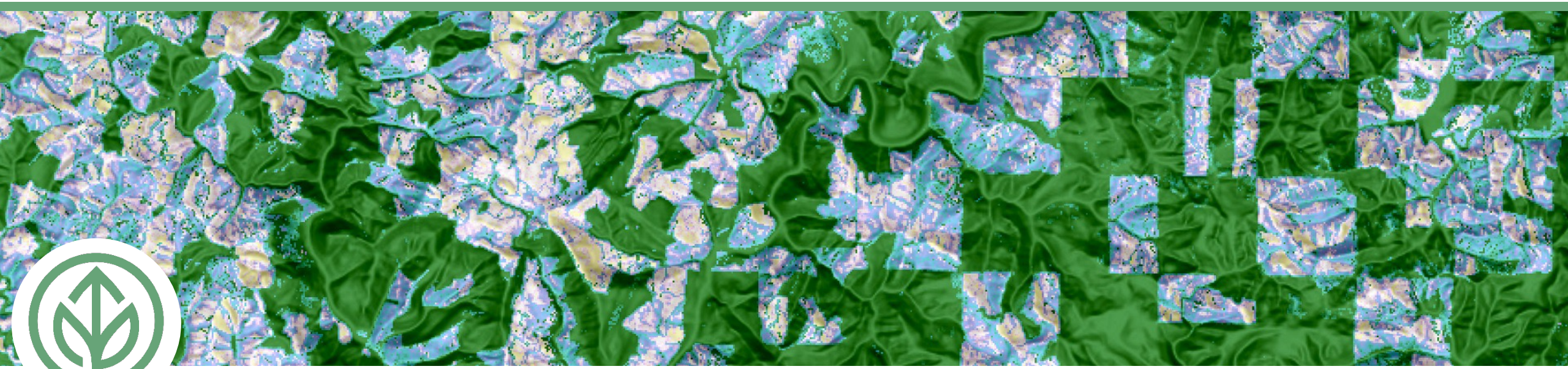
National Aeronautics and Space Administration



Oregon Coast Range Ecological Conservation

Mapping Recent Logging Within Drinking Watersheds of Oregon's Coastal Range to Support Future Resource Management Policies

Emily French • Madison Arndt • Uma Edulbehram • Sarah Hughes

25TH DEVELOP ANNIVERSARY

THE TEAM

Emily French
(Project Lead)

Madison Arndt

Uma Edulbehram

Sarah Hughes

STUDY AREA & PERIOD

Study Period: 2000 - 2022

Study Area: Oregon Coast Range drinking watersheds

Highlighted Watersheds:
- Seaside
- Lincoln City

LOGGING IN OREGON

- **Clearcutting** is common on private industrial land
- **Commercial thinning** occurs mainly on federal and state land

Image Credit: Esri, Maxar, Earthstar Geographics

LOGGING IN OREGON

- **Clearcutting** is common on private industrial land
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Image Credit: Esri, Maxar, Earthstar Geographics

OBJECTIVES

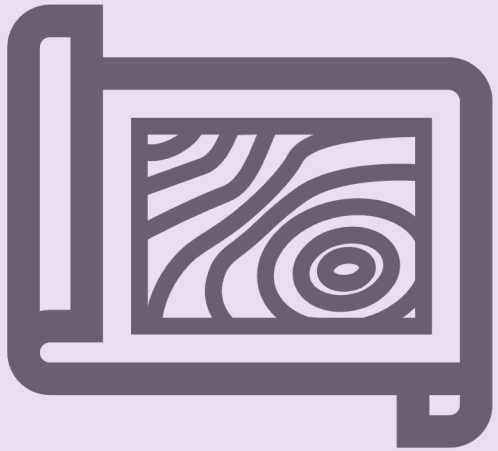
APPLIED RESEARCH

Quantify the extent of...

Clear cutting

Selective harvesting

SCIENCE COMMUNICATION



Produce maps for public education

SURFACE WATER IN OREGON

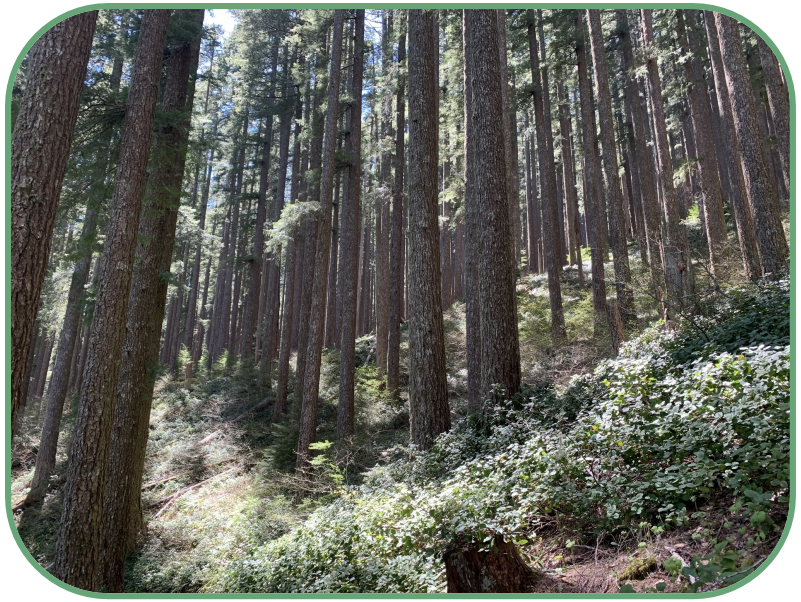
- **3.5 million Oregonians** rely on surface water
  - 70% of all water use
- Contamination from natural and anthropogenic sources
- Forests prevent erosion, filter rain and snowfall
- **Conventional logging practices**
  - Increased erosion
  - Transport sediment to surface water

Image Credit: Tyler Pantle

PARTNER: Oregon Wild

WILDERNESS

WILDLIFE



FORESTS

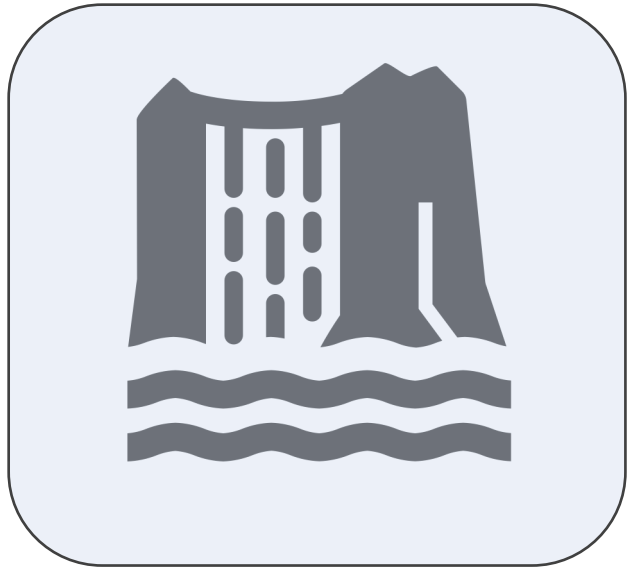
WATER

EDUCATION

Image Credit: Tyler Pantle, Oregon Wild, Brewbrooks

COMMUNITY CONCERNS

Surface water quality



Balance logging and forest ecosystem services

Protect biodiversity and old growth forests

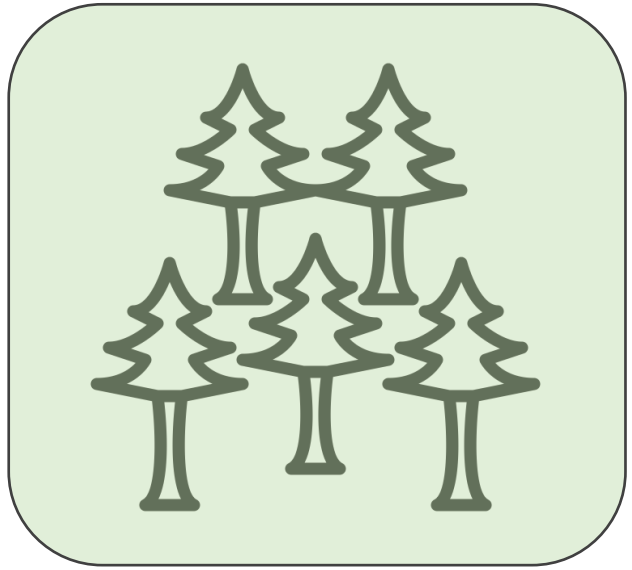
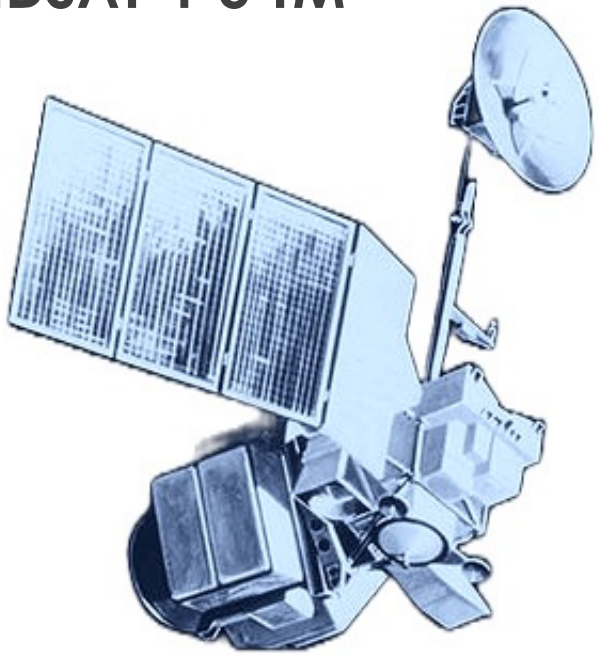
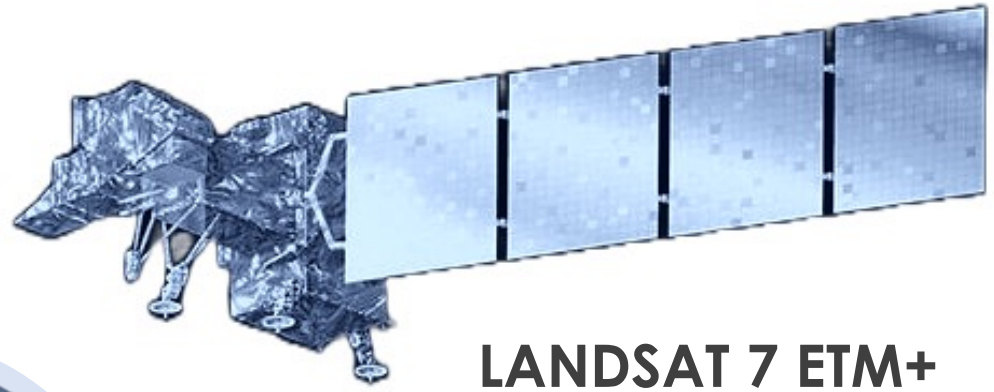


Image Credit: Pike Picture, faisal

EARTH OBSERVATIONS

LANDSAT 4-5 TM





LANDSAT 7 ETM+

LANDSAT 8 OLI &
LANDSAT 9 OLI-2

Image Credit: NASA, New York Public Library

CCDC ALGORITHM

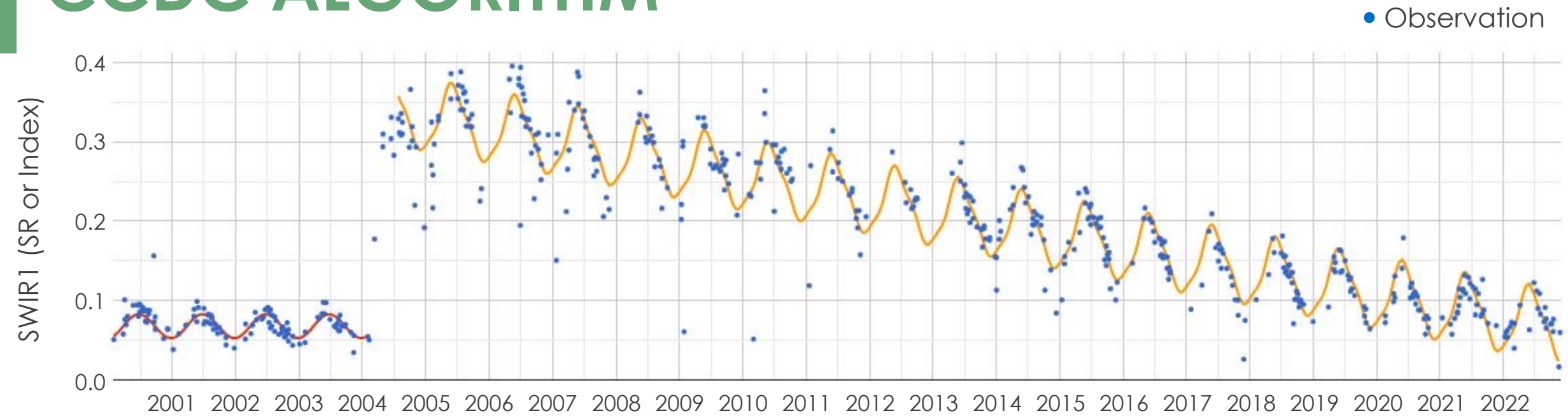
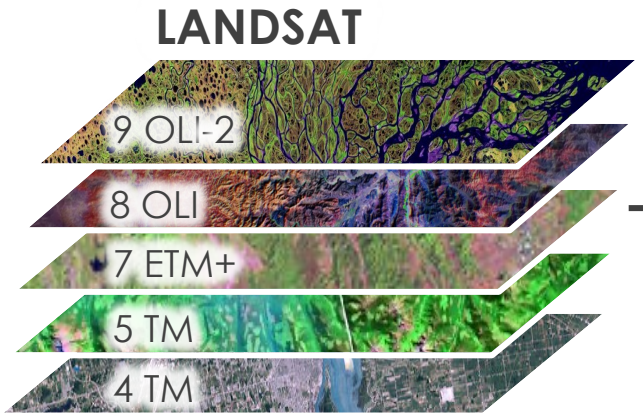
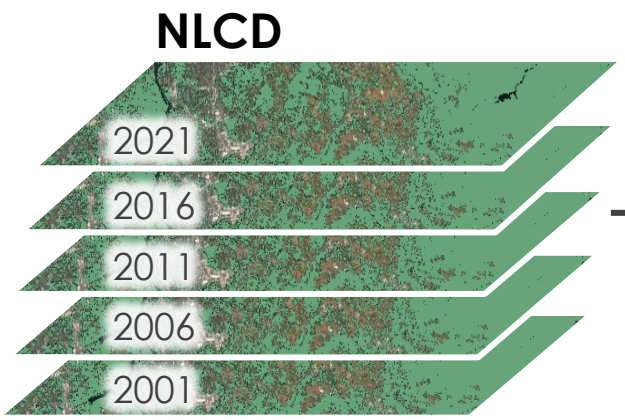


Image Credit: Arévalo et al

METHODOLOGY: Clear Cutting





Landsat Pre-Processing

Run CCDC

Forest Mask CCDC Image

Extract Largest Model Break

Date of Largest Break 1997- 2023

Magnitude of Largest Break (0.075 SWIR1 **)

Forest Mask

Year and Magnitude Mask

Date of Largest Break 2000 - 2022

Small Patch Mask (2 Acres)

Zonal Statistics

Yearly Clearcutting by Watershed & Ownership 2000 – 2022

RESULTS: Clear Cutting

26% of study area clear cut from 2000 to 2022

2020

2022

Percent of Watershed Clear Cut	Number of Watersheds
0 — 10%	23
10 — 25%	18
25 — 50%	35
50 — 75%	2
75 —100%	2

RESULTS: Clear Cutting

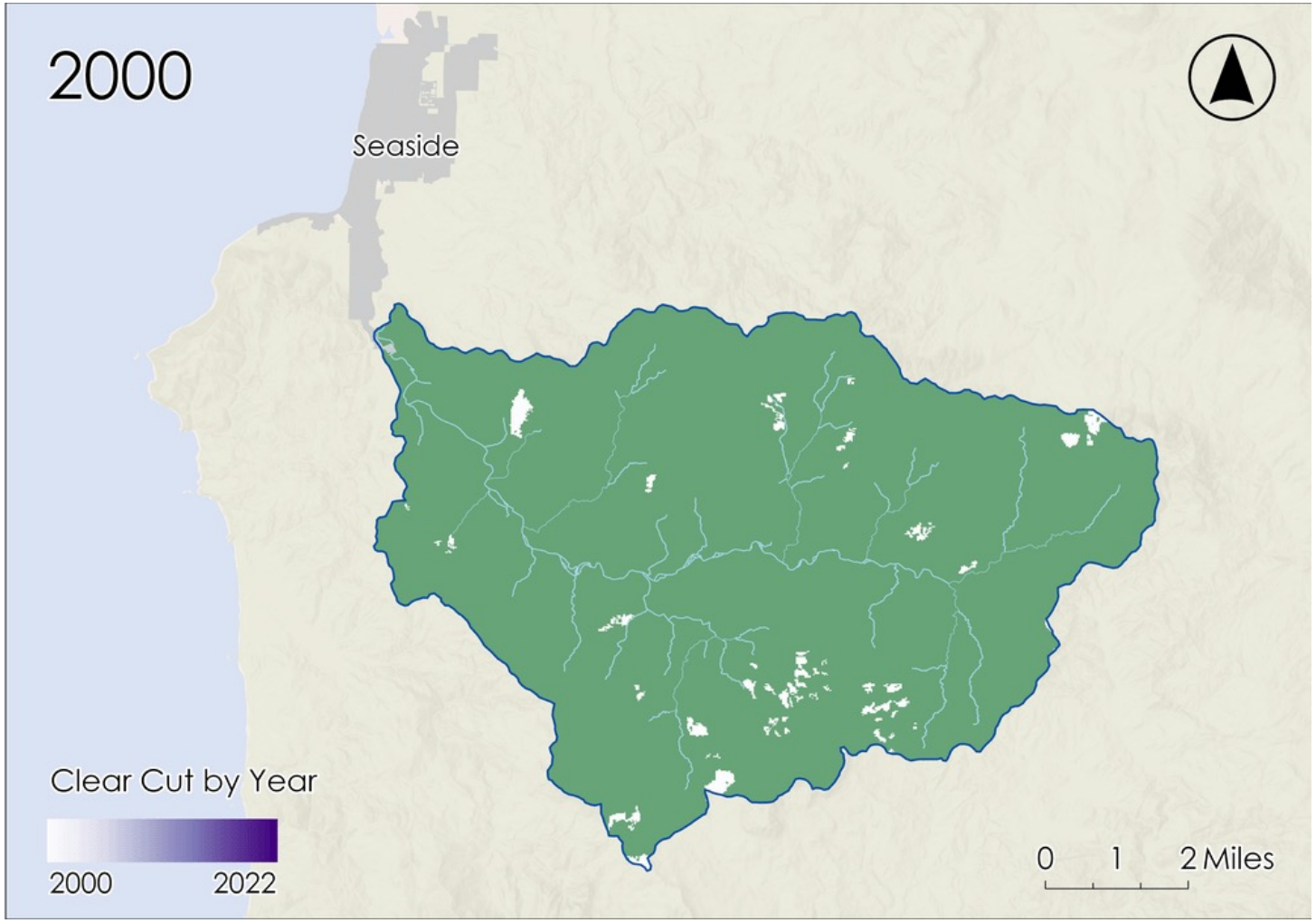
26% of study area clear cut from 2000 to 2022

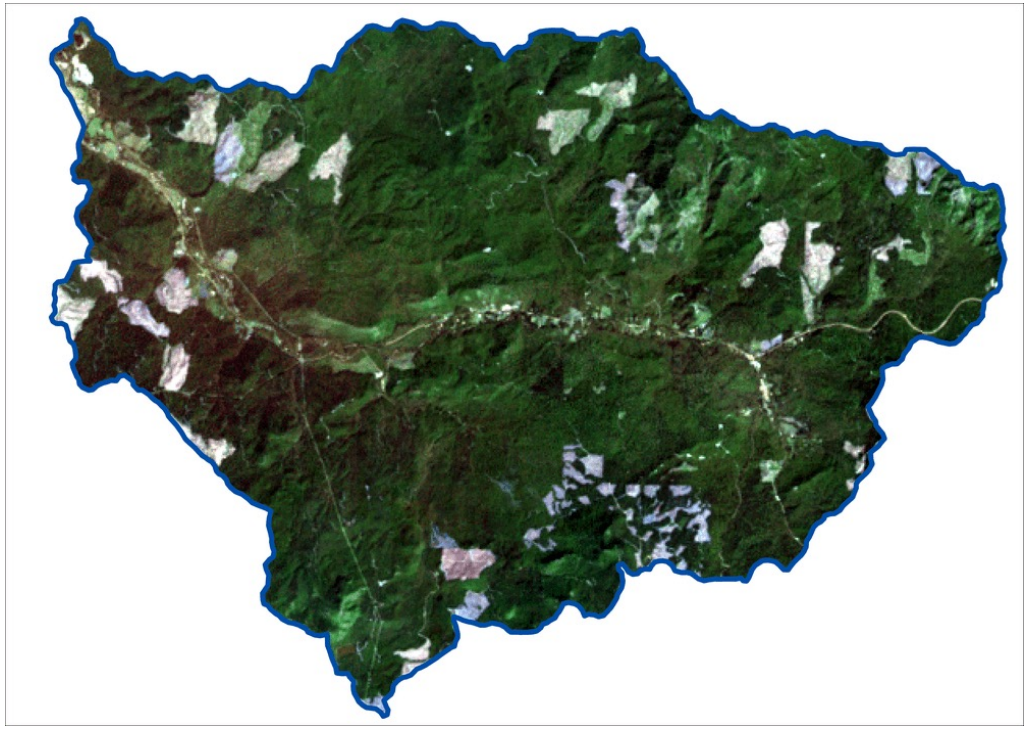
2020

2022

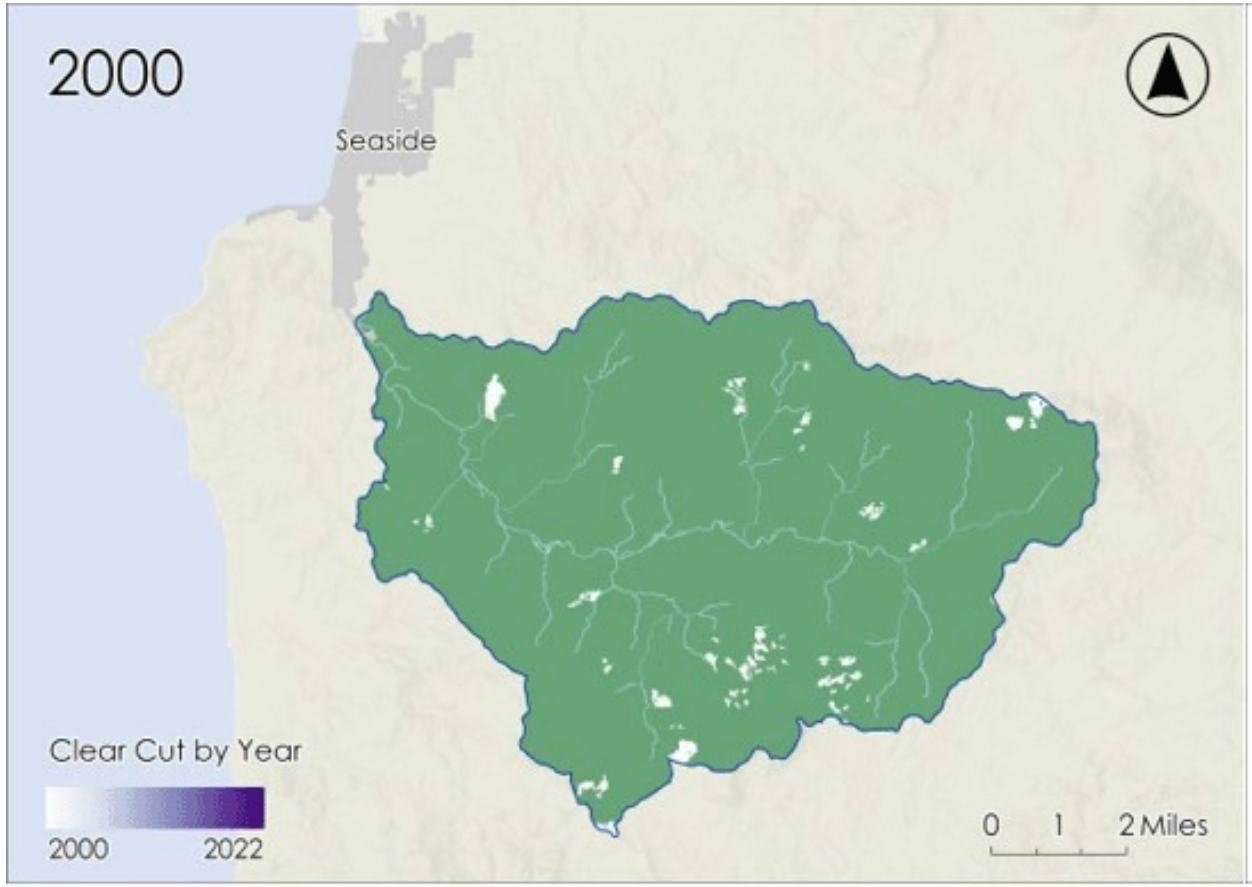
Percent of Watershed Clear Cut	Number of Watersheds
0 — 10%	23
10 — 25%	18
25 — 50%	35
50 — 75%	2
75 —100%	2

RESULTS: Seaside

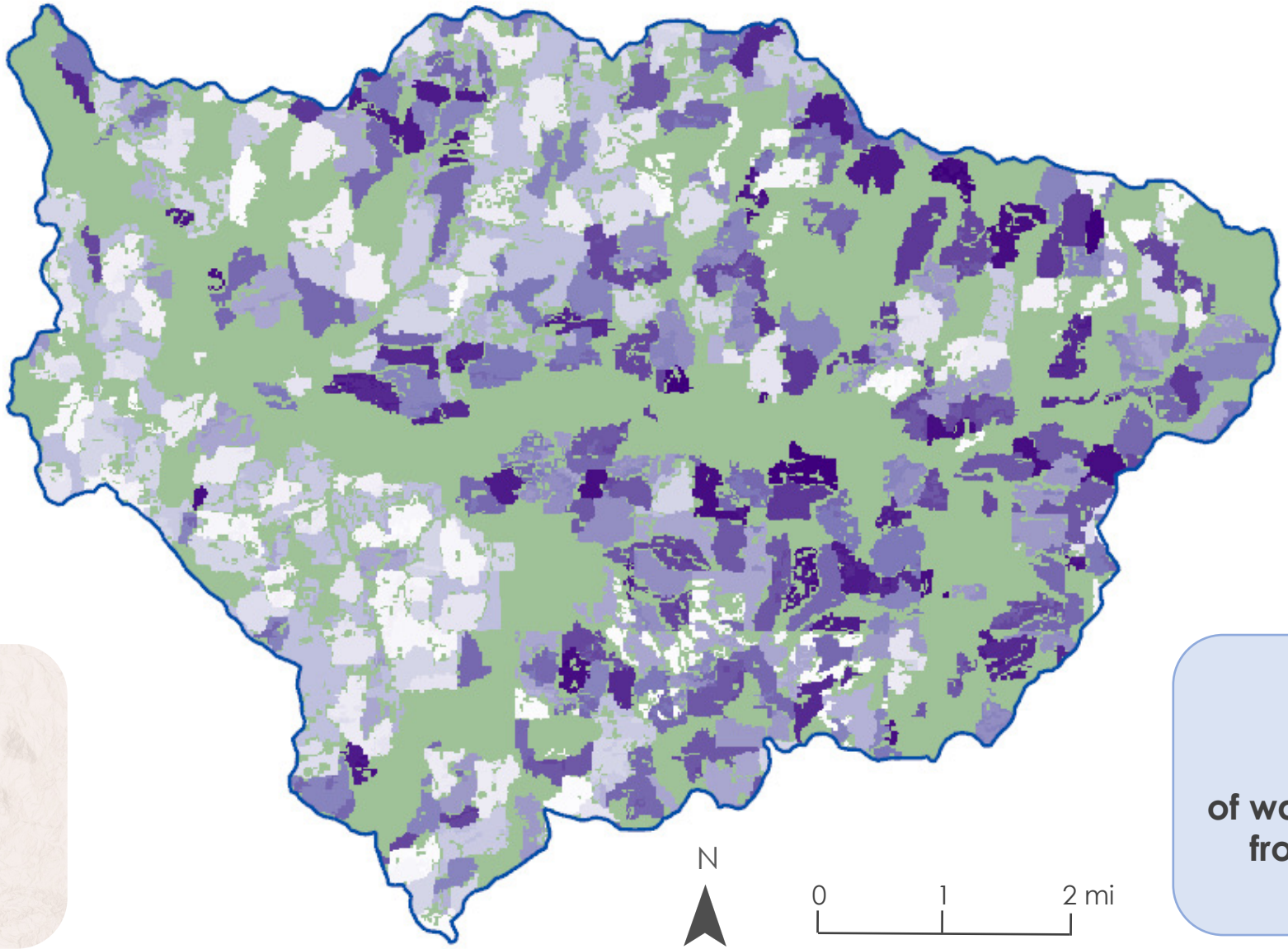




RESULTS: Seaside

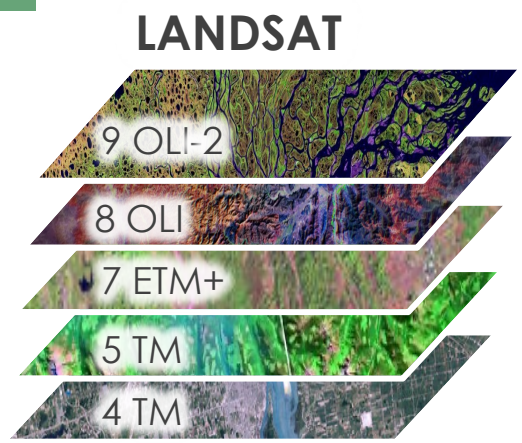


CLEAR CUTTING RESULTS: Seaside



56%
of watershed clear cut from 2000 to 2022

METHODOLOGY: Thinning



Landsat Pre-Processing

Median Summer NDVI 1999-2022

% Change in NDVI by year

% Change Mask
(8% NDVI Loss)

Small Patch Mask
(2 Acres)

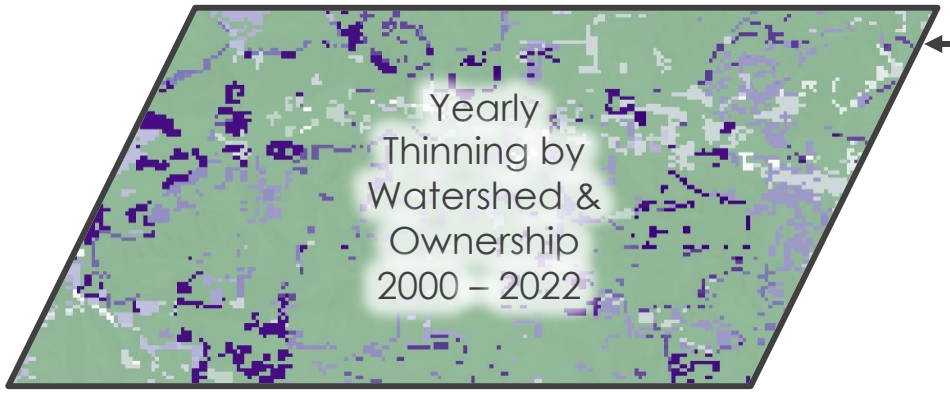
Clear Cut Mask

Cleaned NDVI Change by Year

Select Year of Max NDVI % Change

Noise Mask
(>2 Disturbance Events)

Zonal Statistics



RESULTS: Thinning

16% of study area clear cut from 2000 to 2022

2020

2022

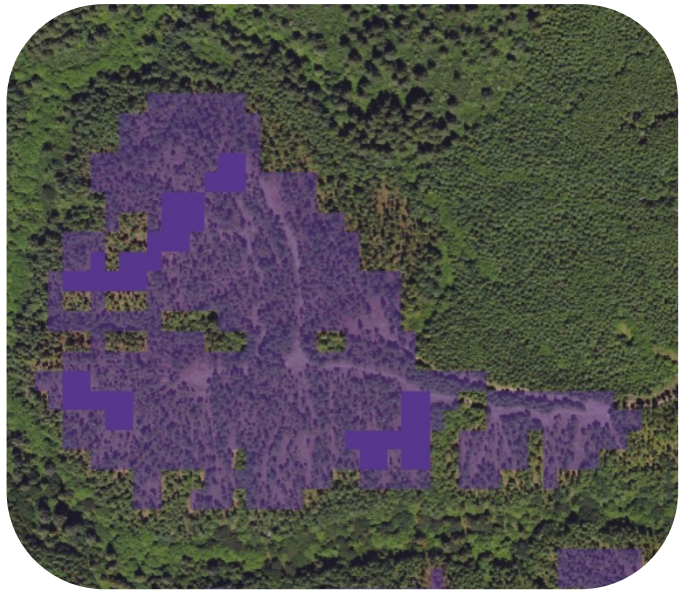
Percent of Watershed Thinned	Number of Watersheds
0 — 10%	33
10 — 25%	41
25 — 50%	5
50 — 75%	0
75 —100%	0

RESULTS: Thinning

16% of study area clear cut from 2000 to 2022

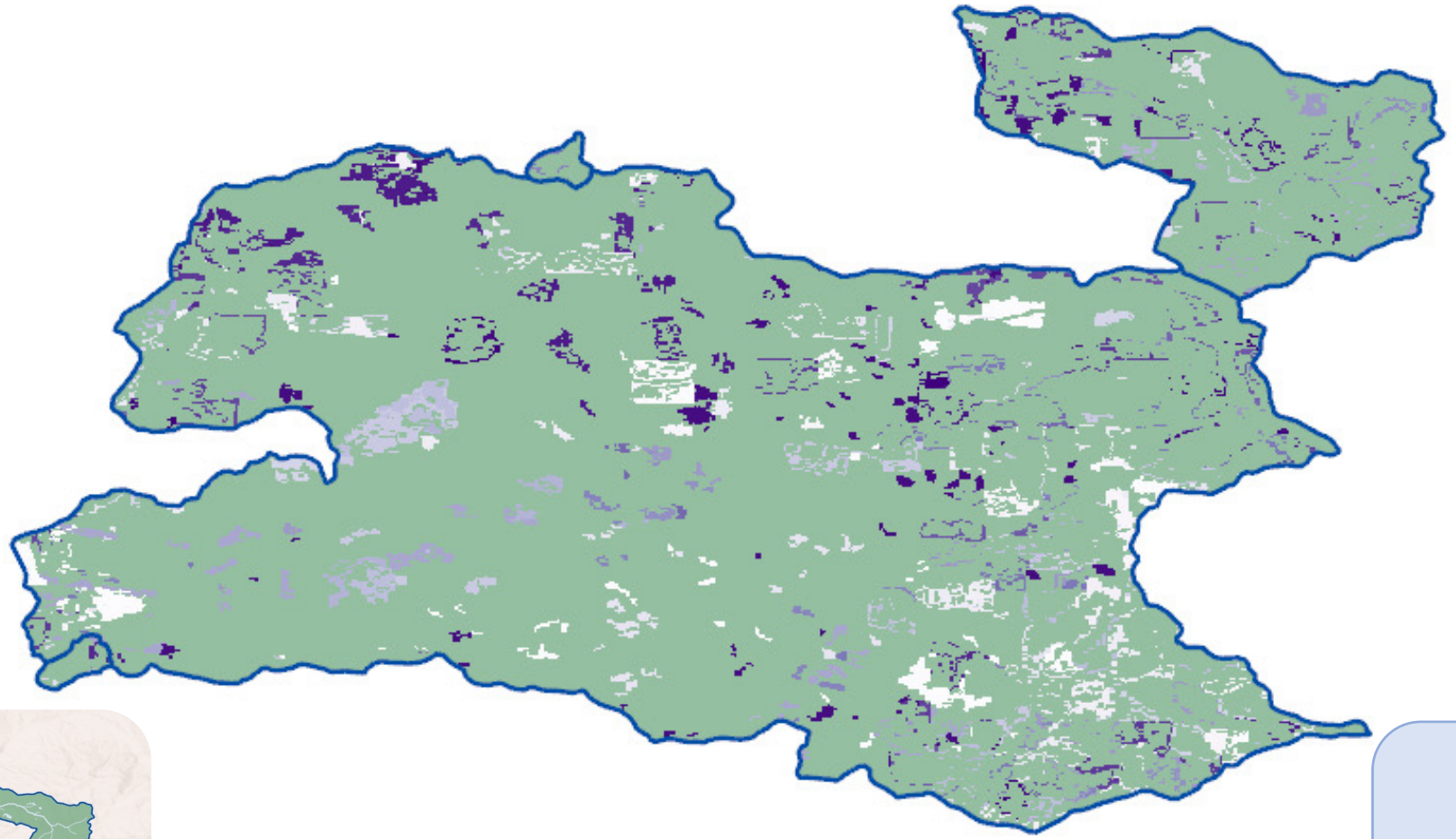
2020

2022



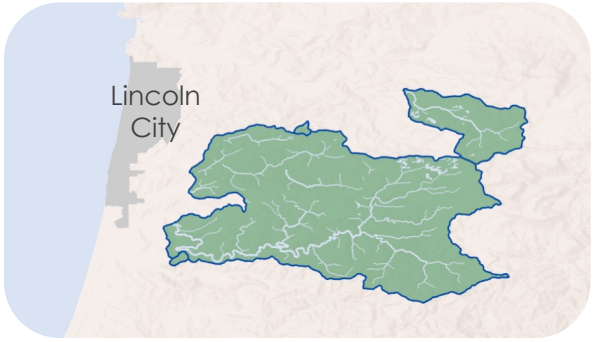
Percent of Watershed Thinned	Number of Watersheds
0 — 10%	33
10 — 25%	41
25 — 50%	5
50 — 75%	0
75 —100%	0

THINNING RESULTS: Lincoln City



Year of Thinning

2000 2022

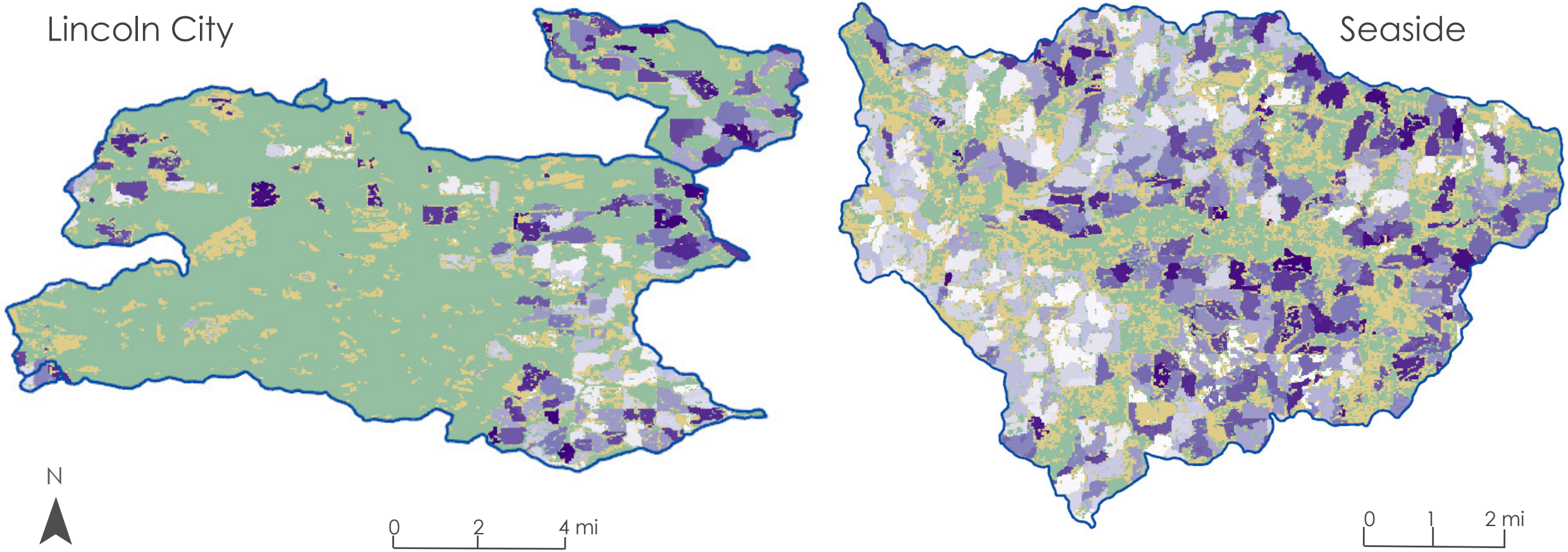


N

14%

of watershed thinned from 2000 to 2022

RESULTS: All Logging



RESULTS: Land Ownership

Private Industrial Land

Land Ownership	Percent Clear Cut	Percent Thinned	Total Percent Logged
Federal	3%	12%	15%
State	18%	24%	42%
Private Industrial	42%	15%	57%

ERRORS & UNCERTAINTIES

Forest mask accuracy

Underestimation of area logged in 2022

Visual validation

Cannot attribute forest loss to logging with certainty

Landsat 7 scan line error

CONCLUSIONS

Logging impacts 42% of forested area in drinking watersheds within Oregon's Coast Range

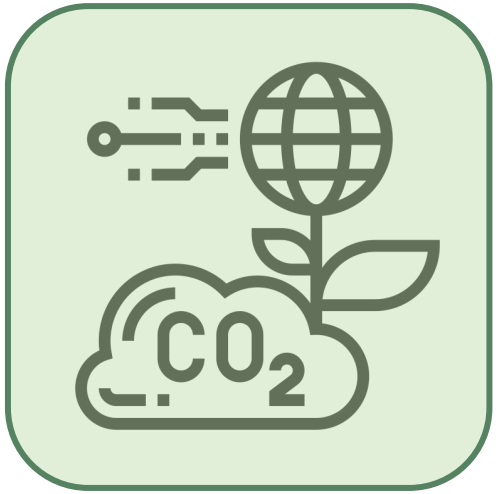
Logging tends to occur on **private land**

CCDC is an **effective method** for detecting clear cutting in Oregon's coast

Subtle forest disturbance, including thinning, can be identified using Landsat-derived **percent change NDVI**

FUTURE WORK

Validate logging results with testing sites identified from NAIP imagery and historic logging data



Estimate carbon impacts of logging using aboveground biomass density data from GEDI and Sentinel-1

Monitor water quality in heavily logged drinking watersheds using Landsat

Acknowledgments

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  - Erik Fernandez, Oregon Wild
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  - Joseph Spruce, Science Systems and Applications, Inc.
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