**Oregon Coast Range Ecological Conservation**

*Mapping Recent Logging within Drinking Watersheds of Oregon’s Coastal Range to Support Future Resource Management Policies*

**Project Team**

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**Project Overview**

***Project Synopsis:***

In the Oregon Coast Range, forests play a critical role in protecting surface water quality by preventing erosion and filtering precipitation. As a result, conventional logging practices in drinking watersheds pose a significant threat to drinking water quality. This study quantifies the extent of logging, more specifically clearcutting and commercial thinning, in Oregon Coast Range drinking watersheds to inform future resource management plans and legislation aimed at balancing the commercial and environmental benefits of forestlands.

***Abstract:***

Logging operations are widespread across the Oregon Coast Range and conventional logging practices pose a risk of contamination to surface water quality. The NASA DEVELOP Boston team partnered with nonprofit, Oregon Wild, to quantify the extent of clearcutting and commercial thinning in the Oregon Coast Range between 2000 and 2022. This project accessed all available Landsat data from 1997 through June 2023 in Google Earth Engine. Sensors used include Landsat 4 and 5 Thematic Mapper, Landsat 7 Enhanced Thematic Mapper Plus, Landsat 8 Operational Land Imager, and Landsat 9 Operational Land Imager-2. The Continuous Change Detection and Classification (CCDC) algorithm was used to identify clearcutting patches and percent change in the Normalized Difference Vegetation Index (NDVI) was used to identify areas of forest disturbance including commercial thinning. The team concluded that logging, including both clearcutting and commercial thinning, impacted 42 percent of forested area in drinking watersheds and the intensity of logging remained consistent from year to year. Clearcutting occurred primarily on private land while commercial thinning occurred primarily on state and federal lands. This study showed that CCDC is an effective method for detecting clearcutting and percent change in NDVI can successfully identify forest disturbances including commercial thinning. Key constraints included the lack of field validation data and the inability to attribute disturbances to logging with certainty. Ultimately, this study identified the drinking watersheds and communities most likely to be impacted by logging activity. These results can inform legislation aimed at balancing the commercial and environmental benefits of forestlands.

***Key Terms:***

Logging, Watershed, Drinking Water Quality, Landsat, Continuous Change Detection and Classification, Google Earth Engine, Oregon Coast Range, Normalized Difference Vegetation Index

***National Application Area Addressed:*** Ecological Conservation

***Study Location:*** Coast Range, OR

***Study Period:*** 2000 – 2022

***Community Concerns:***

* Forests in drinking watersheds play an important role in protecting surface water from contamination. Conventional logging practices thus pose a significant threat to water quality. Protecting surface water quality is vital for ensuring drinking water safety, lowering water treatment costs, and preserving the beauty of Oregon’s natural waterways for recreation and tourism.
* Balance the economic benefits of logging and forest ecosystem services.
* Protect old growth forests and biodiversity from logging expansion.

***Project Objectives:***

* Quantify the extent of clearcutting and commercial thinning in drinking watersheds on the Oregon Coast Range
* Produce accessible maps and statistics for public education

**Partner Overview**

***Partner Organization:***

|  |  |  |
| --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** |
| **Oregon Wild** | Erik Fernandez, Wilderness Program Manager | End User |

***Decision-Making Practices & Policies:***

Oregon Wild is a non-profit organization focused on public education and engaging with policy makers on issues pertaining to Oregon’s natural resources. Prior to this project, Oregon Wild performed their own mapping of natural resources. During this process, they identified a need for more detailed maps of logging activity. Maps and Earth observations have been used by Oregon Wild to communicate their work, and the organization’s GIS team can incorporate Earth observations into future projects. Pieces of forestry and water quality legislation that Oregon Wild has been involved in include River Democracy Act introduced in 2021 to better protect clean drinking water sources, the Siuslaw National Forest management plan, and the state habitat conservation plan.

**Earth Observations & End Products Overview**

***Earth Observations:***

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| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 4 TM** | Continuous Change Detection and Classification (CCDC) Algorithm, Normalized Difference Vegetation Index (NDVI) | Used to calculate CCDC model breaks and corresponding year to identify areas of clearcutting. Observations were also used to calculate threshold percent change in NDVI as a proxy for commercial thinning. |
| **Landsat 5 TM** | CCDC Algorithm, NDVI | Used to calculate CCDC model breaks and corresponding year to identify areas of clearcutting. Observations were also used to calculate threshold percent change in NDVI as a proxy for commercial thinning. |
| **Landsat 7 ETM+** | CCDC Algorithm, NDVI | Used to calculate CCDC model breaks and corresponding year to identify areas of clearcutting. Observations were also used to calculate threshold percent change in NDVI as a proxy for commercial thinning. |
| **Landsat 8 OLI** | CCDC Algorithm, NDVI | Used to calculate CCDC model breaks and corresponding year to identify areas of clearcutting. Observations were also used to calculate threshold percent change in NDVI as a proxy for commercial thinning. |
| **Landsat 9 OLI-2** | CCDC Algorithm, NDVI | Used to calculate CCDC model breaks and corresponding year to identify areas of clearcutting. Observations were also used to calculate threshold percent change in NDVI as a proxy for commercial thinning. |

***Ancillary Datasets:***

* USGS ScienceBase Catalog National Land Cover Database tree canopy cover data (2001) – Forest Mask input
* USGS ScienceBase Catalog National Land Cover Database (2006) – Forest Mask input
* USFS FSGeodata Clearinghouse National Land Cover Database tree canopy cover data (2011, 2016, 2021) – Forest Mask input
* Oregon Wild drinking watersheds shapefile – Zonal statistics on forest cover and logging within each watershed
* Oregon Department of Forestry Public land management dataset – Zonal statistics on forest cover and logging based on land ownership type

***Software & Scripting:***

* Google Earth Engine 7.3.2.5776 – Used to run CCDC analysis on study area to determine areas of clearcutting, calculate percent change in NDVI to identify areas of commercial thinning, and produce median composite Landsat images for each year of our study period
* Esri ArcGIS Pro 3.1.0 – Used to run zonal statistics for each watershed and landcover type, in addition to creating clearcutting and commercial thinning visualizations

***End Products:***

|  |  |  |
| --- | --- | --- |
| **End Products** | **Earth Observations Used** | **Partner Benefit & Use** |
| **Clearcutting Maps by Year for Highlighted Watersheds** | Landsat 4 TM, Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Landsat 9 OLI-2 | These maps will identify and quantify the extent of clearcutting within the study’s highlighted watersheds each year and by land ownership type |
| **Commercial Thinning Maps by Year for Highlighted Watersheds** | Landsat 4 TM, Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Landsat 9 OLI-2 | These maps will identify and quantify the extent of commercial thinning within highlighted watersheds each year and by land ownership type |

***Product Benefit to End User:***

This feasibility study will provide methodology for quantifying clearcutting and commercial thinning in the Oregon Coast Range. The Continuous Change Detection and Classification (CCDC) algorithm can be an effective method for identifying clearcutting activity by year. The percent change in Normalized Difference Vegetation Index (NDVI) can be used to identify subtle forest disturbance, although when solely relying aerial imagery, this cannot always be attributed to commercial thinning with certainty. Maps and summary statistics produced by this study will serve as materials for public education. Additionally, results will help inform the River Democracy Act, introduced in 2021, to better protect clean drinking water sources by restricting improper and harmful logging practices particularly in drinking watersheds.

**References**

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