Western Forest and Fire Initiative - Combining multiple data sources to map stakeholder involvement in wildfire governance in the American West

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Introduction/Background

Forest health and the safety and economical vitality of rural communities are interconnected in the western United States. In response to this fact, new decentralized governance networks have been established in rural wooded regions to promote ecological and socioeconomic health. However, it is unclear who is participating in these networks or how linked these people are. Therefore, **The project Western Forest and Fire Initiative explores the connections between key stakeholders in the forest fire management process in order to help the policymakers better understand the relationship between the actors.**

Figure 1. A preview of initial data table generated from using the automated web scraping python program. The table contains over 1500 incidents and over 250 features.

fire Name	fire Overview	url	Incident Type	Incident Commander	Coordinates	Fuels Involved	Projected Incident Activity	Incident Cooperator
Slash Pile Burning 2021	Image options: [Full Areas on the Clear C Areas on the Canyor	https://inciw	Prescribed Fire	Arapaho and Roosevelt I	40.559 latitude,	Piled Fuels	Pile burning ongoing as con	N/A
Elkhorn-Pingree Hill Pres	Image options: [Full The Elkhorn - Pingree Appropriate condition	https://inciw	Prescribed Fire	Canyon Lakes Ranger Di	40.716 latitude,	N/A	N/A	N/A
Bighorn Sheep Prescribe	Image options: [Full Fire managers on the	https://inciw	Prescribed Fire	USDA Forest Service & C	40.718 latitude,	N/A	N/A	N/A
2021 Umatilla NF Prescrit	Image options: [Full Frequent, low-intensi NEW! Prescribed Fire Prescribed Fire Statu Active - Unit is planne The data represents t	https://inciw	Prescribed Fire	N/A	45.67 latitude, -	N/A	N/A	N/A
Kaibab NF South Zone Rx	Image options: [Full Winter weather with s	https://inciw	Prescribed Fire	Tyler Knight RXB3	35.186 latitude,	Ponderosa Pine, C	Pile Burning on Bill Williams	N/A
San Juan NF Prescribed I	Image options: [Full This Thursday, Jan 2 Reintroduction of fire Prescribed fire smoke For additional informa	https://inciw	Prescribed Fire	N/A	37.279 latitude,	N/A	N/A	N/A
Cedar Central Prescribed	Image options: [Full When Cedar Grove o "We are grateful for th Smoke impacts are e	https://inciw	Prescribed Fire	Sequoia & Kings Canyon	36.784 latitude,	Mixed conifer, dec	N/A	N/A

Methods

1. **Collect Data from different web sources: Inciweb, newsbank.**
2. **clean, organize, and correct data, creating a comprehensive database and a relational table of actors involved in wildfire management.**
3. Using the relational database created, build a comprehensive social network graph that represents relationships between stakeholders

Collecting data from the Inciweb database

Inciweb: a database website that records detailed information of each wildfire that happened in the US.

- Used python beautiful soup to create a automated web scraper.
- The program takes two tail numbers of inciweb as input, one representing the starting webpage and one representing the ending webpage, and scrape all information from the web pages with tail number in those range, compiling them into a csv datatable.

organizing data

Implemented a python program to cleaned and organized data on the initial datatable, creating a relational tables of actors involved in wildfire management.

- Used Stanford Name Entity Recognizer(NER) as a tool to extract all the keywords related to organizations and people involved in each fire(from the fire incidents overview)
- Compressed the information into a relational database(see figure 2.).

Figure 2. A preview of relational data table that relate fire incidents with organizations that involved in the incident. Keywords on each column name extracted using the NER.

fire name/organization names	Southwest of Fraser	Ralph Price Reservoir	U.S. Forest Service Stub Creek Work Center	Blue Ridge St Louis Creek
Slash Pile Burning 2021	1	1	1	1
Elkhorn-Pingree Hill Prescribed Burns	0	0	0	0
Bighorn Sheep Prescribed Burn	0	0	0	0
2021 Umatilla NF Prescribed Fire	0	0	0	0
Kaibab NF South Zone Rx Fire	0	0	0	0
San Juan NF Prescribed Fire Program	0	0	0	0
Cedar Central Prescribed Burn	0	0	0	0
Woodbury Fire	0	0	0	0
Magic Feather Prescribed Burn	0	0	0	0

Name entity recognizing program for future data organizing

Implemented a name entity extracting program that takes a csv table with title of a paragraph on the first column and paragraph that user wants to extract name entity from on the second column.

Figure 3, Figure 4. a example of a input row, and an example of a output table

Article/News Name	Content
2020s_wildfire_season_is_historic_charring_mo	2020's wildfirese aso n is histo ric, charring mo re - Colorado Sun, The (CO) - O cto be r 26, 2020 October 26, 2020 Colorado Sun, The (CO) Lucy Hag g ard In the 35 years that Mike Lester has worked as a forester, nothing compares to the East Troublesome fire's behavior last week. Its 105,000-acre jump from Wednesday night into Thurs "I've never heard of something going quite this fast," said Lester, the state forester and director of the Colorado State Forest Service. This year's wildfireseason, Lester says, is raising literal and metaphorical red flags that forests in Colorado and across the American West might be unhealthy. But to understand why 2020 has been the worst fire season on record, ithelps to have a crash course in fire ecology and its history. MORE: Five charts that show 2020 ranks in Colorado wildfire history Some of the main factors that determine a fire's intensity and size are wind, temperature, humidity and fuel moisture. Colorado has experienced significant drought this year, drying out The type of fuel also matters, but Lester noted that stands of dead trees -- including those killed by pine or spruce beetles -- don't necessarily make a fire worse; they just make it less Right now, most of Colorado's forests are incredibly dense. When the U.S. Forest Service enacted early 20th century fire suppression policies -- often known as the "10 o'clock rule," v MORE: Huge western fires in 1910 changed U.S. wildfire policy. Will today's conflagrations do the same? But fire has always been a natural part of Colorado's ecosystem, albeit to varying degrees based on elevation. Lower elevations are historically used to low-grade fires as often as ever Historically, wildfires in Colorado were almost always sparked by lightning, but that doesn't mean human-caused fires have always been bad. In fact, native tribes regularly lit fires to keep the land healthy and refreshed. Each tribe had its own reason for burning the land, according t In the century or so since the "10 o'clock" mentality, forests have grown increasingly dense with both live and dead vegetation. And while the mindset around fire management has cha All of this is occurring in the context of climate change, which is leading to warmer years, longer fire seasons, and often drier weather patterns. In other words, we've teed up 2020 for a long time

Article/ News Title	Lester	Grand County	Colorado Sun	Larimer	Colorado	U.S. Forest Service	Continental	Cameron Peak
2020s_wildfire_season_is_histo	1	1	1	1	1	1	1	1
20_years_of_planning_saved_R	0	0	1	0	1	0	1	1
416_Fire_turned_out_to_be_a_h	0	0	0	0	0	0	0	0
A - Act_now_to_guard_against_	0	0	0	0	0	0	0	0
A - Allenspark firefighters get n	0	0	0	1	0	1	1	0
A - Analyzing data on the Cryst	0	0	0	0	1	0	0	0
A - An_unexpected_variable_Ex	0	0	0	0	0	0	0	0
A - Black_Forest_residents_exp	0	0	0	0	0	0	0	0
A - Cameron_Peak_fire_resulte	0	0	0	0	0	0	0	1

Collecting Data from the News Bank

Newsbank: a news database that provides archives of media publications as reference materials to libraries.

- We collected data by manually querying the newsbank database and extracting the data to a table. The Name entity recognizing program will be used to generate the final relational database.

Result/Conclusion

- Current result is a comprehensive database that contains data collected from different web sources, social media, newspapers, and articles.
- Expected result is a detailed network diagram that allows people to visualize the relationship between stakeholders in the forest fire management process generated from the data mentioned above.
  - May also include spatial information in the network diagram in order for people to better understand the physical connection between each stakeholder.
  - Will further perform social network analysis on the resulting diagram, which will allow us to explore the social structure of the management network and possible aspects of improvement in the forest fire management process.