Jun 21st, 2:30 PM - 2:50 PM

Estimating Salmon Escapement across the Snake River basin: a novel approach using PIT tags

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QCI

Chris Beasley
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Rick Orme
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Mike Ackerman
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Estimating Salmon Escapement across the Snake River basin: a novel approach using PIT tags

Fish Passage Conference – June 2017

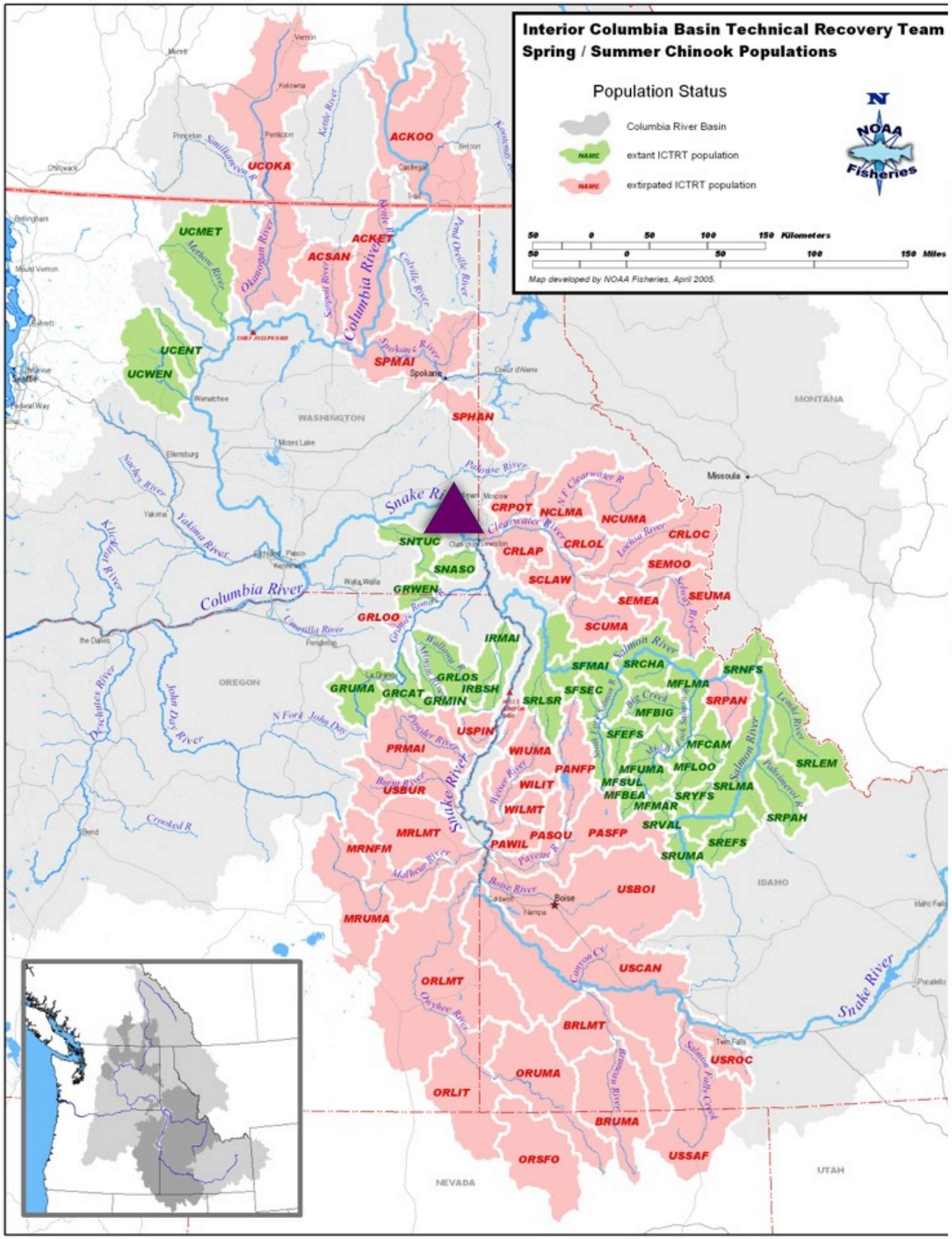
Presenter:

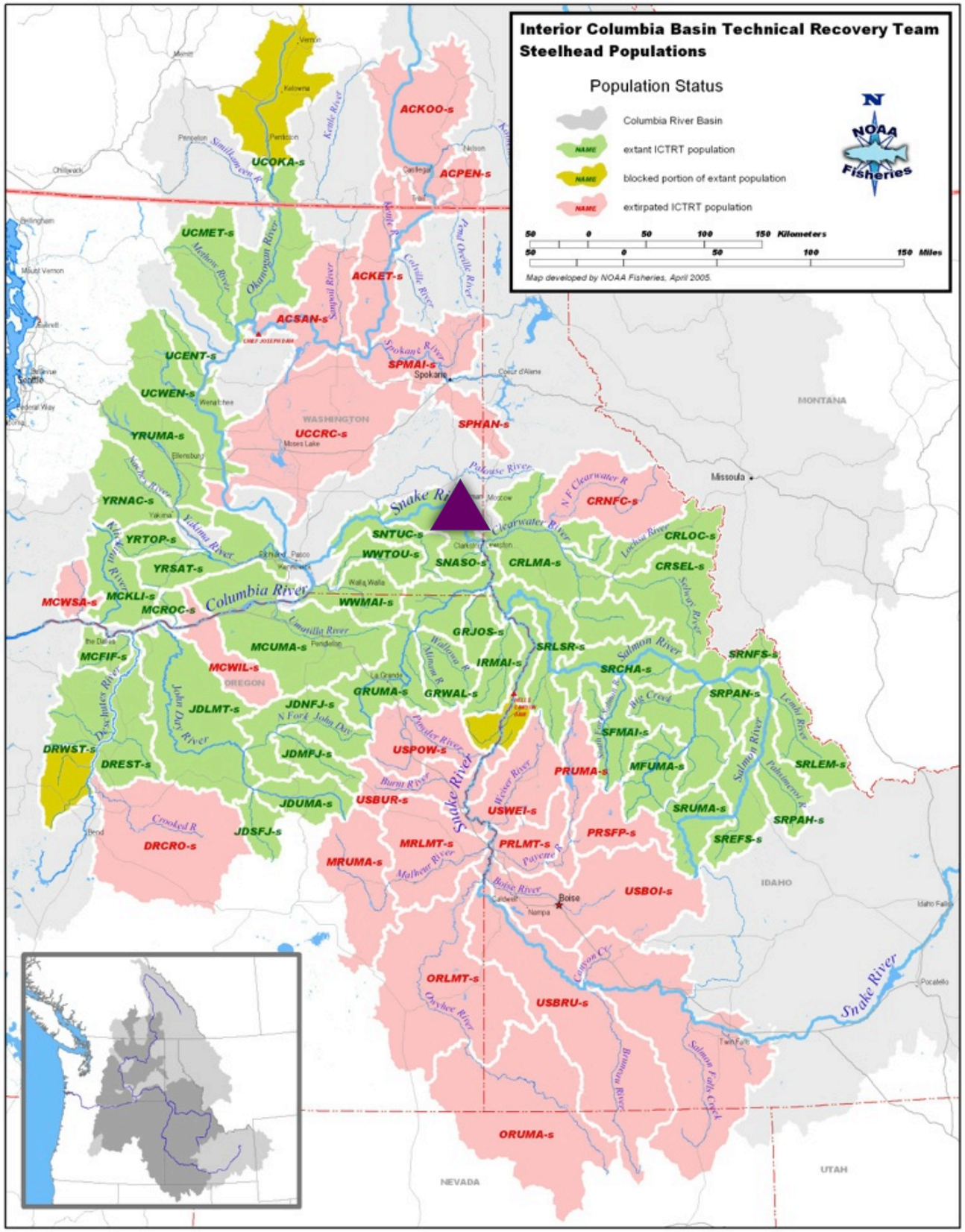
Kevin See

Co-authors:

Chris Beasley, Ryan Kinzer, Rick Orme, Mike Ackerman

Motivation


Interior Columbia Basin Technical Recovery Team
Spring / Summer Chinook Populations
Population Status
Columbia River Basin
extant ICTRT population
extirpated ICTRT population
NOAA Fisheries
Map developed by NOAA Fisheries, April 2005.
UCOKA
ACKOO
UCMET
ACKET
ACSAN
UCENT
UCWEN
SPMAI
SPHAN
CRPOT
NCLMA
NCUMA
CRLOC
SNTUC
CRLAP
CRLOL
SNASO
SEMOO
SCLAW
GRWEN
SEMEA
SEUMA
GRLOO
SCUMA
IRMAI
SFMAI
SRCHA
SRNFS
GRLOS
IRBSH
SFSEC
MFLMA
GRUMA
GRCAT
GRMIN
SRLSR
MFBIG
SRPAN
USPIN
SFEFS
MFCAM
PRMAI
WIUMA
PANFP
MFUMA
MFLOO
SRLEM
USBUR
WILIT
MFSUL
SRLMA
MFBEA
SRYFS
WILMT
MFMAR
SRPAH
MRLMT
PASQU
PASFP
SRVAL
MRNFM
PAWIL
SREFS
SRUMA
USBOI
MRUMA
USCAN
ORLMT
BRLMT
USROC
ORUMA
ORLIT
BRUMA
ORSFO
USSAF
WASHINGTON
OREGON
IDAHO
NEVADA
UTAH
MONTANA
Columbia River
Snake River


Interior Columbia Basin Technical Recovery Team
Steelhead Populations
Population Status
Columbia River Basin
extant ICTRT population
blocked portion of extant population
extirpated ICTRT population
NOAA Fisheries
Map developed by NOAA Fisheries, April 2005.
UCOKA-s
ACKOO-s
ACPEN-s
UCMET-s
ACKET-s
ACSAN-s
UCENT-s
UCWEN-s
SPMAI-s
SPHAN-s
YRUMA-s
UCCRC-s
YRNAC-s
YRTOP-s
YRSAT-s
SNTUC-s
WWTOU-s
SNASO-s
CRLMA-s
CRLOC-s
CRSEL-s
CRNFC-s
MCWSA-s
MCKLI-s
MCROC-s
WWMAI-s
MCUMA-s
GRJOS-s
SRLSR-s
IRMAI-s
SRNFS-s
MCFIF-s
MCWIL-s
SRCHA-s
GRUMA-s
GRWAL-s
SRPAN-s
JDLMT-s
JDNFJ-s
SFMAI-s
DRWST-s
JDMFJ-s
USPOW-s
PRUMA-s
MFUMA-s
SRLEM-s
DREST-s
JDUMA-s
USBUR-s
USWEI-s
SRUMA-s
SRPAH-s
JDSFJ-s
PRSFP-s
SREFS-s
DRCRO-s
MRLMT-s
PRLMT-s
MRUMA-s
USBOI-s
ORLMT-s
USBRU-s
ORUMA-s
WASHINGTON
OREGON
IDAHO
NEVADA
UTAH
MONTANA
Columbia River
Snake River

Current Methods

- Redd Counts
- Weirs

Objective

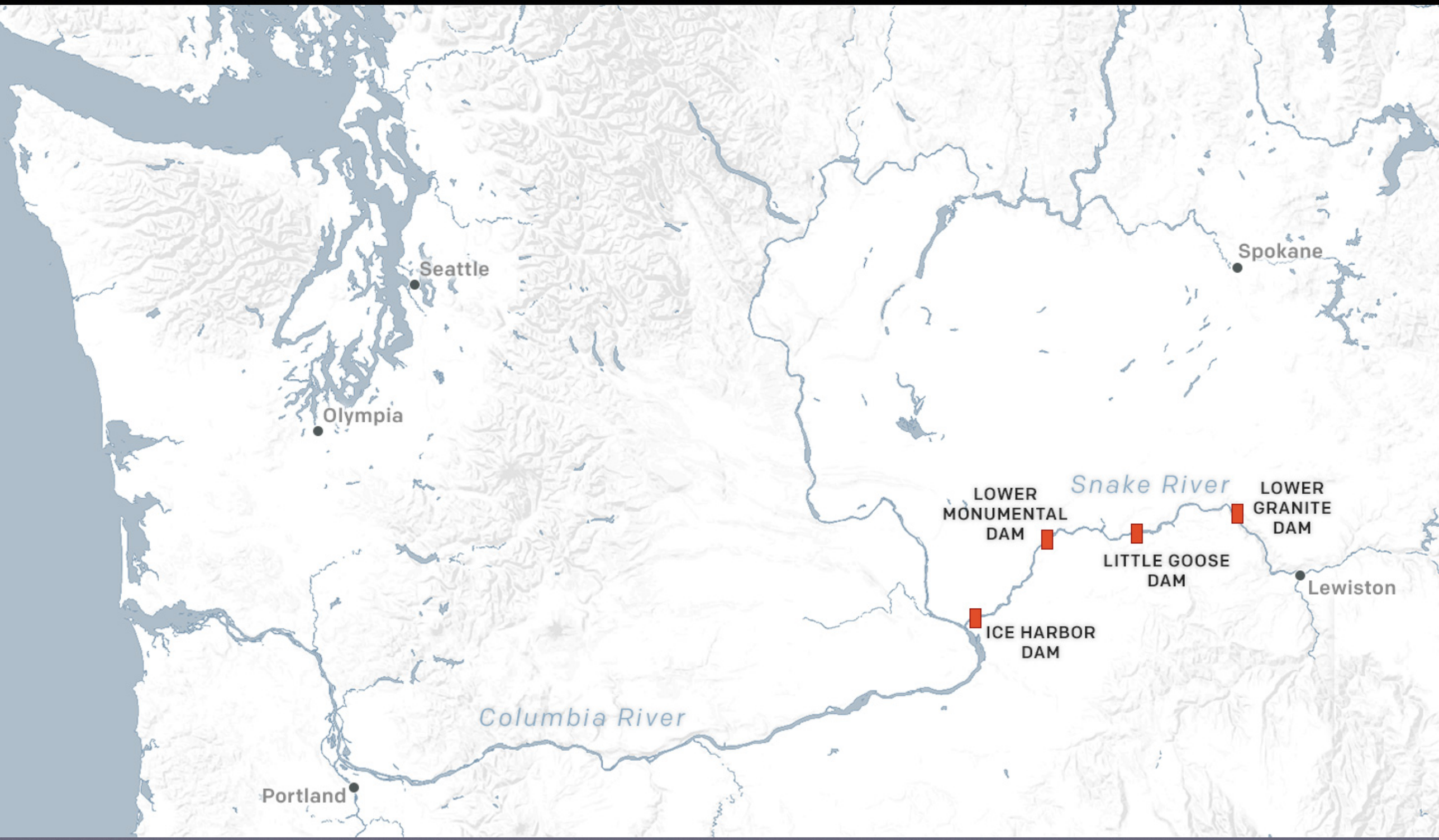
- Estimate spring/summer Chinook and steelhead escapement to major tributaries above Lower Granite Dam with PIT tag data

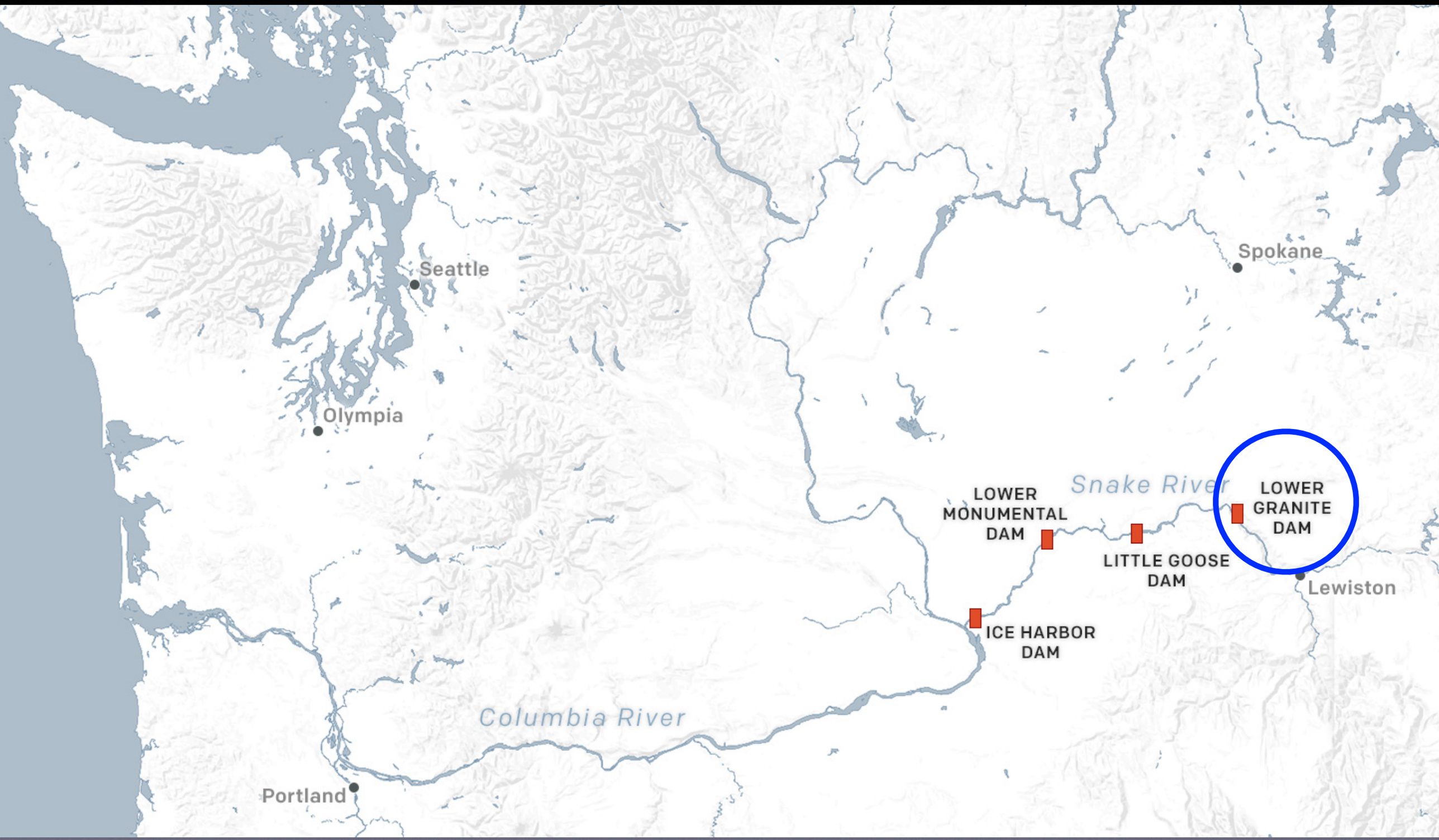
Modeling Plan

Total Wild Escapement Model → Total Wild Escapement

Hierarchical Patch-Occupancy Model → Movement Probabilities

Total Wild Escapement + Movement Probabilities → Tributary Escapement Estimates


Seattle
Spokane
Olympia
Snake River
LOWER MONUMENTAL DAM
LOWER GRANITE DAM
LITTLE GOOSE DAM
Lewiston
ICE HARBOR DAM
Columbia River
Portland


Seattle
Spokane
Olympia
Snake River
LOWER
MONUMENTAL
DAM
LOWER
GRANITE
DAM
LITTLE GOOSE
DAM
Lewiston
ICE HARBOR
DAM
Columbia River
Portland

Lower Granite Dam

Total Escapement Past Lower Granite Dam

How many are there?

Total Escapement Over LGD

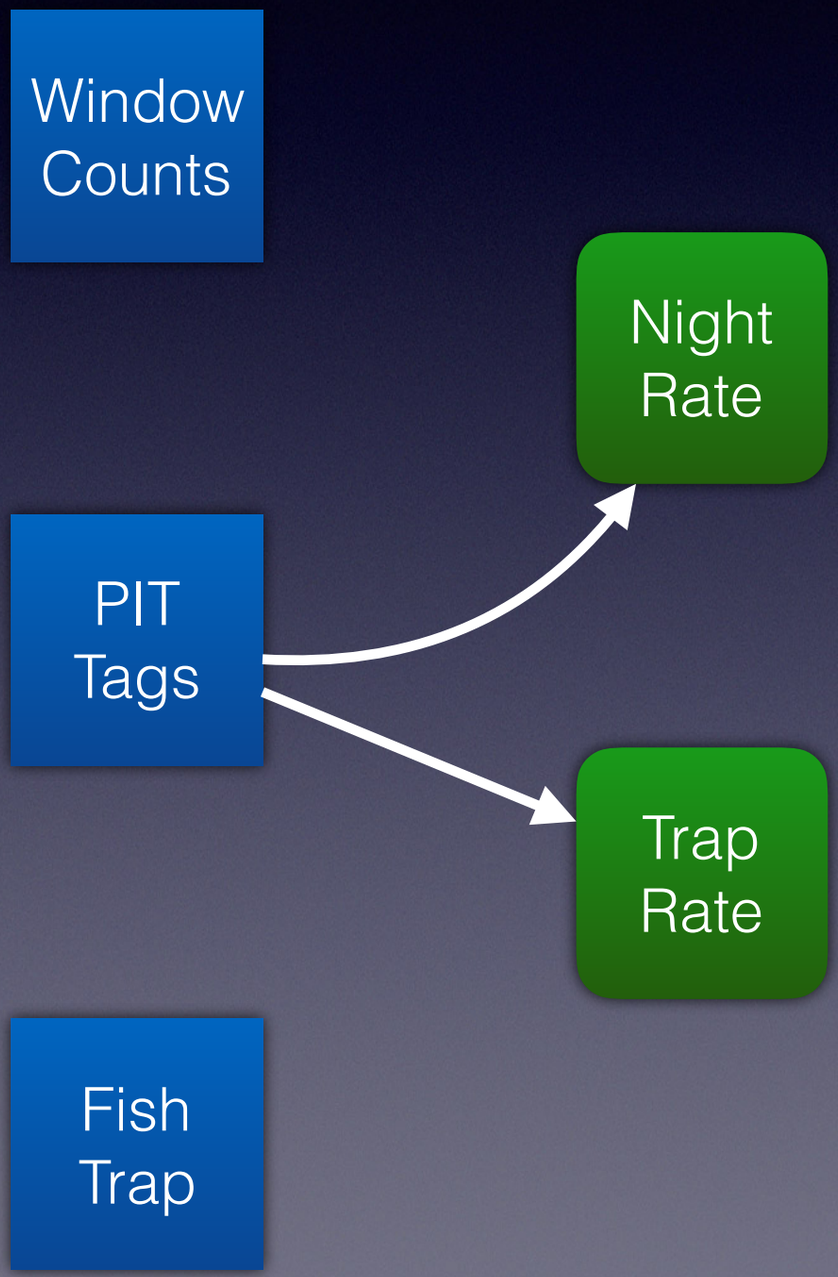
Total Escapement Over LGD

Window Counts

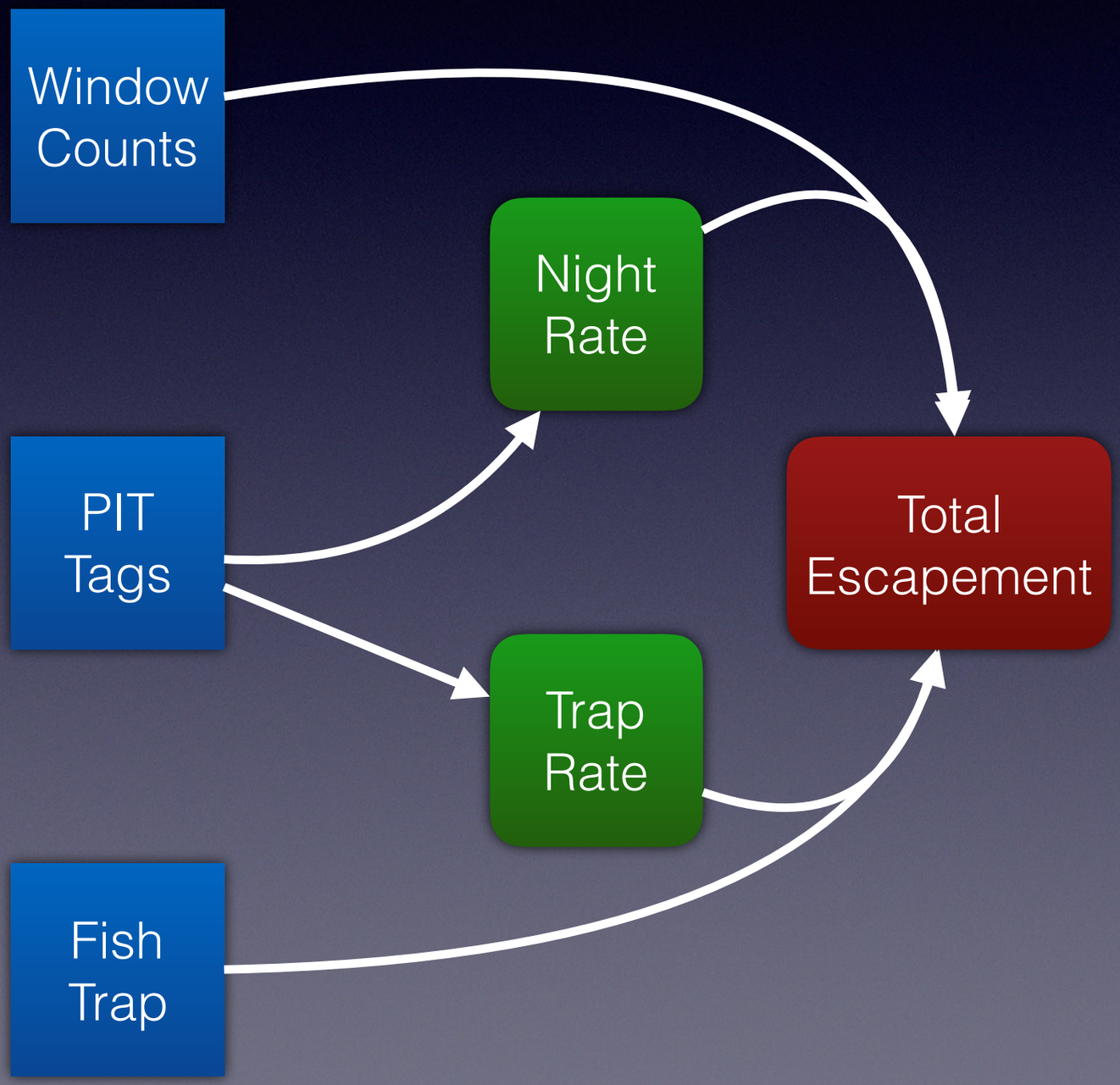
PIT Tags

Fish Trap

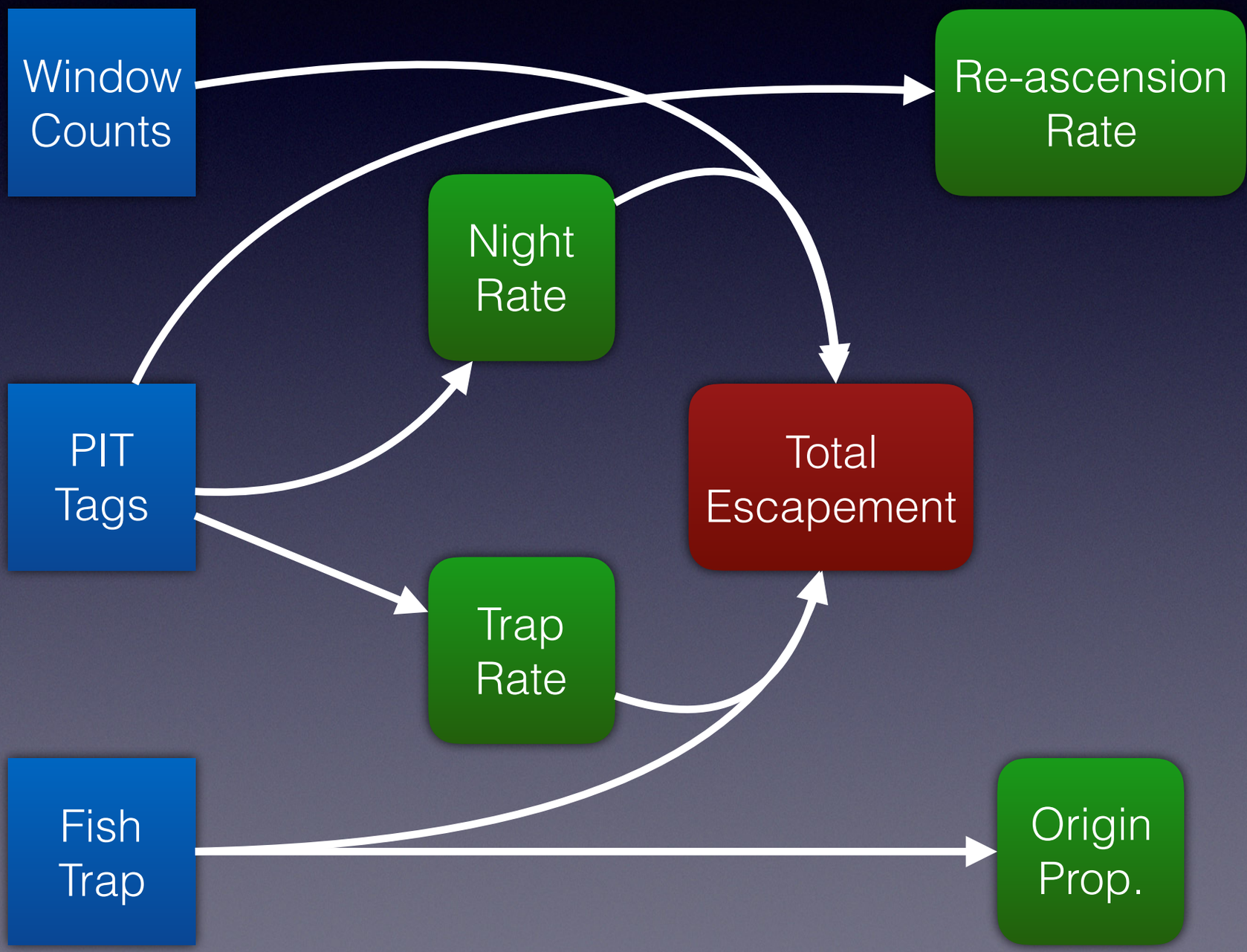
Total Escapement Over LGD



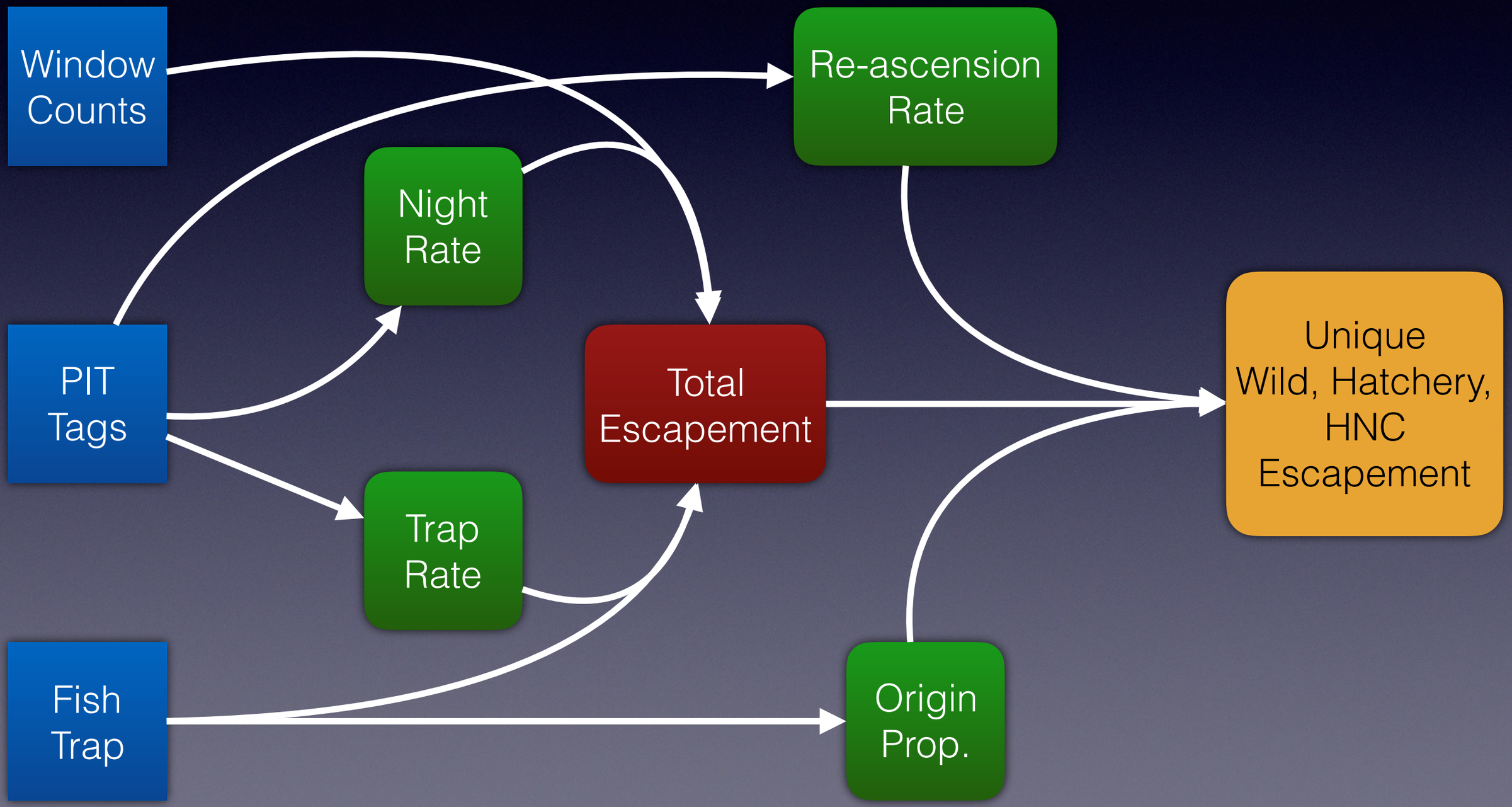
Total Escapement Over LGD



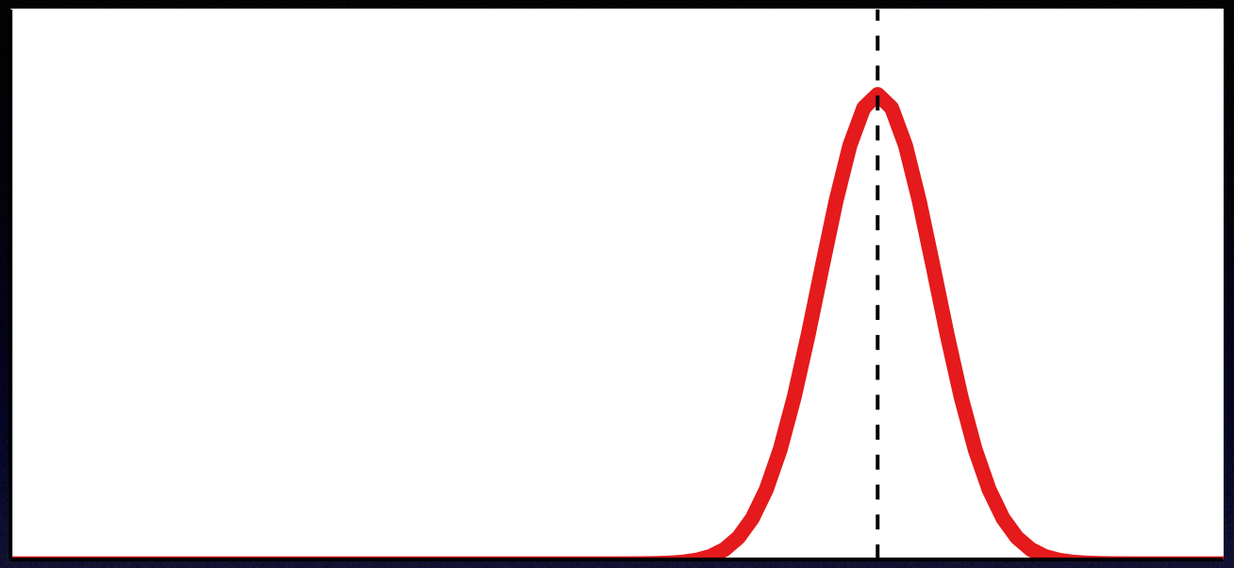
Total Escapement Over LGD



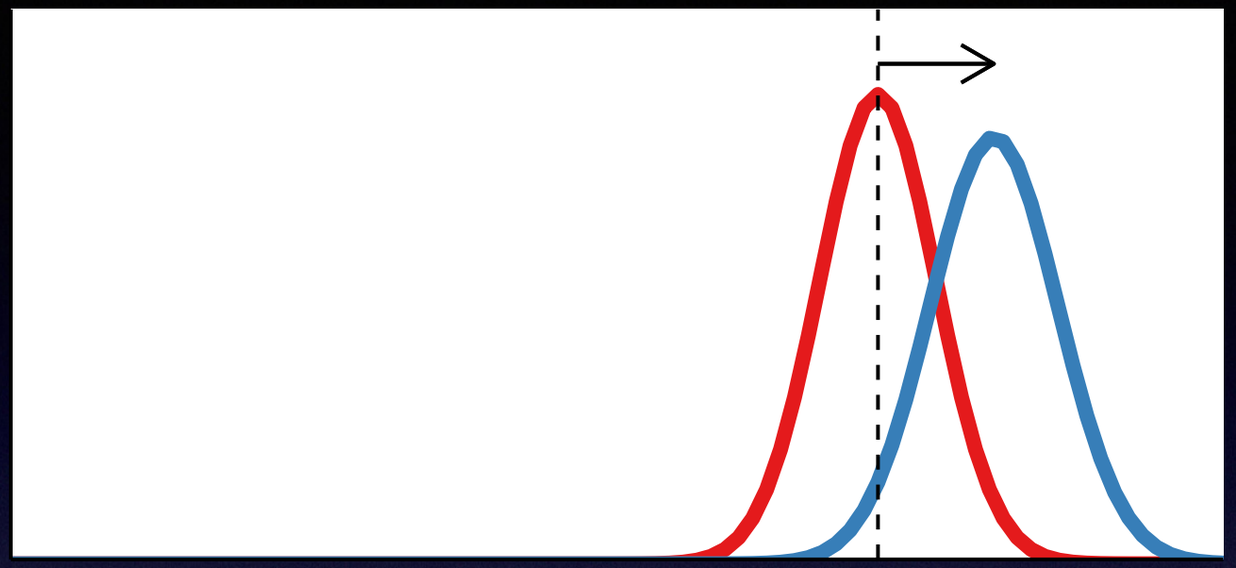
Total Escapement Over LGD



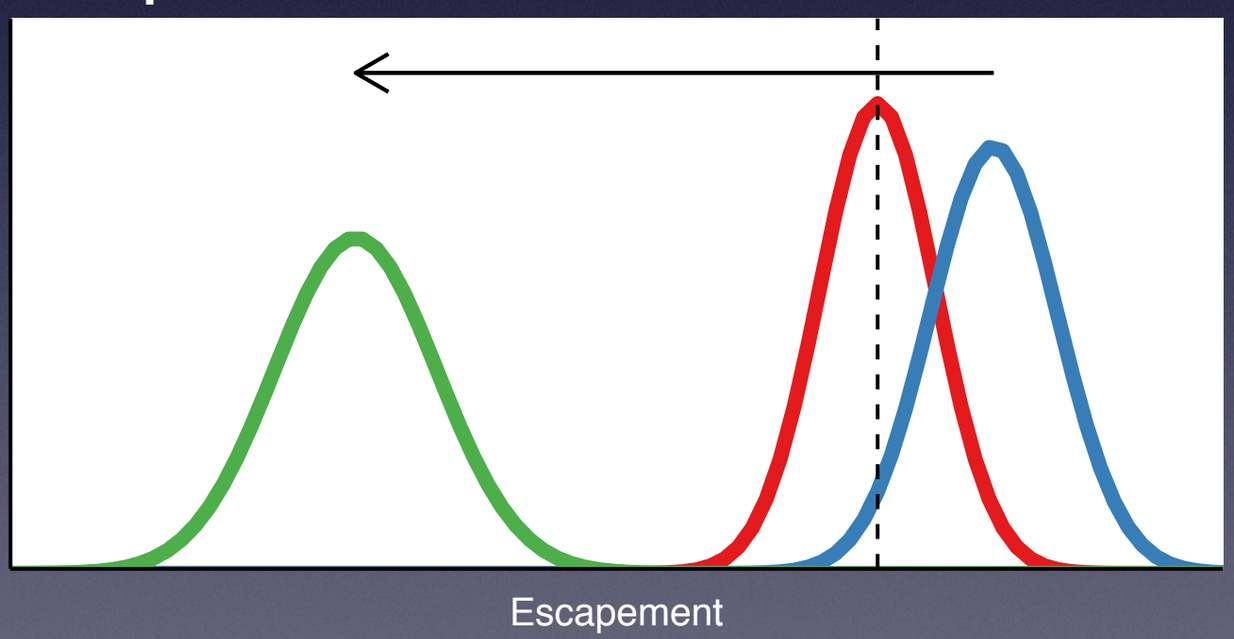
Daytime Fish



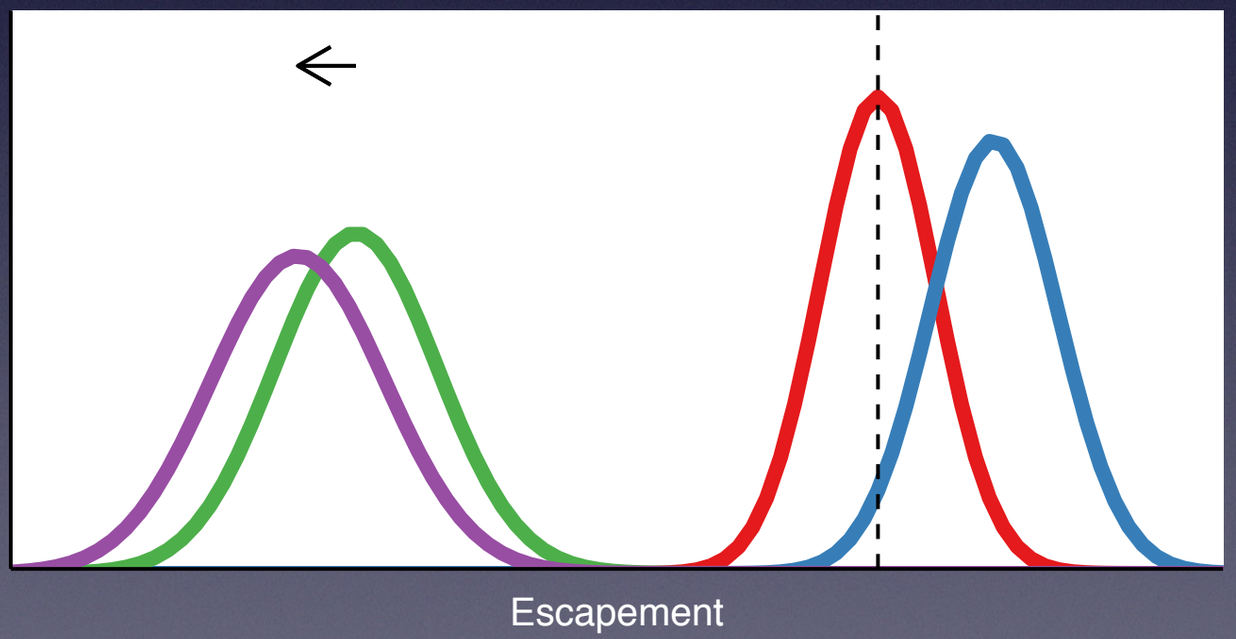
Including Night Passage



Proportion Wild

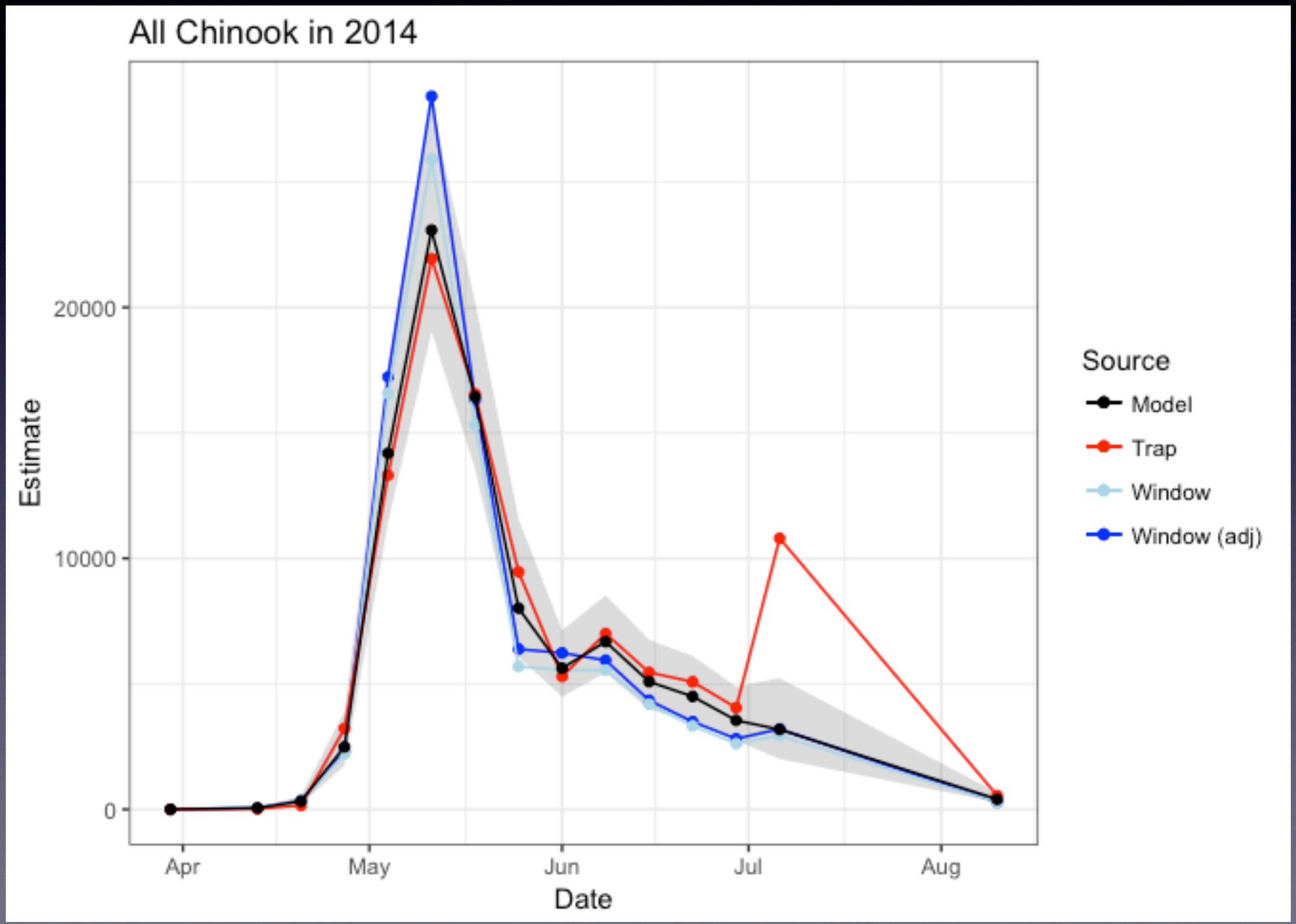


Account for Reascension



Fish Type — Daytime Fish — Total Fish — Total Wild Fish — Unique Wild Fish

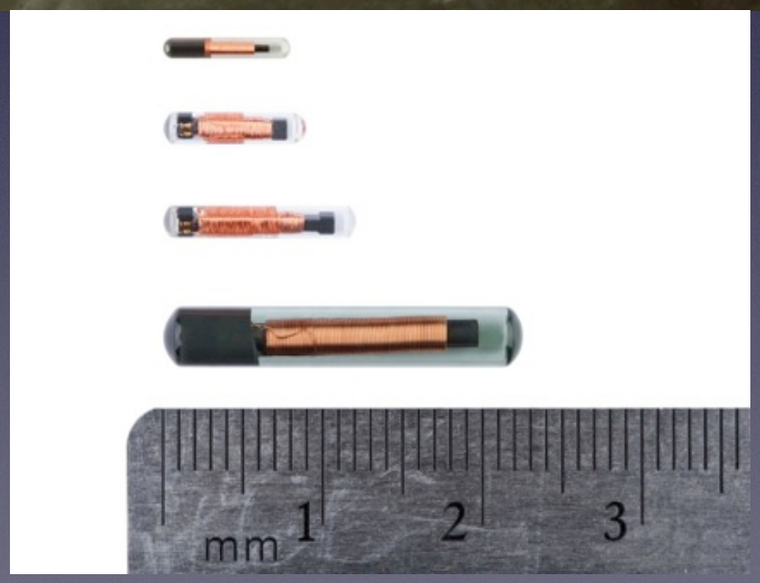
Example Results



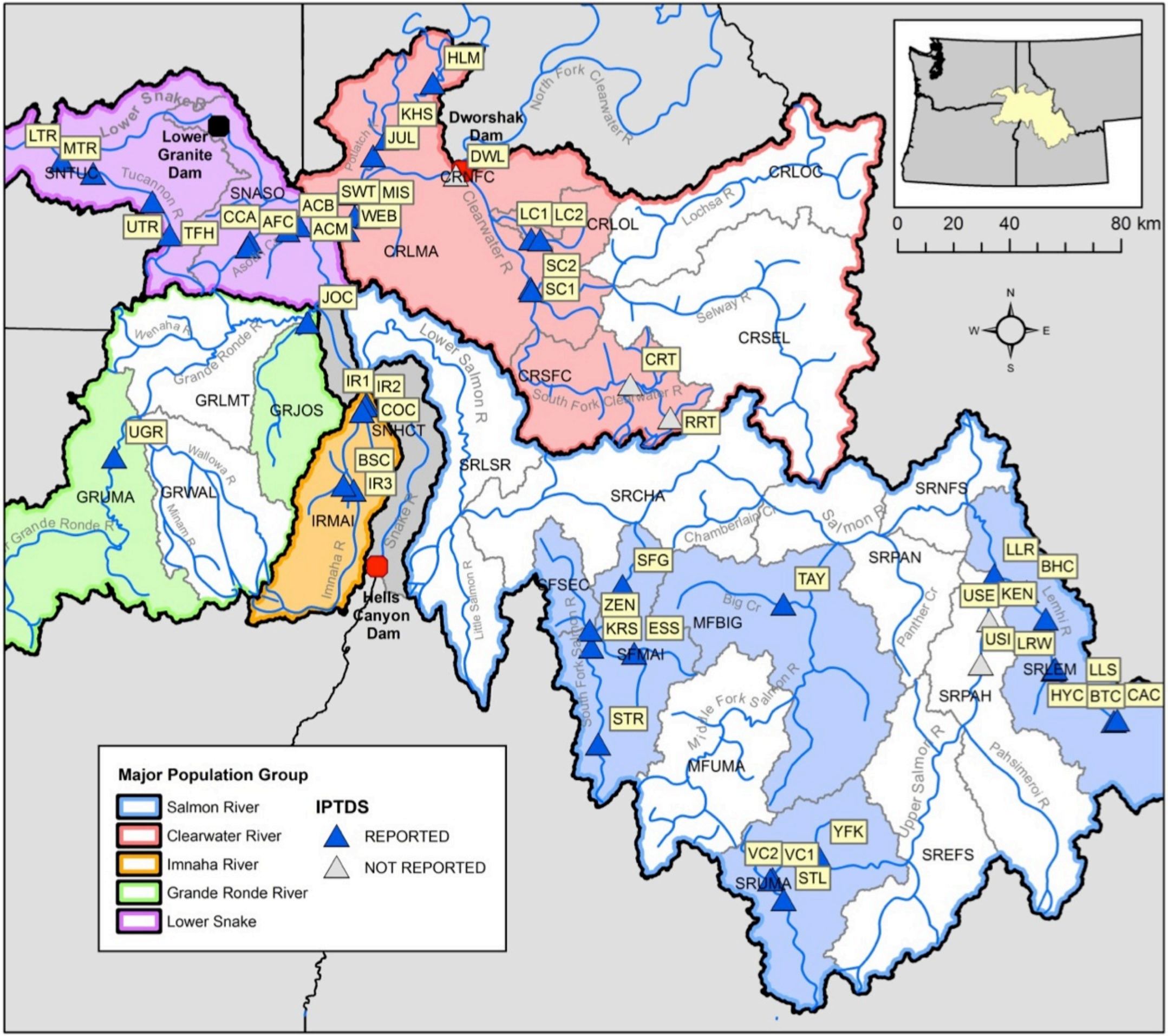
Hierarchical Patch-Occupancy Model

Where do they go?

Fish are PIT tagged…



And re-sighted upstream


HLM
KHS
JUL
Dworshak Dam
DWL
CRNFC
North Fork Clearwater R
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LTR
MTR
SNTUC
Lower Granite Dam
Lower Snake R
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LLR
BHC
SFSEC
ZEN
KRS
ESS
MFBIG
Big Cr
Panther Cr
USE
KEN
Lemhi R
USI
LRW
SFMAI
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LLS
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HYC
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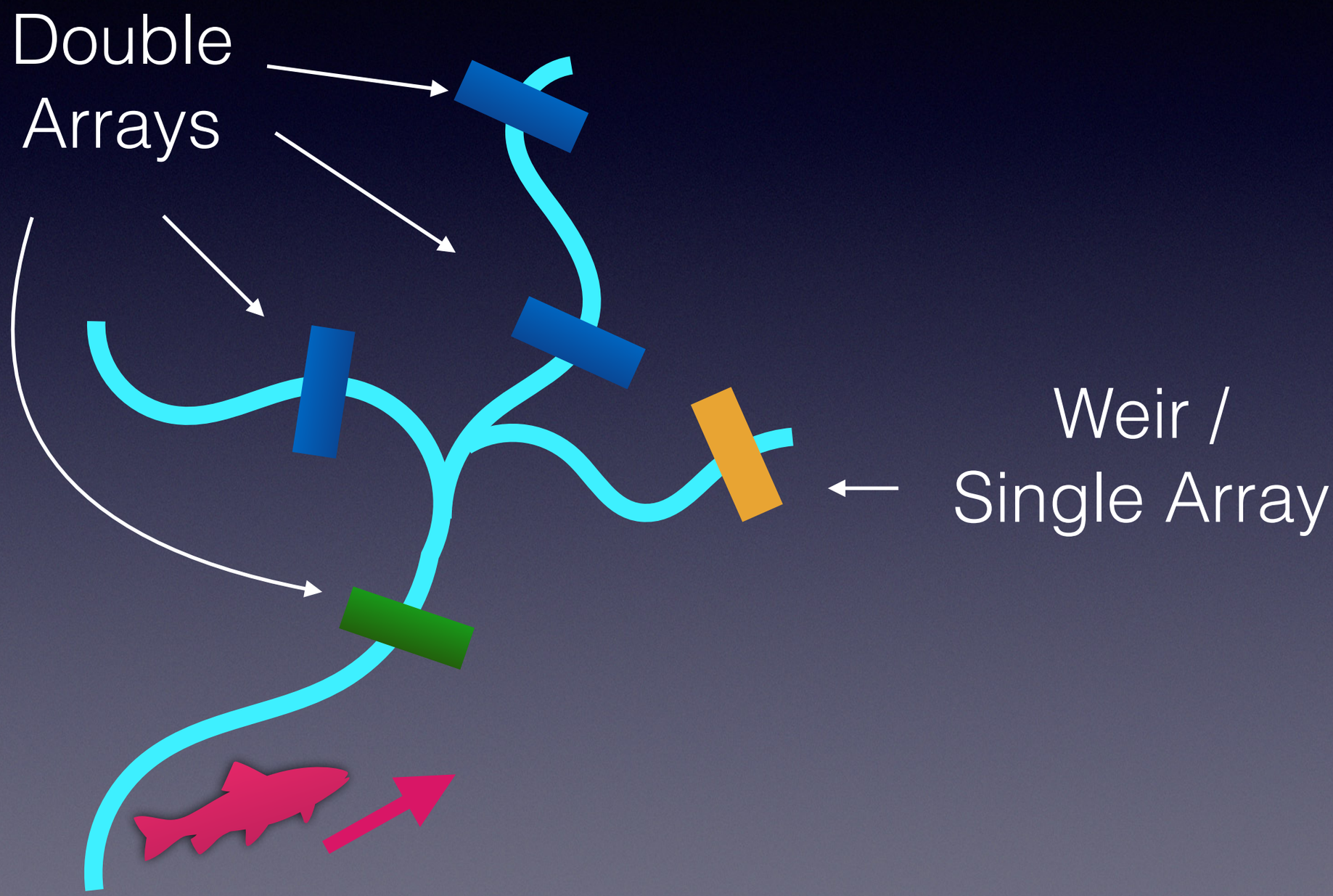
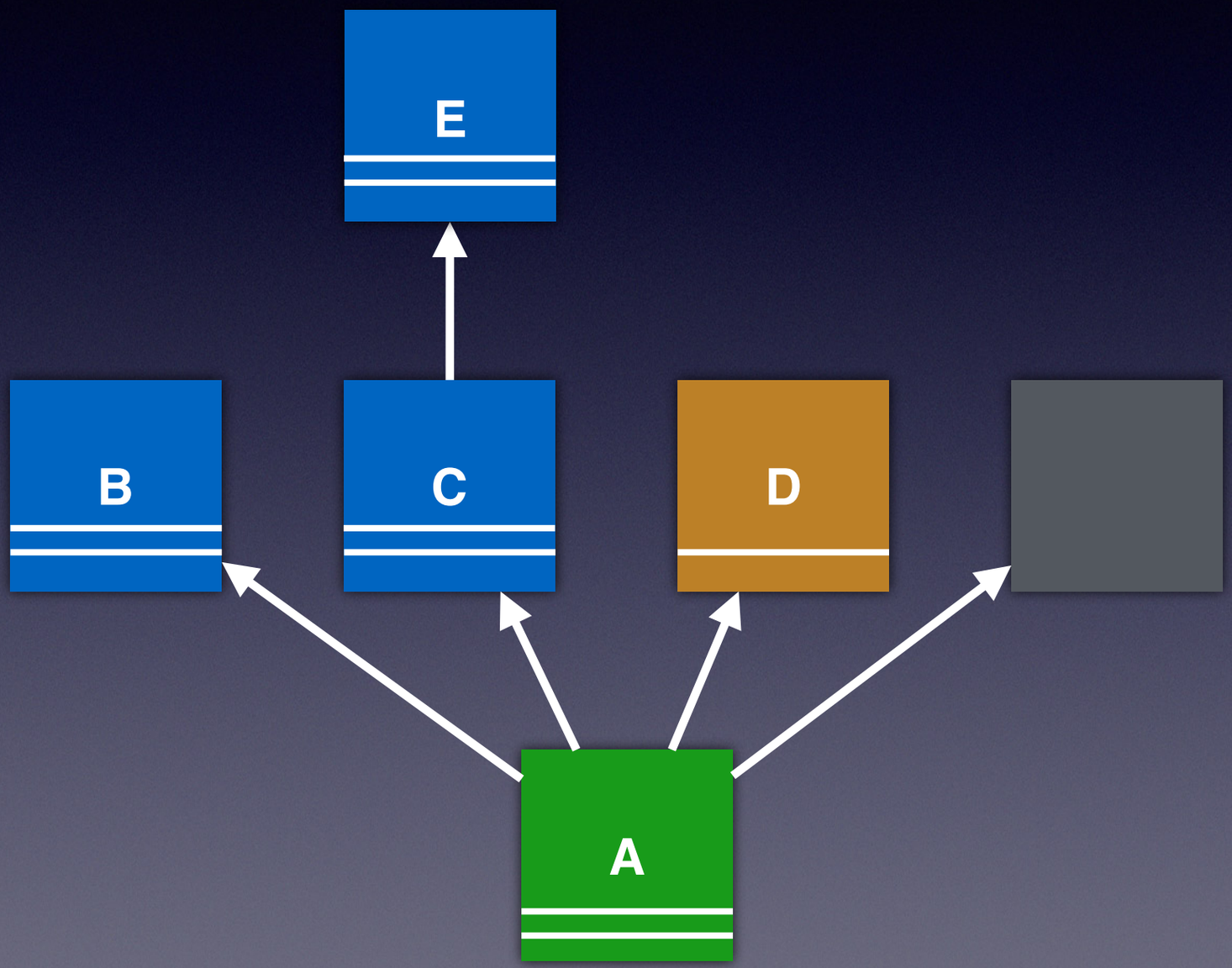
CAC
STR
Middle Fork Salmon R
MFUMA
Upper Salmon R
Pahsimeroi R
YFK
VC2
VC1
STL
SRUMA
SREFS
0 20 40 80 km
N
W
E
S
Major Population Group
Salmon River
Clearwater River
Imnaha River
Grande Ronde River
Lower Snake
IPTDS
REPORTED
NOT REPORTED

Model

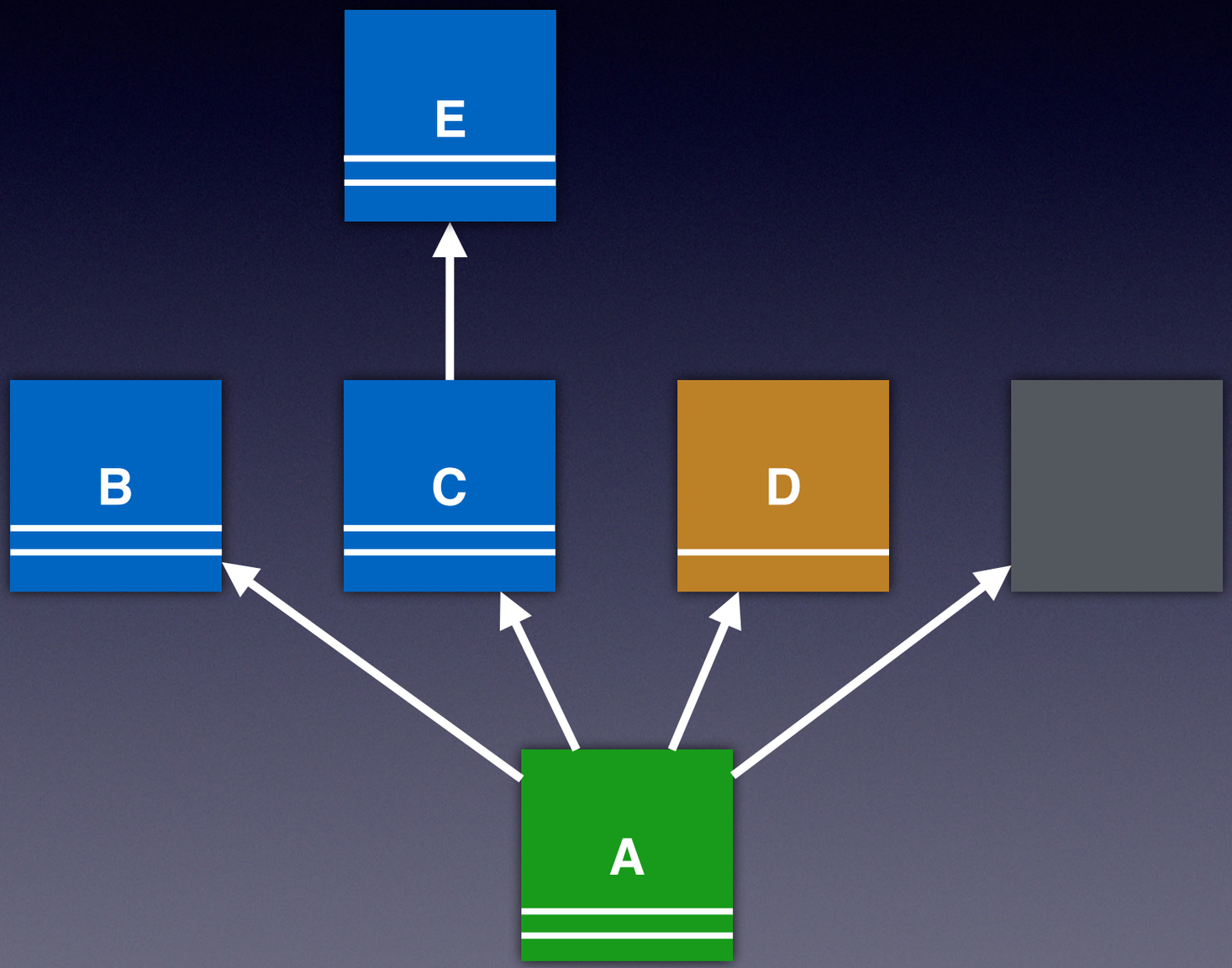


Model Pieces

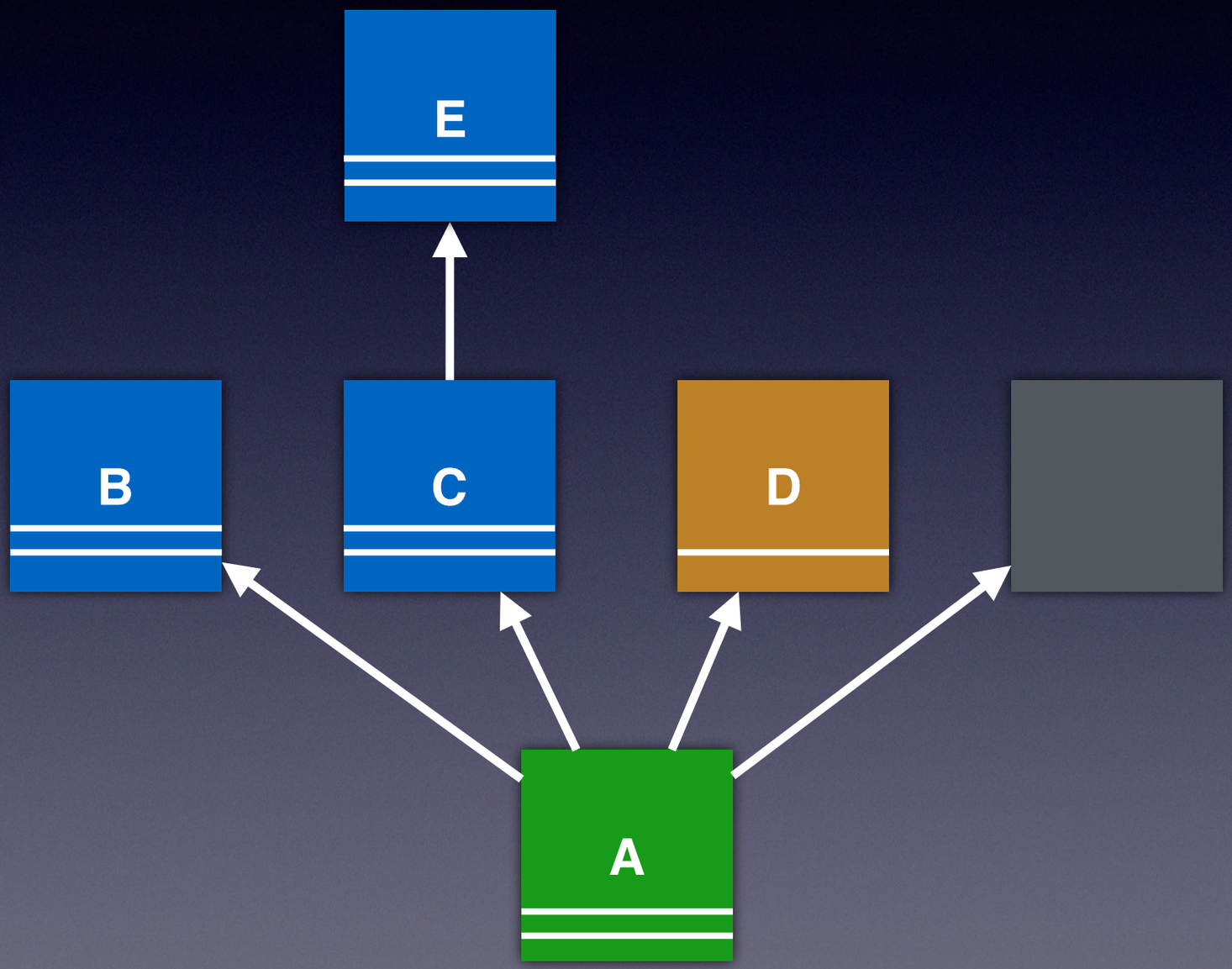


Model Pieces

Movement Probabilities (Ψ)



Model Pieces



Movement Probabilities (Ψ)

A → B

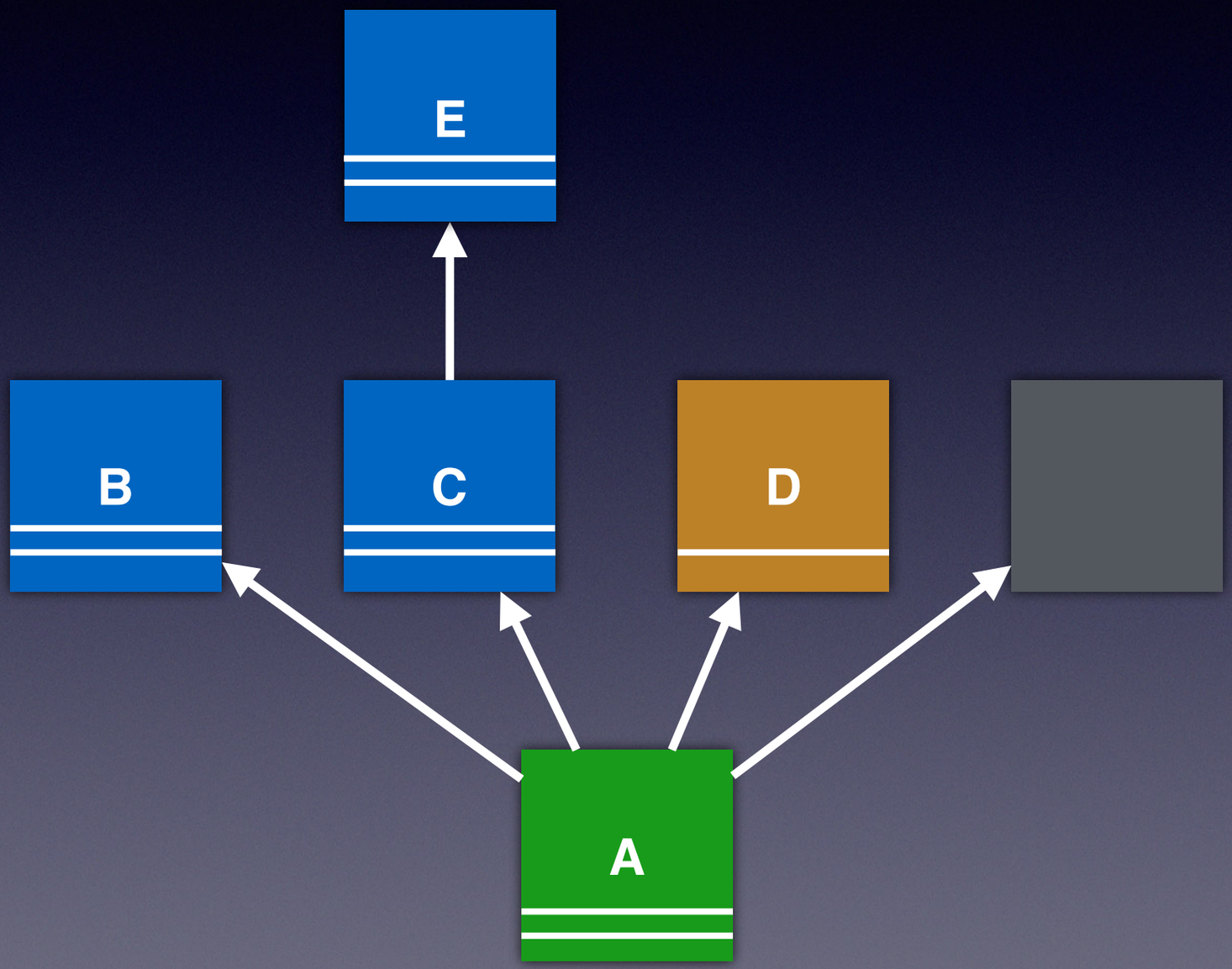
A → C

A → D

A → ■

C → E

Model Pieces



Movement Probabilities (Ψ)

A → B

A → C

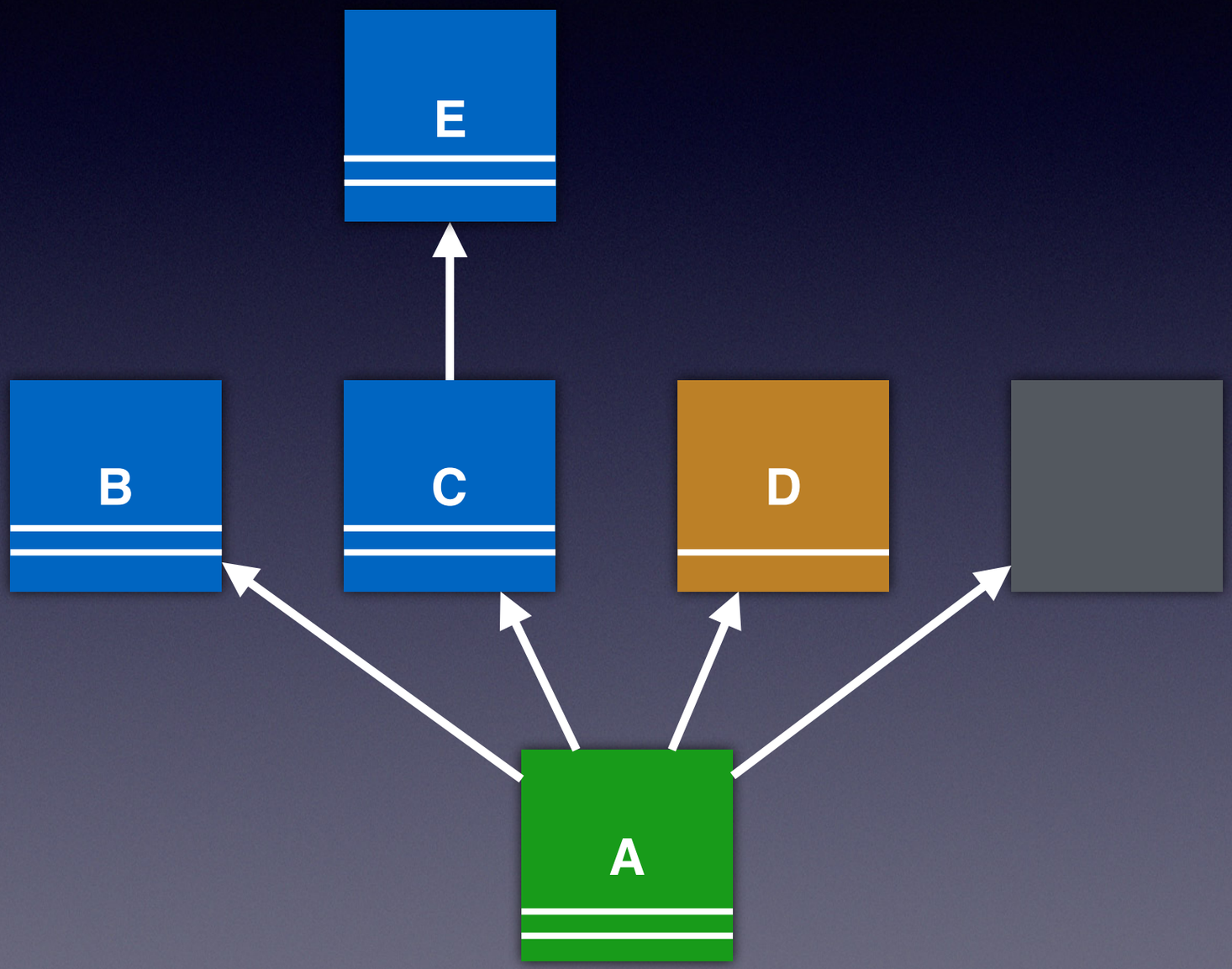
A → D

A → ■

C → E

$A \rightarrow E = (A \rightarrow C) \times (C \rightarrow E)$

Model Pieces



Movement Probabilities (Ψ)

A → B

A → C

A → D

A → ■

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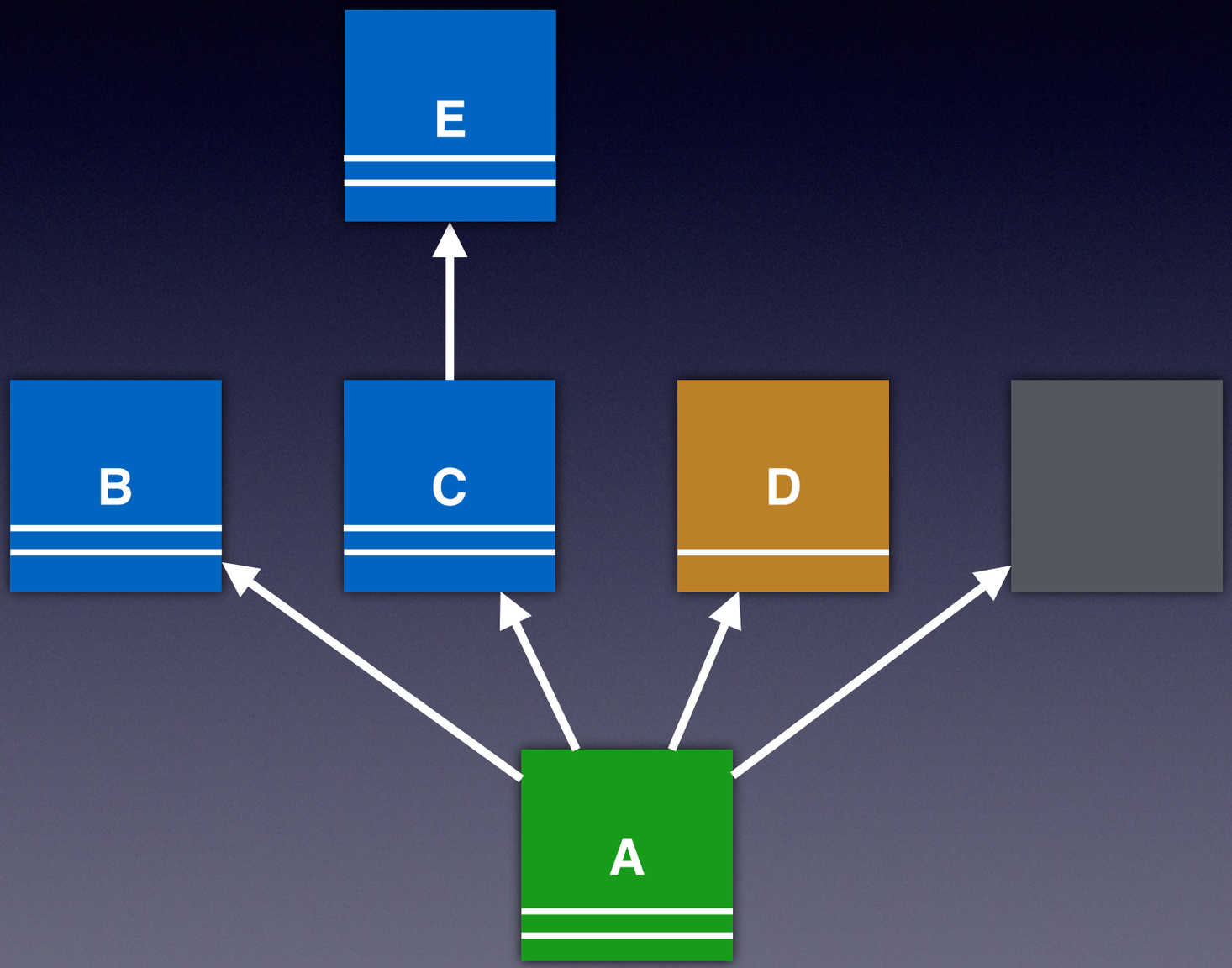
$A \rightarrow E = (A \rightarrow C) \times (C \rightarrow E)$

Detection Probabilities (p)

Model Pieces



Movement Probabilities (Ψ)

A → B

A → C

A → D

A → ■

C → E

$A \rightarrow E = (A \rightarrow C) \times (C \rightarrow E)$

Detection Probabilities (p)

Estimate: A, B, C, E

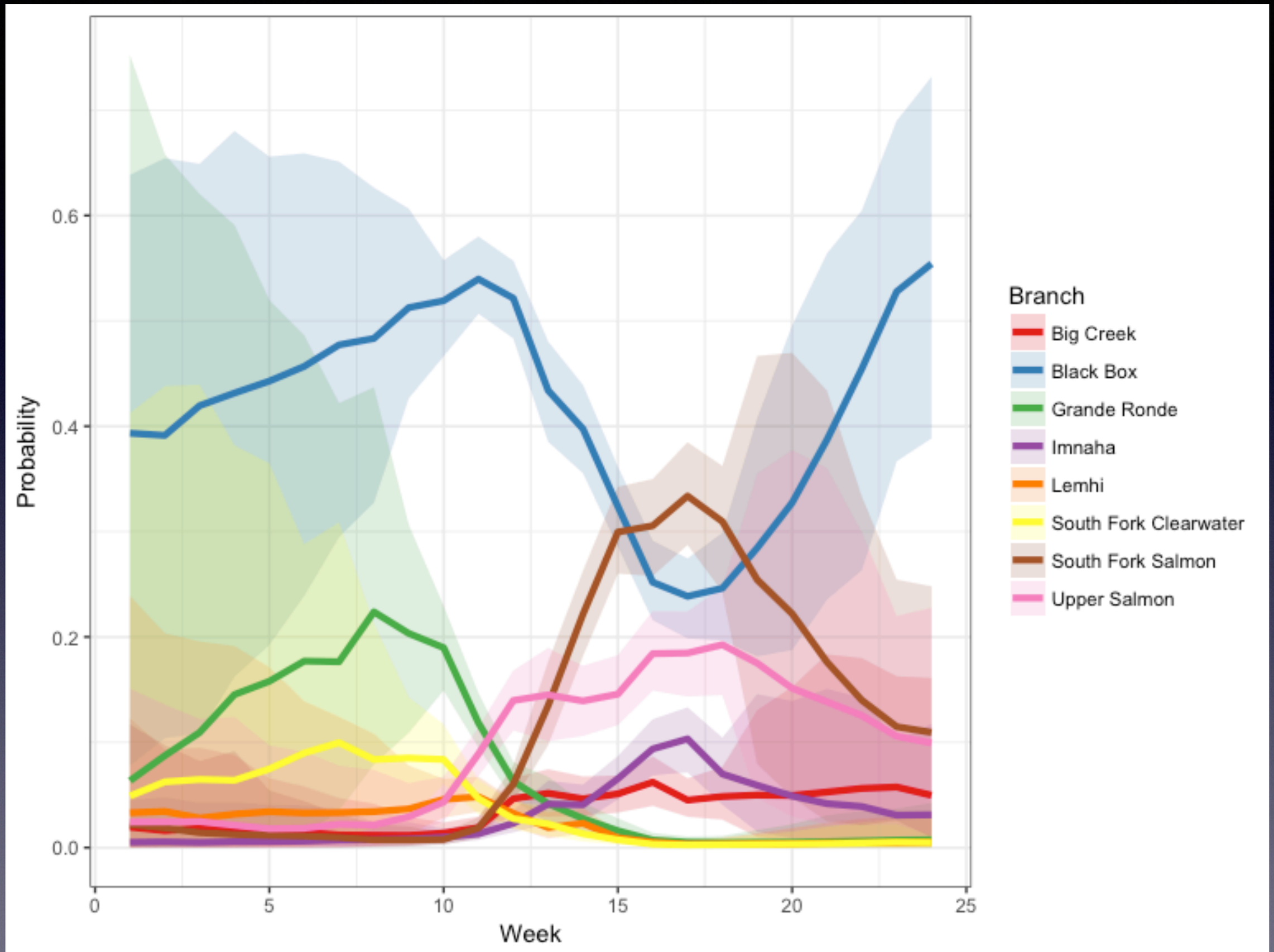
Fixed: D

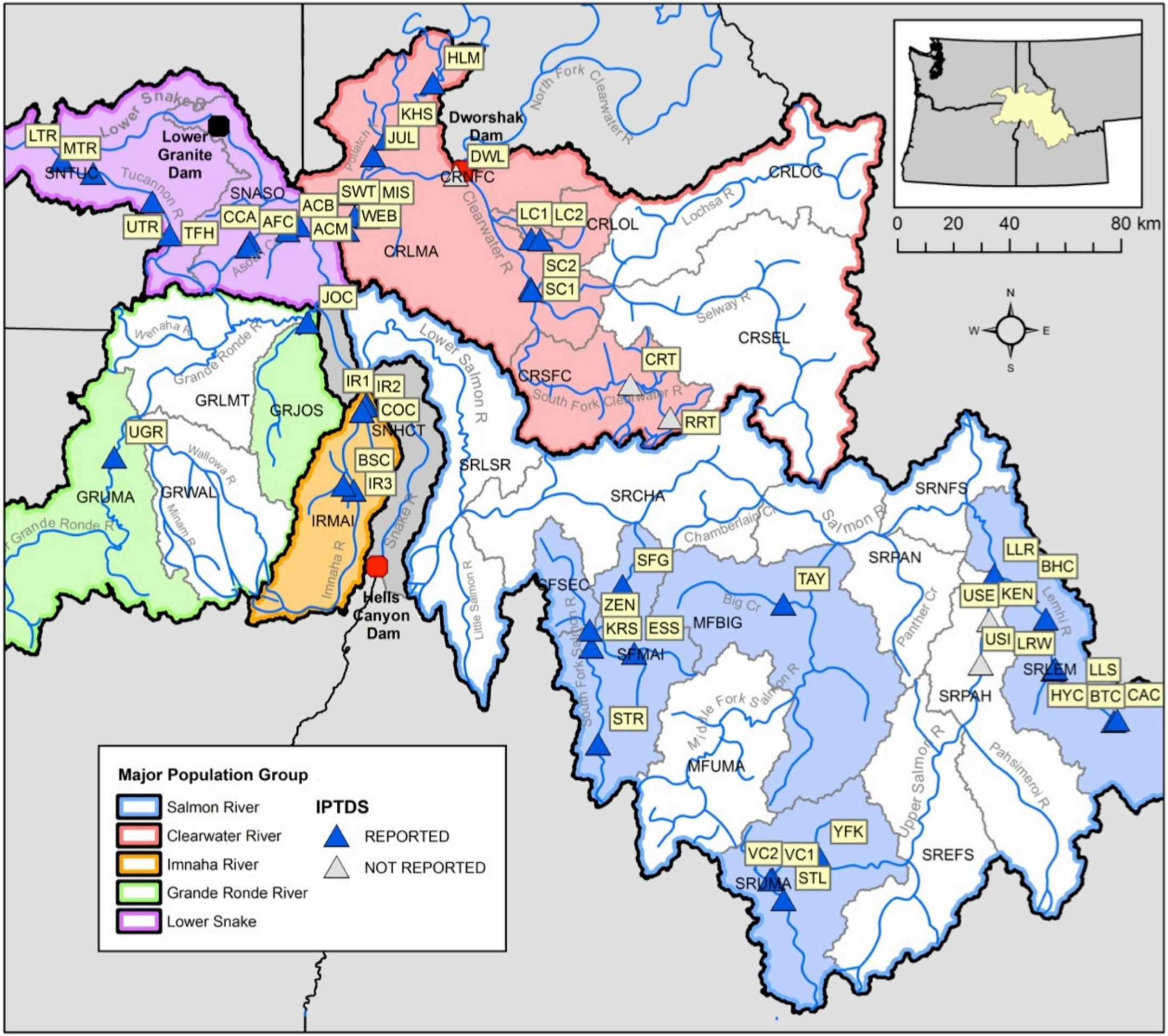
Model Benefits

- Initial branches have time-varying probabilities
  - Tagged fish may not be representative of run at large
  - Trap rate changes / shut down
  - Differential run timing

- Escapement estimates on various spatial scales
  - MPG
  - Population
  - Tributary

- Incorporates all uncertainty
- Potentially cost-effective compared to weirs and redd counts


Probability
0.6
0.4
0.2
0.0
0
5
10
15
20
25
Week
Branch
Big Creek
Black Box
Grande Ronde
Imnaha
Lemhi
South Fork Clearwater
South Fork Salmon
Upper Salmon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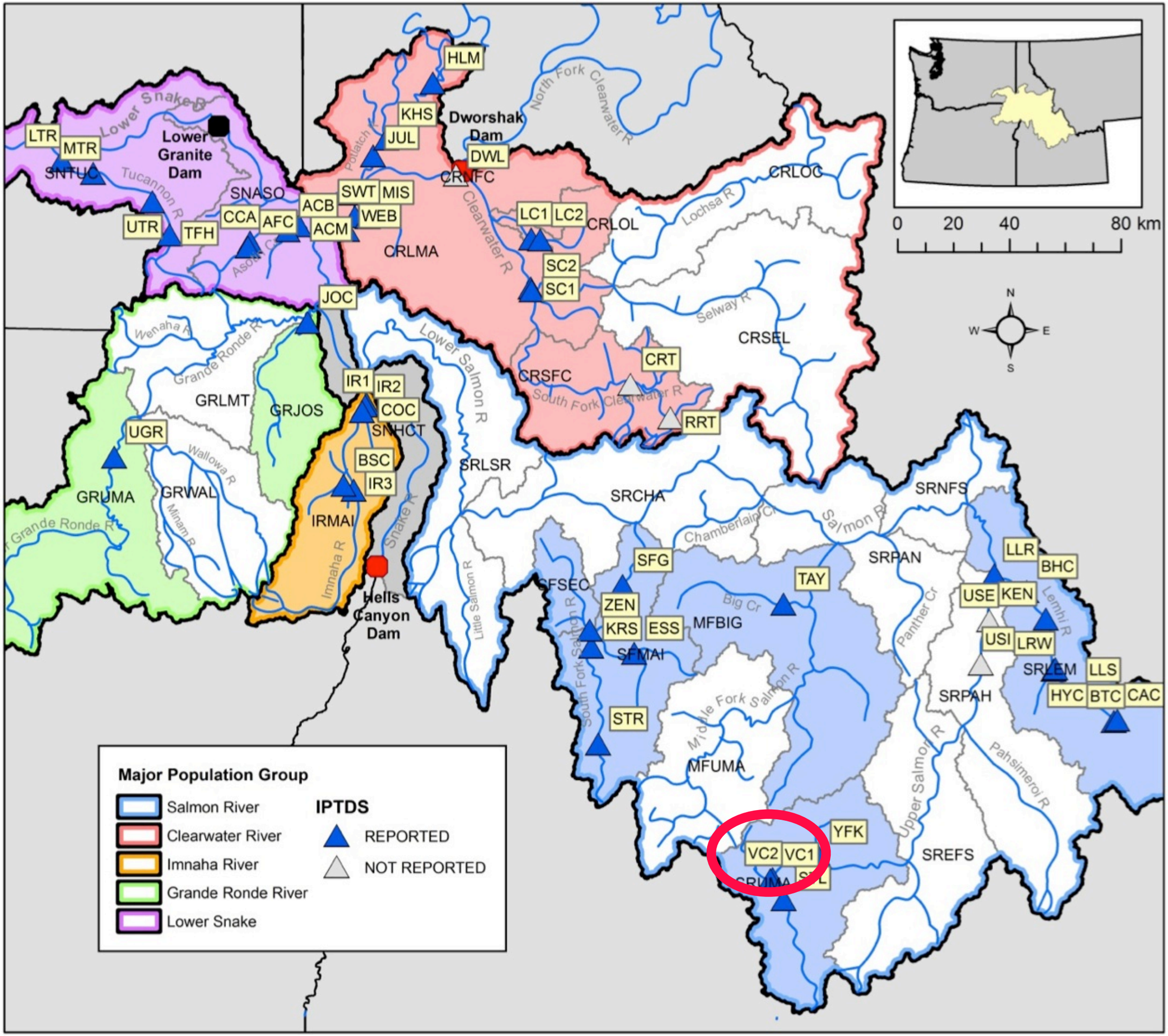
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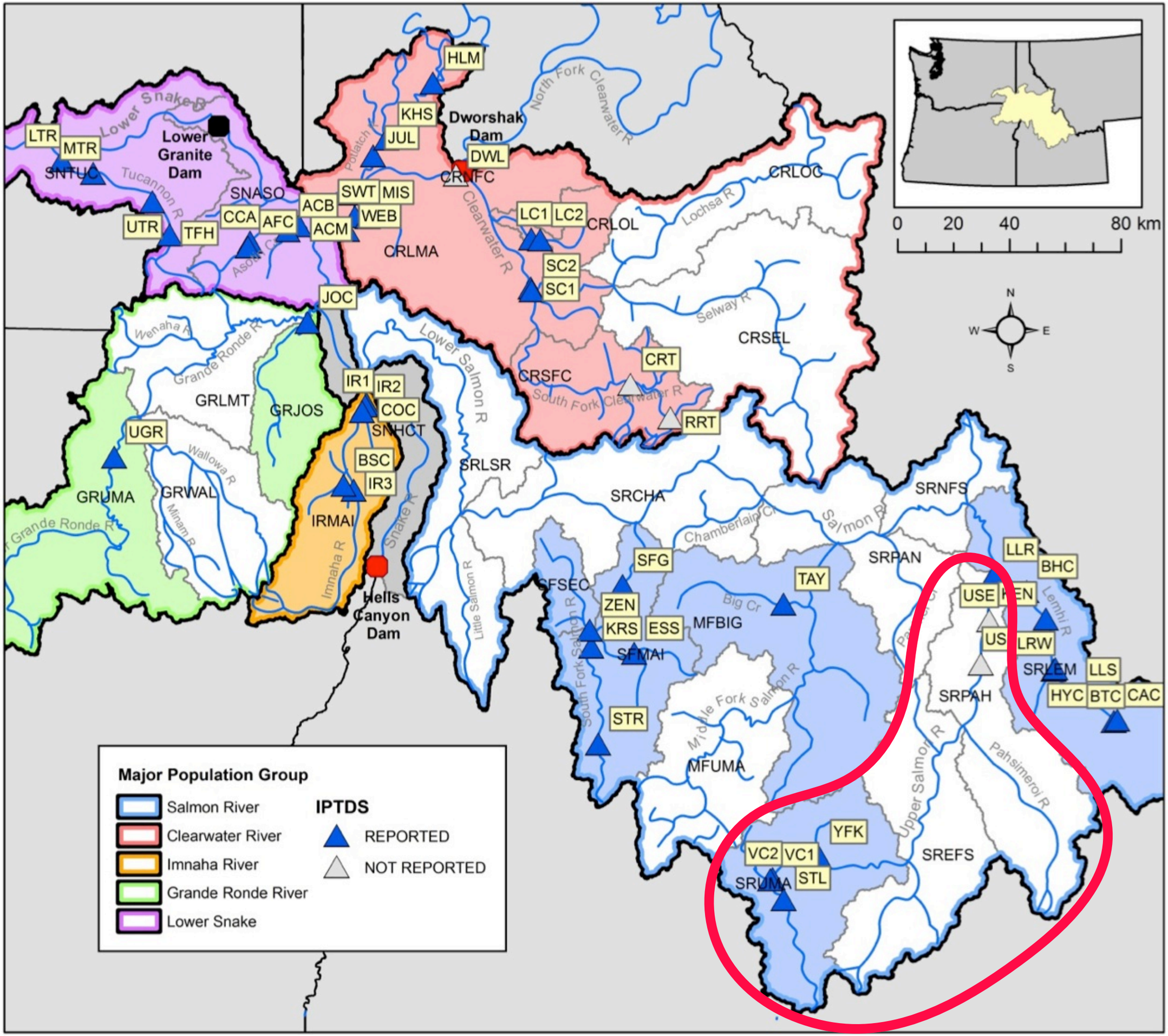
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Chamberlain Cr
Salmon R
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SRPAN
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ESS
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Lemhi R
US
LRW
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SRLEM
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South Fork Salmon R
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HYC
BTC
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YFK
VC2
VC1
SREFS
STL
SRUMA
0 20 40 80 km
N
W
E
S
Major Population Group
Salmon River
Clearwater River
Imnaha River
Grande Ronde River
Lower Snake
IPTDS
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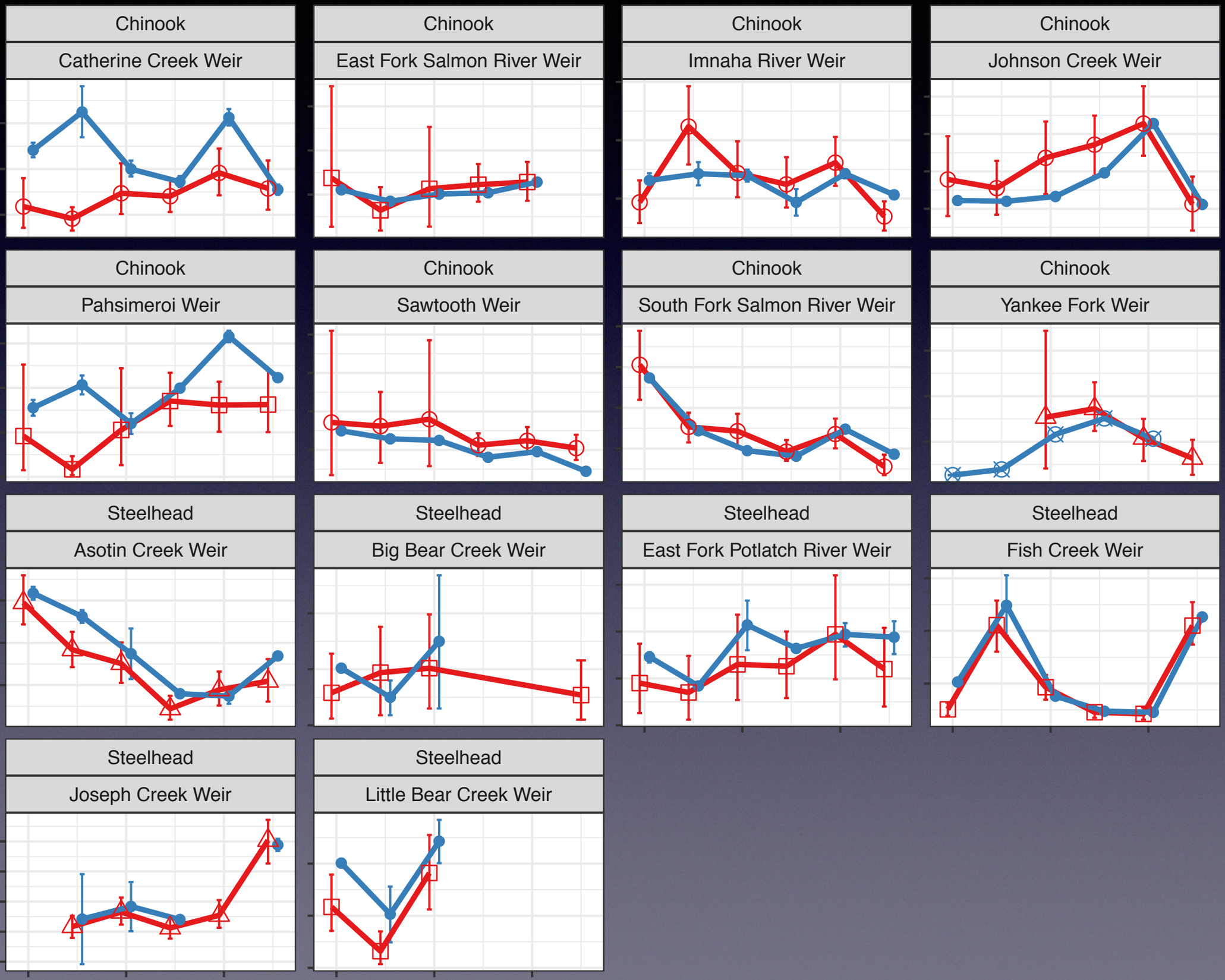
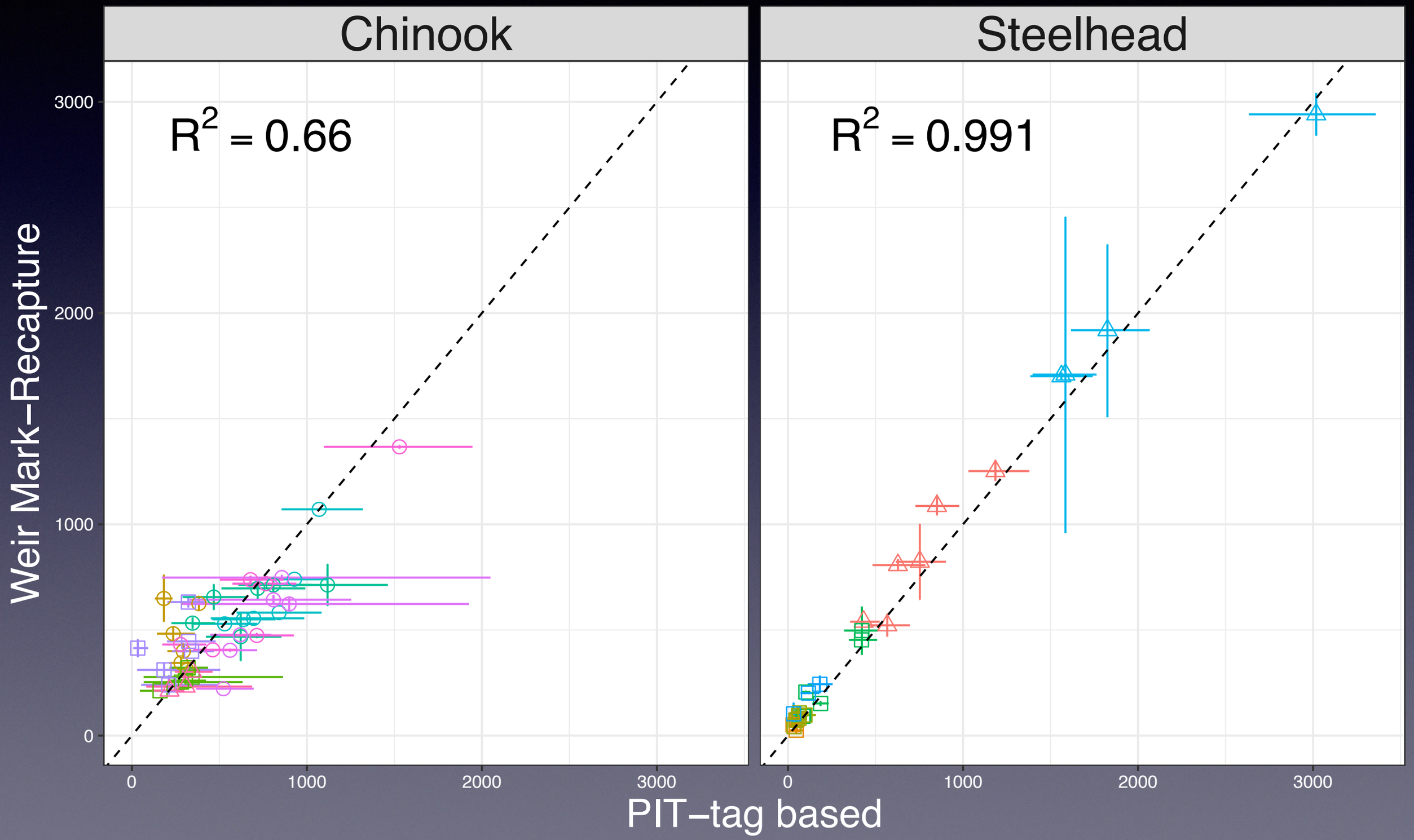
Validation

Comparison with Weirs



Comparison with Weirs

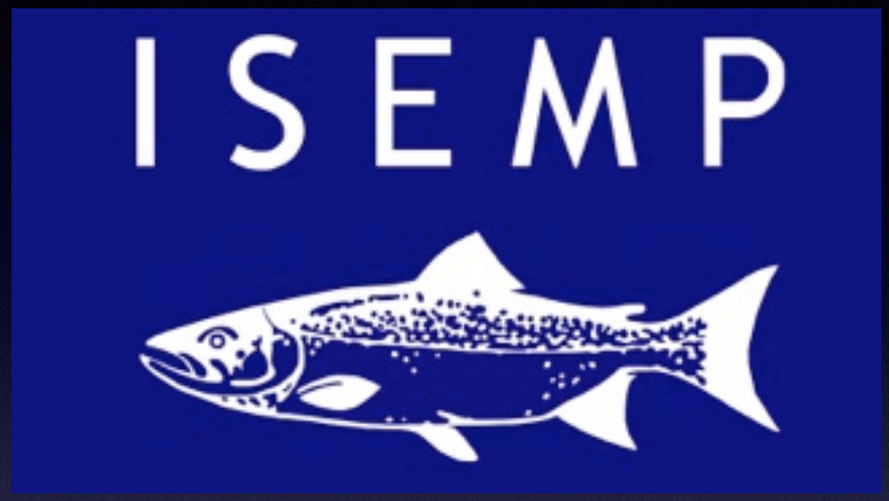


Conclusions

Take home messages

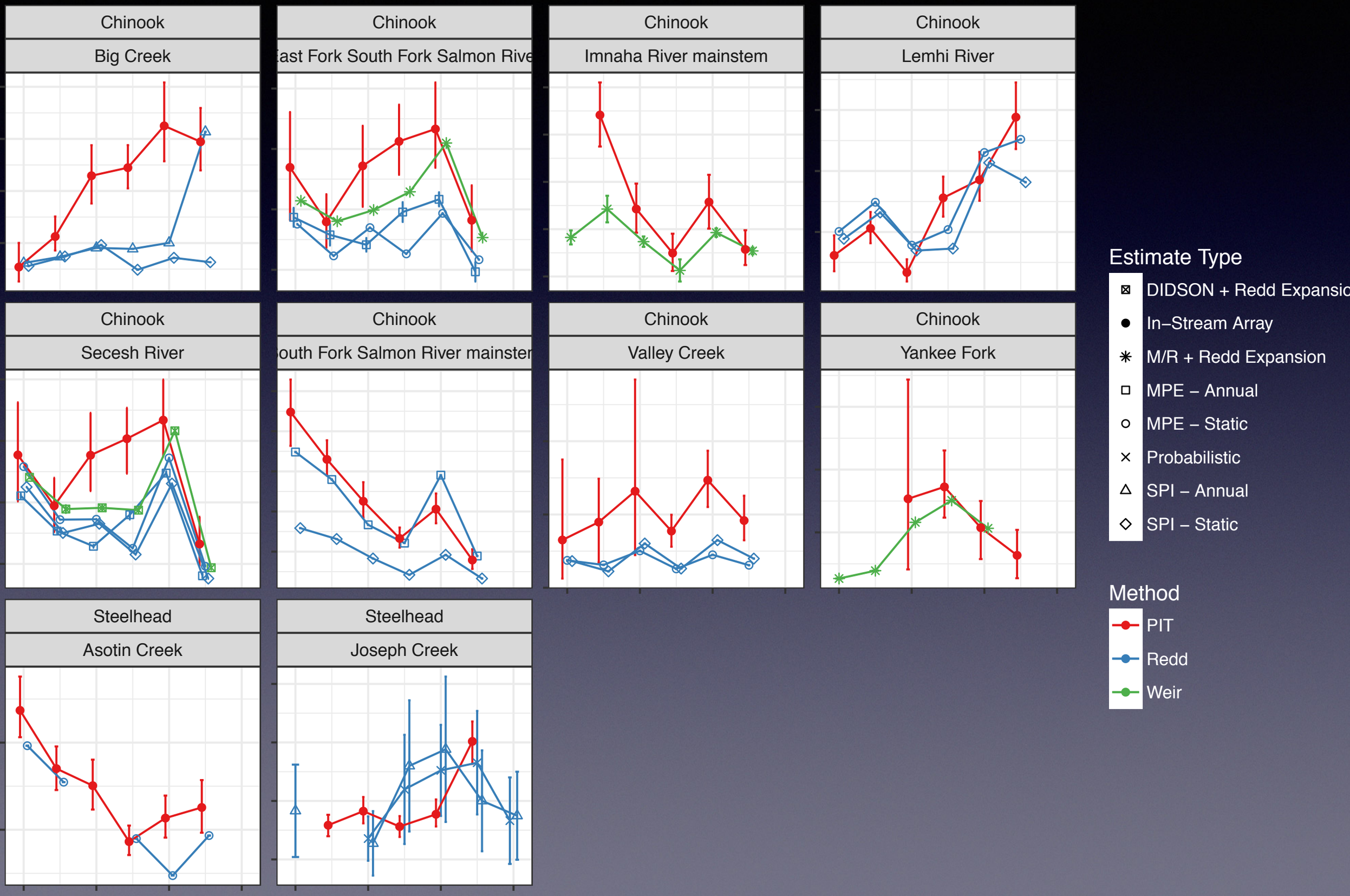
- This works!
- Accurate estimate of total escapement, with uncertainty
- Match up well with independent estimates
- Movements incorporate differential run timing
- Available in many places with no alternative method

Acknowledgements

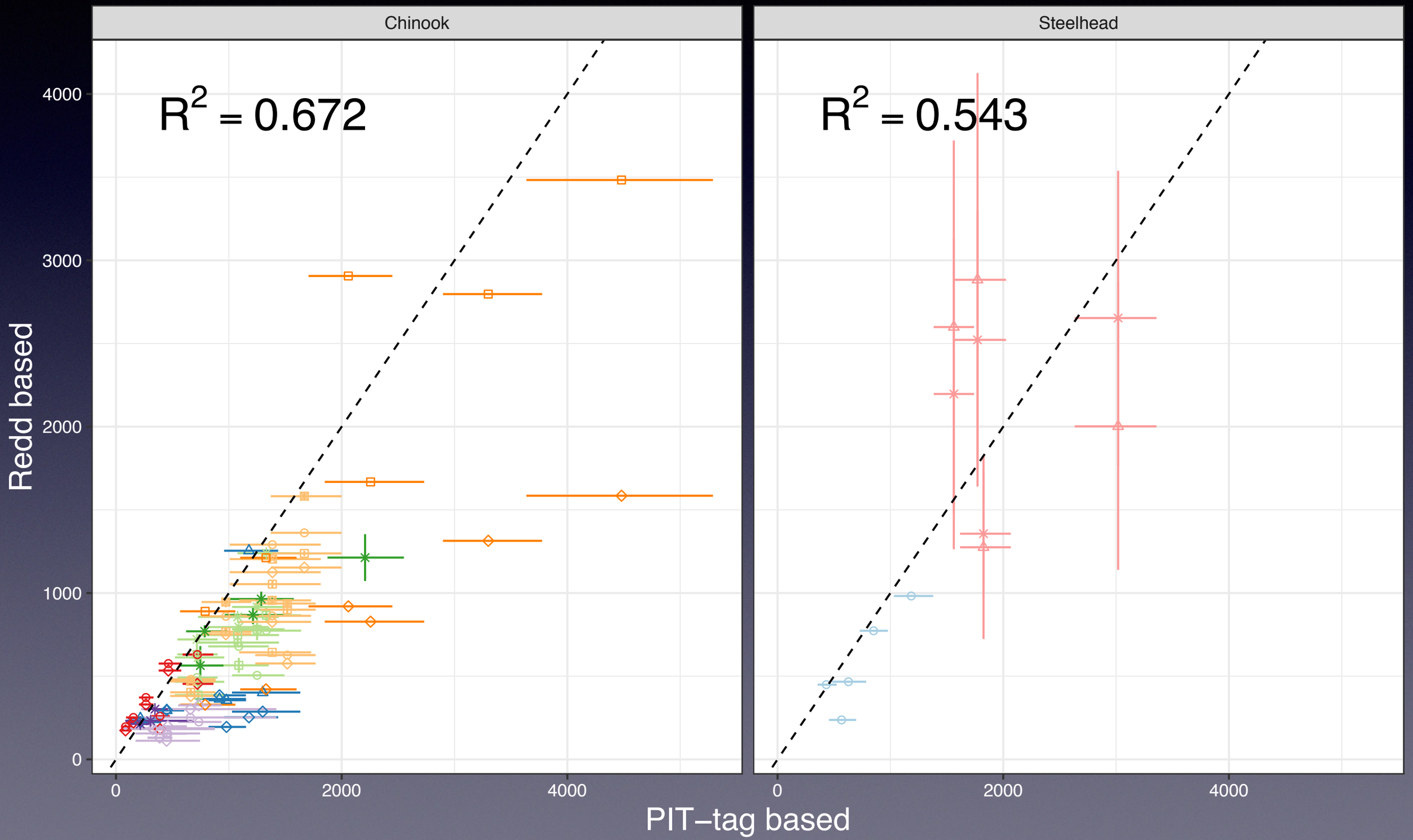


Questions?

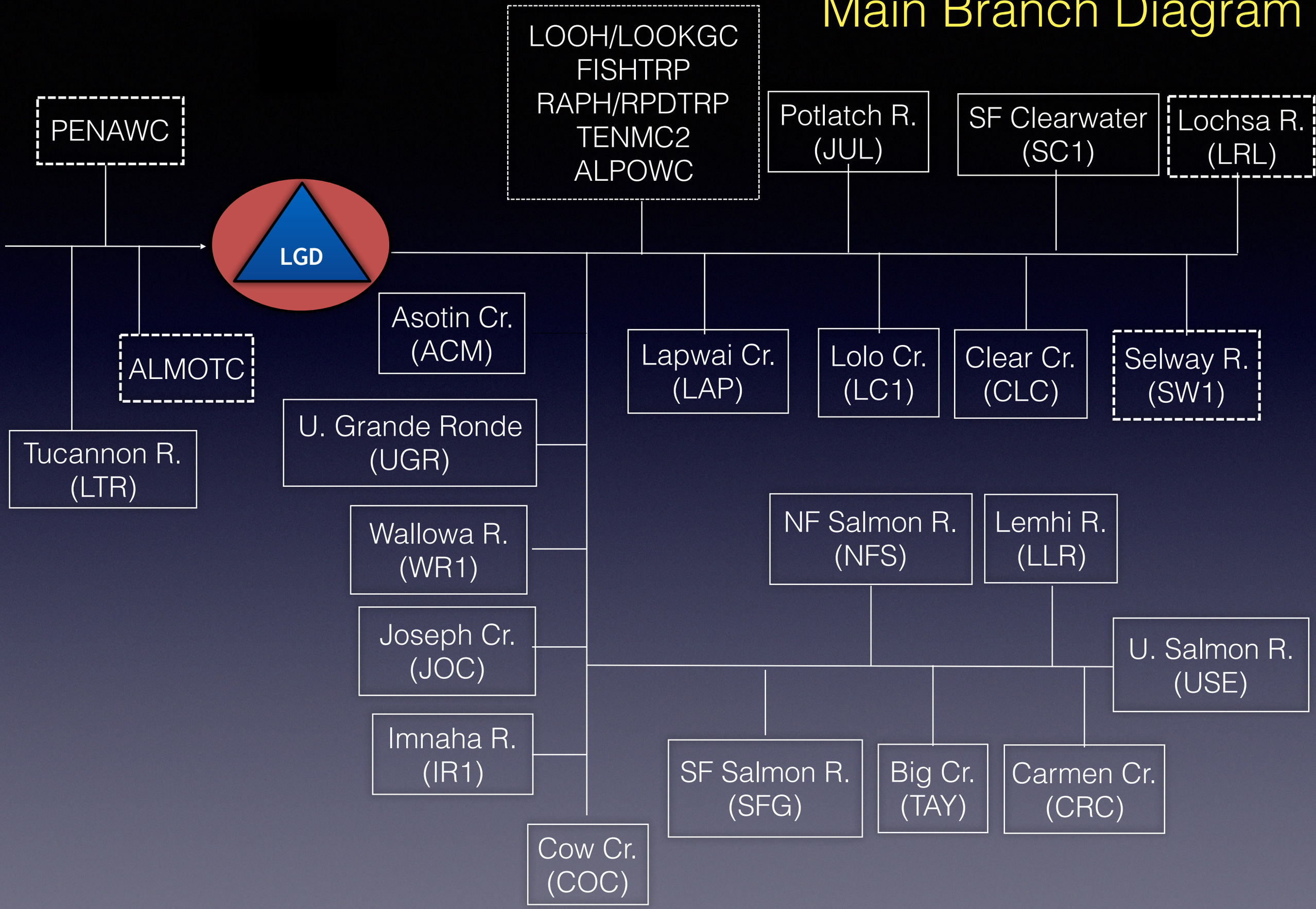
Comparison with Redds



Comparison with Redds



Main Branch Diagram



Salmon Branch Diagram