Oregon State University
College of Forestry

Riparian harvest effects on headwater streams:

Changing summer flow after harvests in coastal Northern California

Jonah Nicholas
Advised by: Dr. Kevin Bladon and Dr. Catalina Segura

Land Acknowledgement

Oregon State University in Corvallis is located within the traditional homelands of the Marys River or Ampinefu Band of Kalapuya. Following the Willamette Valley Treaty of 1855, Kalapuya people were forcibly removed to reservations in Western Oregon. Today, living descendants of these people are part of the Confederated Tribes of Grand Ronde Community of Oregon and the Confederated Tribes of the Siletz Indians.

Introduction

Research Question/Expectations

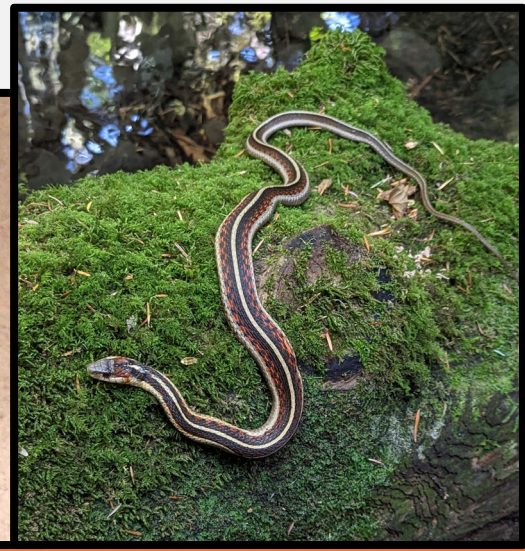
Study Setup

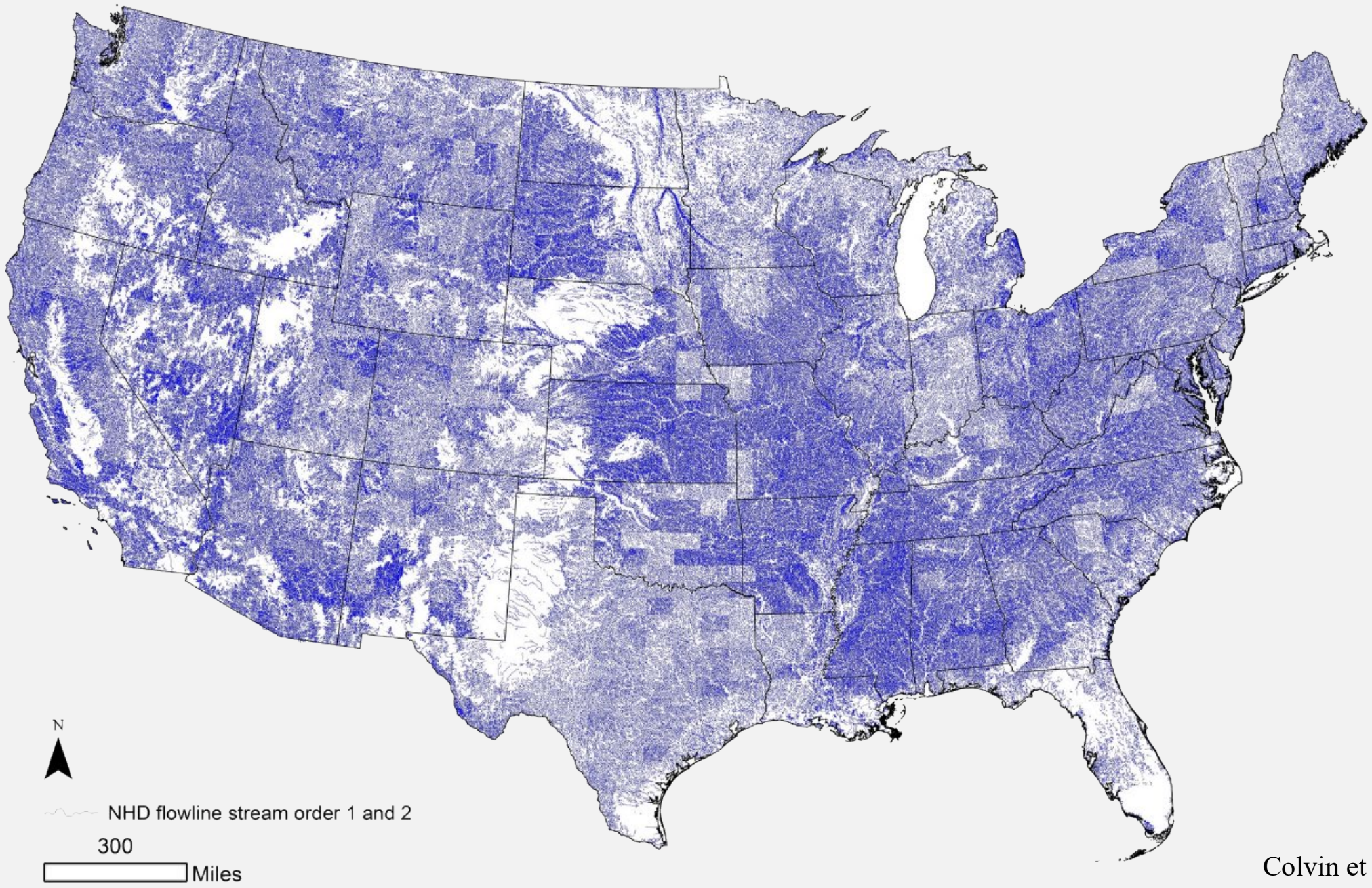
Results

Interpretation

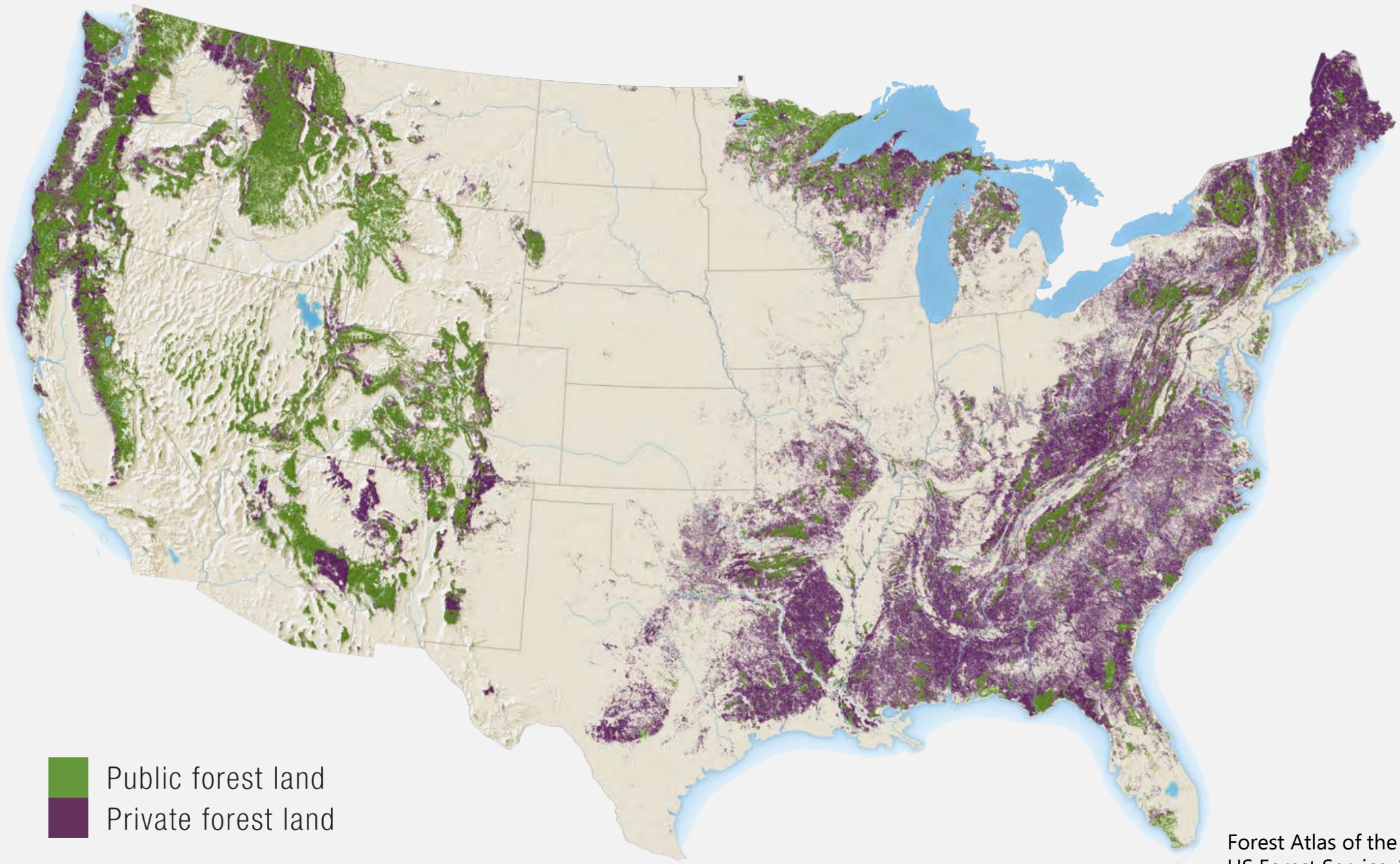
Headwater Streams:

- Essential habitat: cooler air temperature, stable wind, higher humidity
- Climate Refugia
- Add nutrients and oxygen to water

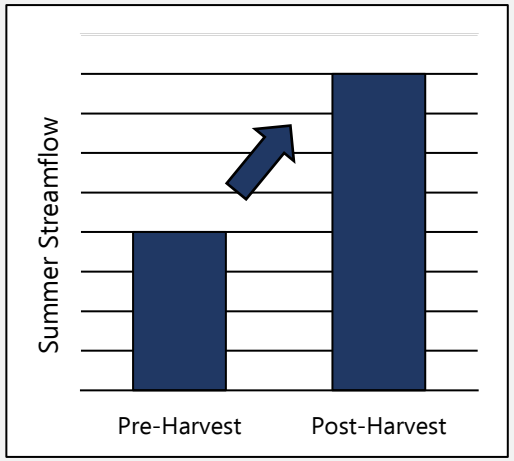


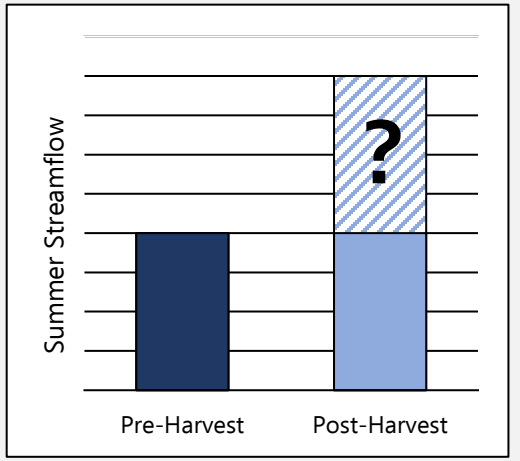


Colvin et al. 2019



Forest Atlas of the United States
US Forest Service, 2022





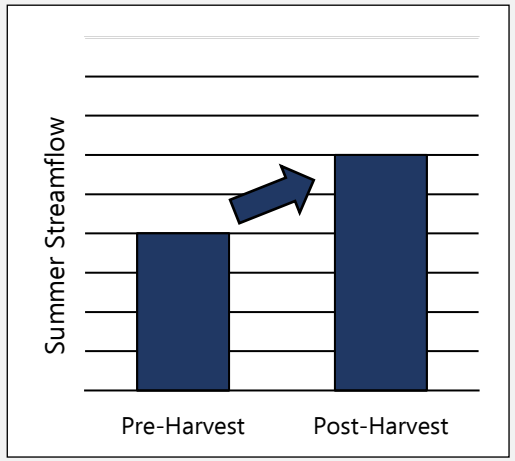
Pre-1960s

1960-70s

1980-2010s

2009, 2021, 2022

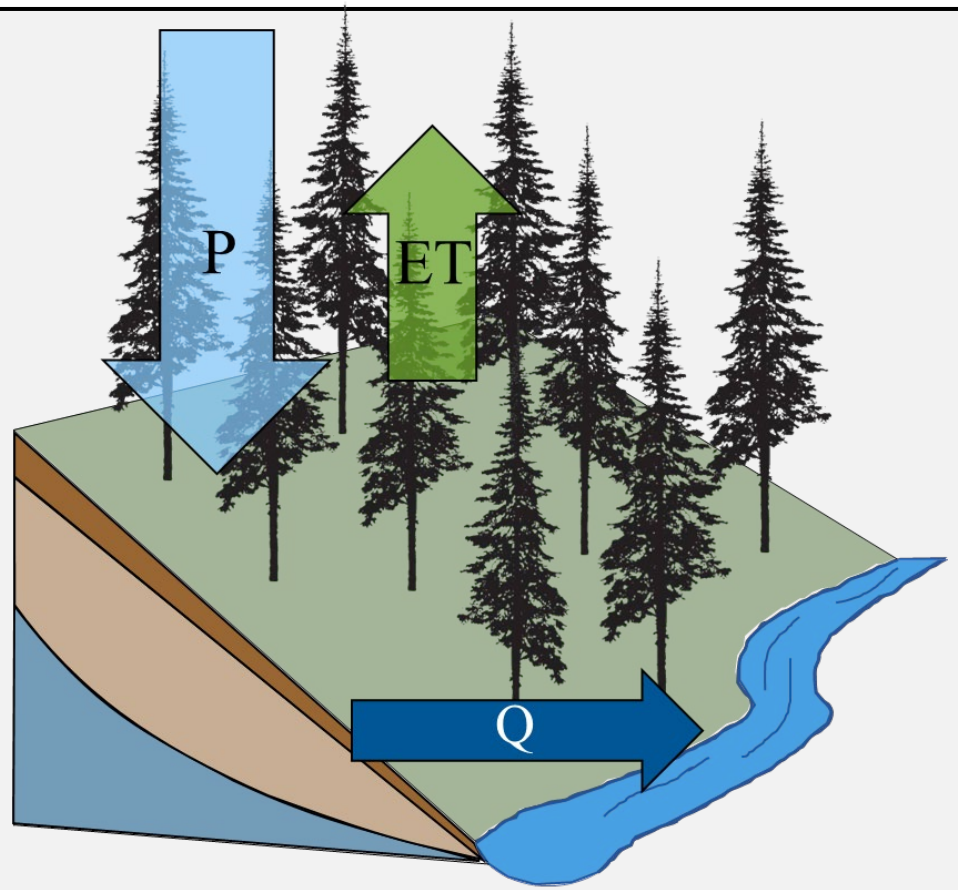
Riparian Buffer Regulations Introduced



Daily Streamflow:

Total stream discharge in 24 hours

Presented in normalized discharge (mm)

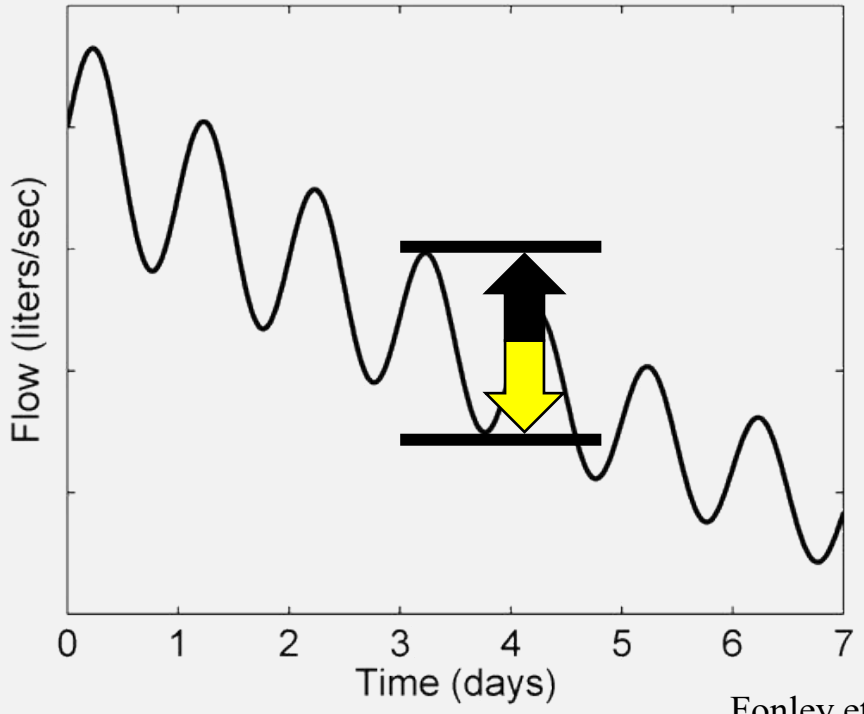


Precipitation - Evapotranspiration ≈ Streamflow

Diel Streamflow:

Range of streamflow rate in 24 hours

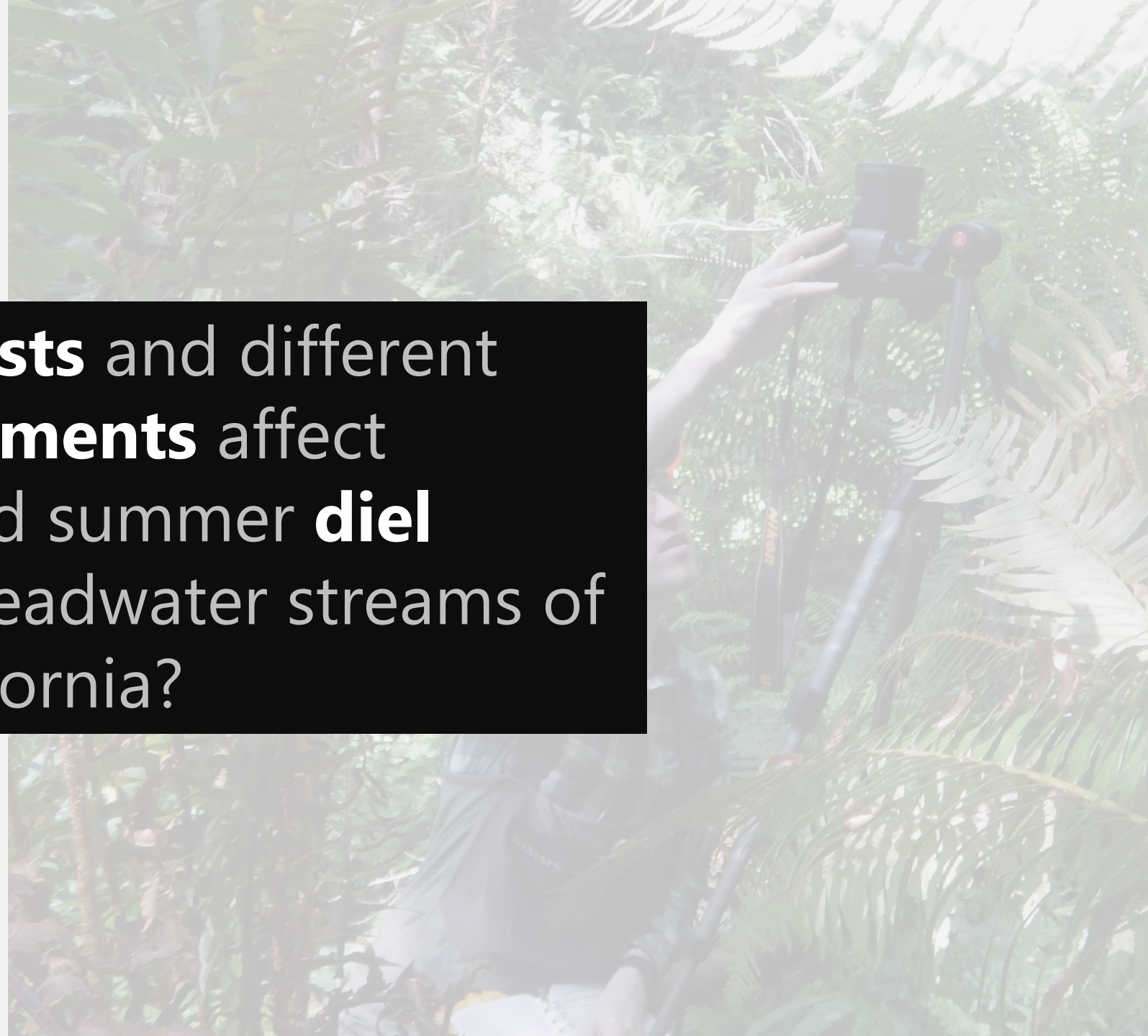
Presented in L/s



Fonley et al. 2019

Diel Streamflow = max flow rate – min flow rate

How do **forest harvests** and different **riparian buffer treatments** affect summer **low flow** and summer **diel fluctuations** in the headwater streams of coastal northern California?

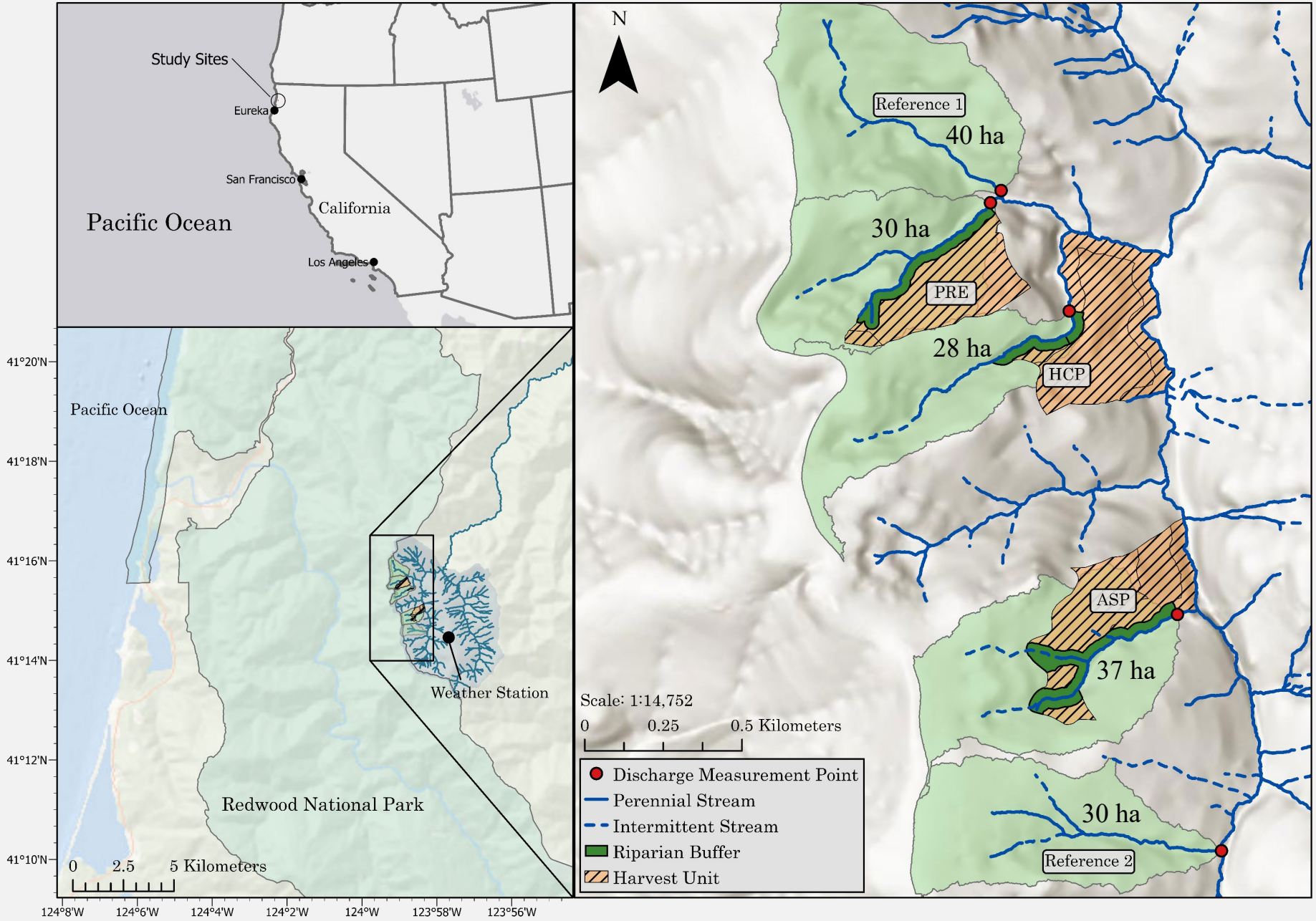


Expectations

1. Timber harvests increase daily streamflow

2. More intense riparian treatment ➡ larger <u>daily</u> streamflow

3. Less intense riparian treatment ➡ larger <u>diel</u> streamflow



Study Set-Up

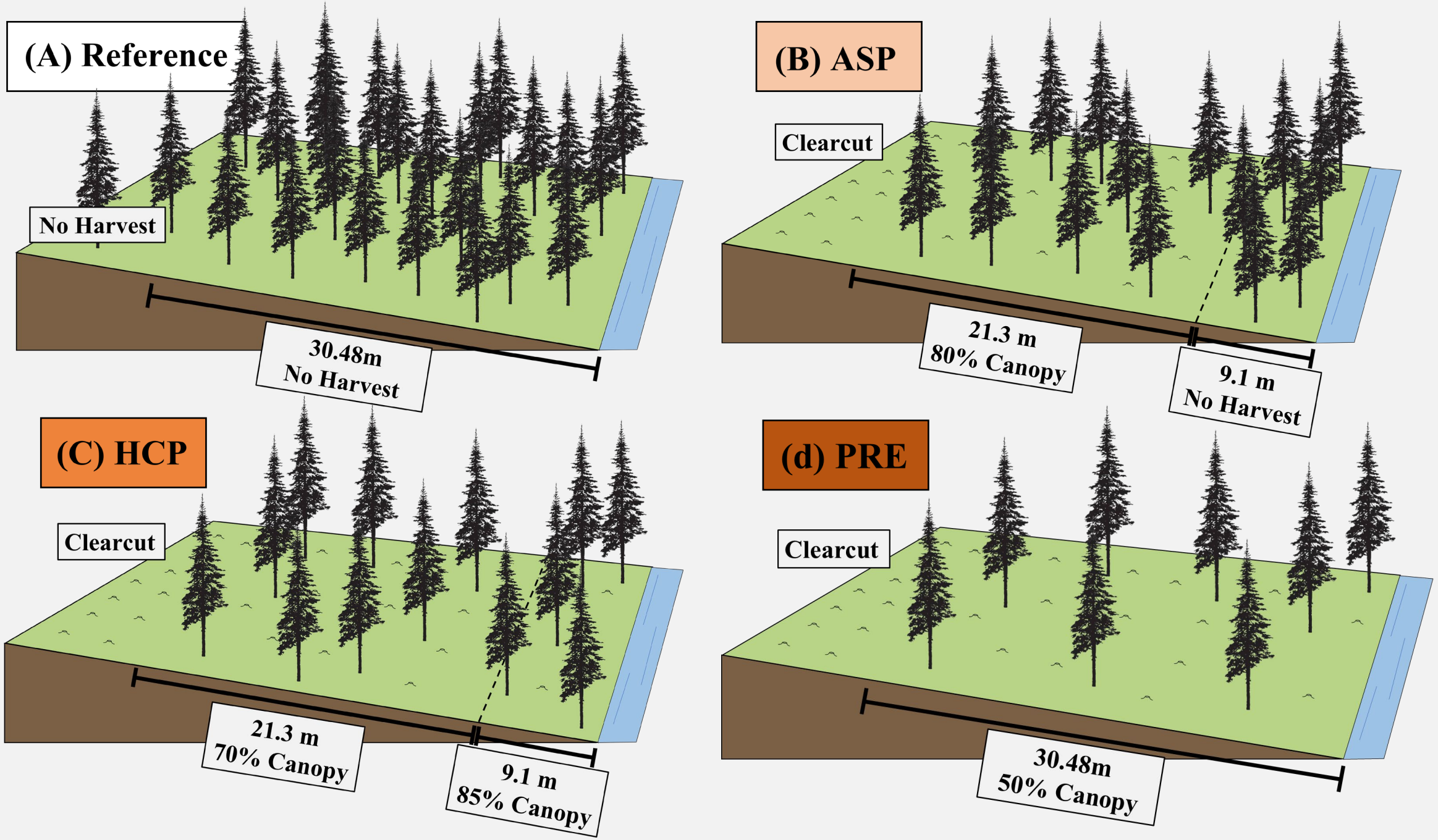
3 treatment streams,
2 reference streams

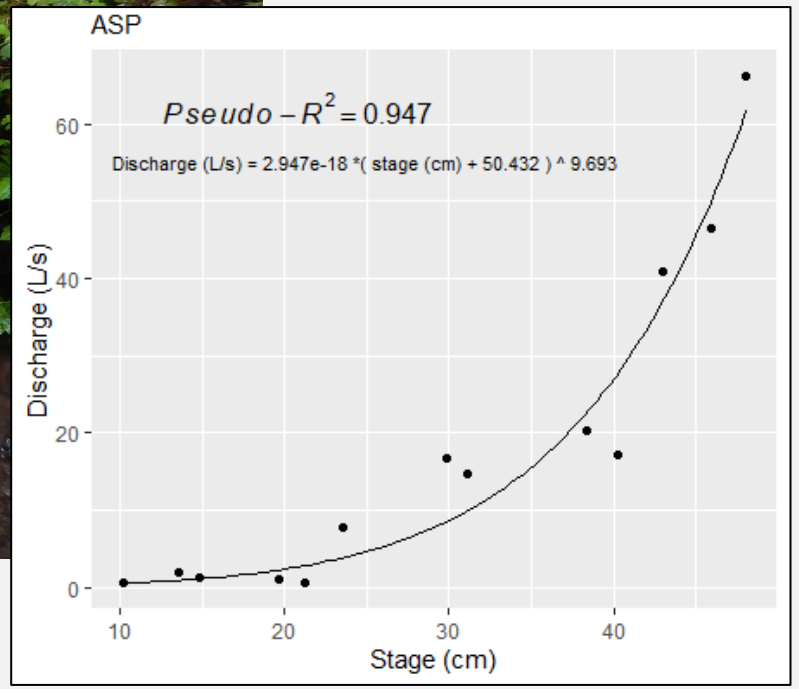
3 years of measurement

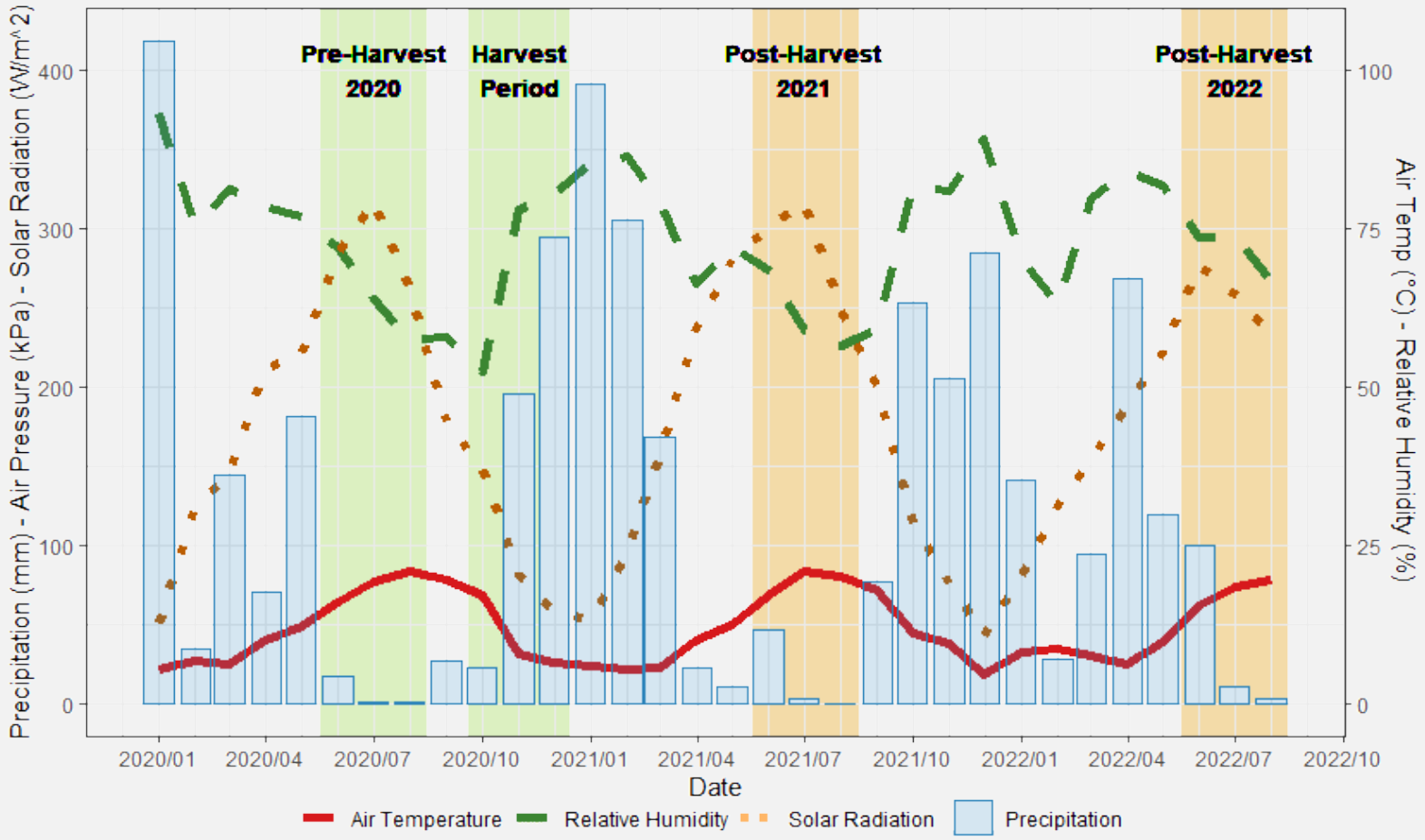
BACI study design

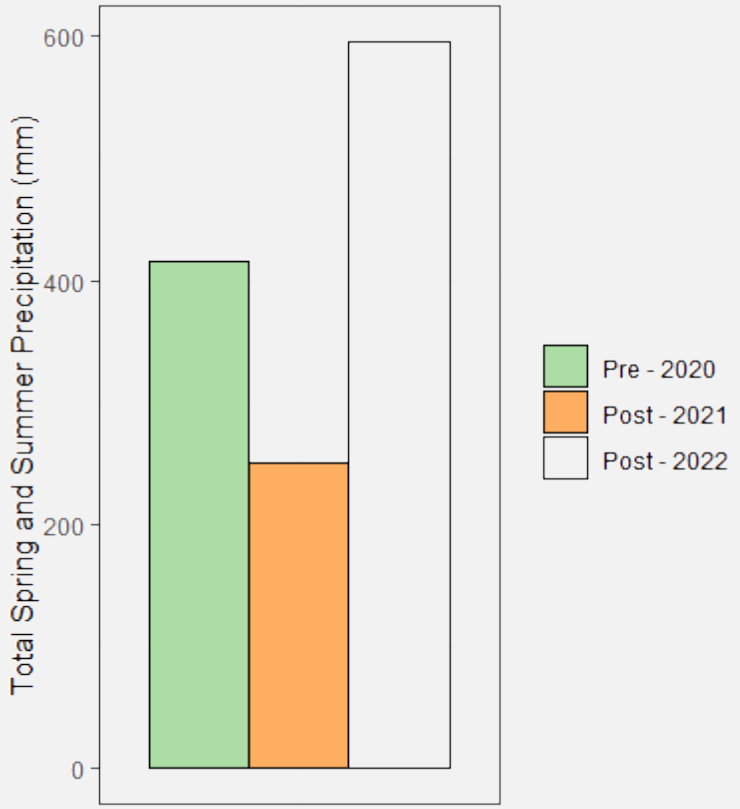
Measured:

- Streamflow: 15 min
- Weather: 15 min
- Canopy closure: pre- and post-harvest

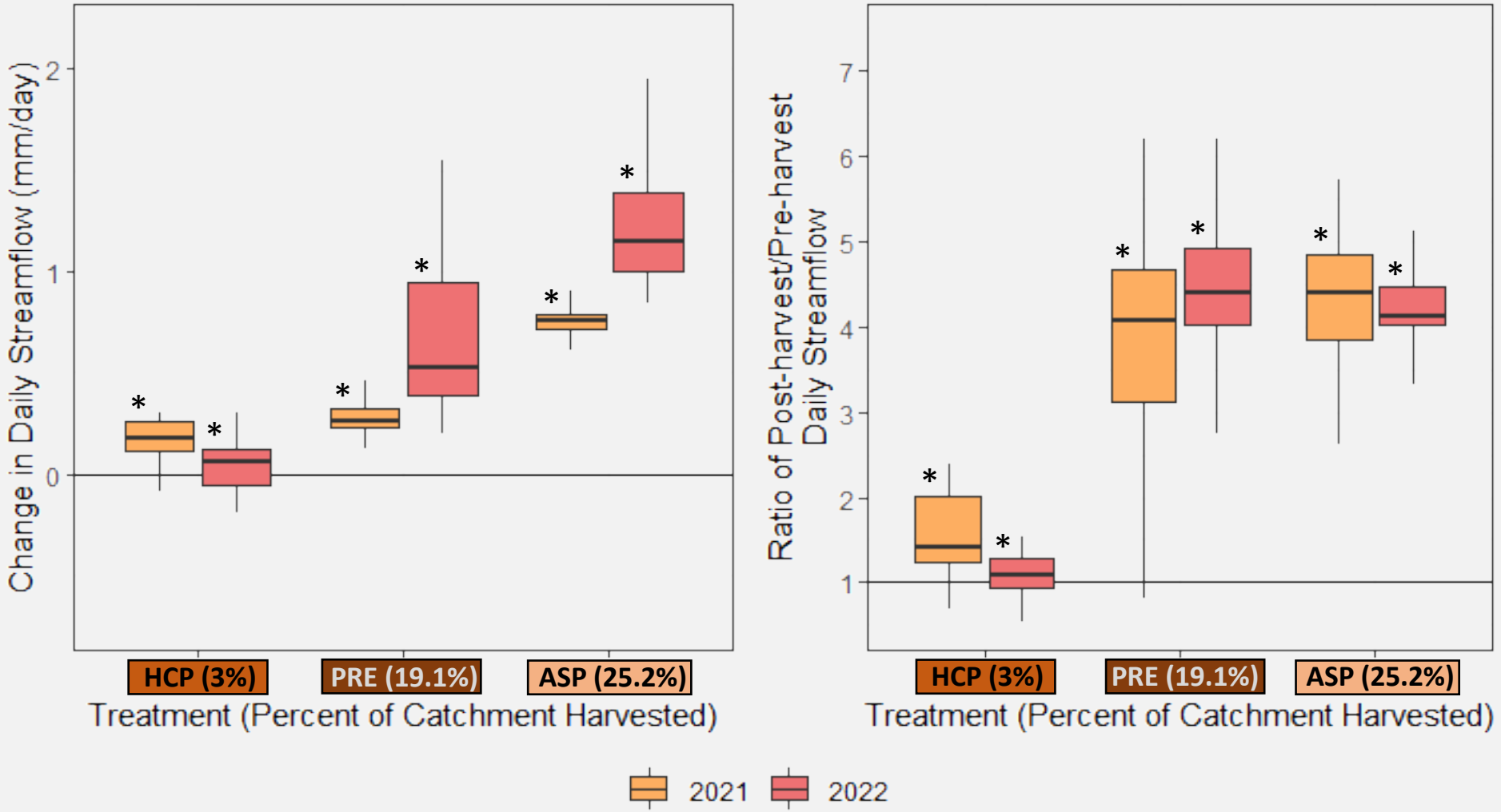

(A) Reference
No Harvest
30.48m
No Harvest
(B) ASP
Clearcut
21.3 m
80% Canopy
9.1 m
No Harvest
(C) HCP
Clearcut
21.3 m
70% Canopy
9.1 m
85% Canopy
(d) PRE
Clearcut
30.48m
50% Canopy


ASP
$Pseudo - R^2 = 0.947$
Discharge (L/s) = 2.947e-18 *(stage (cm) + 50.432) ^ 9.693
Discharge (L/s)
0
20
40
60
10
20
30
40
Stage (cm)


Pre-Harvest
2020
Harvest
Period
Post-Harvest
2021
Post-Harvest
2022
Precipitation (mm) - Air Pressure (kPa) - Solar Radiation (W/m^2)
Air Temp (°C) - Relative Humidity (%)
0
100
200
300
400
0
25
50
75
100
2020/01
2020/04
2020/07
2020/10
2021/01
2021/04
2021/07
2021/10
2022/01
2022/04
2022/07
2022/10
Date
Air Temperature
Relative Humidity
Solar Radiation
Precipitation

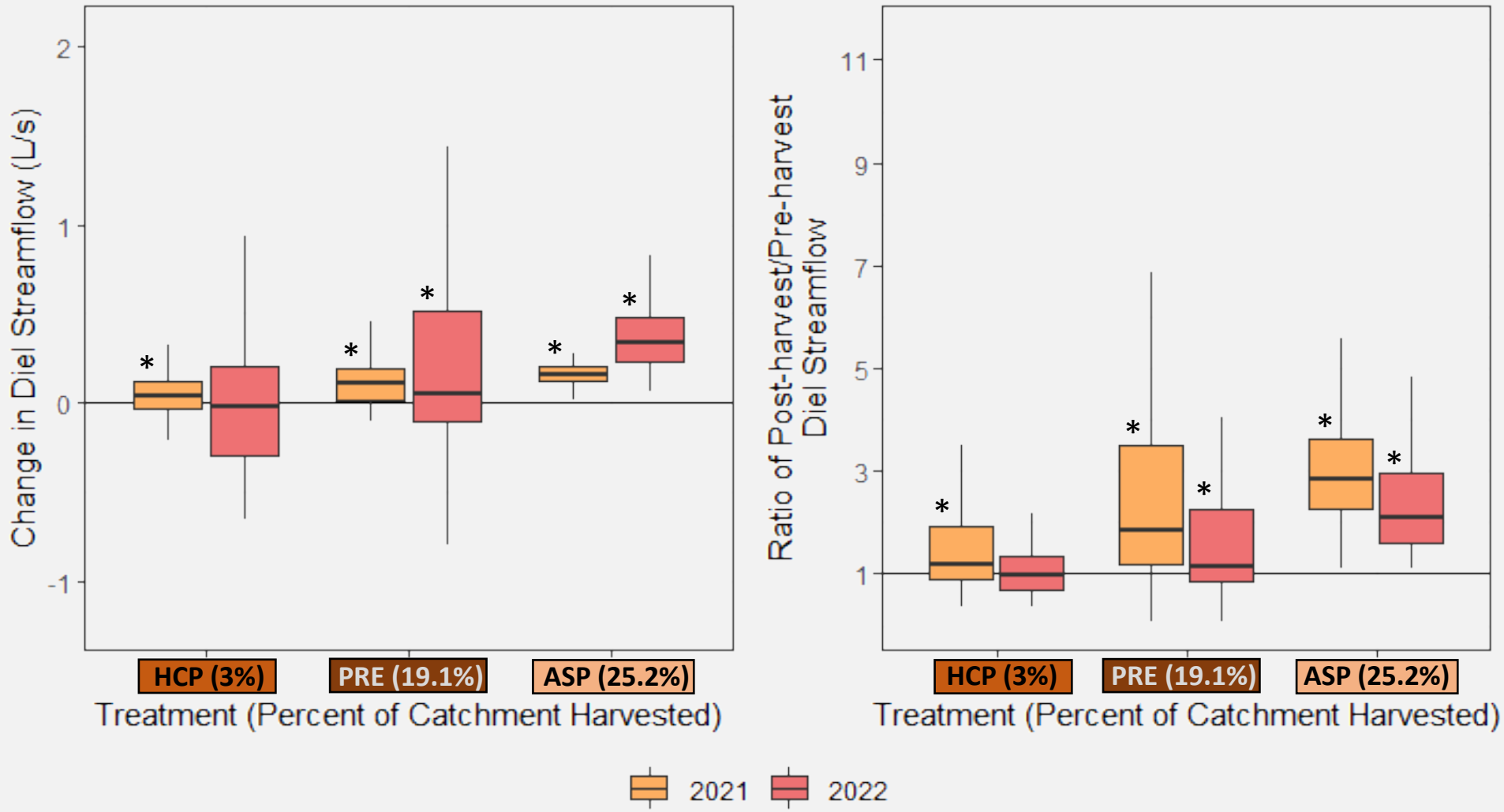

Total Spring and Summer Precipitation (mm)
0
200
400
600
Pre - 2020
Post - 2021
Post - 2022

Daily Streamflow:



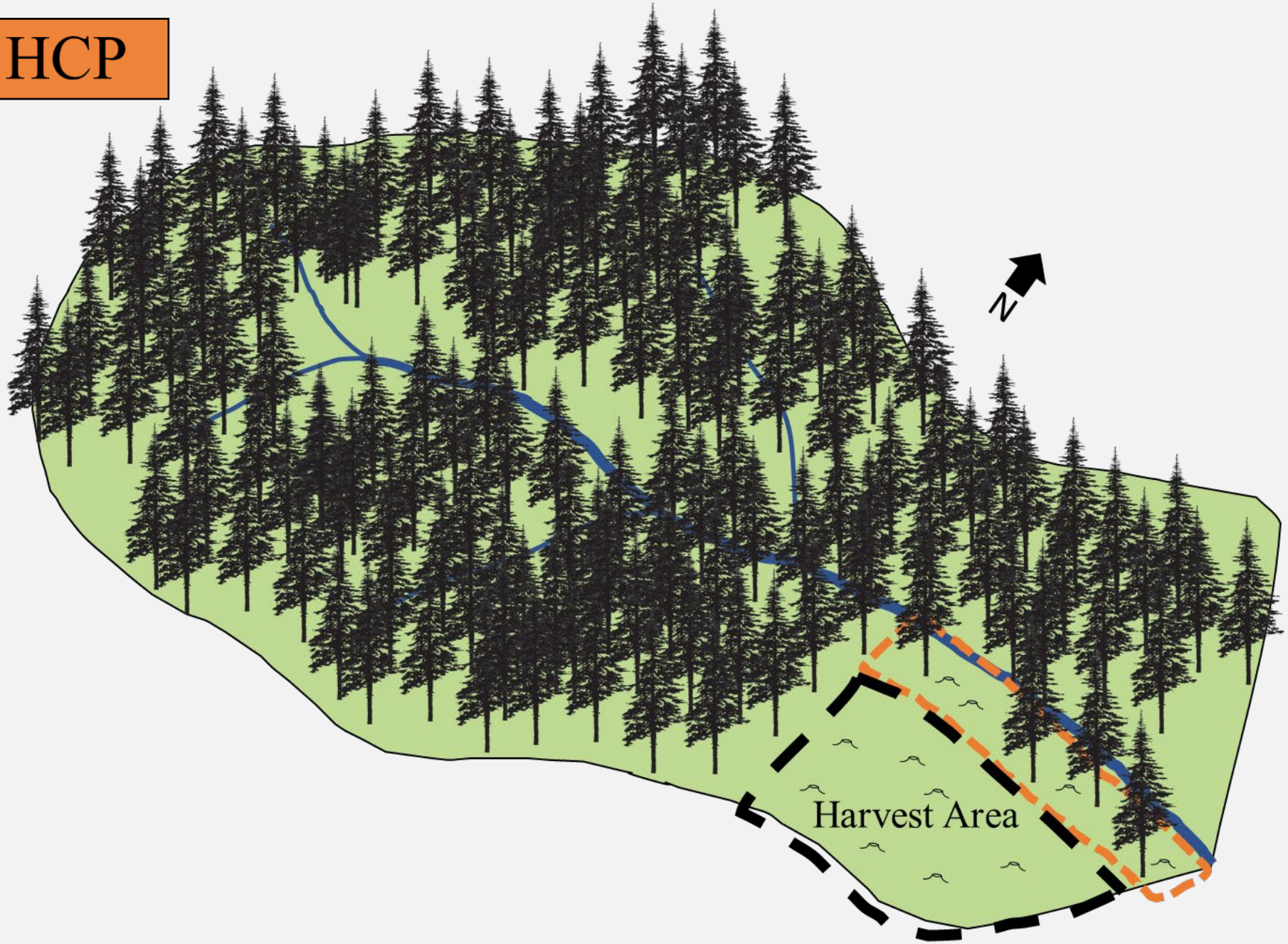
*: Significant change at α = 0.05

Diel Streamflow:



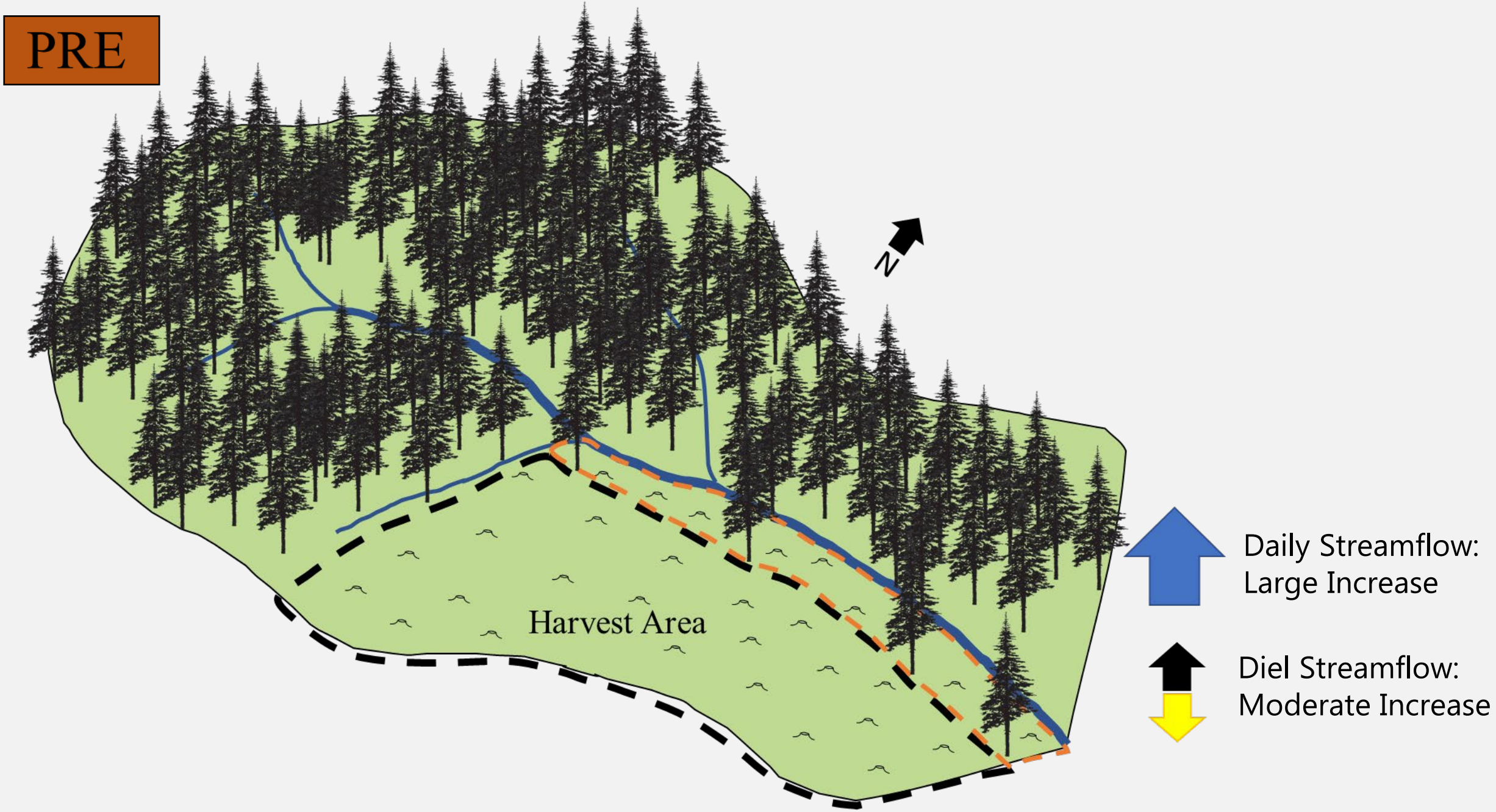
*: Significant change at α = 0.05

HCP

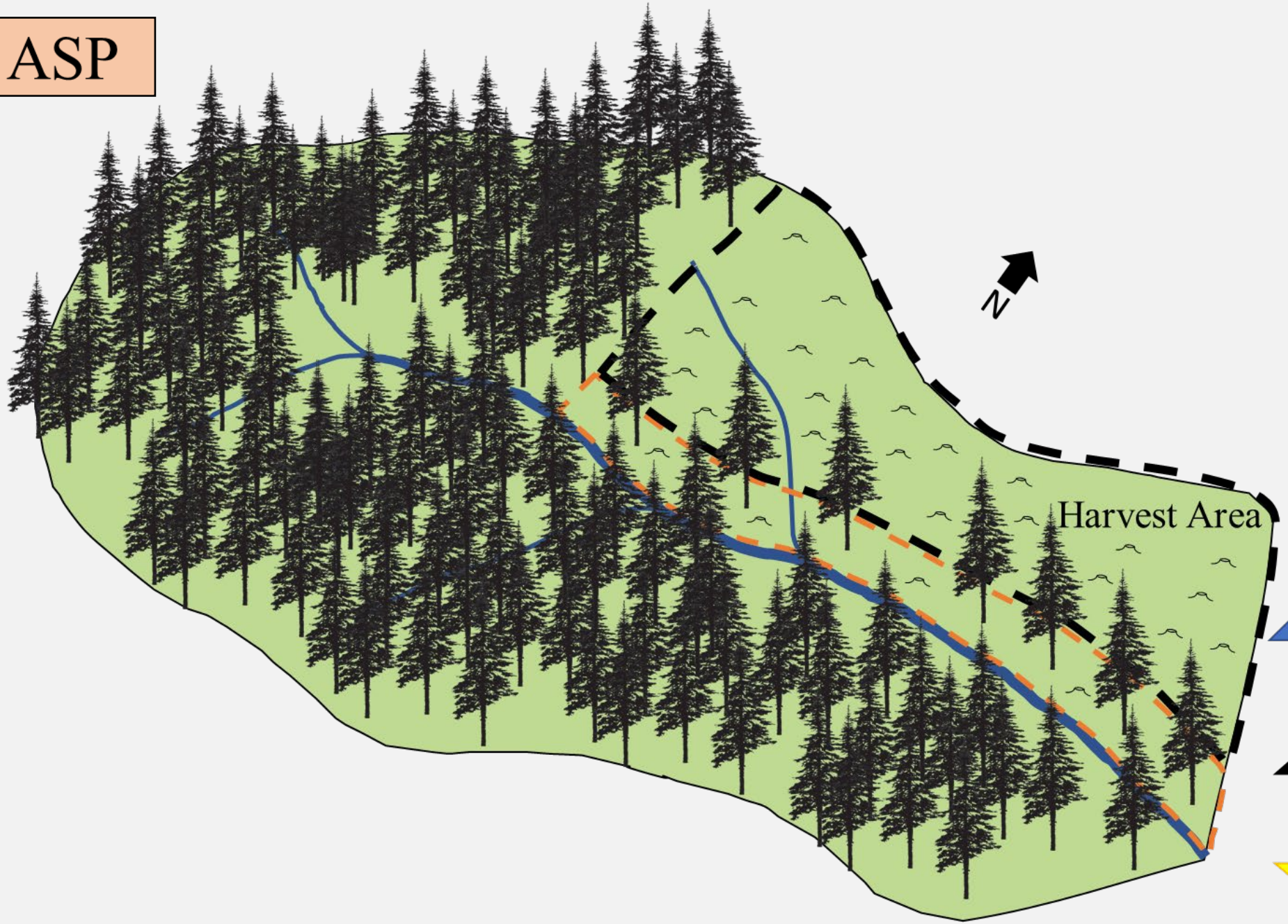


Daily Streamflow:
Small Increase

Diel Streamflow:
Small Increase


PRE
N
Harvest Area
Daily Streamflow:
Large Increase
Diel Streamflow:
Moderate Increase

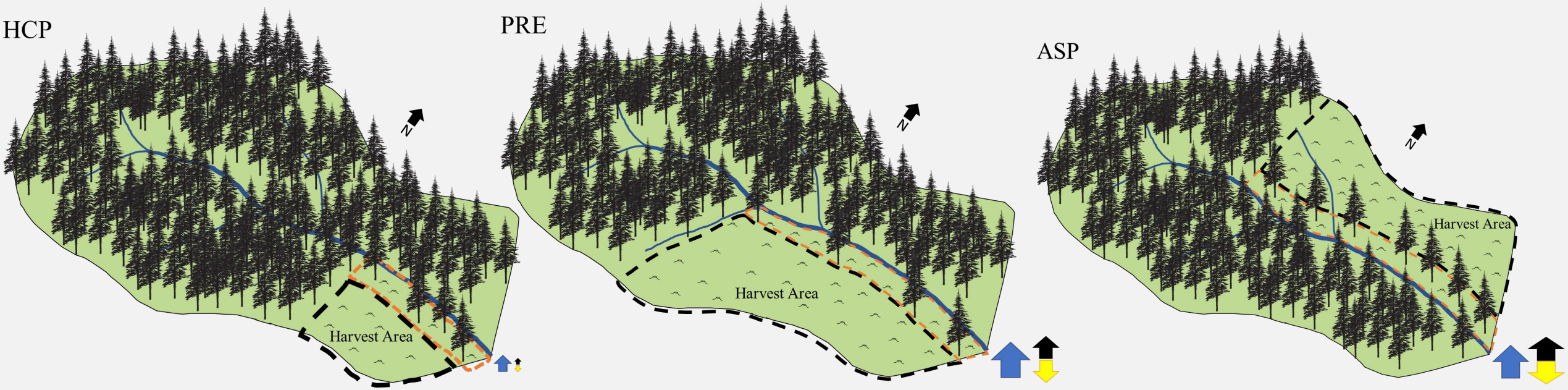
ASP



Daily Streamflow:
Large Increase

Diel Streamflow:
Large Increase

Stream	Harvest Area	Riparian Treatment Intensity	Harvest Aspect	Daily Streamflow Increase	Diel Streamflow Increase
HCP	3%	Moderate	N		
PRE	19%	Heavy	N		
ASP	25%	Light	S		



Expectations

1. Timber harvests increase daily streamflow

   Yes, large increase

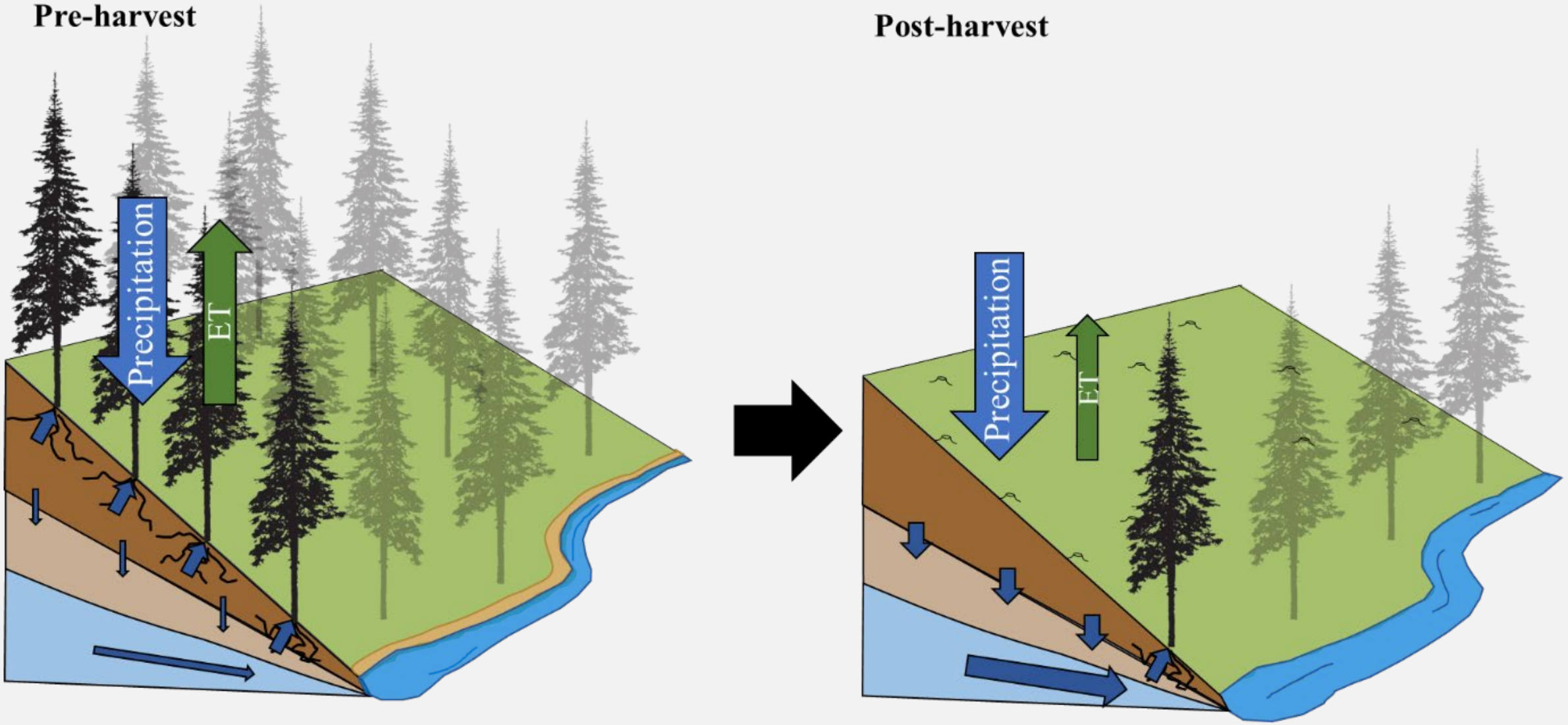
2. More intense riparian treatment → larger daily streamflow

   No, we found a larger effect from harvest area

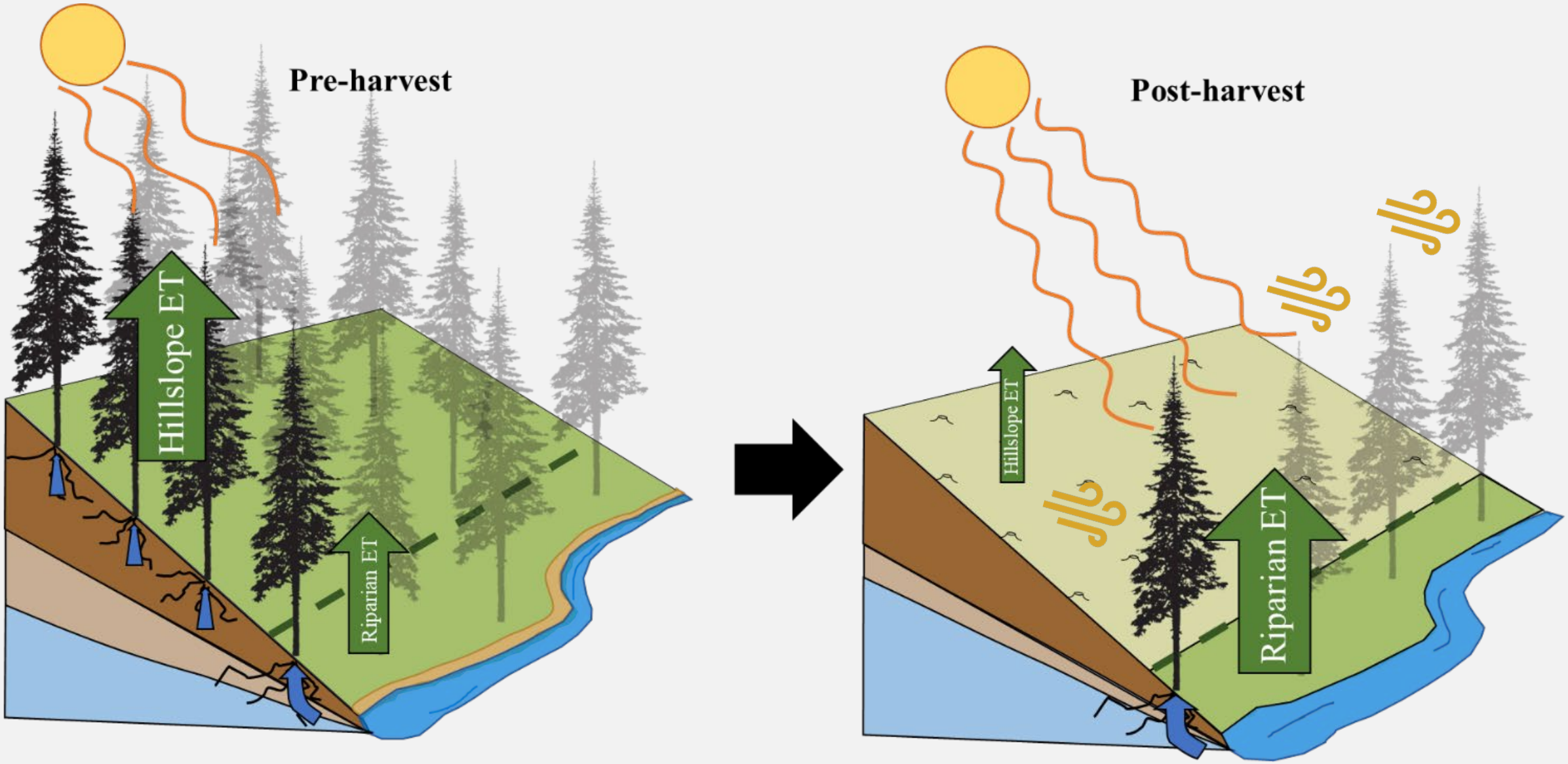
3. Less intense riparian treatment → larger diel streamflow

   Yes, least intense treatment had highest increase

Daily Streamflow:



Diel Streamflow:



Caveats of Results

- **Time frame of results**
- Large weather variations
- Harvest area differences

Management implications:

Whole catchment, not just riparian buffer, affects streamflow

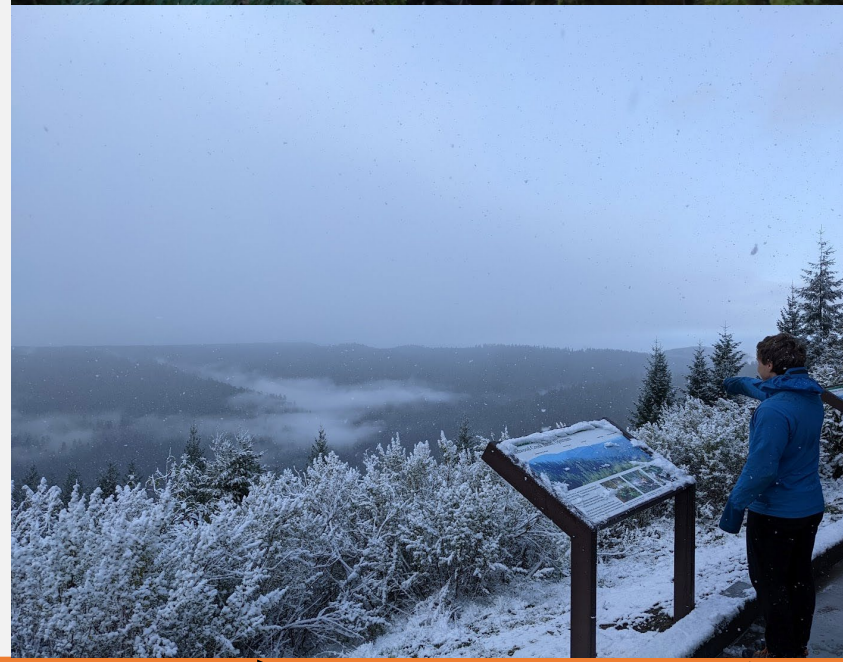
Amount of the catchment harvested is more influential than buffer

Overall stream health effects

Site variability seems high

Take Home Points:

Forest operations → large effects on streamflow
The whole catchment affects streamflow, not just riparian area
The amount of harvest > riparian buffer treatment
Riparian vegetation controls diel fluctuations
Protections for headwater streams are complicated!



Acknowledgements

Kevin and Catalina

Green Diamond Folks:
Matt House, Pat Righter, Matt Kluber, Matt Nannizzi, Nicholas Simpson

CalFire: Drew Coe

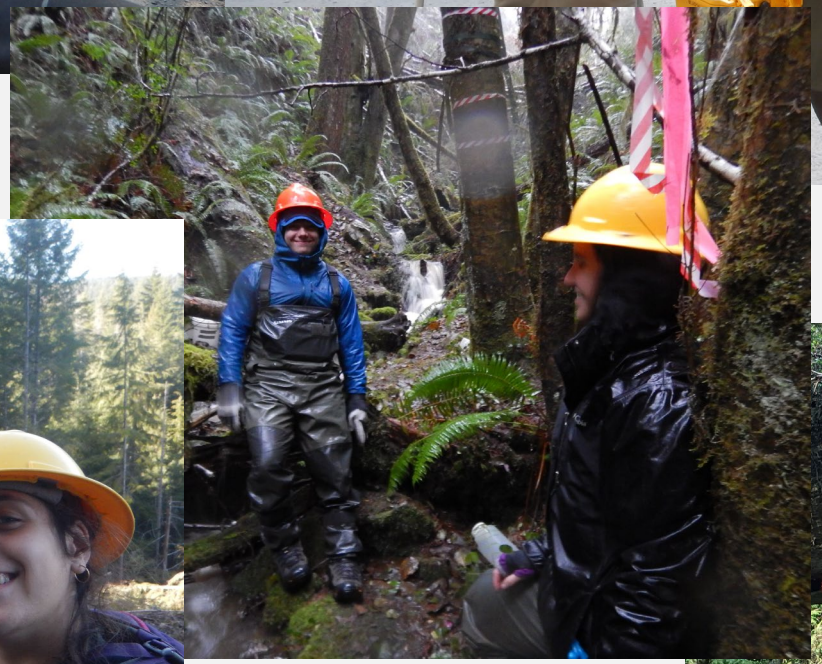
EMC Committee

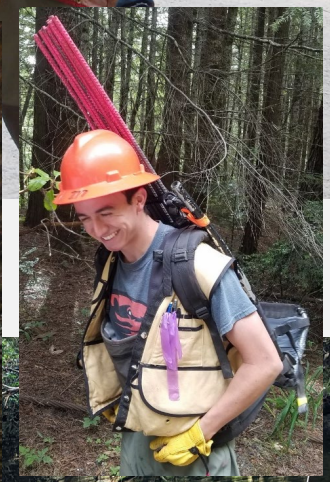
FERM Department: Madison Dudley, Chelsey Durling

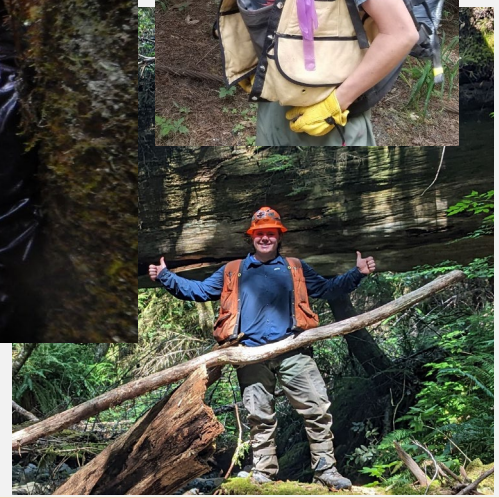
My Committee Members

Sukhyun Joo and Lorrayne Miralha

Everyone who helped with field work!







Thank you!

I hope you enjoyed this research as much as the wildlife did!