Passage and survival of steelhead smolts at Toppenish National Wildlife Refuge

U.S. Department of the Interior
U.S. Fish and Wildlife Service

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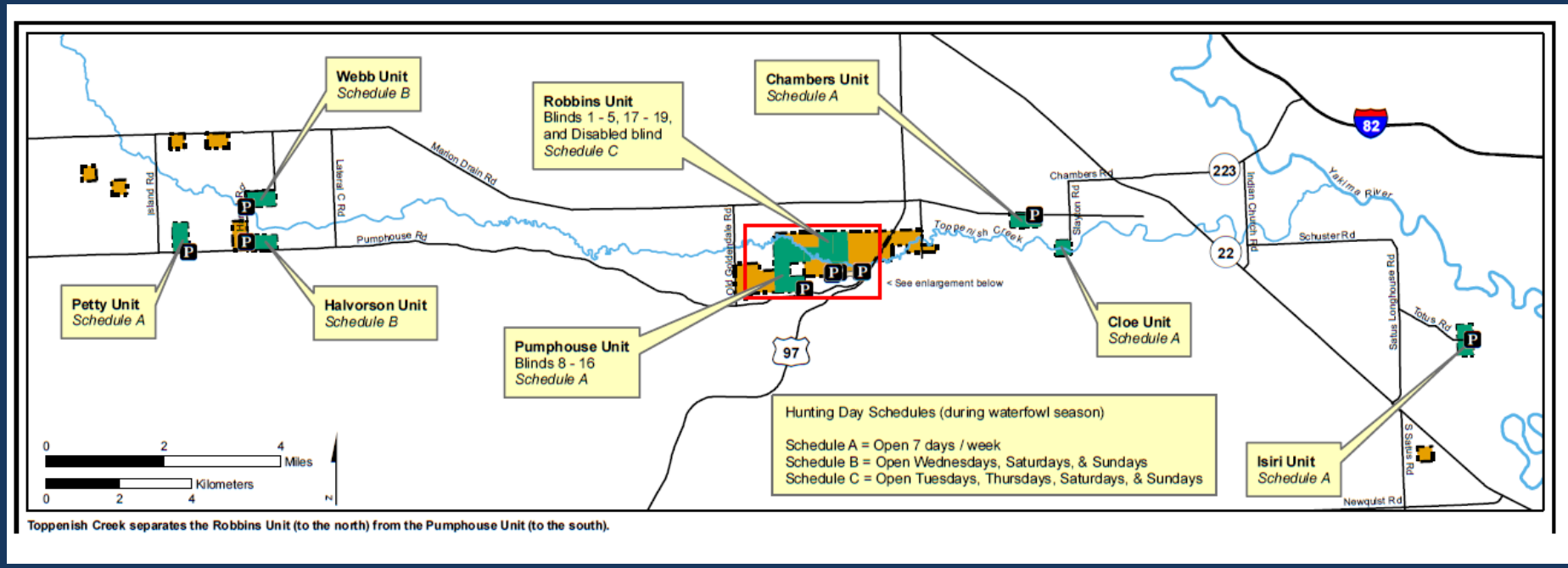
U.S. Department of the Interior
U.S. Fish and Wildlife Service

Toppenish National Wildlife Refuge



Toppenish Creek separates the Robbins Unit (to the north) from the Pumphouse Unit (to the south).

Quality hunt opportunity

Fish passage and entrainment

- Native fishes of concern
  - Mid-Columbia River Steelhead (*O. mykiss*) ESA Threatened (Yakima Unit)
  - Pacific Lamprey (*Lampetra tridentata*)
    - State concern
- FWCO tasked with quantifying entrainment and survival of out-migrating smolts
  - Yakama Nation Fisheries marks smolts, steelhead, and lamprey (adults and macrothalmia)

Photo : USFWS

Steelhead Concerns

- Entrainment through lateral pipe (unscreened)
- Stranding
- Passage
- Management for anadromous fishes
- Toppenish and Satus pops are carrying the population

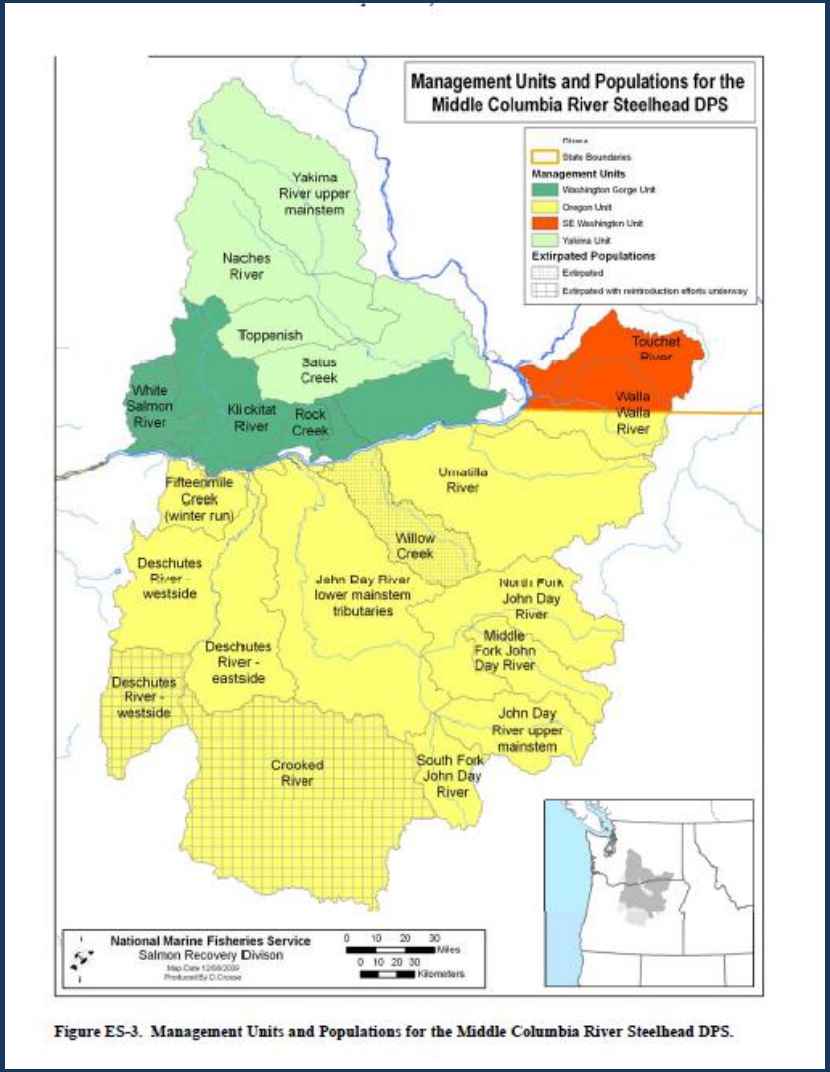
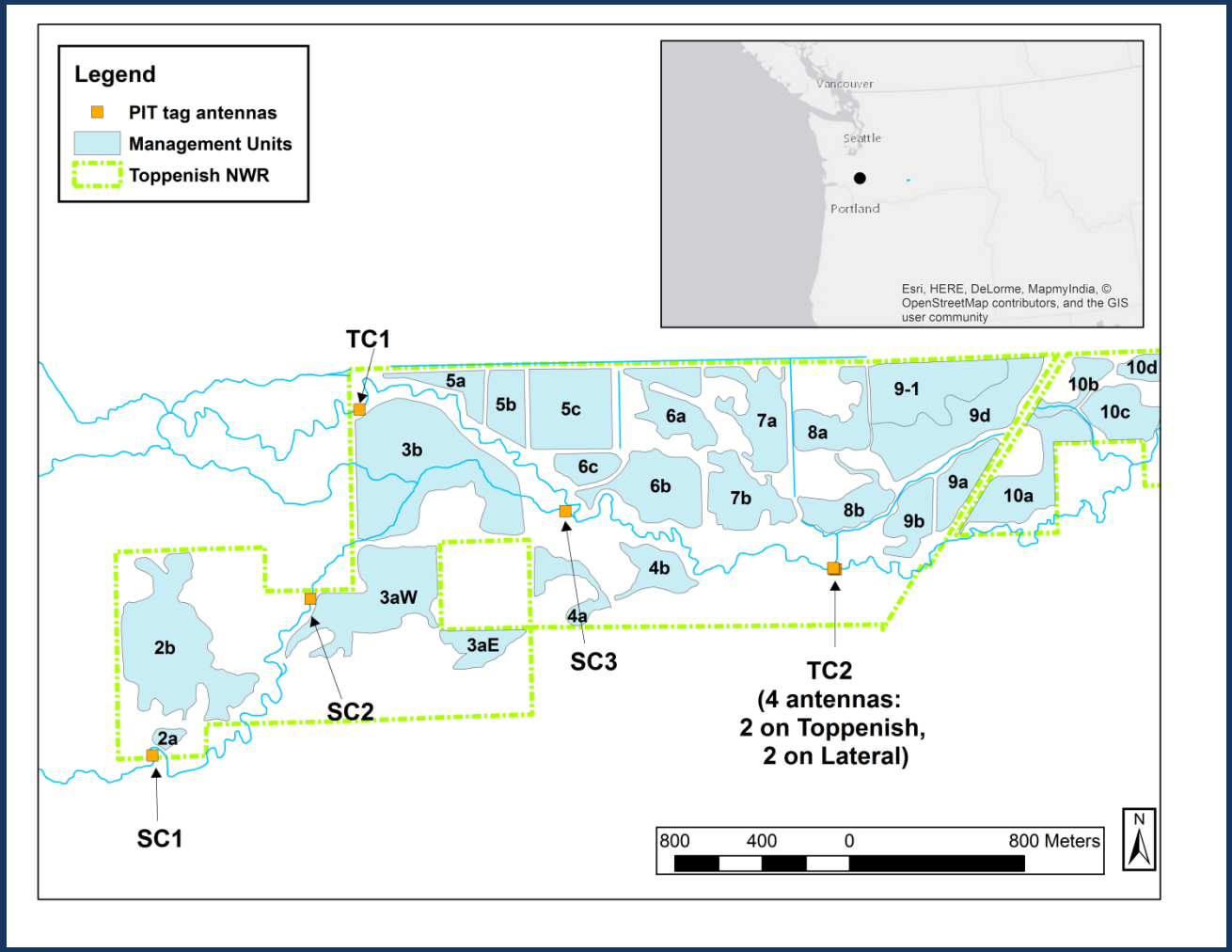


Figure ES-3. Management Units and Populations for the Middle Columbia River Steelhead DPS.

FWCO approach

- Use PIT antennas to monitor entrainment into potential problem areas
- Identify timing of refuge use
- Estimate survival through the refuge

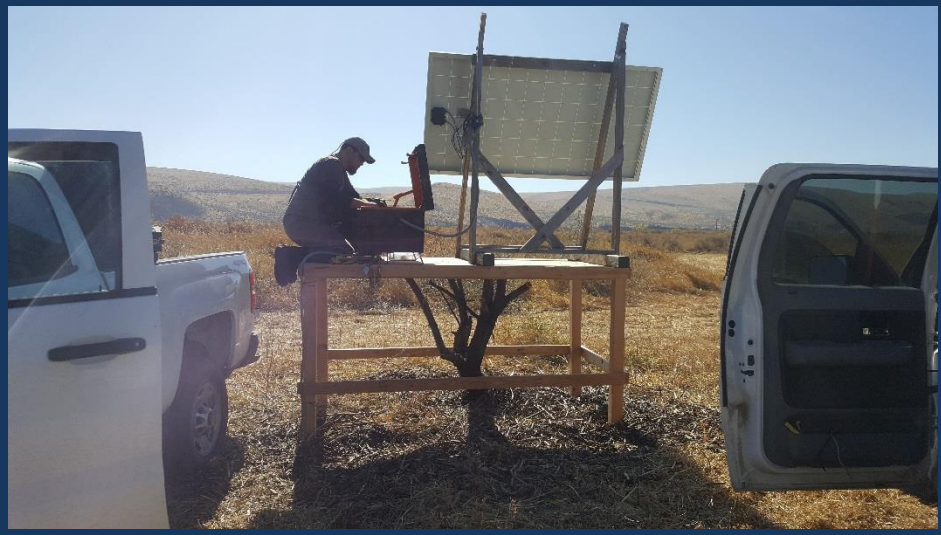
Monitoring Winter 2017/2018

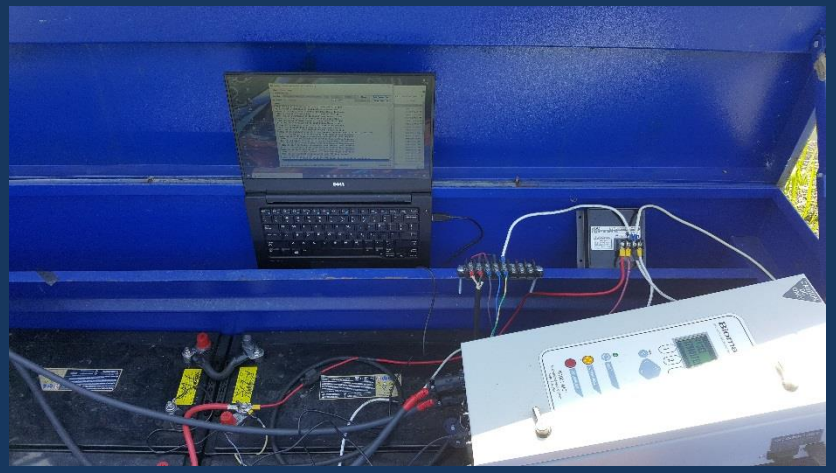


Water control structures

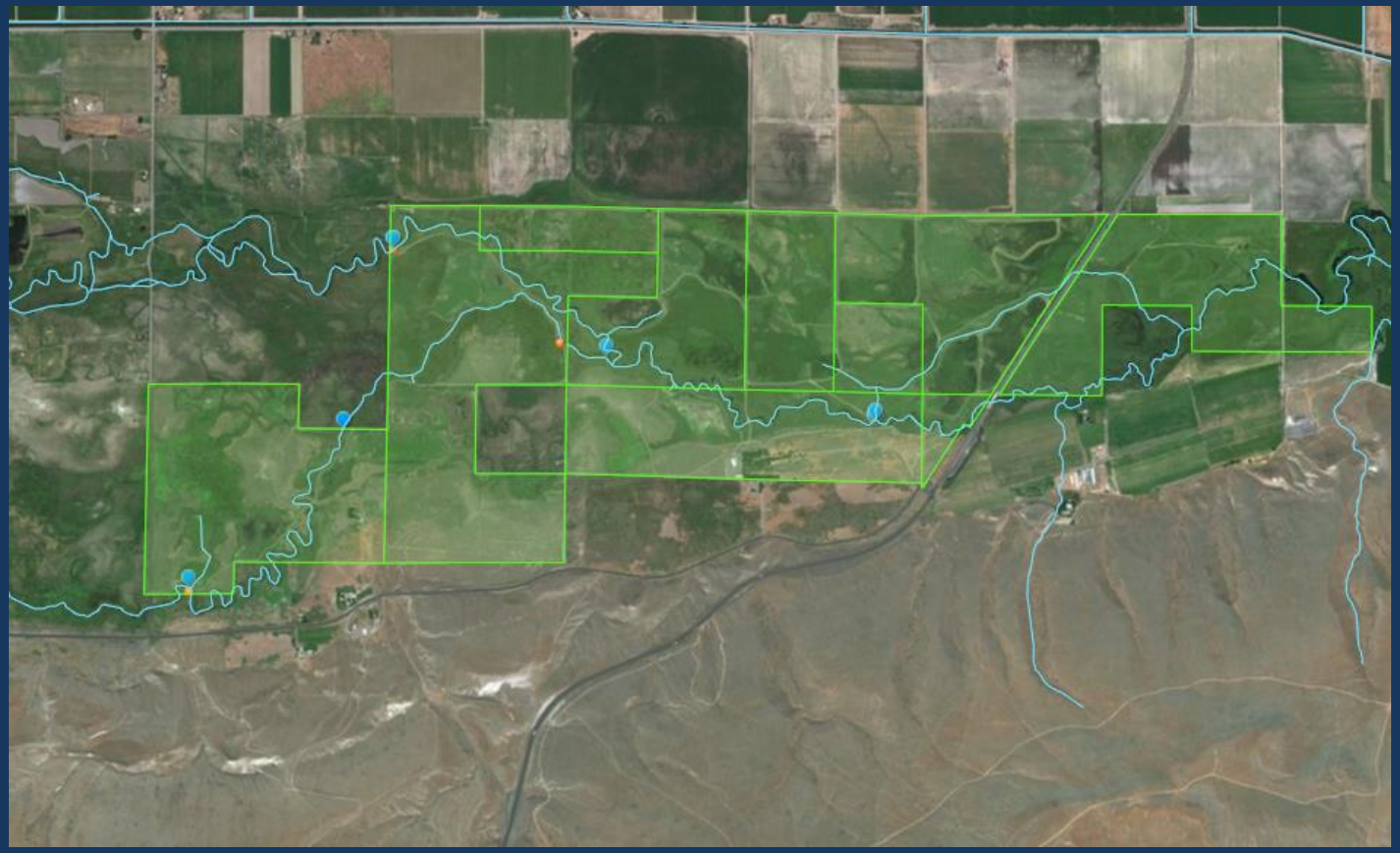
- Mainly flash board risers and board stop type structure
- 1 paddle wheel screen on Snake Creek
- Potential issues for passage
- Dynamic management approach

Antennas

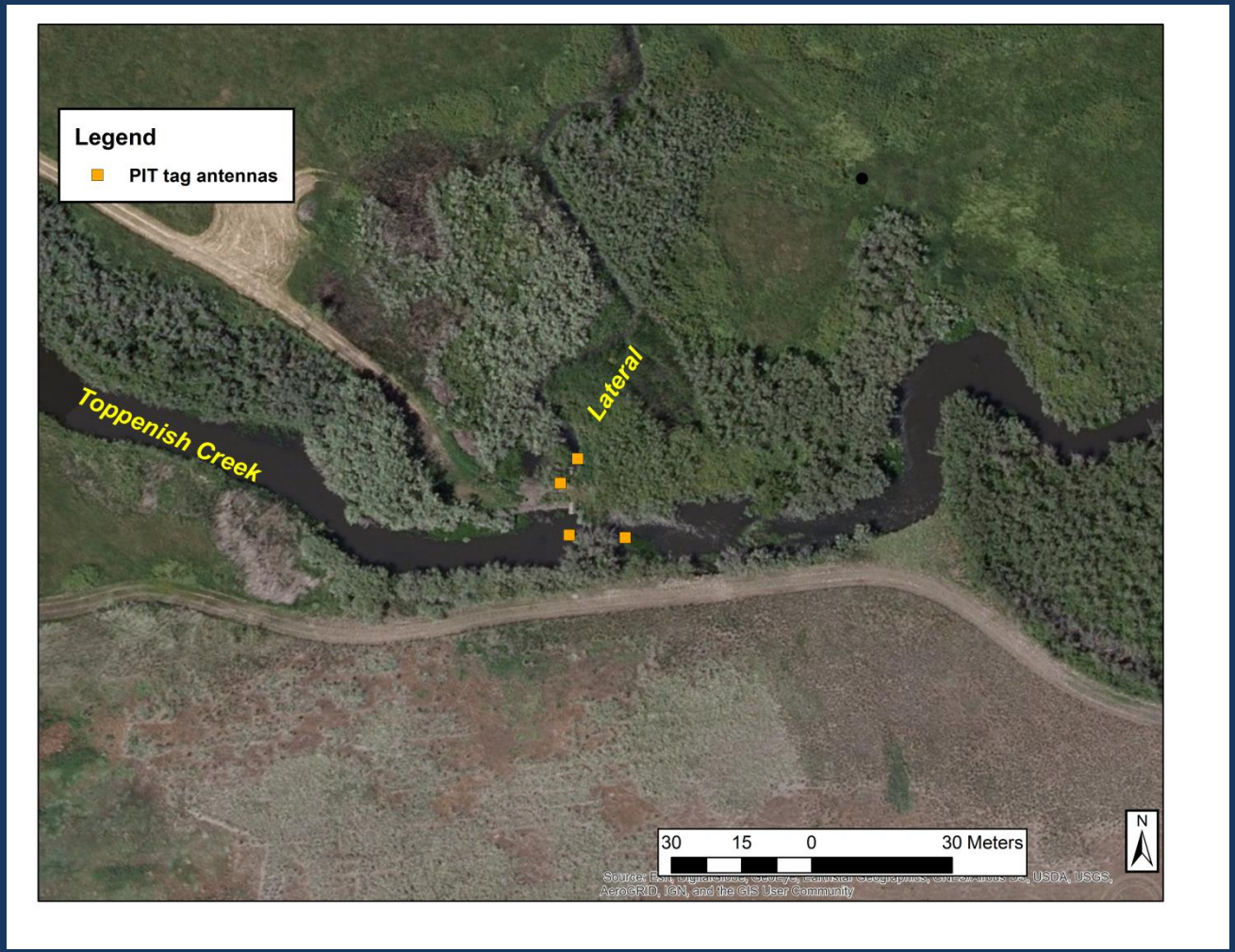




Toppenish National Wildlife Refuge



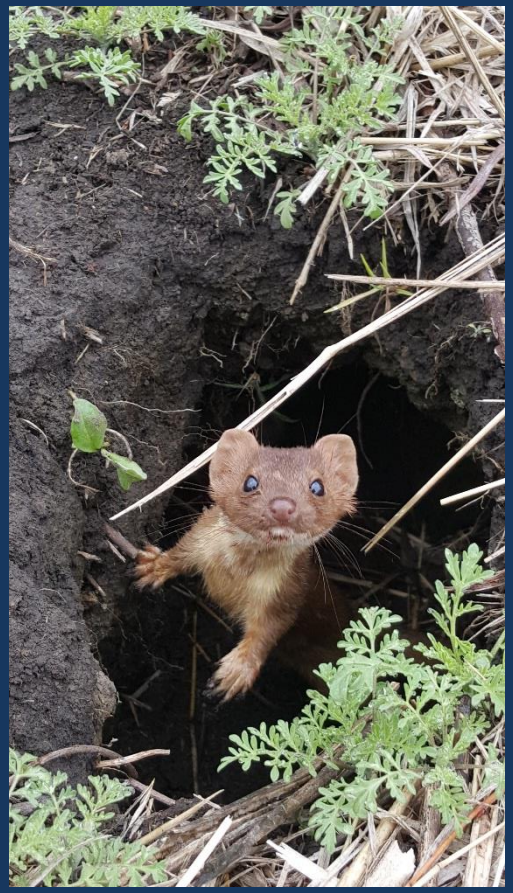
Downstream sites



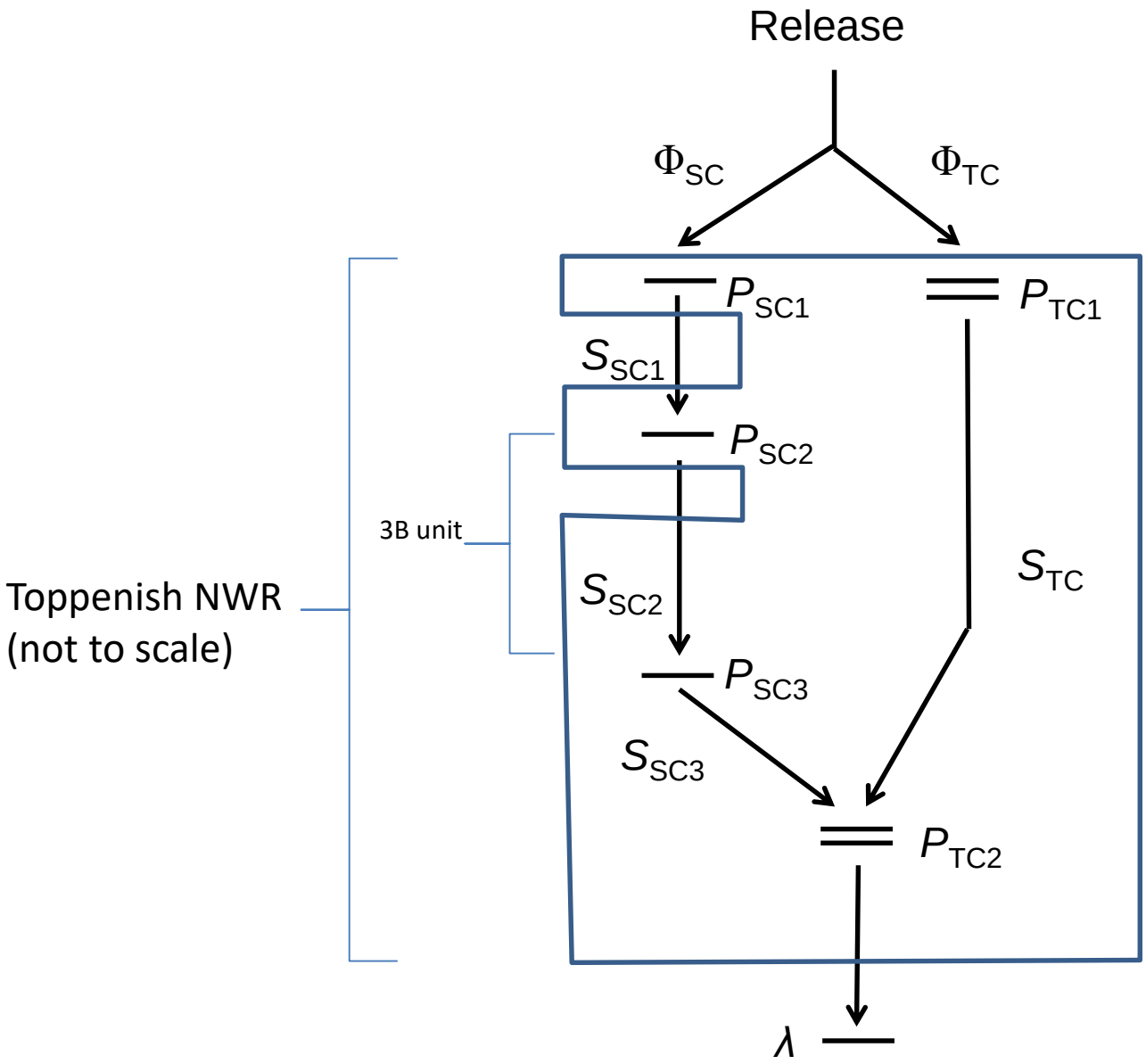
Downstream sites

Multistate mark-recapture model approach

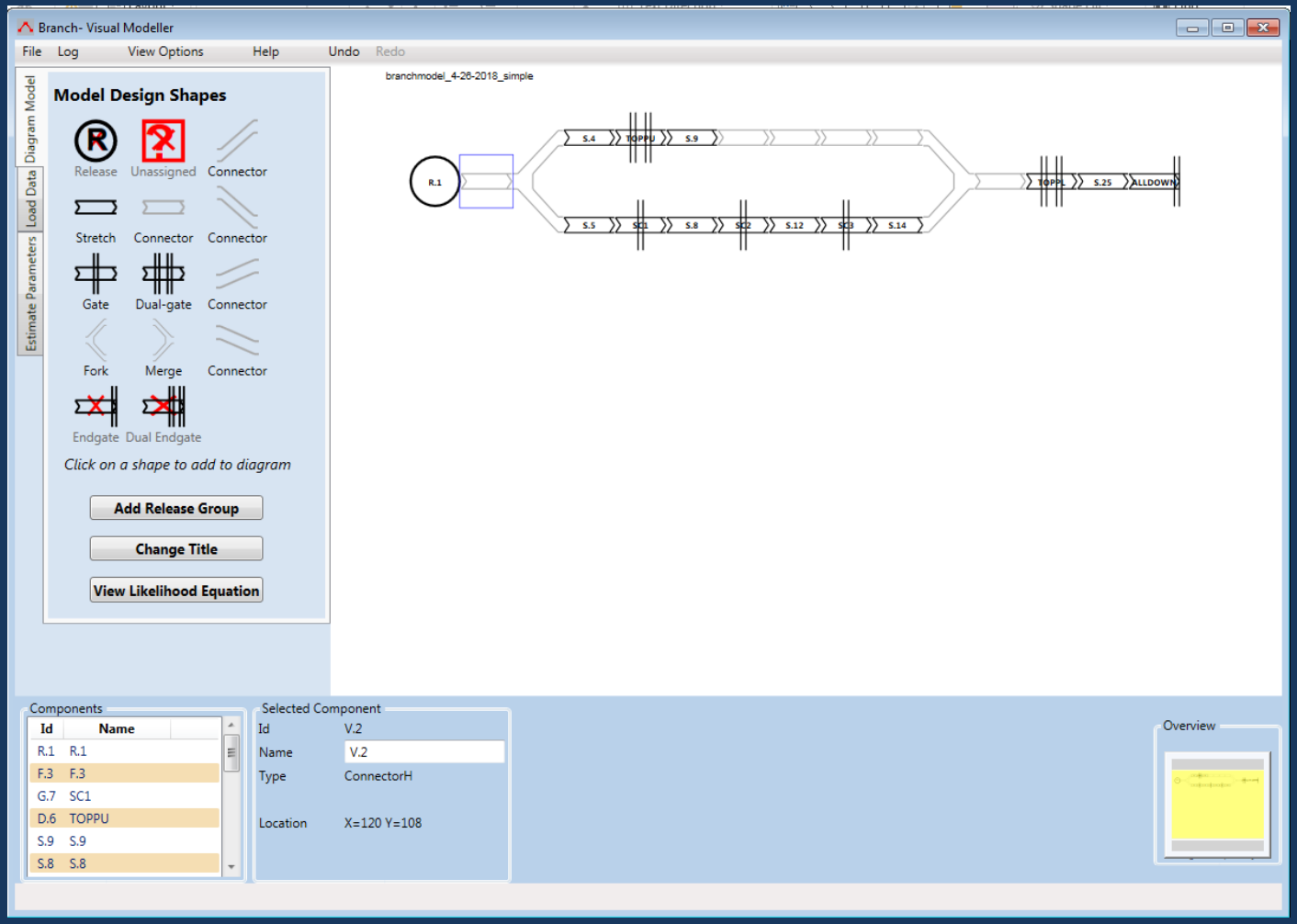
- USER/BRANCH or could use unmarked for R
  - Product of CBR
  - GUI
- Estimate survival (S), detection probability (P), and joint routing and survival probability (Φ)
- All antennas downstream of the refuge were combined to inform detection probabilities
  - (λ = P * S)



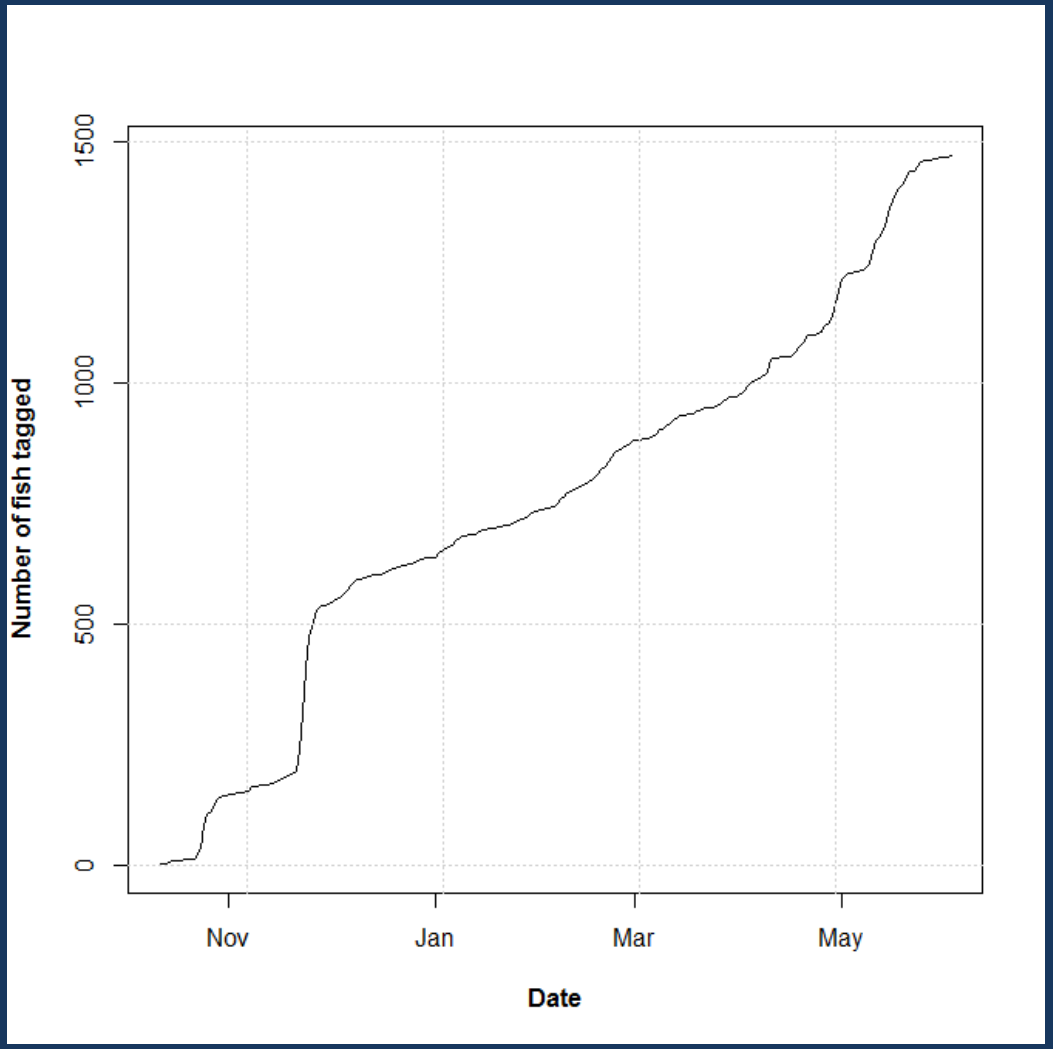
Protector of SC1 antenna


Release
Φ_{SC}
Φ_{TC}
P_{SC1}
P_{TC1}
S_{SC1}
P_{SC2}
3B unit
S_{TC}
S_{SC2}
P_{SC3}
S_{SC3}
P_{TC2}
λ
Toppenish NWR
(not to scale)

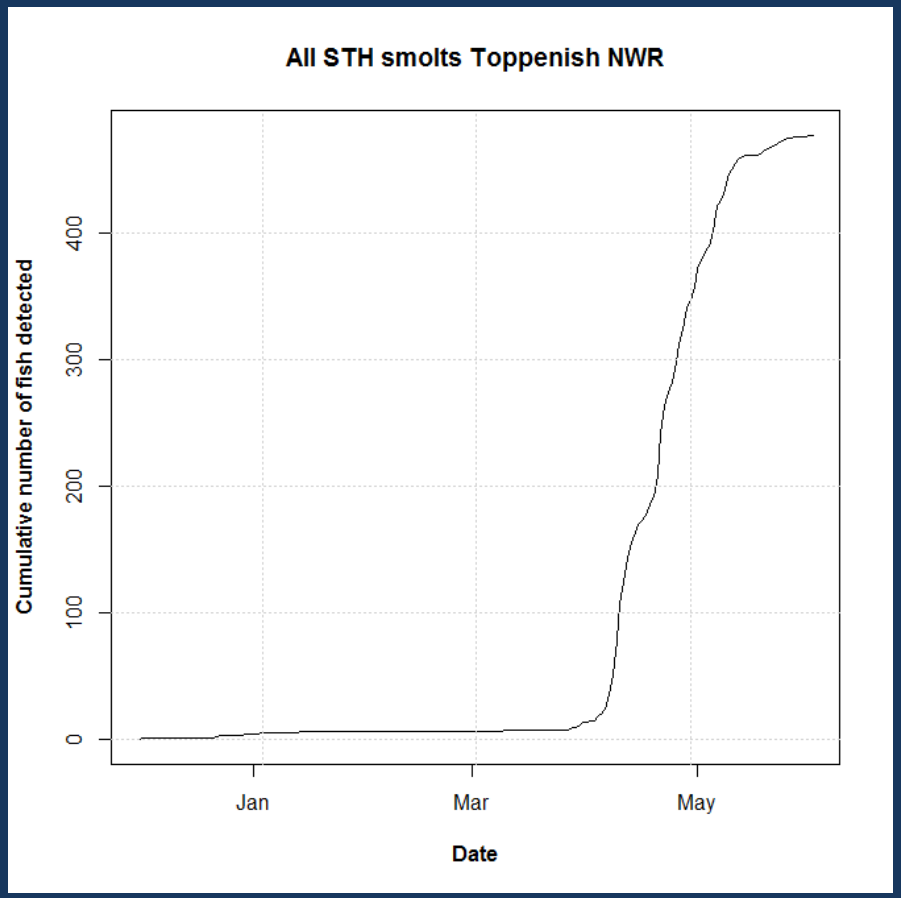
BRANCH

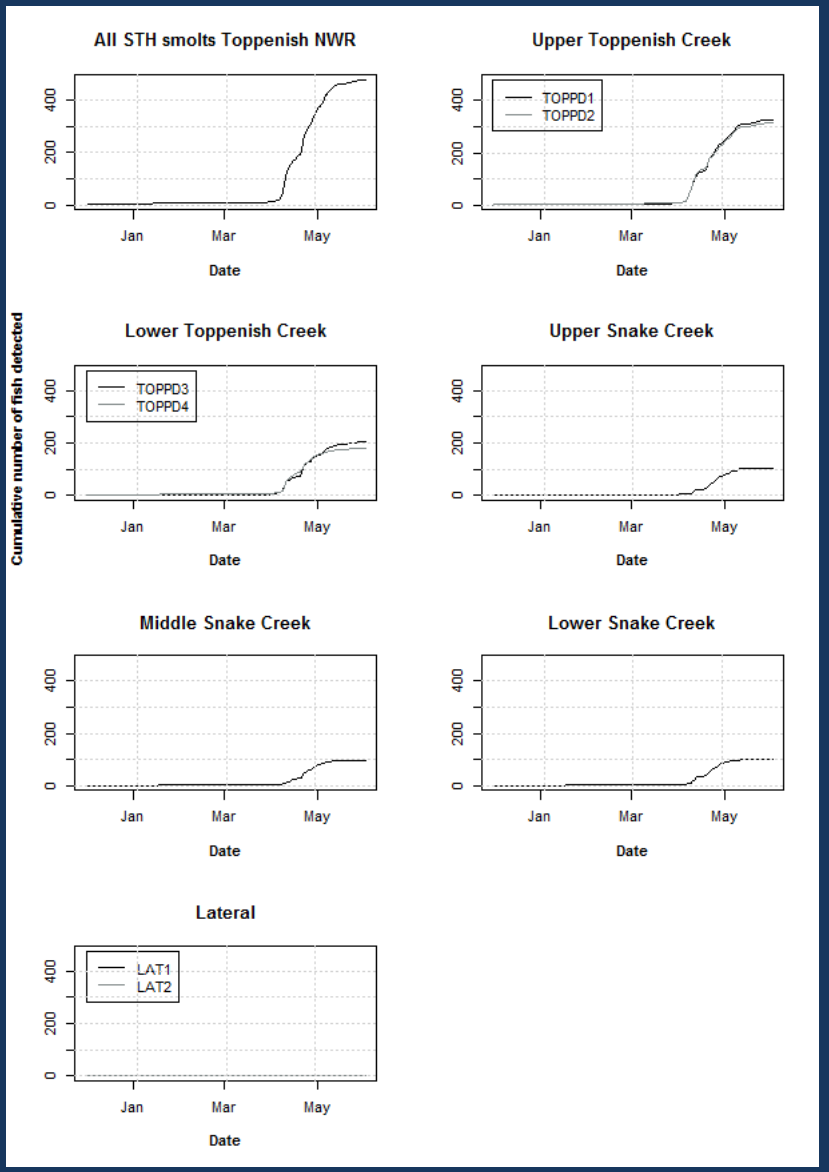

Branch- Visual Modeller
File
Log
View Options
Help
Undo
Redo
Diagram Model
Load Data
Estimate Parameters
Model Design Shapes
Release
Unassigned
Connector
Stretch
Connector
Connector
Gate
Dual-gate
Connector
Fork
Merge
Connector
Endgate
Dual Endgate
Click on a shape to add to diagram
Add Release Group
Change Title
View Likelihood Equation
branchmodel_4-26-2018_simple
R.1
S.4
TOPPU
S.9
S.5
SC1
S.8
SC2
S.12
SC3
S.14
TOPPL
S.25
ALLDOWN
Components
Id
Name
R.1 R.1
F.3 F.3
G.7 SC1
D.6 TOPPU
S.9 S.9
S.8 S.8
Selected Component
Id V.2
Name V.2
Type ConnectorH
Location X=120 Y=108
Overview

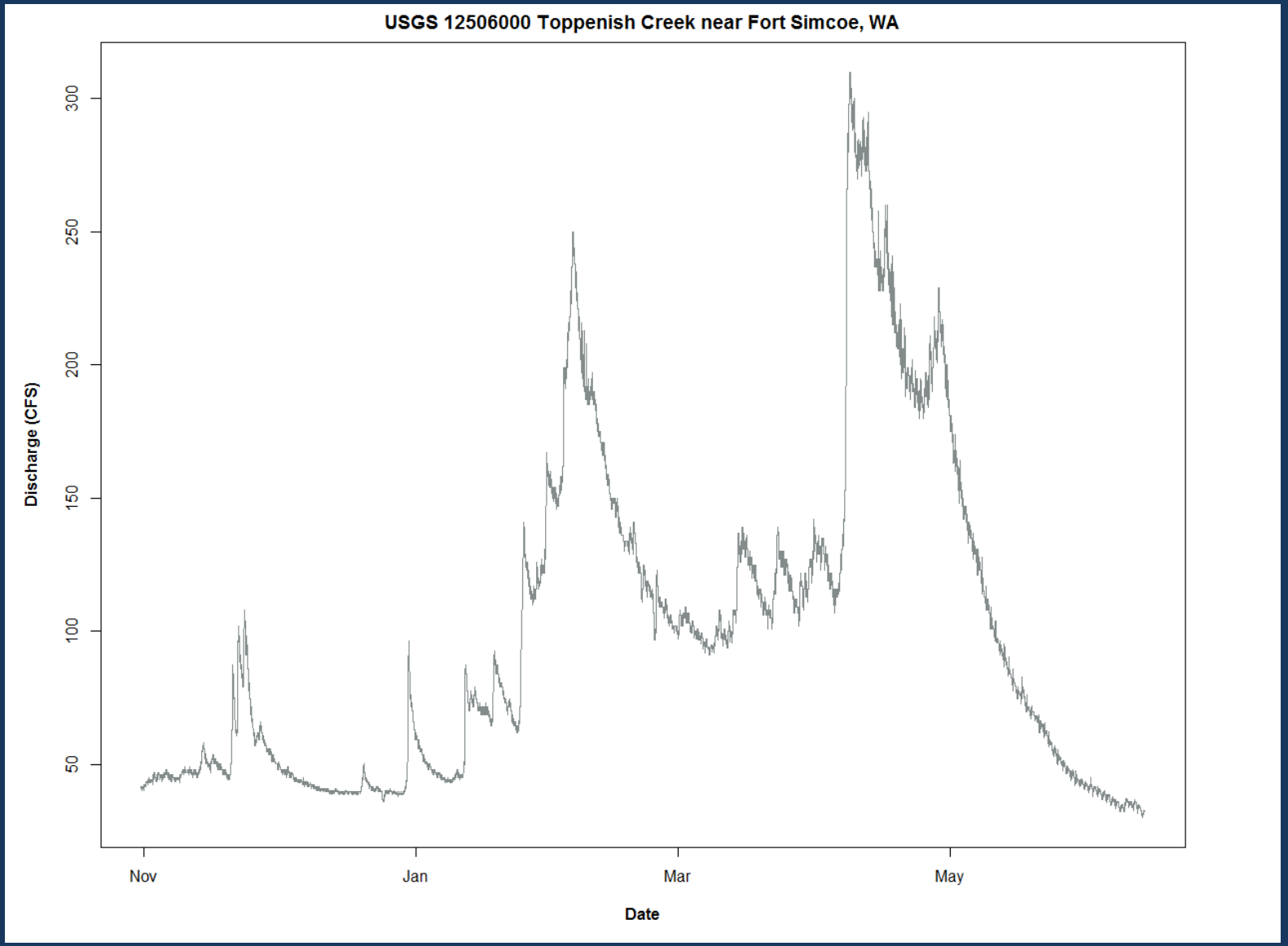
YN smolt tagging

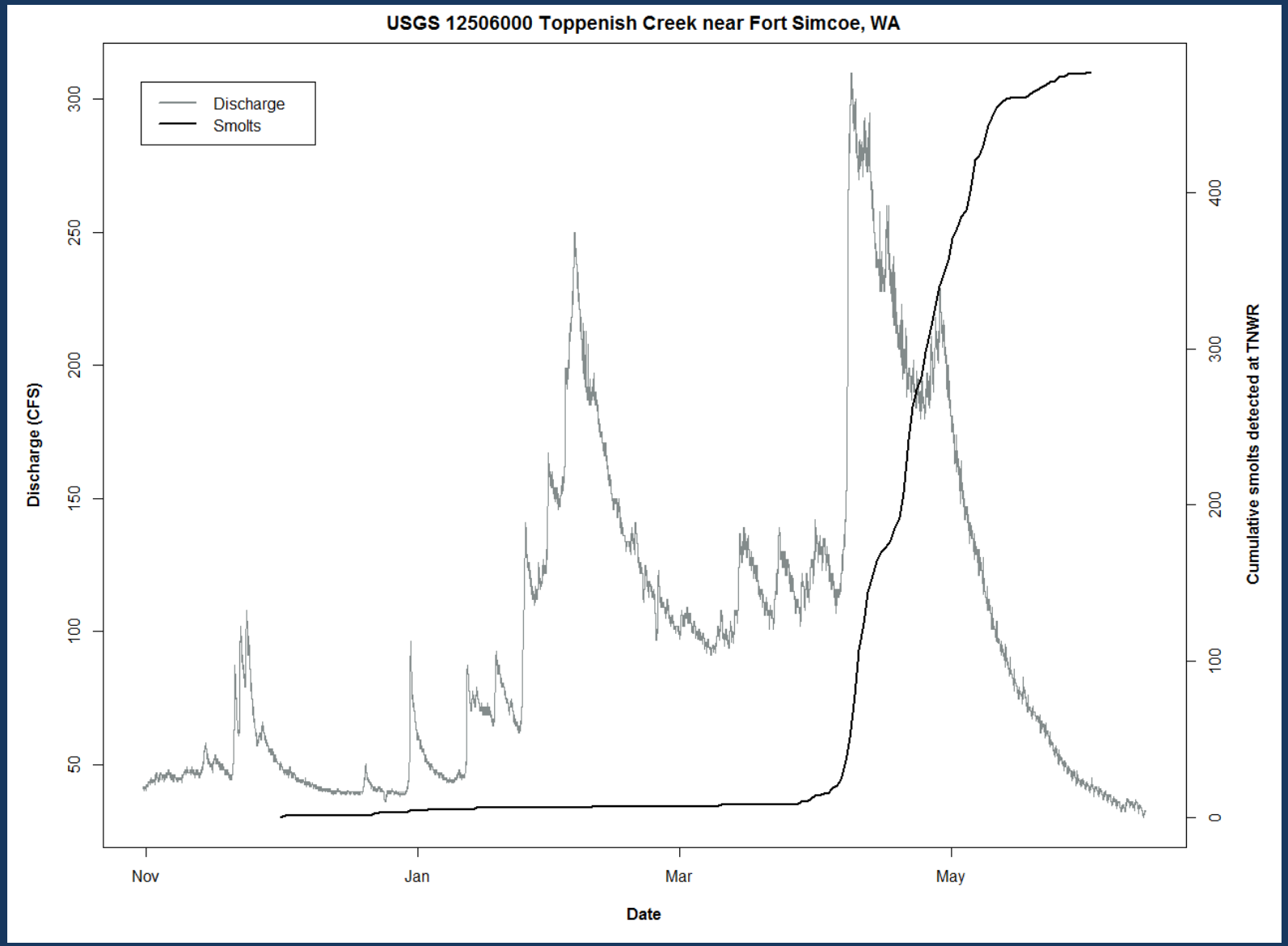


Arrival at the refuge






USGS 12506000 Toppenish Creek near Fort Simcoe, WA
Discharge (CFS)
50
100
150
200
250
300
Nov
Jan
Mar
May
Date

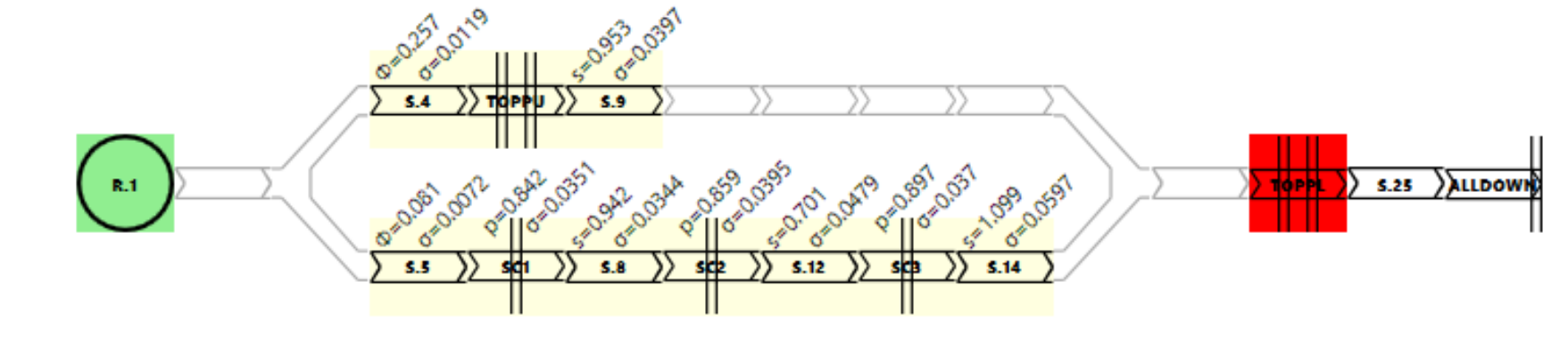

USGS 12506000 Toppenish Creek near Fort Simcoe, WA
Discharge
Smolts
Discharge (CFS)
50
100
150
200
250
300
Cumulative smolts detected at TNWR
0
100
200
300
400
Nov
Jan
Mar
May
Date

Preliminary results

- To date
  - 1,473 tagged and released
    - 10/12/17- 6/02/18
  - 477 detected at refuge
  - So far 188 detected downstream of refuge
  - 0 not detected at refuge, but downstream
  - 3 fish entrained into lateral
    - 2 detected down stream
    - 1 appears to be in a predator

Category	Observed
R.1 TOPPU	347
R.1 SC1	101
R.1 SC2	12
R.1 TOPPL	12
R.1 SC3	5
R.1 ALLDOWN	0
R.1 0	996
SC1 SC2	85
SC1 SC3	4
SC1 TOPPL	0
SC1 ALLDOWN	2
SC1 0	10
TOPPU__a	326
TOPPU__b	315
TOPPU__ab	293
TOPPU TOPPL	234
TOPPU ALLDOWN	36
TOPPU 0	77
SC2 SC3	62
SC2 TOPPL	3
SC2 ALLDOWN	2
SC2 0	30
SC3 TOPPL	51
SC3 0	10
TOPPL__a	205
TOPPL__b	183
TOPPL__ab	88
TOPPL ALLDOWN	138
TOPPL 0	162

Magic…


Φ=0.257
σ=0.0119
S.4
TOPPU
S.9
ς=0.953
σ=0.0397
R.1
Φ=0.081
σ=0.0072
S.5
SC1
p=0.842
σ=0.0351
S.8
ς=0.942
σ=0.0344
SC2
p=0.859
σ=0.0395
S.12
ς=0.701
σ=0.0479
SC3
p=0.897
σ=0.037
S.14
ς=1.099
σ=0.0597
TOPPL
S.25
ALLDOWN

Preliminary-results 2017/18

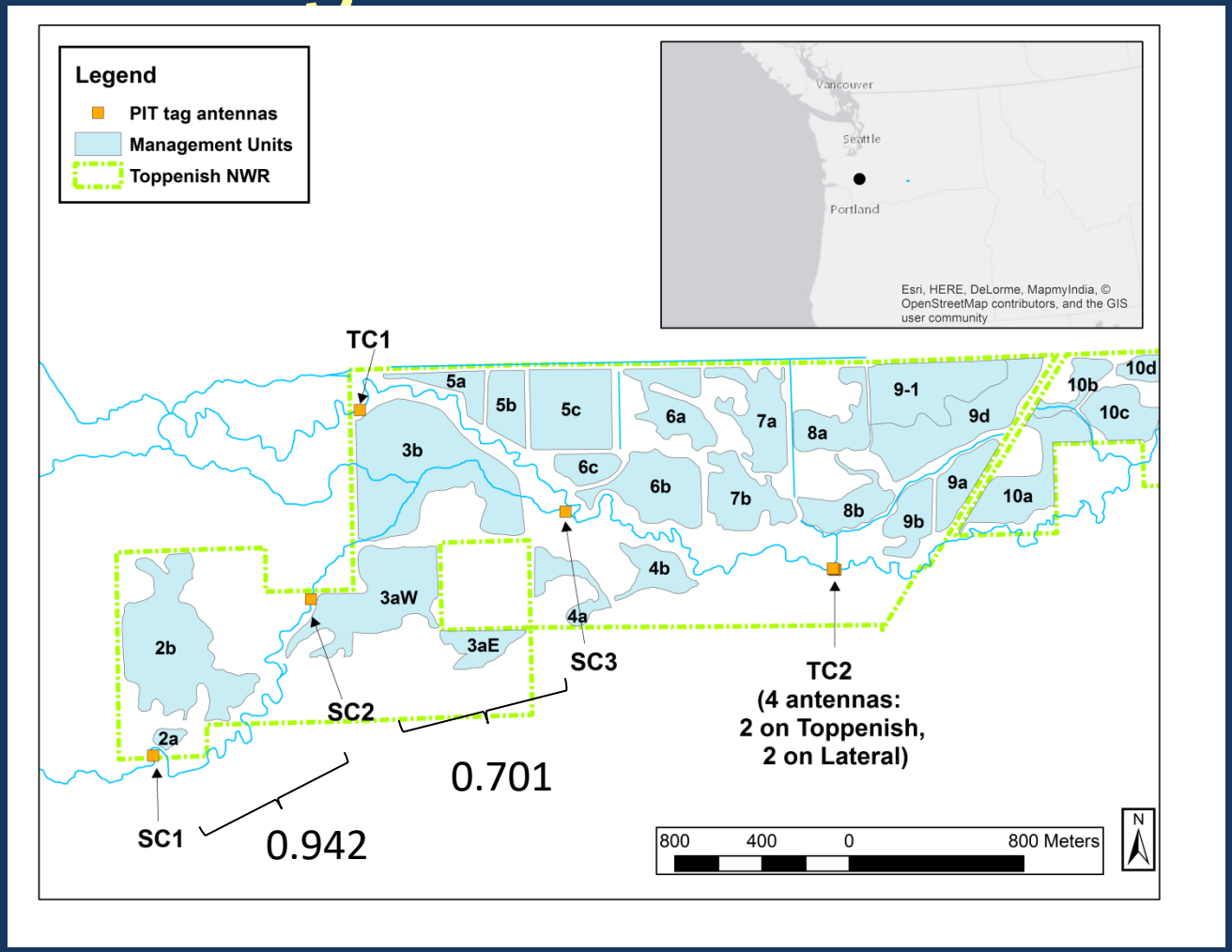
Detection probabilities (0-1)

Parameter	Estimate	s.e.
P_{SC1}	0.842	0.0351
P_{SC2}	0.859	0.0395
P_{SC3}	0.897	0.0370
$P_{TC1\ (upper\ Topp)}$	0.798	0.0129
$P_{TC2\ (lower\ Topp)}$	0.624	0.0237

Survival estimates (0-1)

Parameter	Estimate	s.e.
Φ_{TC1}	0.257	0.0119
Φ_{SC1}	0.081	0.0072
S_{TC}	0.953	0.0397
S_{SC1}	0.942	0.0344
$S_{SC2\ (3B\ unit)}$	0.701	0.0497
S_{SC3}	1.099	0.0597

Monitoring Winter 2017/2018



Preliminary-results

- **Derived survival estimates**

2018

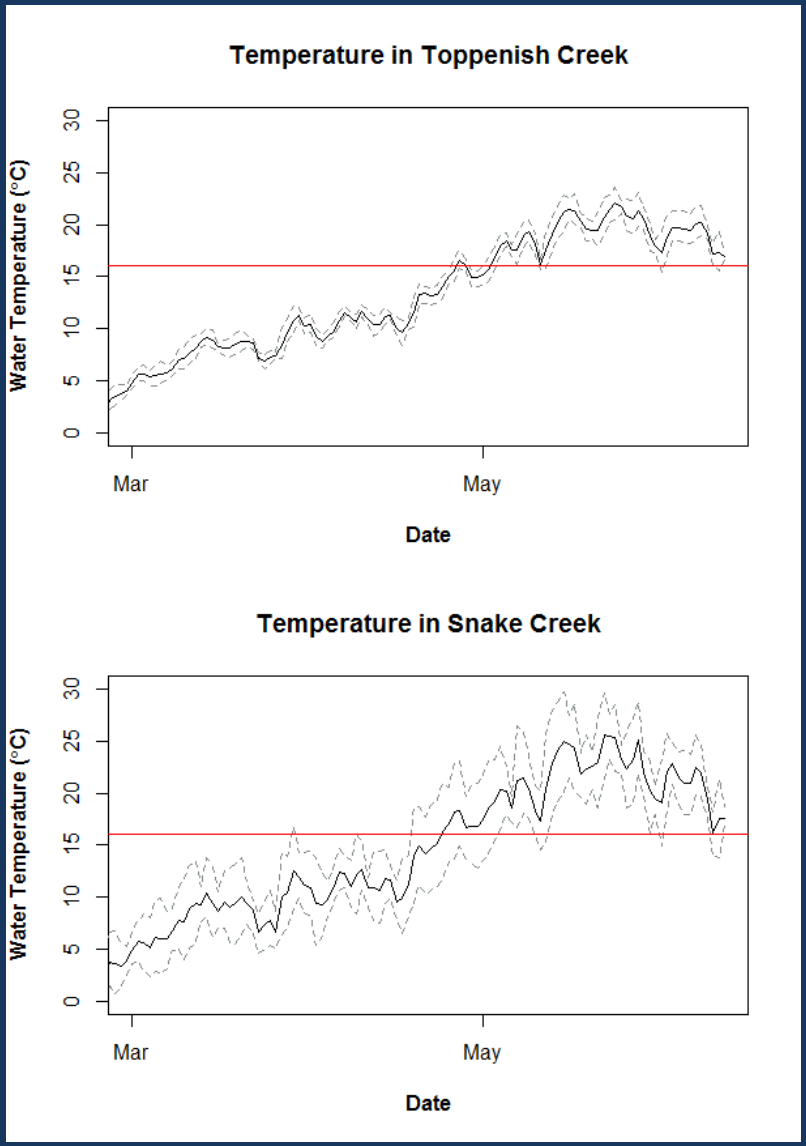
Convenience Function	Survival Estimate
Release to Refuge Exit	0.304 (0.016)
Snake Creek on refuge	0.660 (0.045)
Toppenish Creek on refuge	0.953 (0.040)

2017

Convenience Functions	Survival Estimate
Release to Refuge Exit	0.267 (0.058)
Snake Creek on refuge	0.188 (0.128)
Toppenish Creek on refuge	0.657 (0.157)

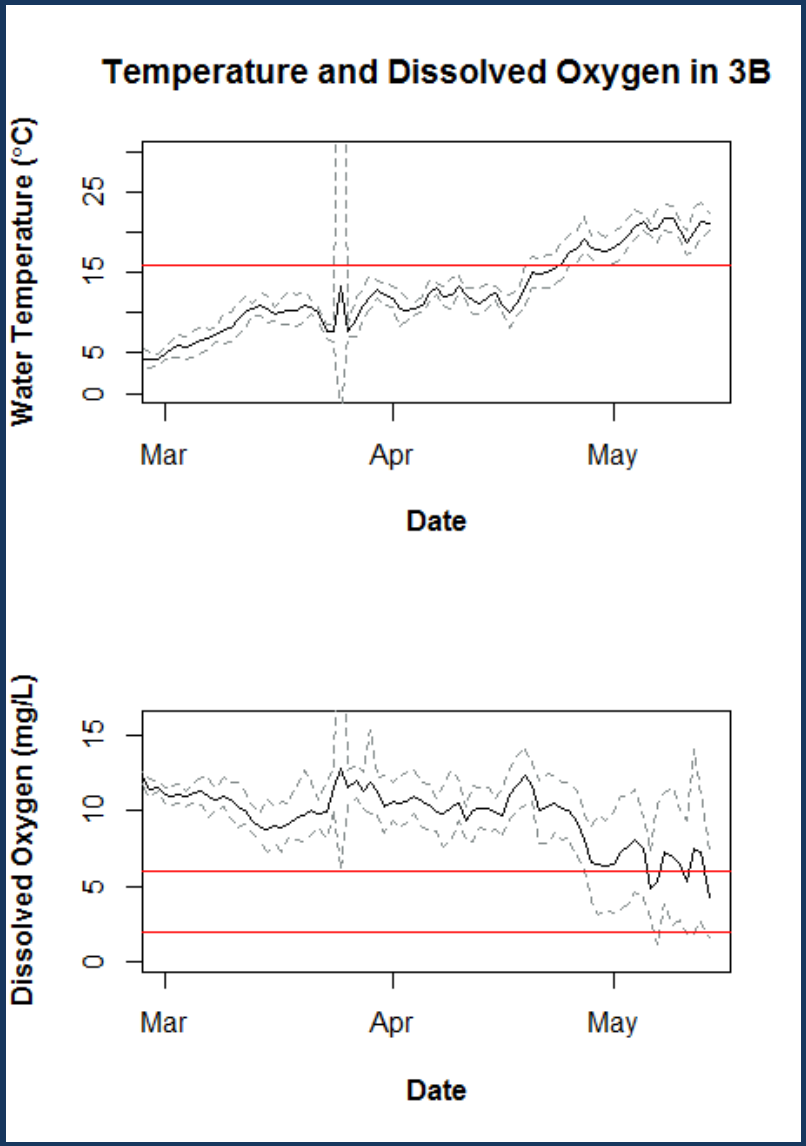
Issues?

- First week of May survival in Snake Creek dropped 10 percentage points…
- Predation events?



Issues?

- First week of May survival in Snake Creek dropped 10 percentage points…
- Predation events?
- WTQ in 3B unit?



Floater

WTQ

- **Water quality in Snake Creek**

Flow

Site	Temperature	DO (mg/L)	Date time
SC1	22.1	10.18	5/14/2018 1205
Paddle Wheel	22	5.93	5/14/2018 1210
SC2	22	5.06	5/14/2018 1224
SC entry ditch	21.7	5.2	5/14/2018 1237
3B outlet	24	6.5	5/14/2018 1300
SC3	20.8	6.75	5/14/2018 1321

Site	Temperature	DO (mg/L)	Date time
ToppD1	20.4	7.7	5/14/2018 1315

Degraded riparian

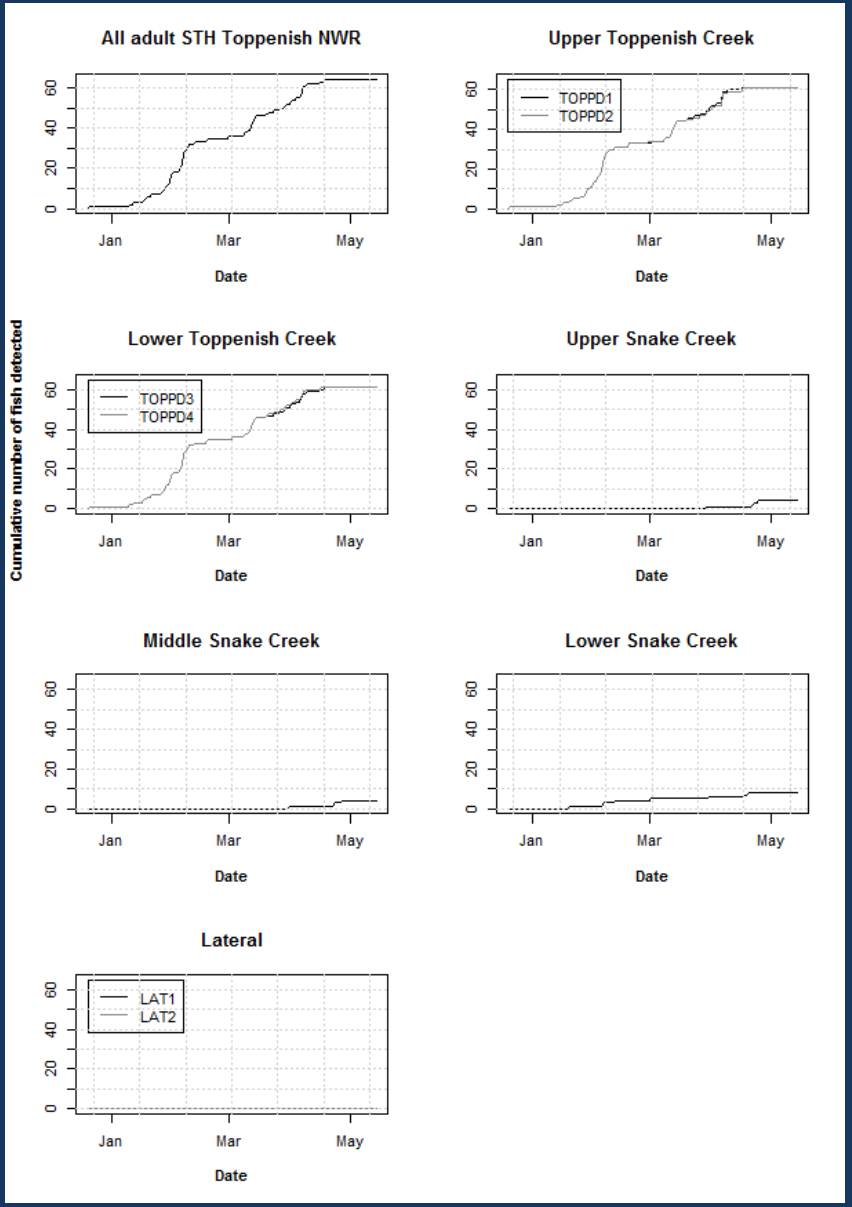
Travel Times

Transition	Average travel time in days	Minimum	Maximum	n
SC1 SC2	0.400	0.077	2.93	85
SC2 SC3	0.581	0.072	16.339	62
SC3 TOPPL	0.119	0.037	0.776	51
TOPPU TOPPL	0.255	0.068	5.39	234

- **Snake Creek → 27.8 hours**
- **Toppenish Creek → 6.12 hours**
- **No differential survival downstream of refuge**
  - **Trade offs**

Adults

- Some returns from 2015, most tagged at Prosser
- 4 presumed kelts entered refuge via Snake Creek from upstream
  - Stall at first control structure
  - 1 made it through
  - 2 turned around and went back to Toppenish Creek
  - 1 potential mortality in 3B



Thoughts….

- Snake Creek upstream of refuge needs some love
  - Riparian restoration
  - Reduce nutrient load
- Get Snake Creek fish back into Toppenish Creek ASAP
  - Move connection with Toppenish Creek back to original confluence
- 3B is a habitat restoration “opportunity”

Thanks!

- **Heidi Newsome USFWS**
- **Robert Luna USFWS**
- **YRBWEP**

Questions?