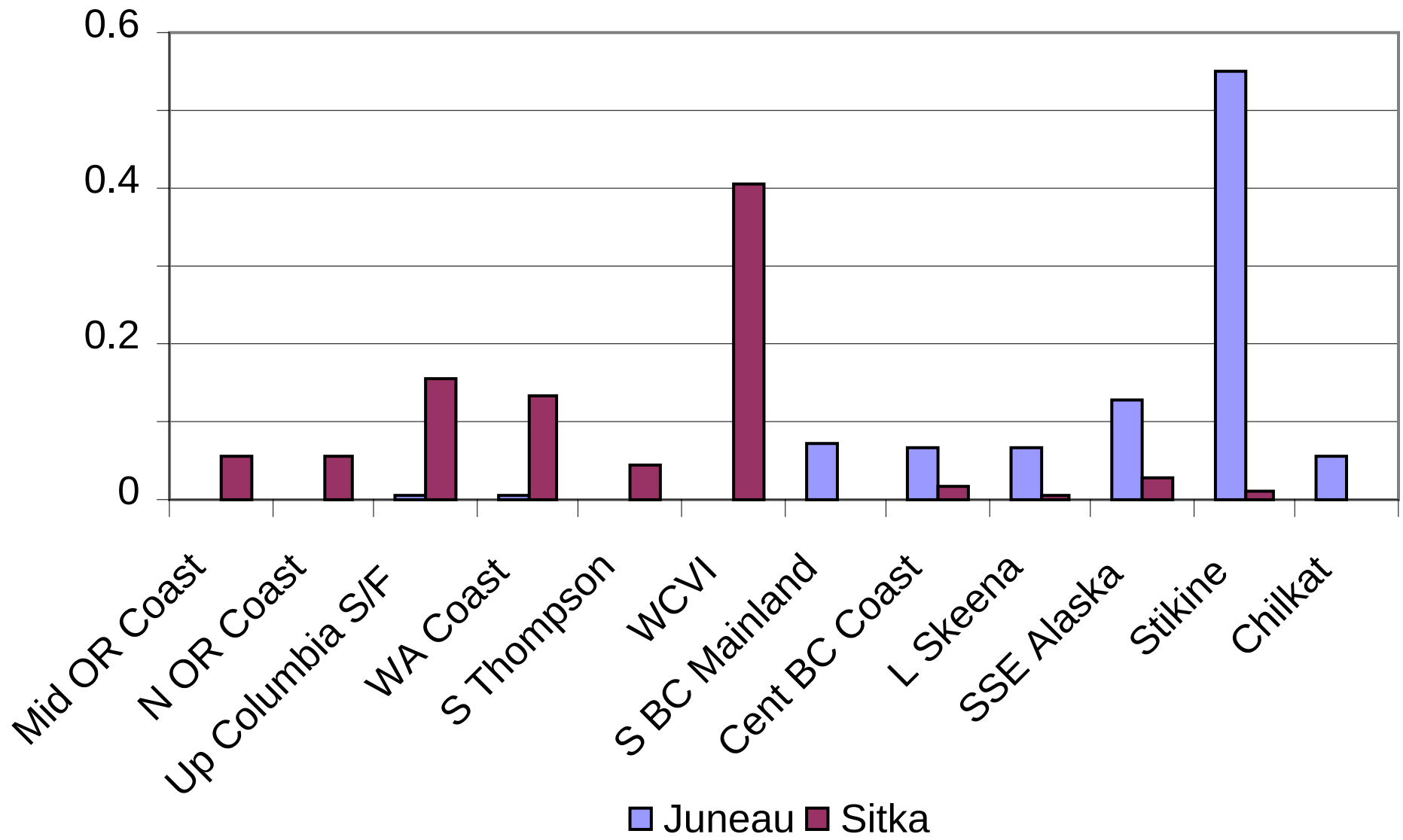
Gillnet Fishery Sampling Design

Area	District	Port	Goal	Weekly Sampling Rate
Stikine	108	Petersburg	440	40 fish per week
		Wrangell	880	80 fish per week
			1320	
Taku Inlet	111	Juneau	880	80 fish per week
		Total	**2200**	

SE Alaska Troll Fishery 2004

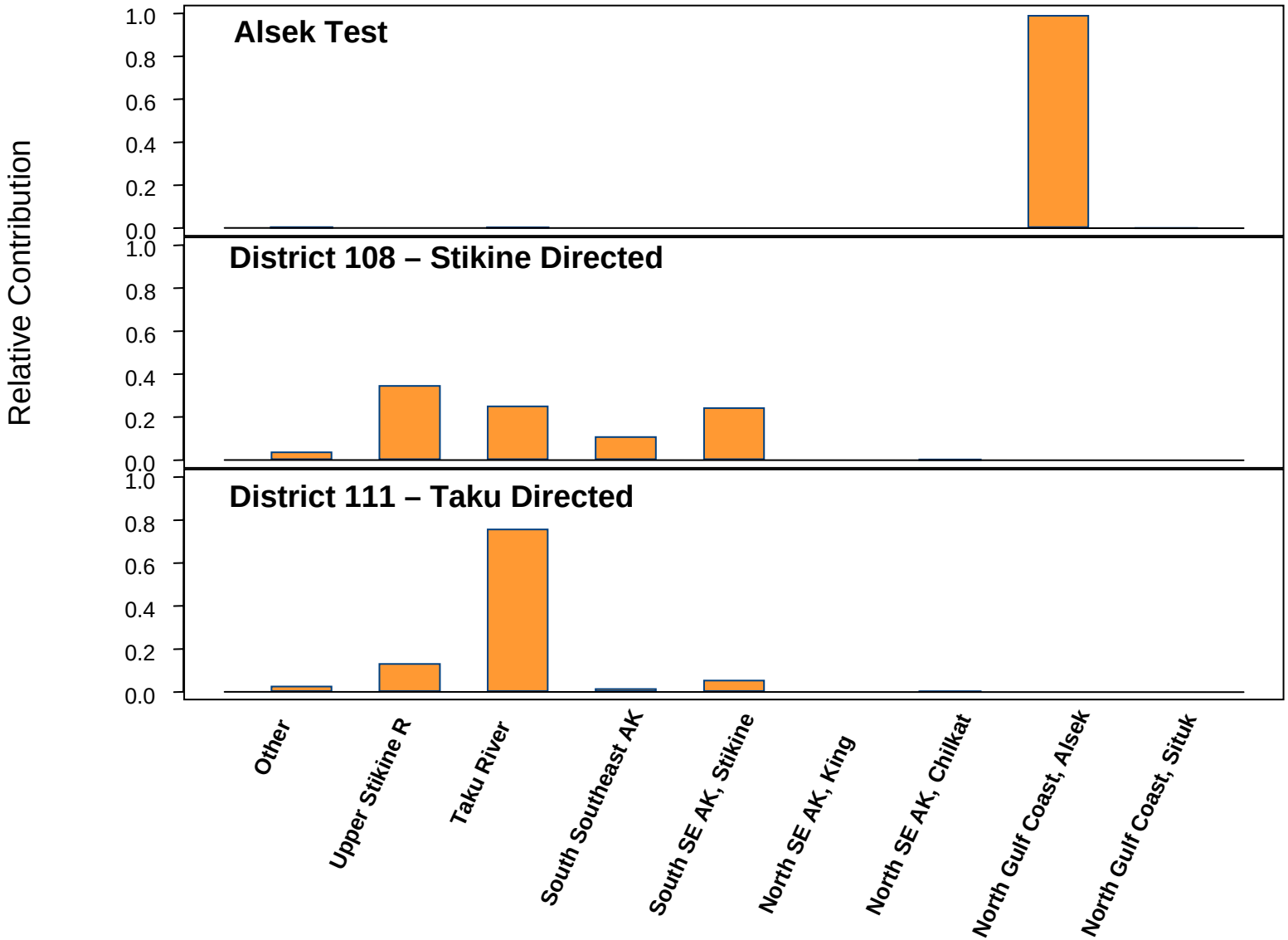


SE Alaska Sport Fishery
2004 after July 1



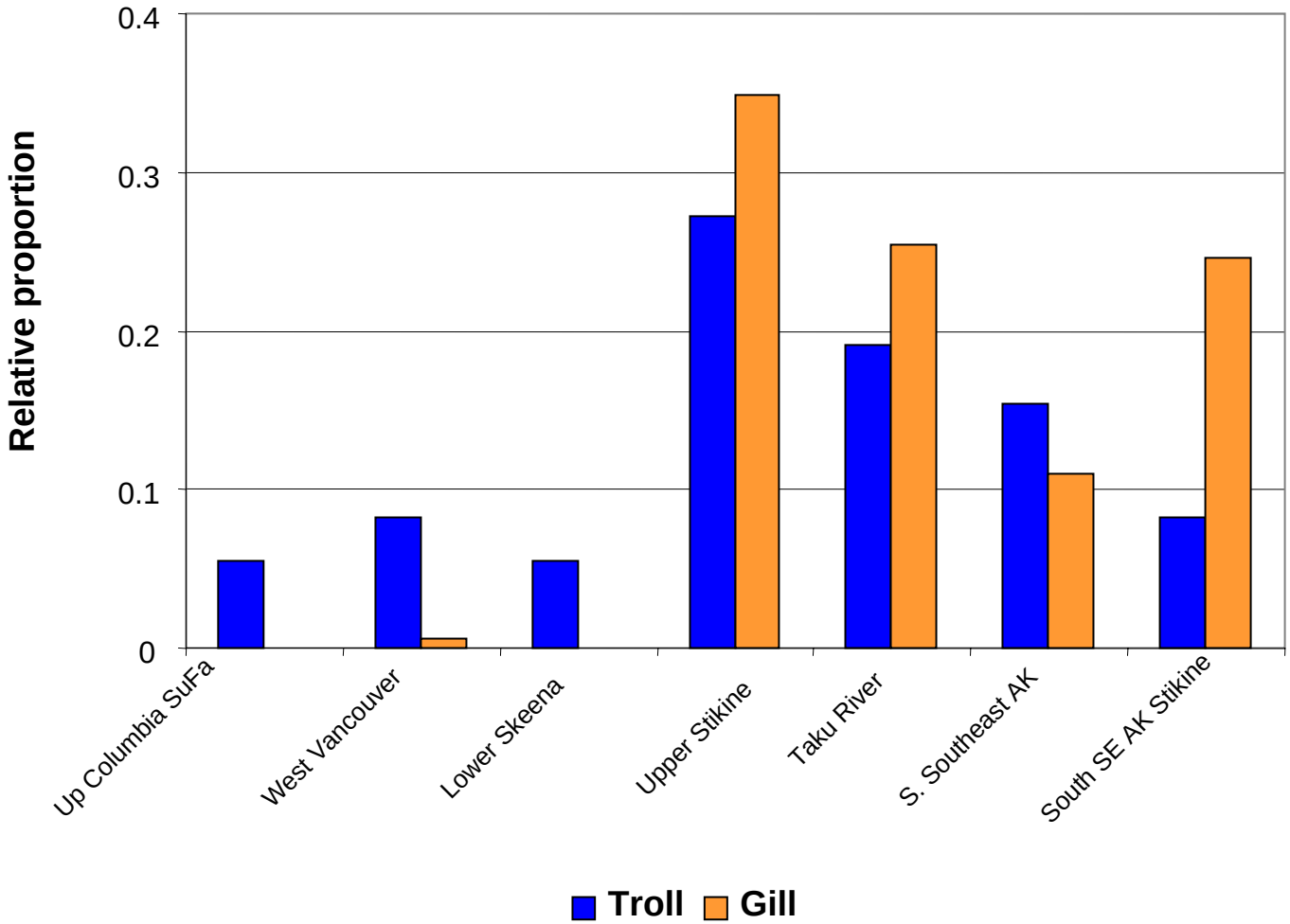
Local Gillnet Fisheries

2005



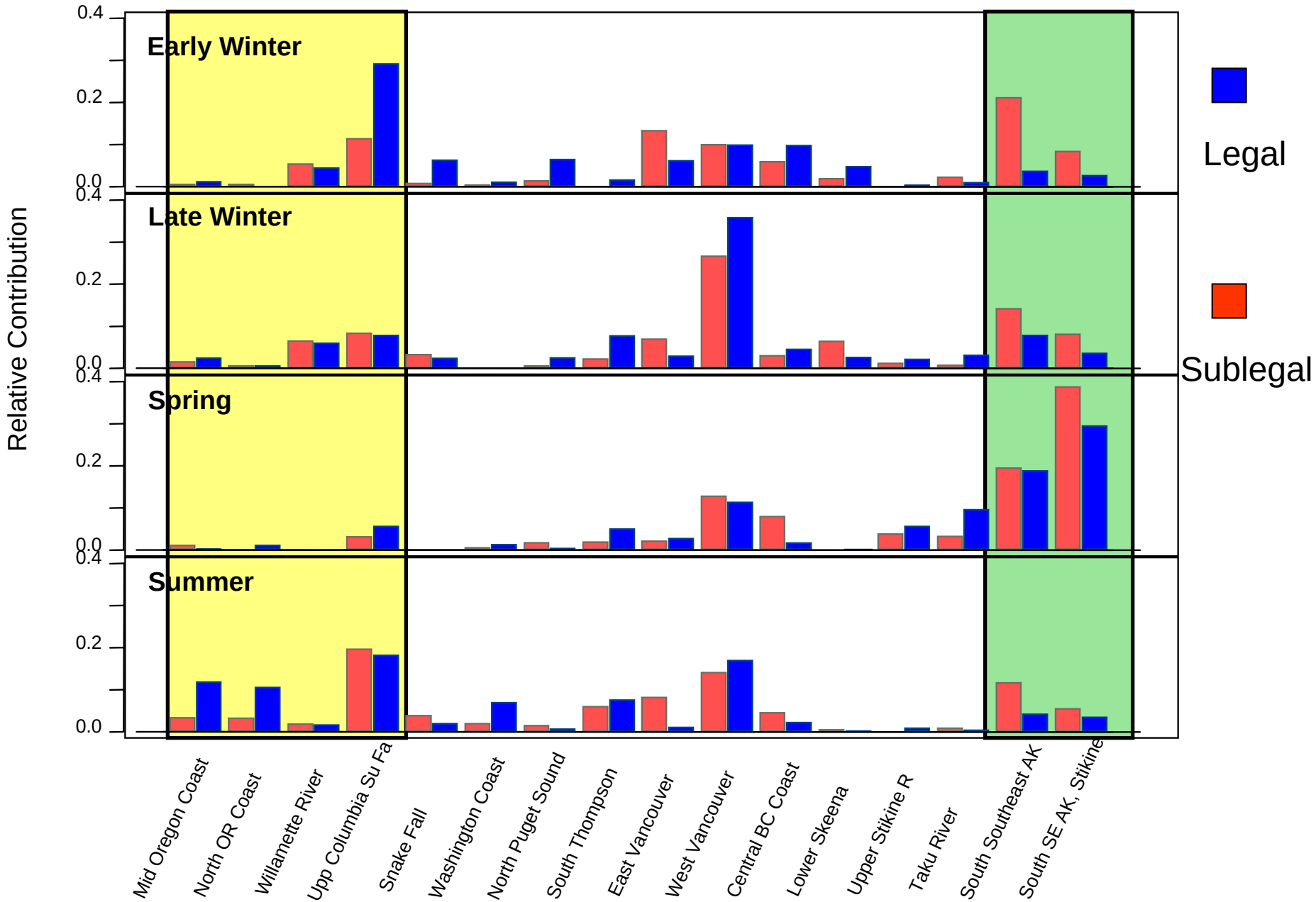
District 108 Directed Fishery - Stikine

2005 Troll vs. Gillnet



Legal and Sublegal Composition - Troll Fishery

Within 2004 Across Fisheries

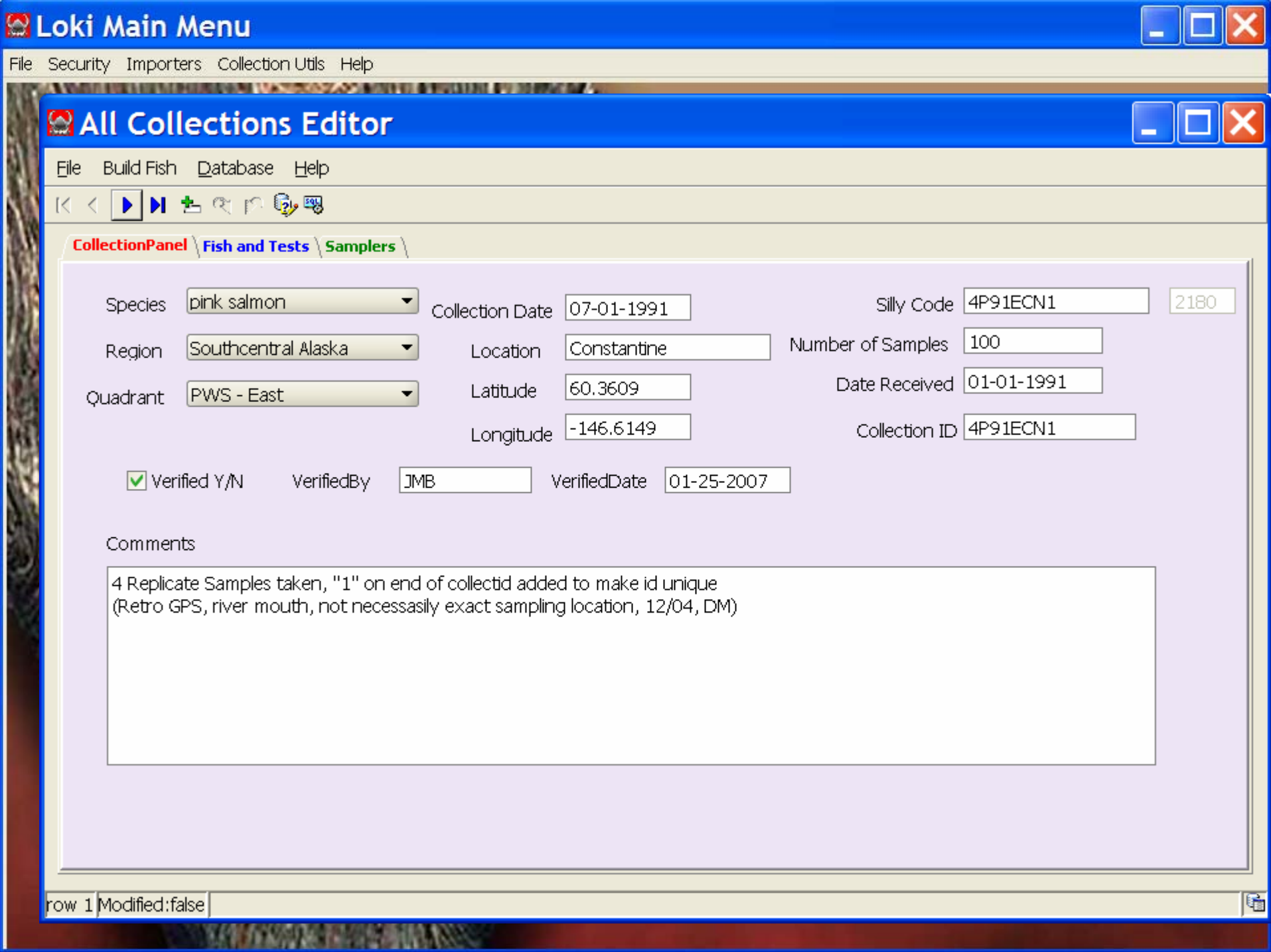


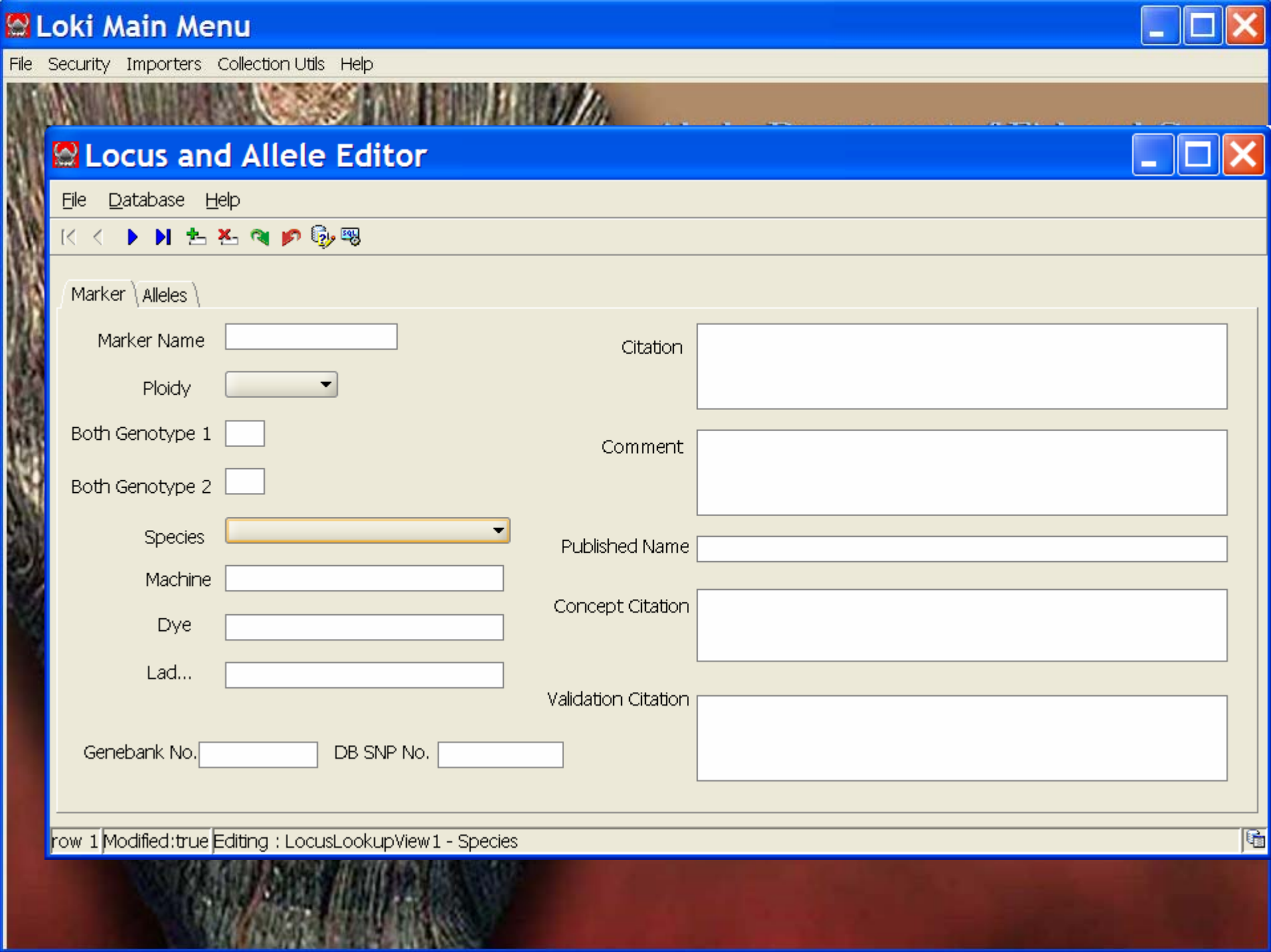
ADFG Priorities

- Database development
  - Web accessible PSC GAPs database
  - Within laboratory—LOKI
- Development of high resolution genotyping
  - With Kalinowski/Taper from Montana State Univ.
    - *"Statistical methods to improve genetic stock identification" funded by US LOA*
- Conversion to SNPs
  - ADFG has converted all GSI applications to SNPs except SEAK Chinook
    - Pacific Rim Chinook, chum, sockeye
  - Improve automation, multiplexing, reduced costs

LOKI—Within Laboratory Database

- Control and error checking for:
  - Loci
  - Alleles
  - Collections/individuals
- Directly imports from multiple instruments
  - NO “cut and paste” or manual alignments
- Built in QC abilities
  - ADFG reruns 8% of scores
- Tracks metadata, tissue collections, extractions
- 5.5 million genotypes in ADFG database


Loki Main Menu
File Security Importers Collection Utils Help
All Collections Editor
File Build Fish Database Help
CollectionPanel Fish and Tests Samplers
Species pink salmon
Region Southcentral Alaska
Quadrant PWS - East
Collection Date 07-01-1991
Location Constantine
Latitude 60.3609
Longitude -146.6149
Silly Code 4P91ECN1
2180
Number of Samples 100
Date Received 01-01-1991
Collection ID 4P91ECN1
Verified Y/N
VerifiedBy JMB
VerifiedDate 01-25-2007
Comments
4 Replicate Samples taken, "1" on end of collectid added to make id unique
(Retro GPS, river mouth, not necessasily exact sampling location, 12/04, DM)
row 1
Modified:false


Loki Main Menu
File Security Importers Collection Utils Help
Locus and Allele Editor
File Database Help
Marker Alleles
Marker Name
Ploidy
Both Genotype 1
Both Genotype 2
Species
Machine
Dye
Lad...
Genebank No.
DB SNP No.
Citation
Comment
Published Name
Concept Citation
Validation Citation
row 1 Modified:true Editing : LocusLookupView1 - Species

Loki Main Menu

File Security Importers Collection Utils Help

Alaska Department of Fish and Game

LOKI Importers - Main Menu

File Excel Help

SNP Importer

QC

mSAT Text Import

Silly

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- Conversion to SNPs nearly complete
  - GSI applications converted to SNPs except SEAK Chinook
  - Highly automated, cost-efficient
  - Low error rate

ADFG Priorities
Development of high resolution genotyping

- PIs Kalinowski/Taper from Montana State Univ., Templin ADFG
    - *"Statistical methods to improve genetic stock identification" funded by US LOA*
- Objectives
  - Refine methods to estimate contribution of low freq stocks
  - Identification of the source of estimation error in mixtures
  - Incorporate improvements into GMA computer program

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  - Within laboratory—LOKI
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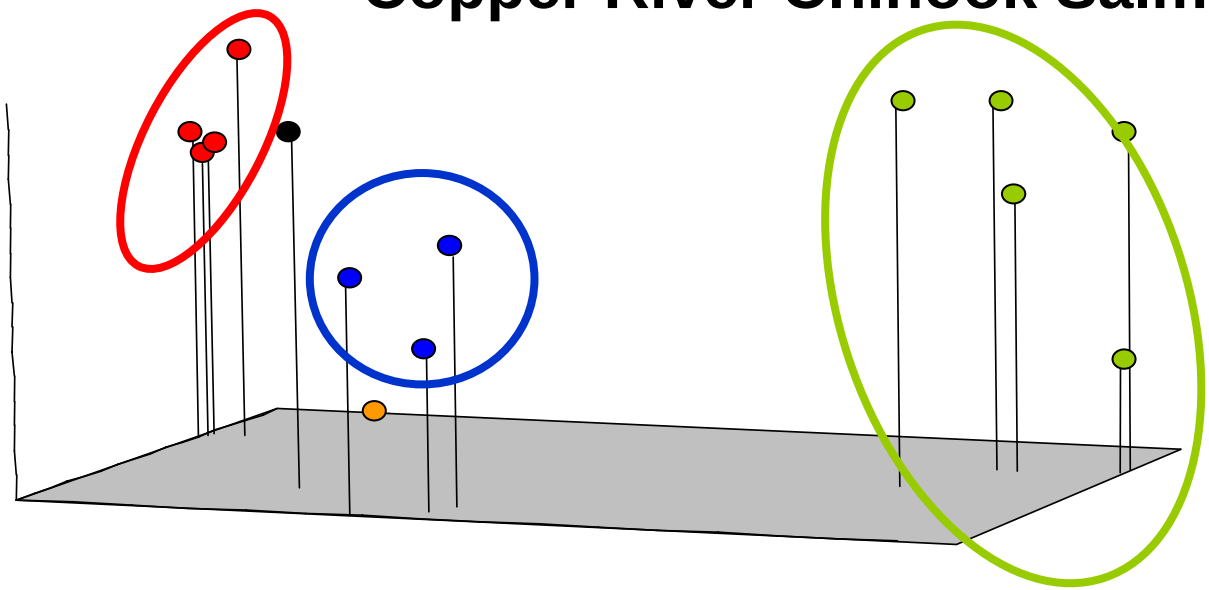
- Conversion to SNPs nearly complete
  - GSI applications converted to SNPs except SEAK Chinook
  - Highly automated, cost-efficient
  - Low error rate
  - Ease of standardization

SNPs

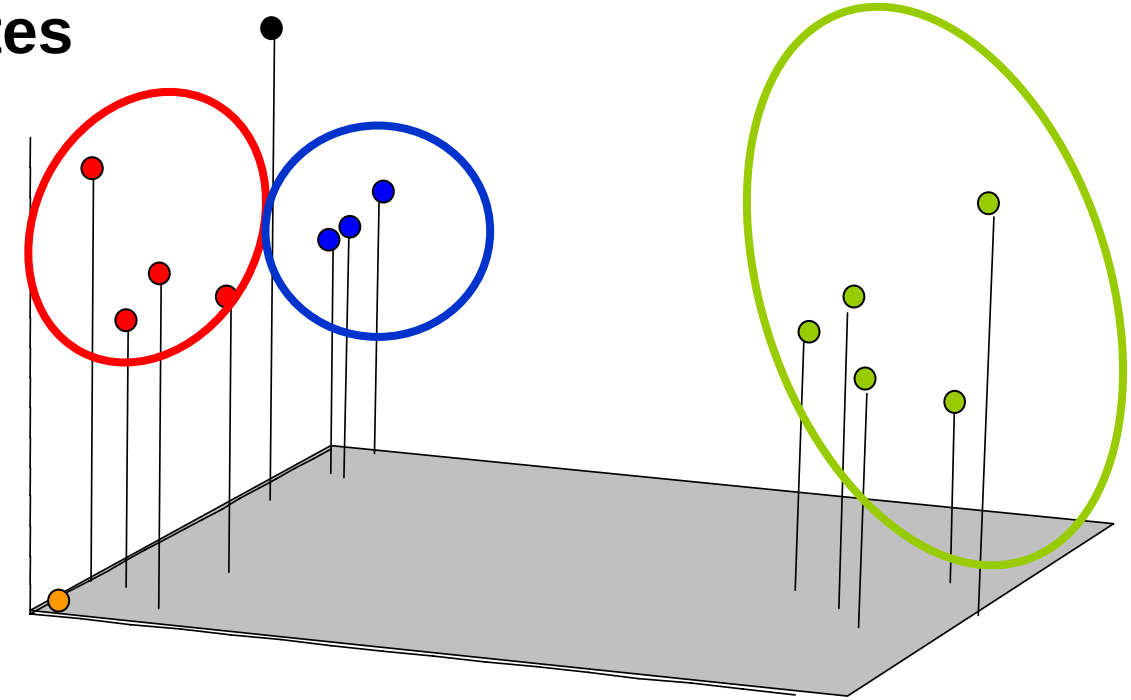
45 loci

Copper River Chinook Salmon



Microsatellites

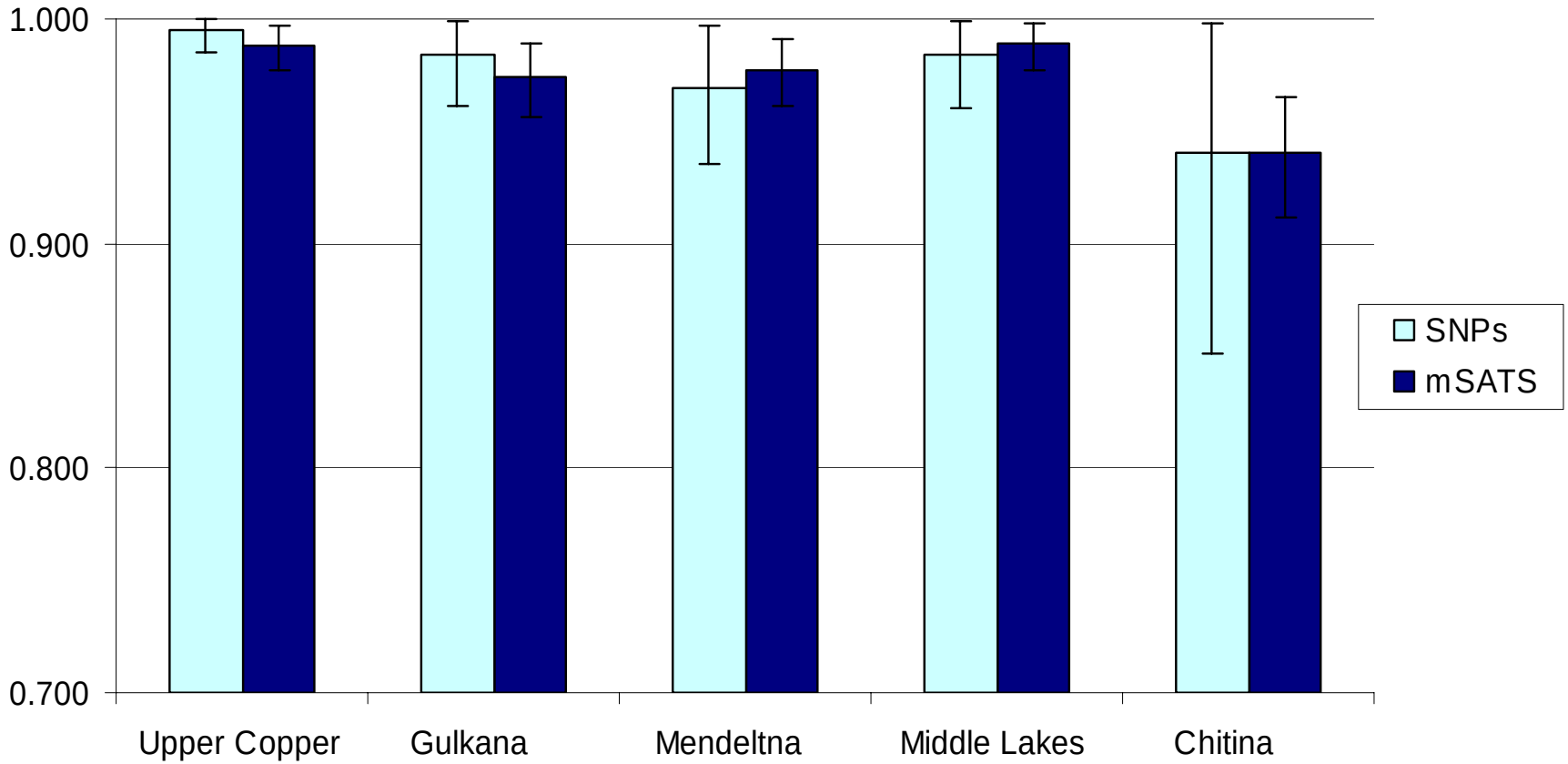
GAPs 13



High concordance in population structure

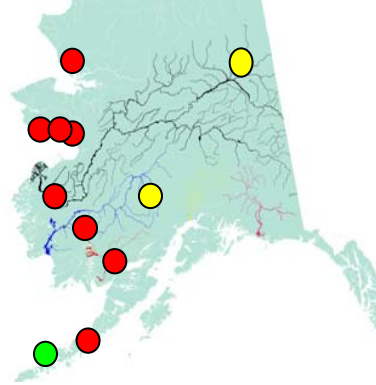
Genetic Markers for Stock Identification of Copper Chinook

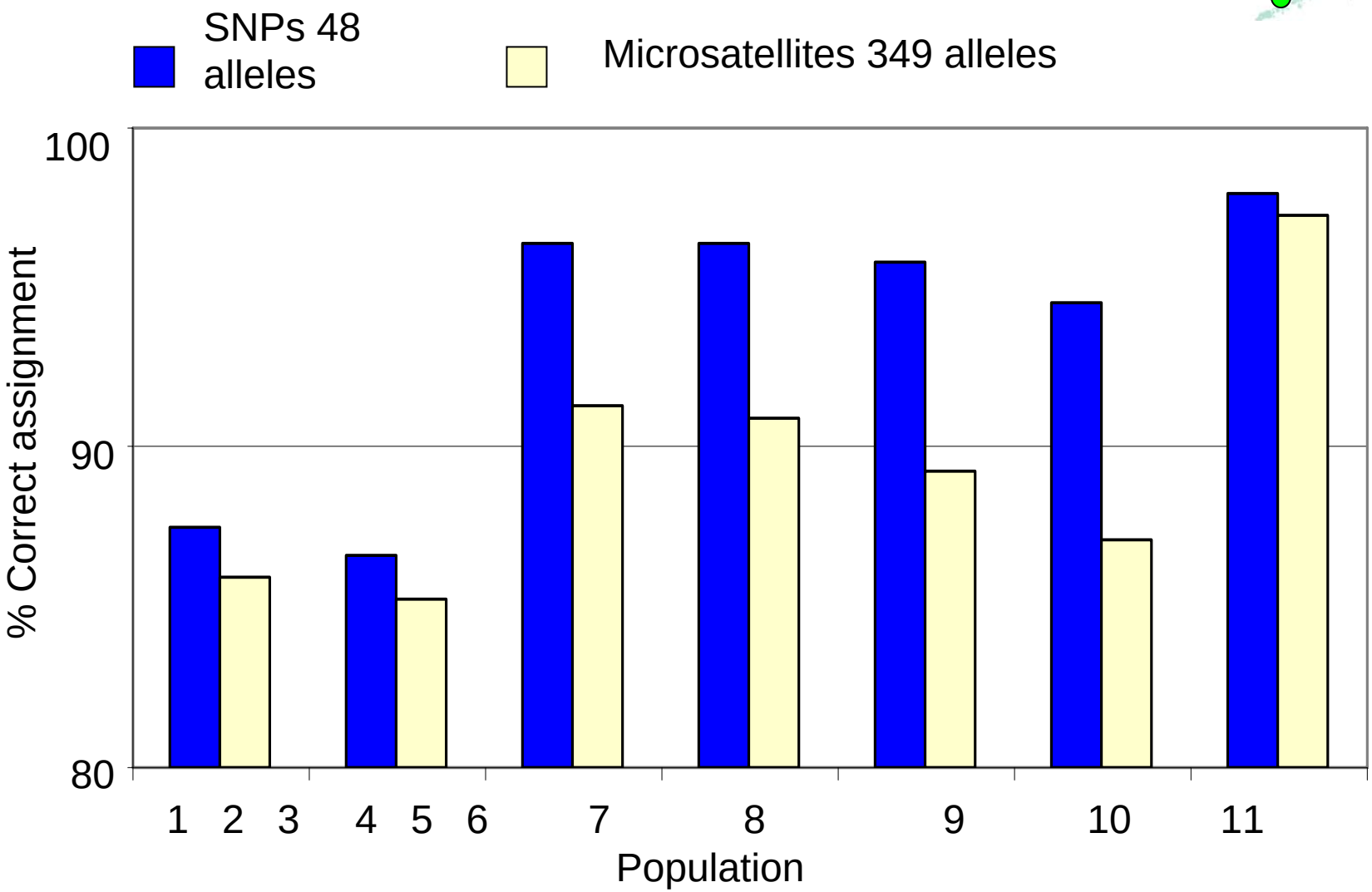
100% Simulations By Region



Alleles: 255 mSATS,
45 SNP loci

Accuracy of proportional assignments Chum Salmon





Cost of SNP Analyses

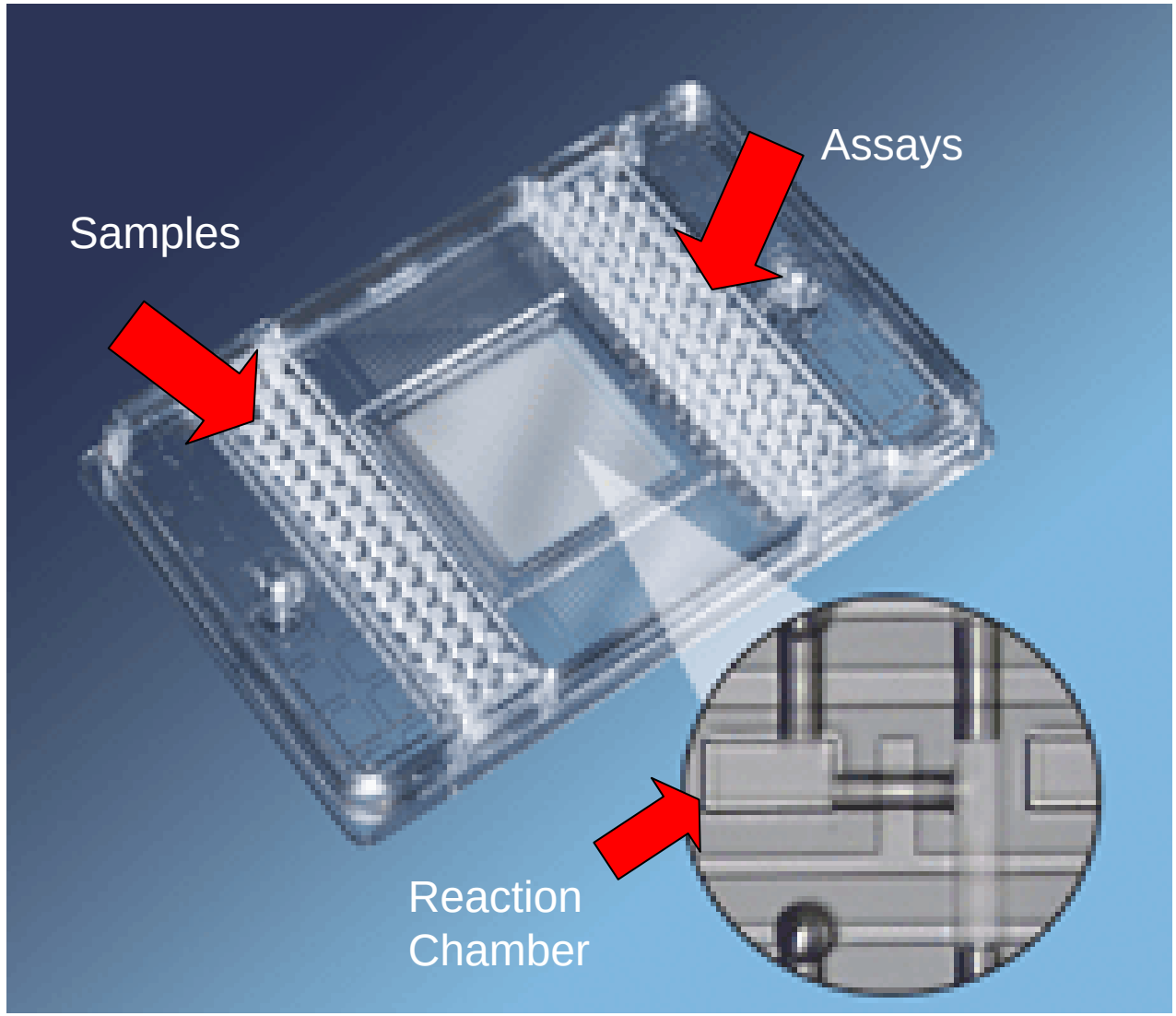
Reagents & Consumables

	Reaction volume	Cost/Genotype	Total cost (approx.)
96-well format, low volume purchasing	20 μL	$0.003 Plastics $0.710 TaqMan $0.827 Assay	$1.540
96-well format, high volume purchasing	20 μL	$0.003 Plastics $0.453 TaqMan $0.220 Assay	$0.676
384-well format, high volume purchasing	5 μL	$0.009 Plastics $0.113 TaqMan $0.055 Assay	$0.177

48.48 Dynamic Array

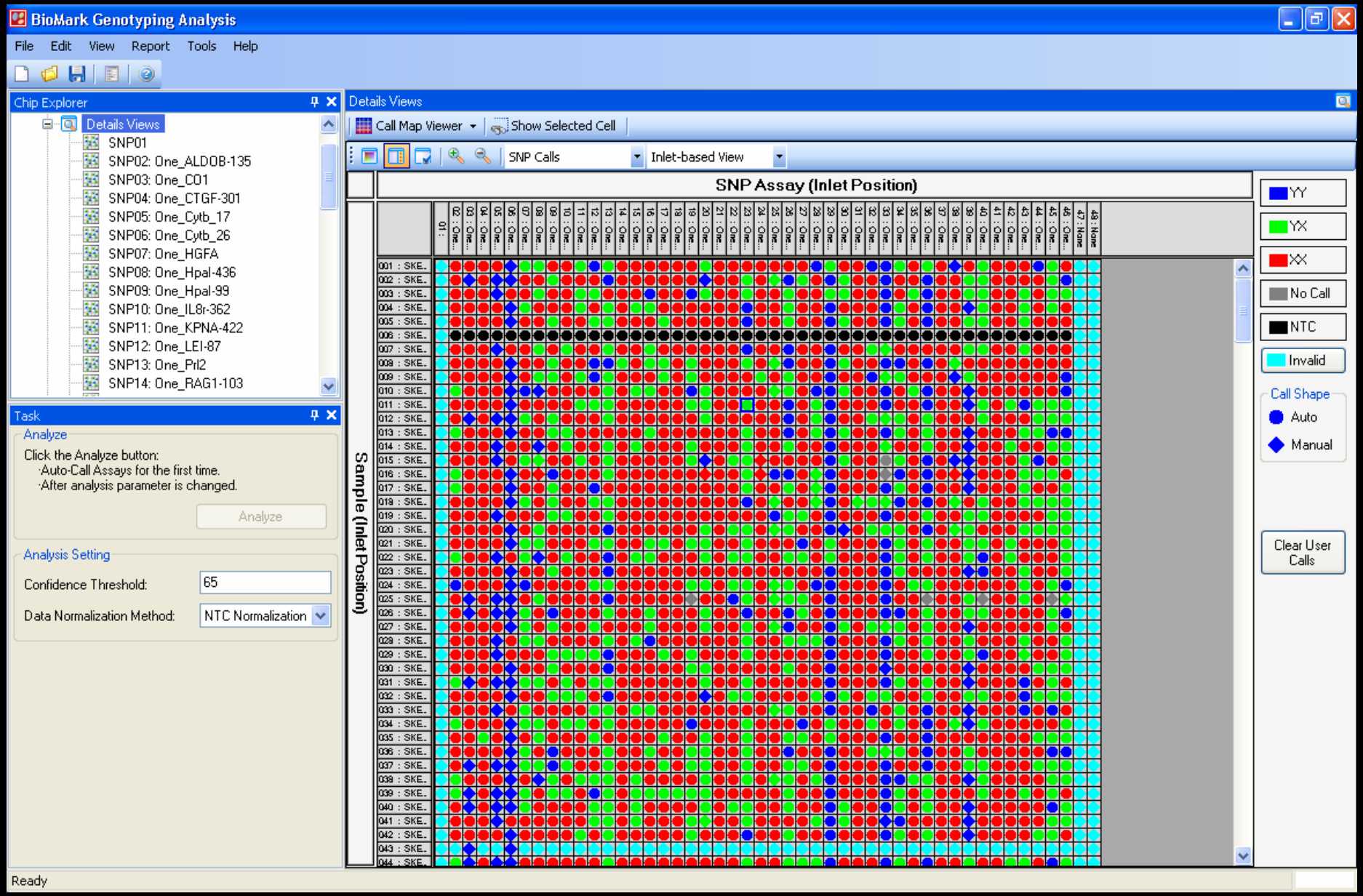
(48 samples X 48 assays)

10 nL reaction volume



2304 wells

Biomark Chip by Fluidigm



Biomark; 2304 wells

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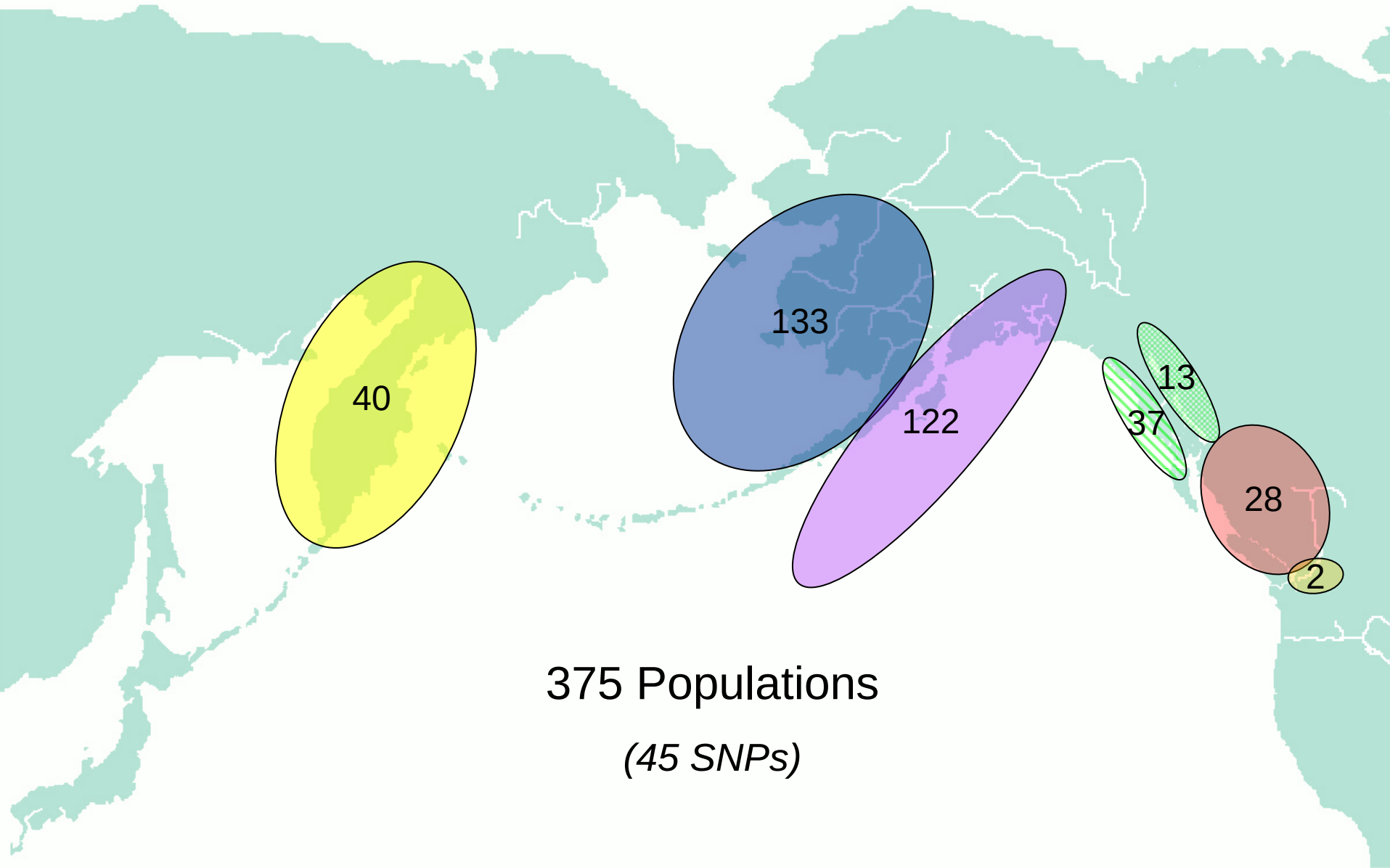
384-well format, high volume purchasing	5 μL	$0.009 Plastics $0.113 TaqMan $0.055 Assay	$0.177
Multiplex-48.48	10 nL	$0.102 Chip $0.002 TaqMan $0.001 Assay	$0.106

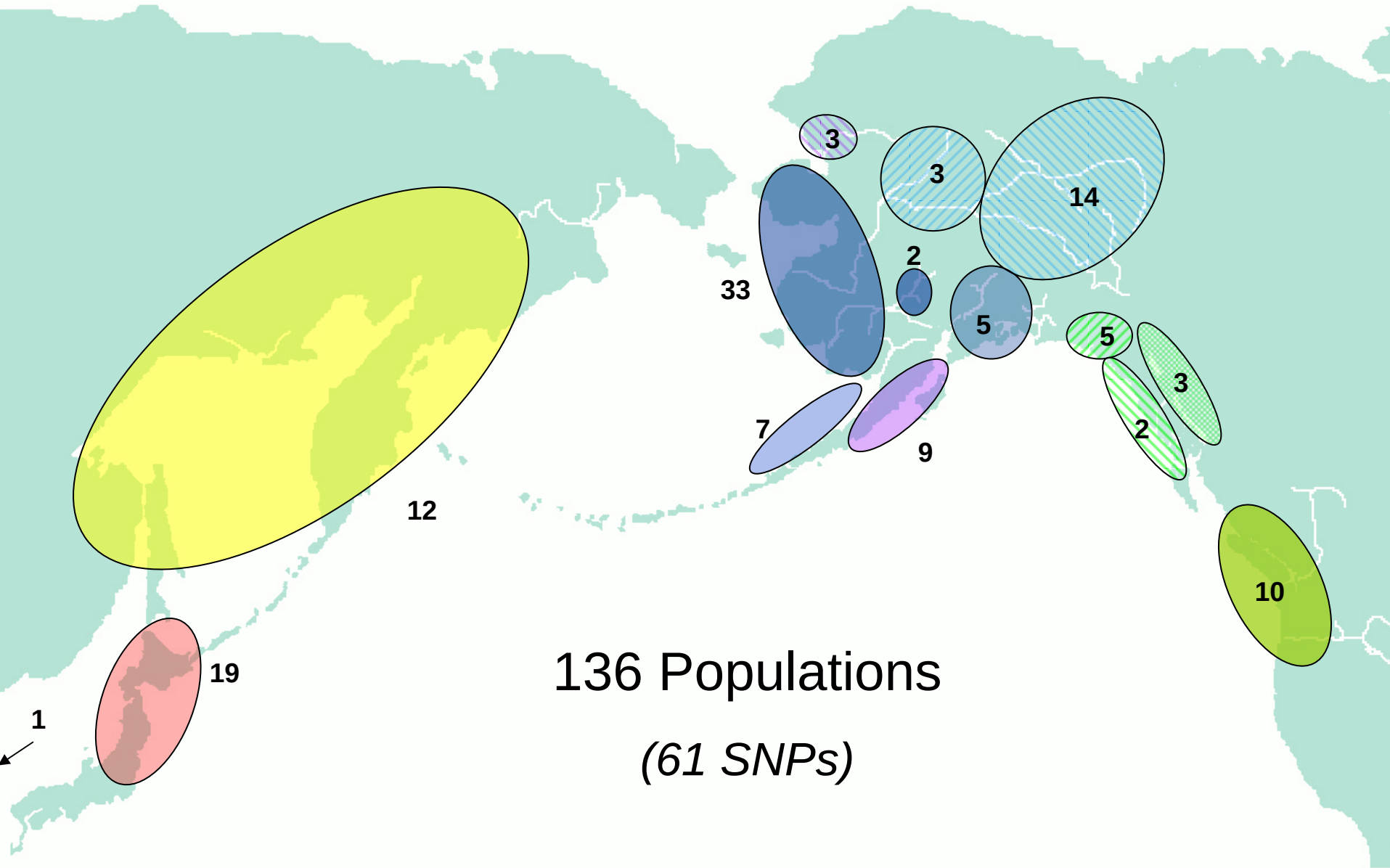
2007 Sockeye SNP Baseline



375 Populations

(45 SNPs)

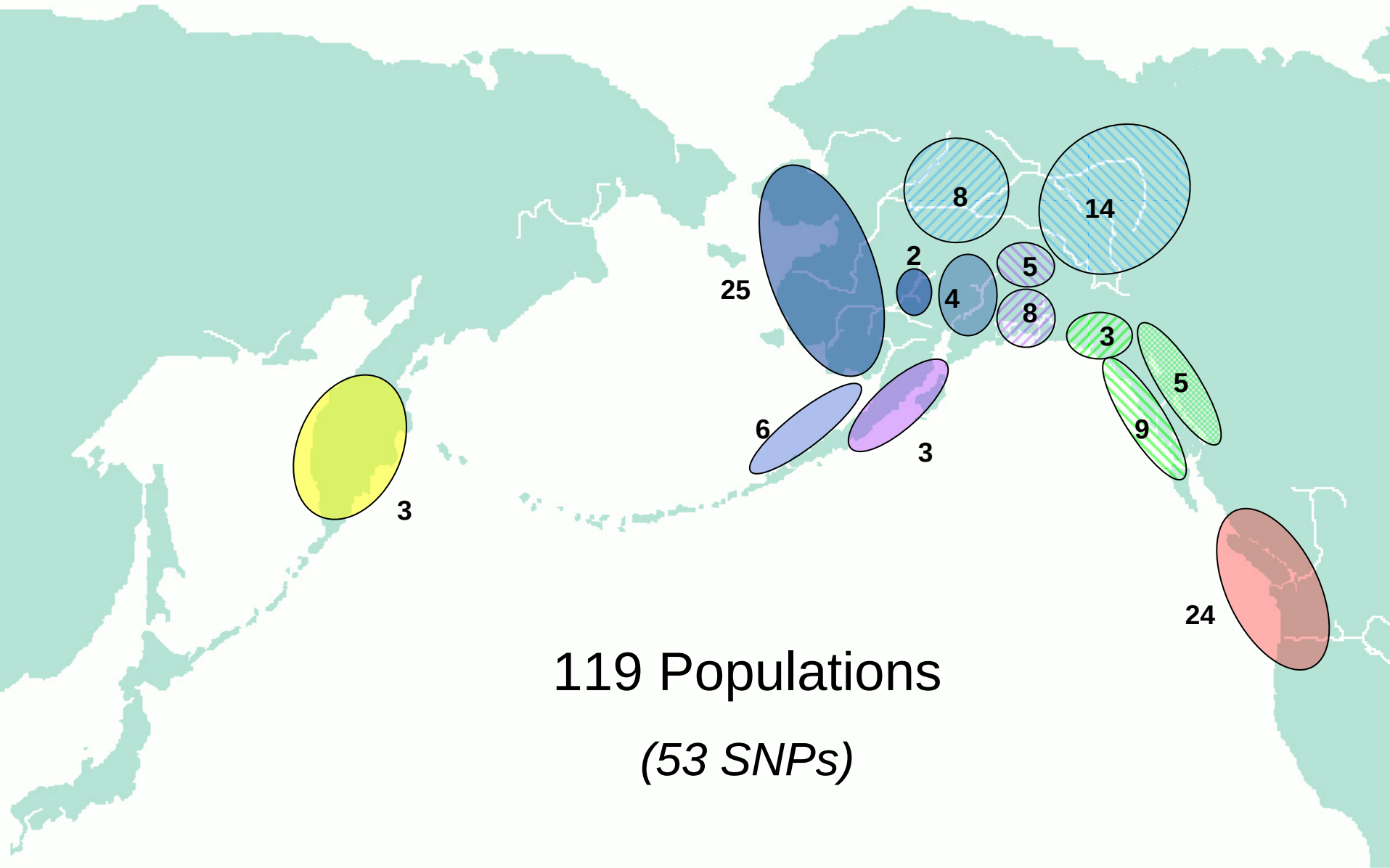
2007 Chum SNP Baseline



136 Populations

(61 SNPs)

2007 Chinook SNP Baseline

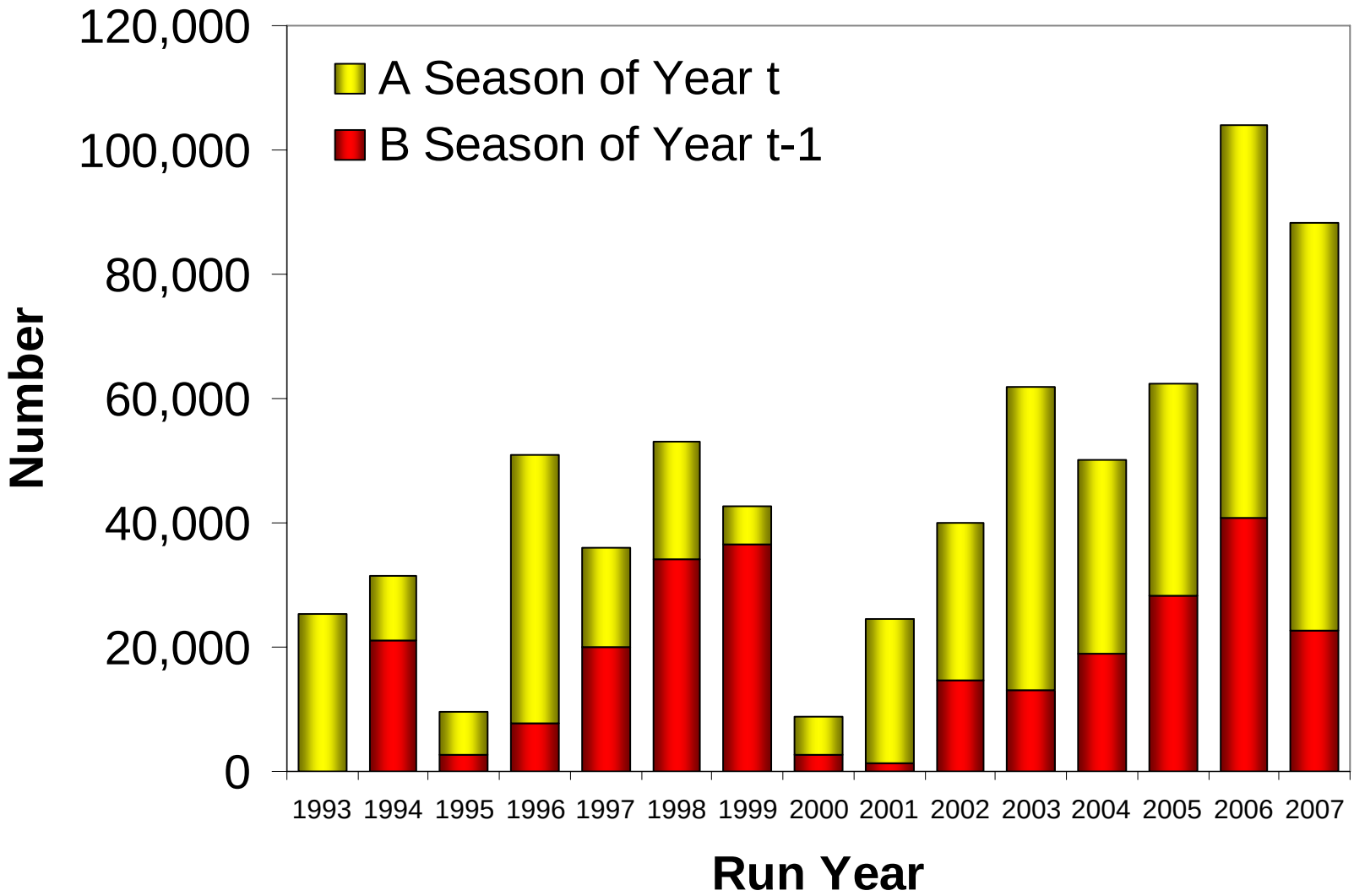


119 Populations

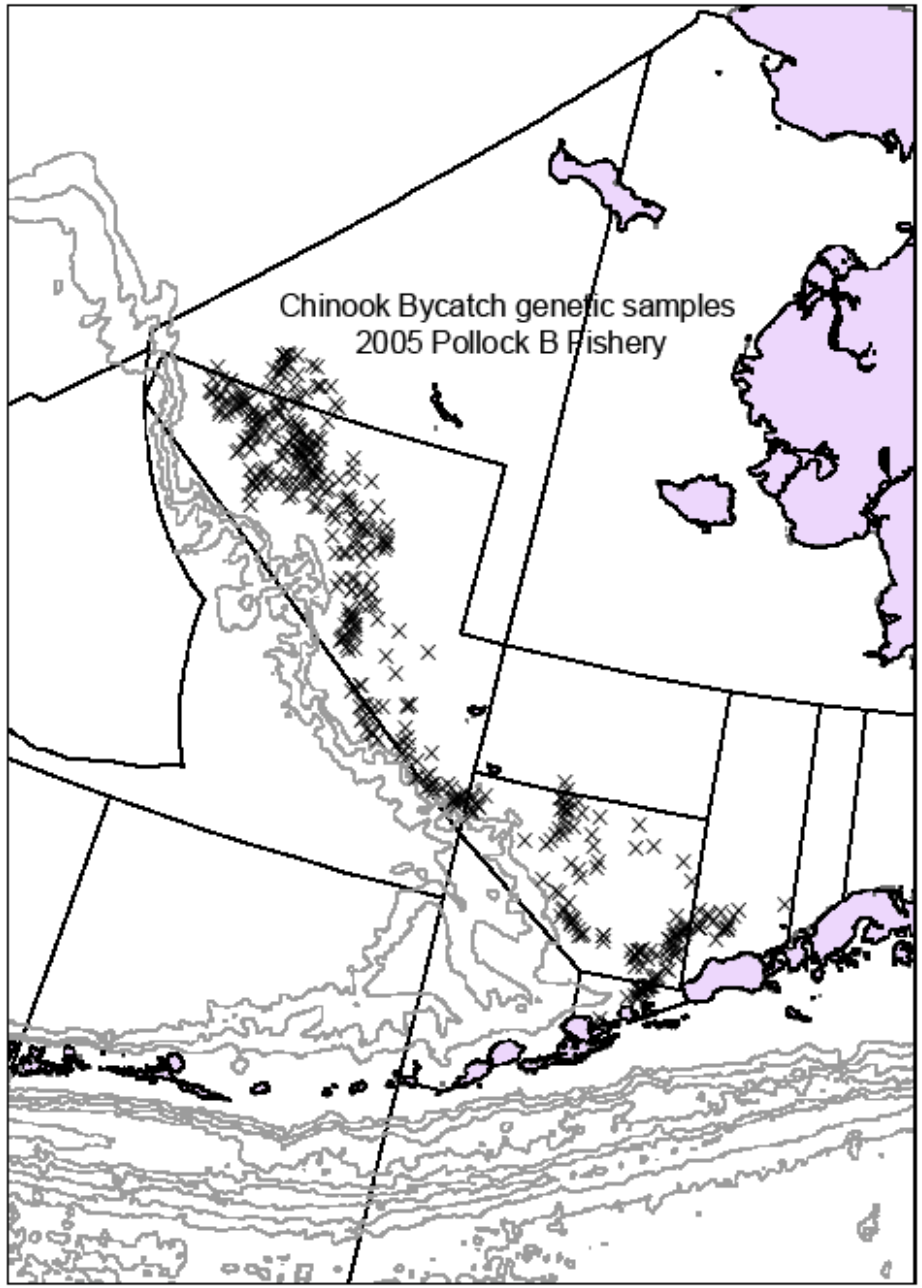
(53 SNPs)

BSAI Bycatch of Chinook salmon

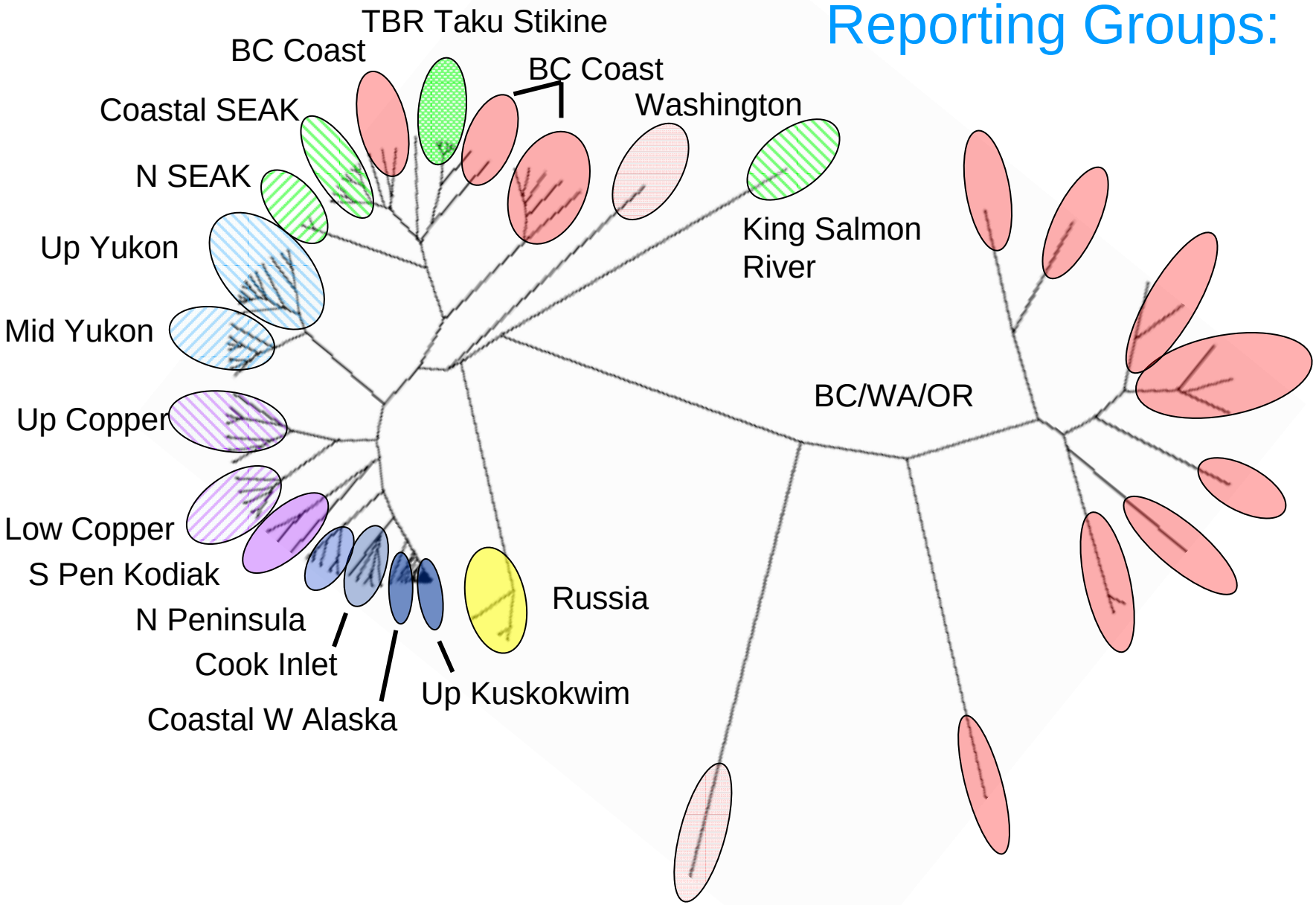
(by run year)



Origin of samples: 2005 Pollock B fishery

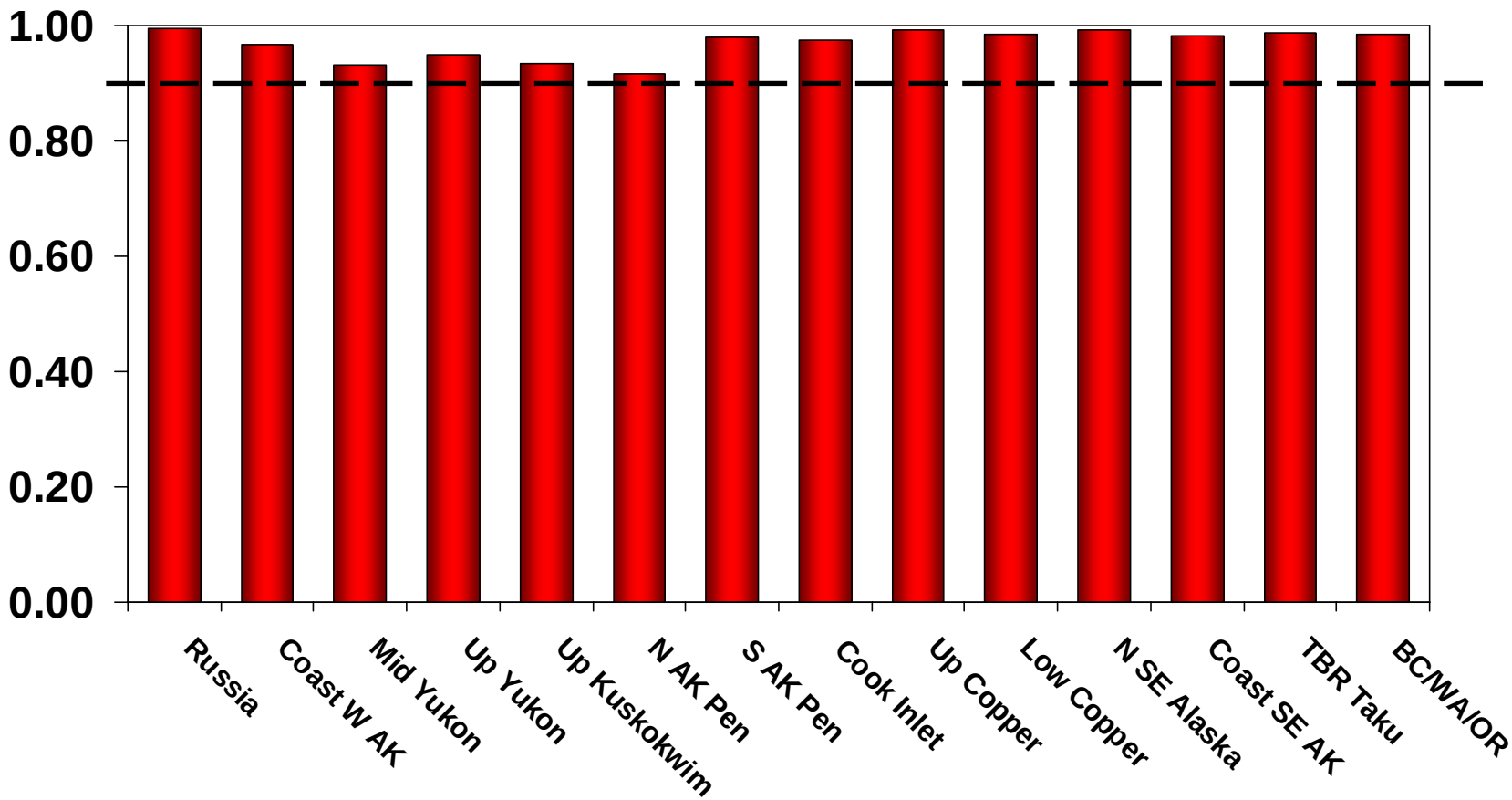


Broad-scale Reporting Groups:



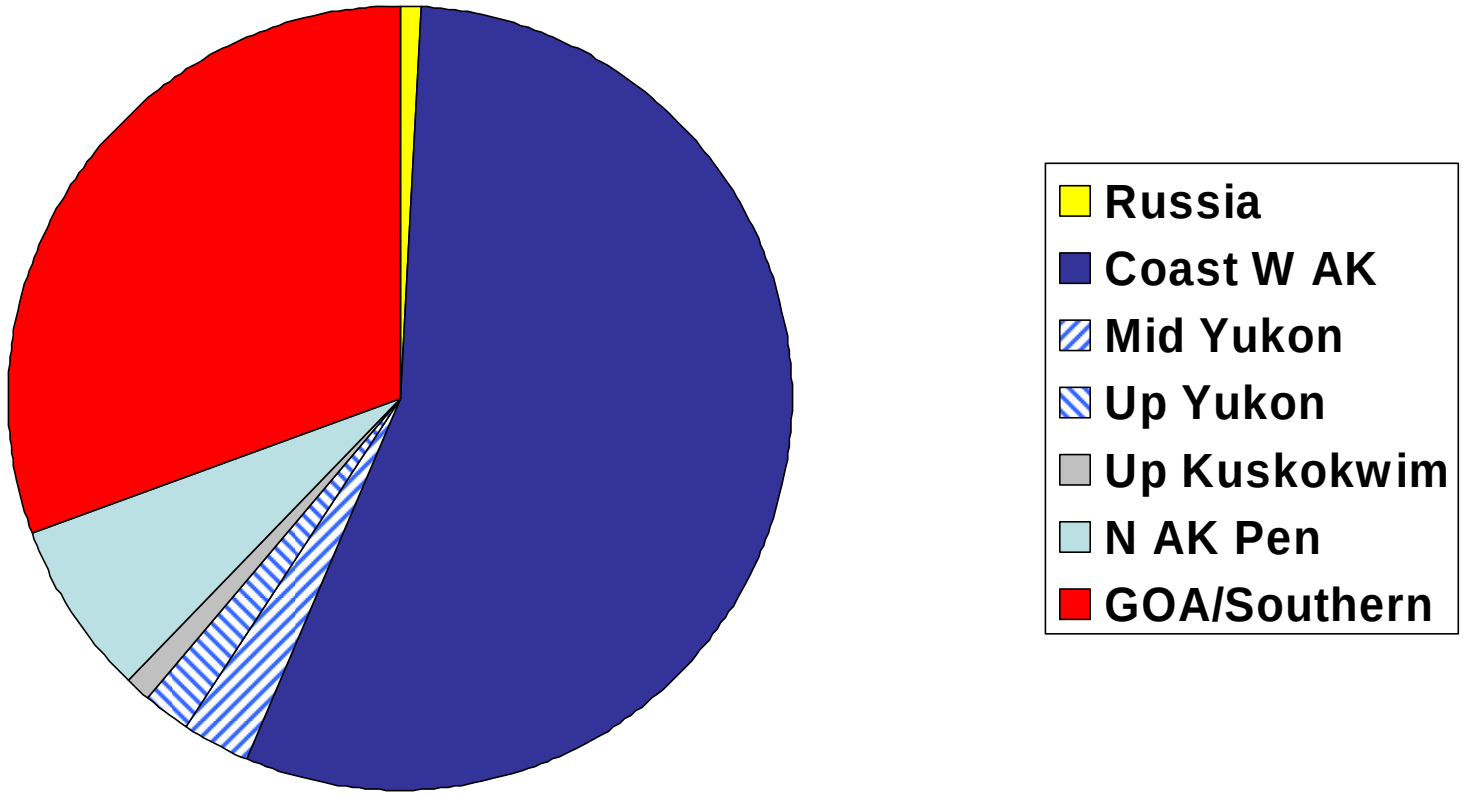
100% Simulations

(48 SNPs)



2005 B Season Estimates

(Composition of sample)



N = 887

GSI Applications in PSC ADFG Perspective

- Fishery sampling--extensive
  - Multiple strata---time, area, age, gear
  - Sample size adequate to provide resolution required by managers (control sampling error)
- Laboratory processing--highly automated, cost-efficient
  - Continued baseline improvement (control genetic error)
  - Very low genotyping error rate, extensive QC procedures
  - Robotics, barcoding, fast turnaround when needed
  - Coastwide labs will vary in processing power
    - Low throughput -- 10,000+ samples/year
    - High throughput (most efficient) -- 50,000+ samples/year
- Data processing
  - Statistical development to reduce effects of errors
  - Within- and among-laboratory databases

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Acknowledgements

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