



**Public Participation GIS
in environmental research and planning**

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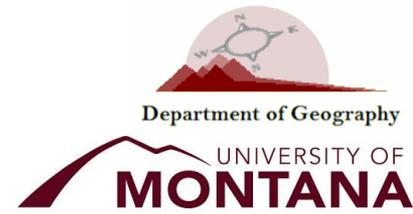
Missoula, February 24th, 2014

Outline

- Terminology
- Goals
- Pros and cons
- Components of an online PPGIS tool
- Conducting research using PPGIS data
- Advanced topics in PPGIS data analysis
- Case studies on the Flathead Indian Reservation

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Public Participation GIS in environmental research and planning

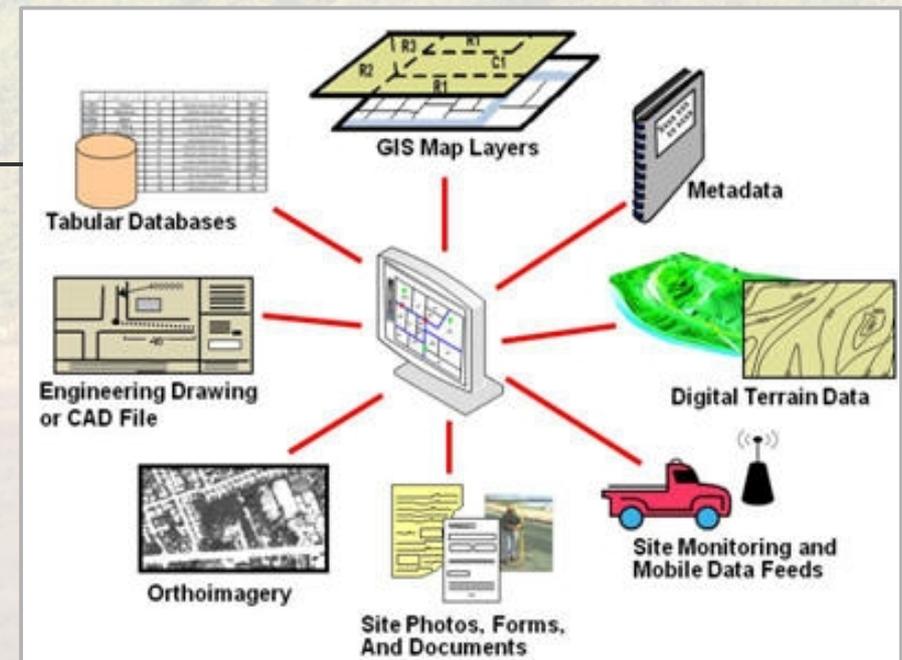


Terminology



Geographic Information Systems and Science

Organization, tools, mindset and epistemology on the collection, abstraction and usage of data with geospatial properties.



Public Participation

Involvement of stakeholders potentially affected by a decision, implying their capacity to influence the final decision. Based on the principle that those affected by a decision should participate in the decision-making process.



Public Participation

- Design and Implement Public Meetings
- Interview Key Stakeholders
- Engage Community
- Build Trust in the Process
- Create Public Support for the Plan

Volunteered Geographic Information (VGI)

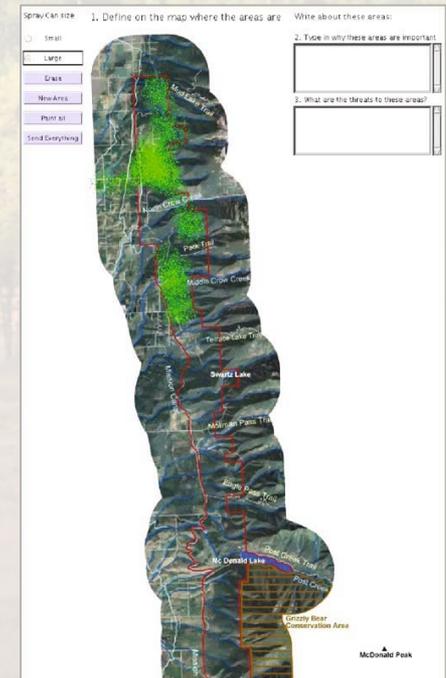
Voluntary production and distribution of geospatial data. A significant contribution during large scale emergencies.



Haiti Crisis Map - OpenStreetMap NL (<http://haiti.openstreetmap.nl/>)

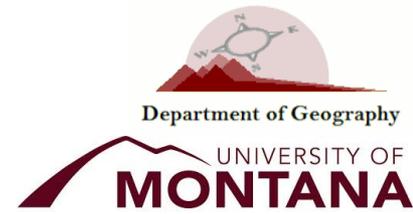
Participatory GIS / Public Participation GIS

Involvement of local groups in the creation of GIS data and its use in spatial decision-making processes that affect them.



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Goals

Goals

Democratize GIS teaching and usage, so that it is accessible to and understood by the widest possible range of communities and groups.



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Goals

Make citizens participate in spatial planning and policy-making.



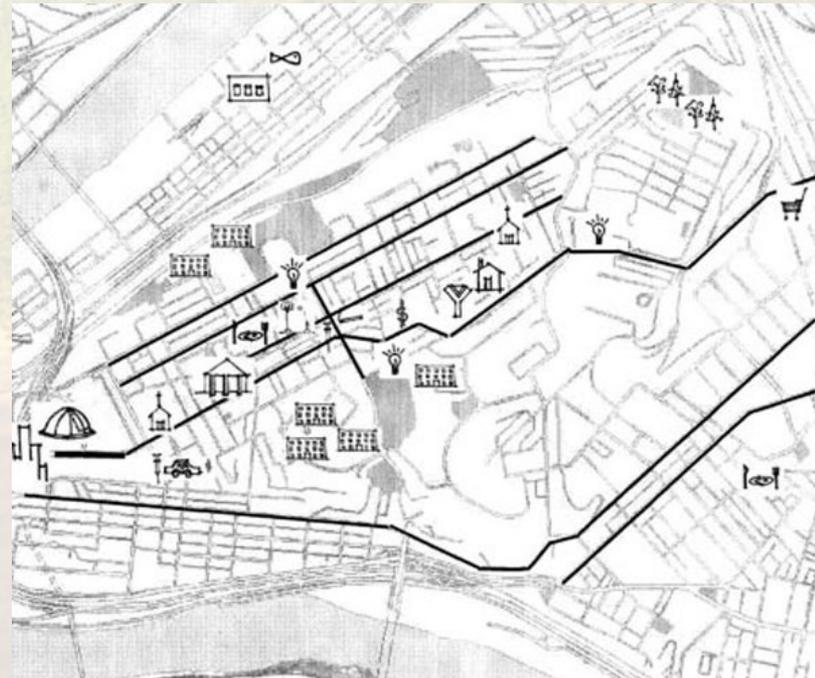
Levels of participation

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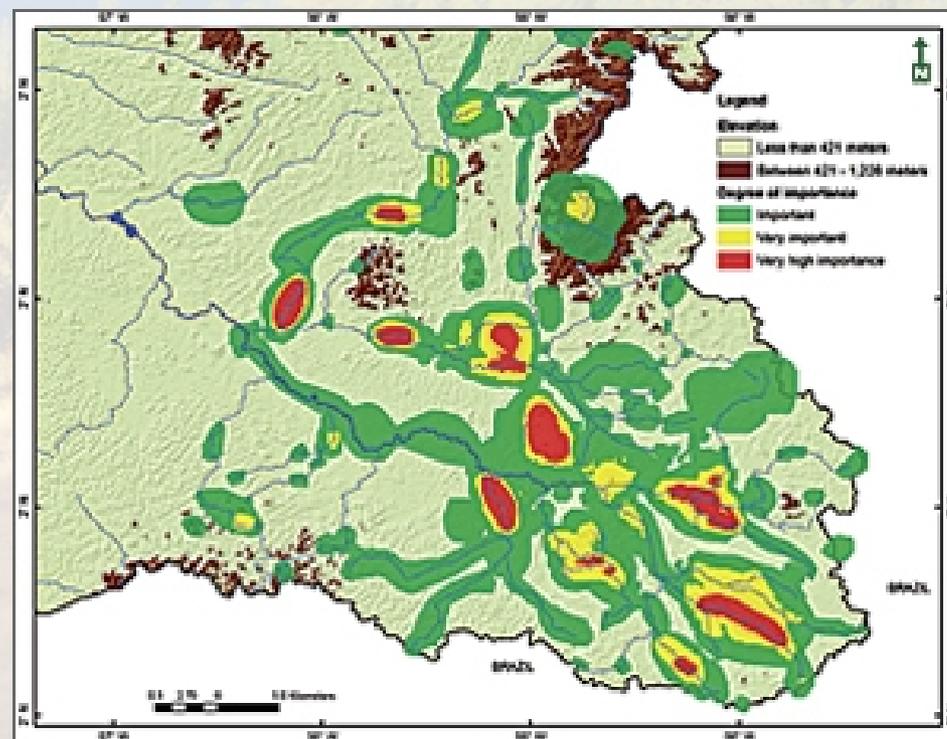
Goals

Capture local knowledge and vernacular geographies, by mapping spatial perceptions of the public and the meanings they attach to locations.



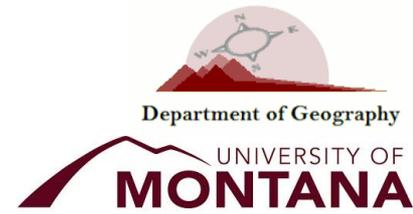
Goals

Include public values in Decision Support Systems.



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Pros and cons



Disadvantages of PPGIS

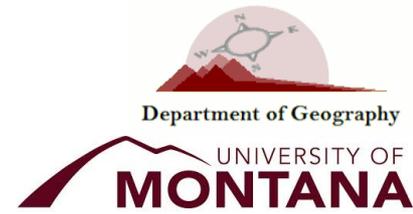
- Access to PPGIS technology by the public may be limited.
- Depends on the geographical and computer literacy of participants.
- Data quality limitations deriving from the survey (involvement of respondents, sample representativity).
- Distrust between the survey client, the author, and potential participants.

Advantages of PPGIS

- Stimulates the use of GIS technologies as well as geographical thinking in the public.
- Data inaccuracies tend to be low-weighted by increasing the numbers of participants.
- Includes opinions and the involvement of a wide range of stakeholders in the planning process.
- Helps improve mutual understanding and trust between all parties in the project.
- Places a large portion of labor on the public end, with a minimal cost.
- United we stand!

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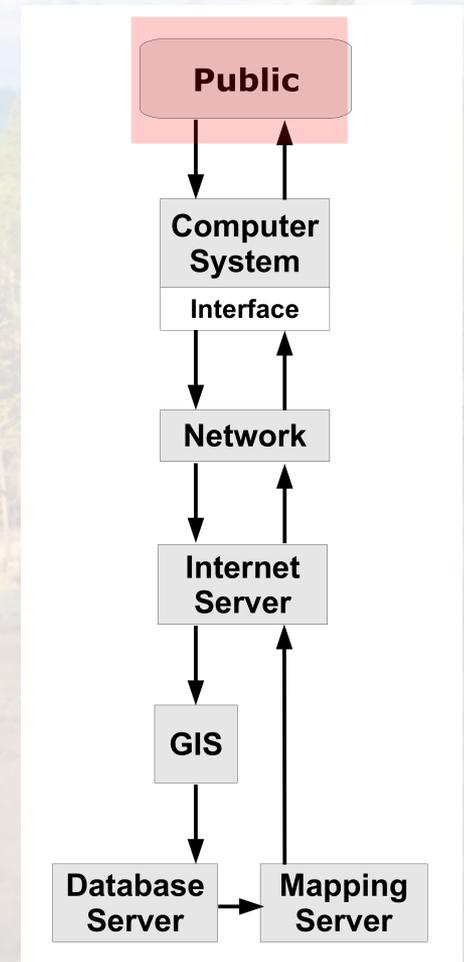


Components of an online PPGIS tool



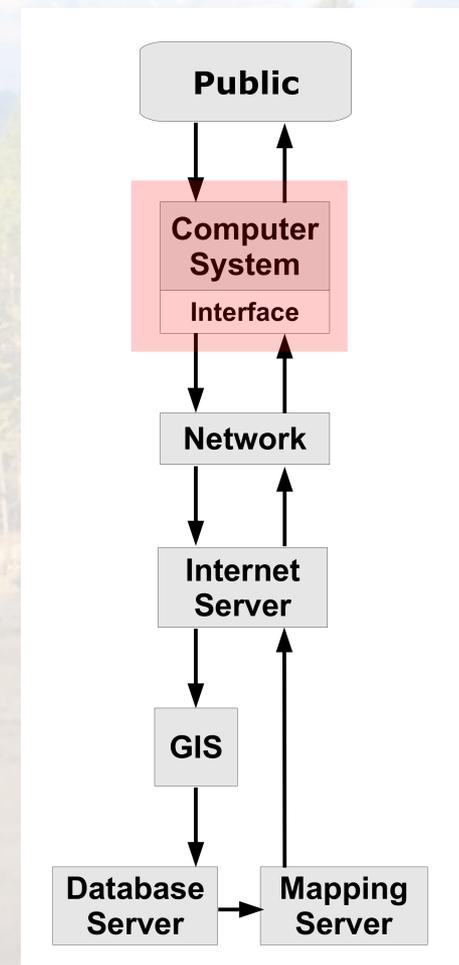
Components of an on-line PPGIS: the public

- It is the source of information of PPGIS data.
- As in any survey procedure, it is the respondents who ultimately determine the information quality of the collected data.



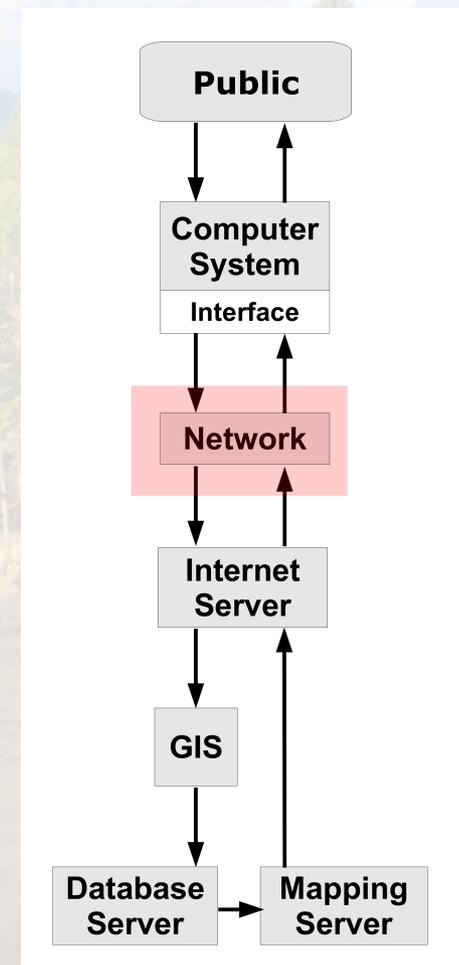
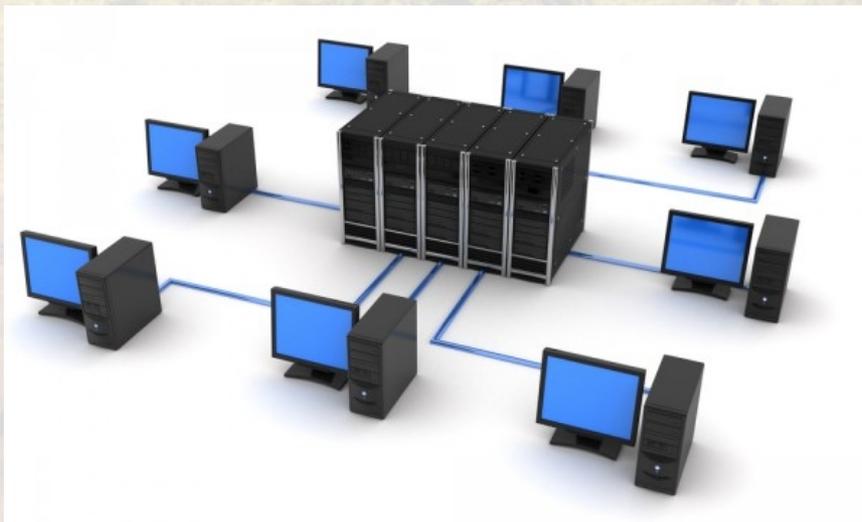
Components of an on-line PPGIS: computer

- Consists of a *client* (terminal where data is introduced into the system) and a number of interfaces used for human-machine communication (screen, mouse, keyboard).



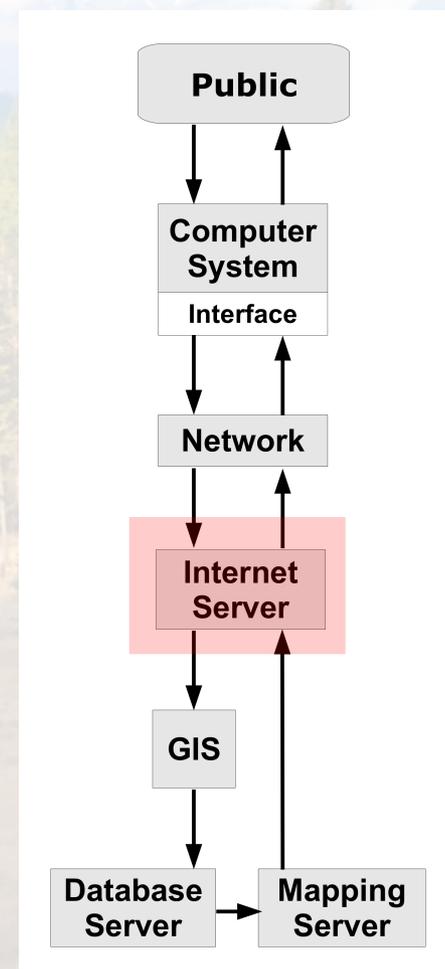
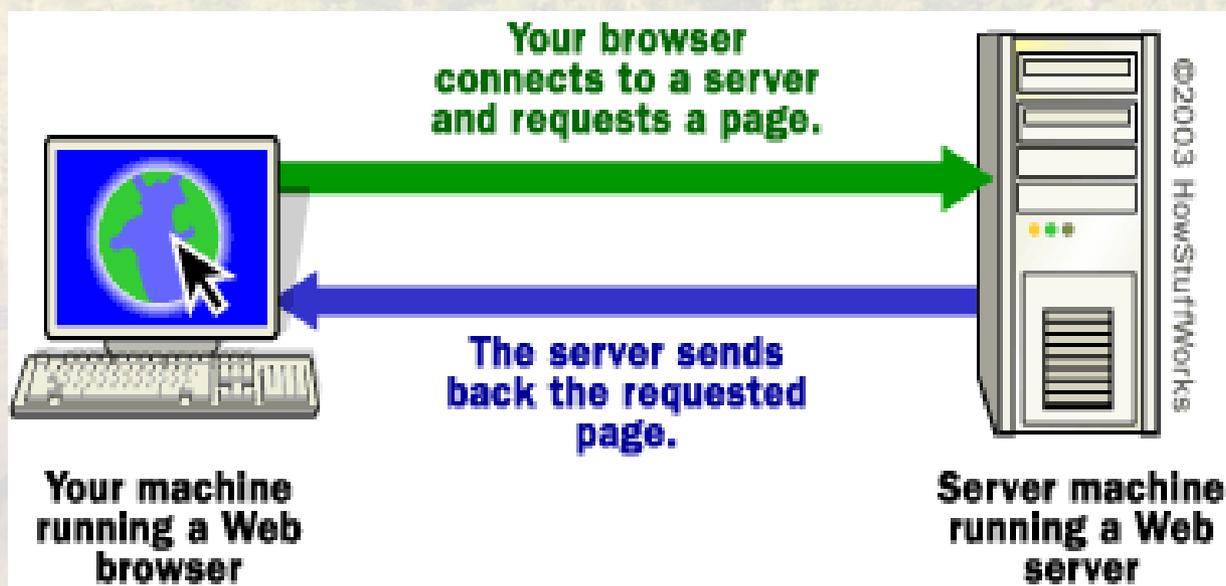
Components of an on-line PPGIS: network

- Transmits data through a structure of interconnected computers.
- Not necessarily the Internet (could be a local network).



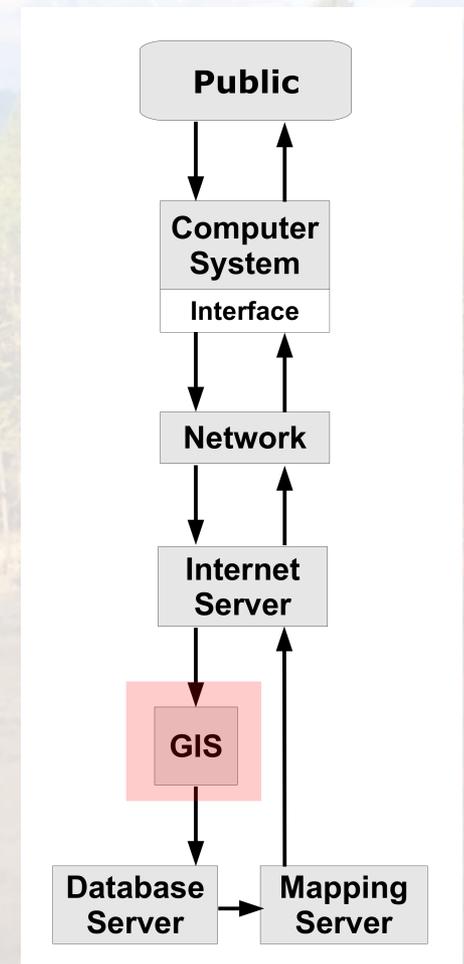
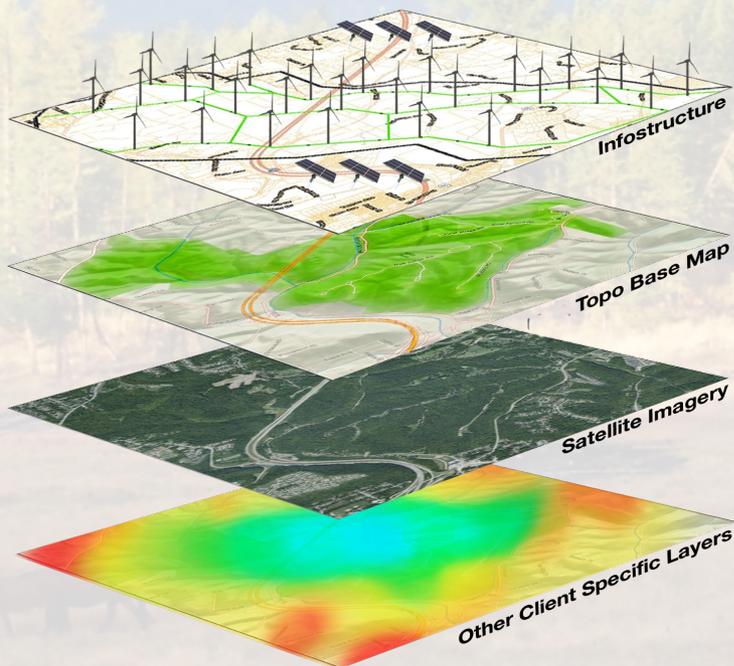
Components of an on-line PPGIS: web server

- Receives and delivers web content that circulates through the network.



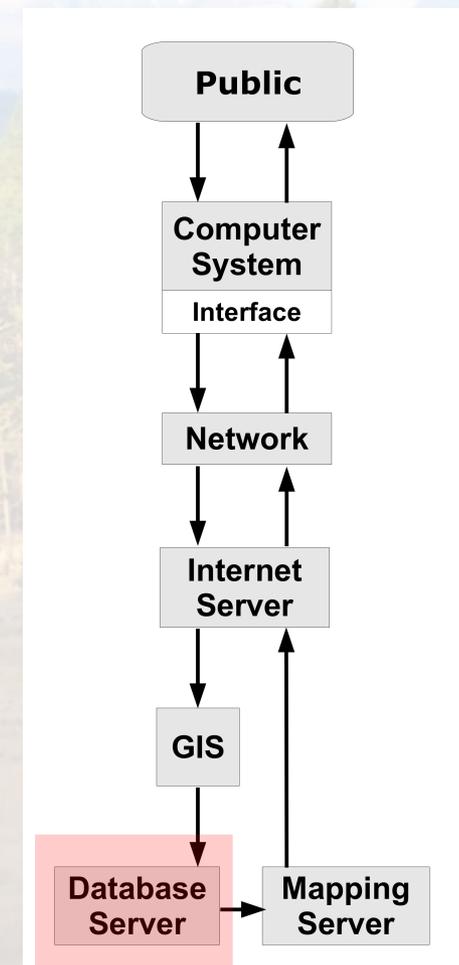
Components of an on-line PPGIS: GIS

- Processes both geospatial and non-spatial data to be stored in the database.



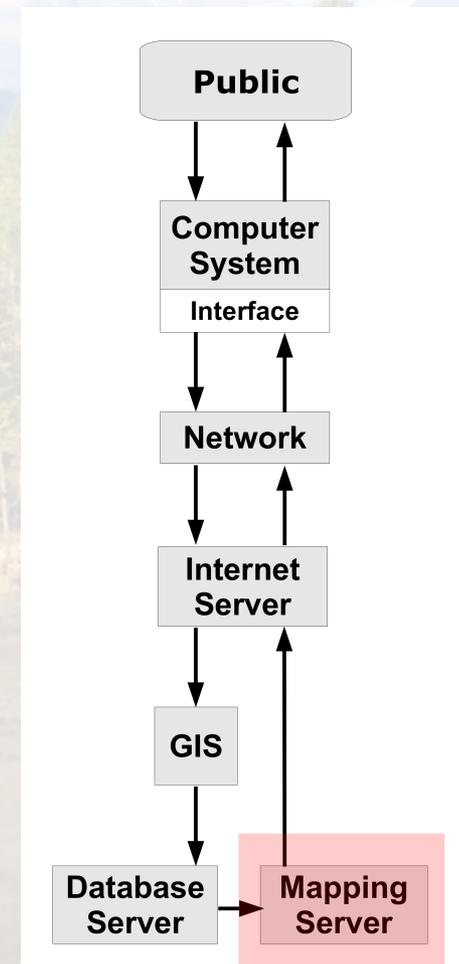
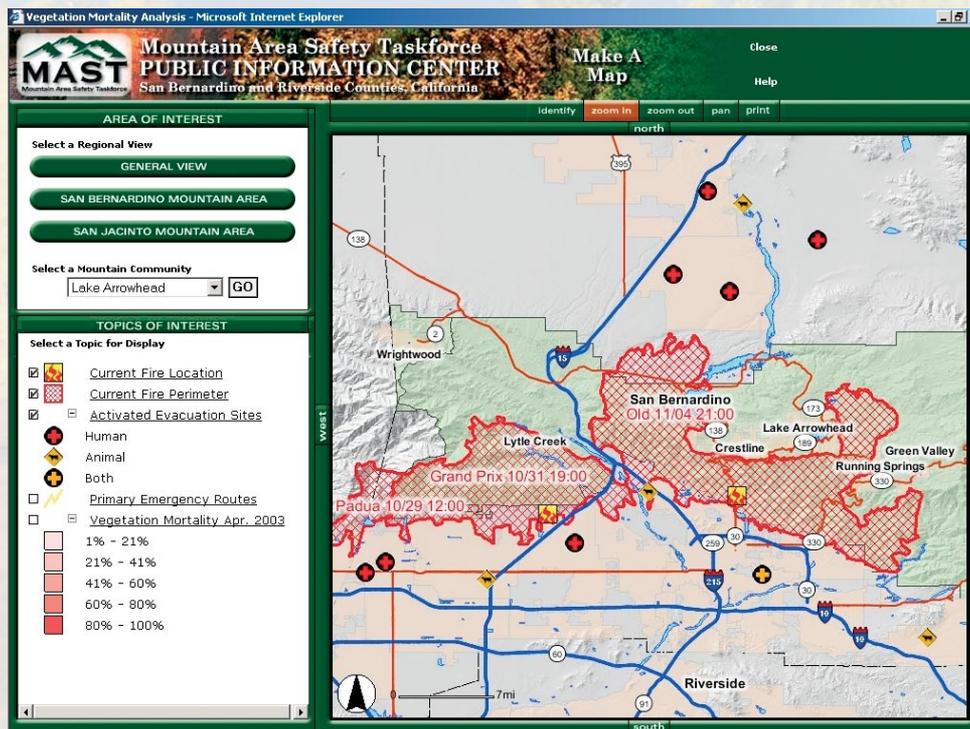
Components of an on-line PPGIS: database

- Controls storage, management and retrieval of PPGIS data.

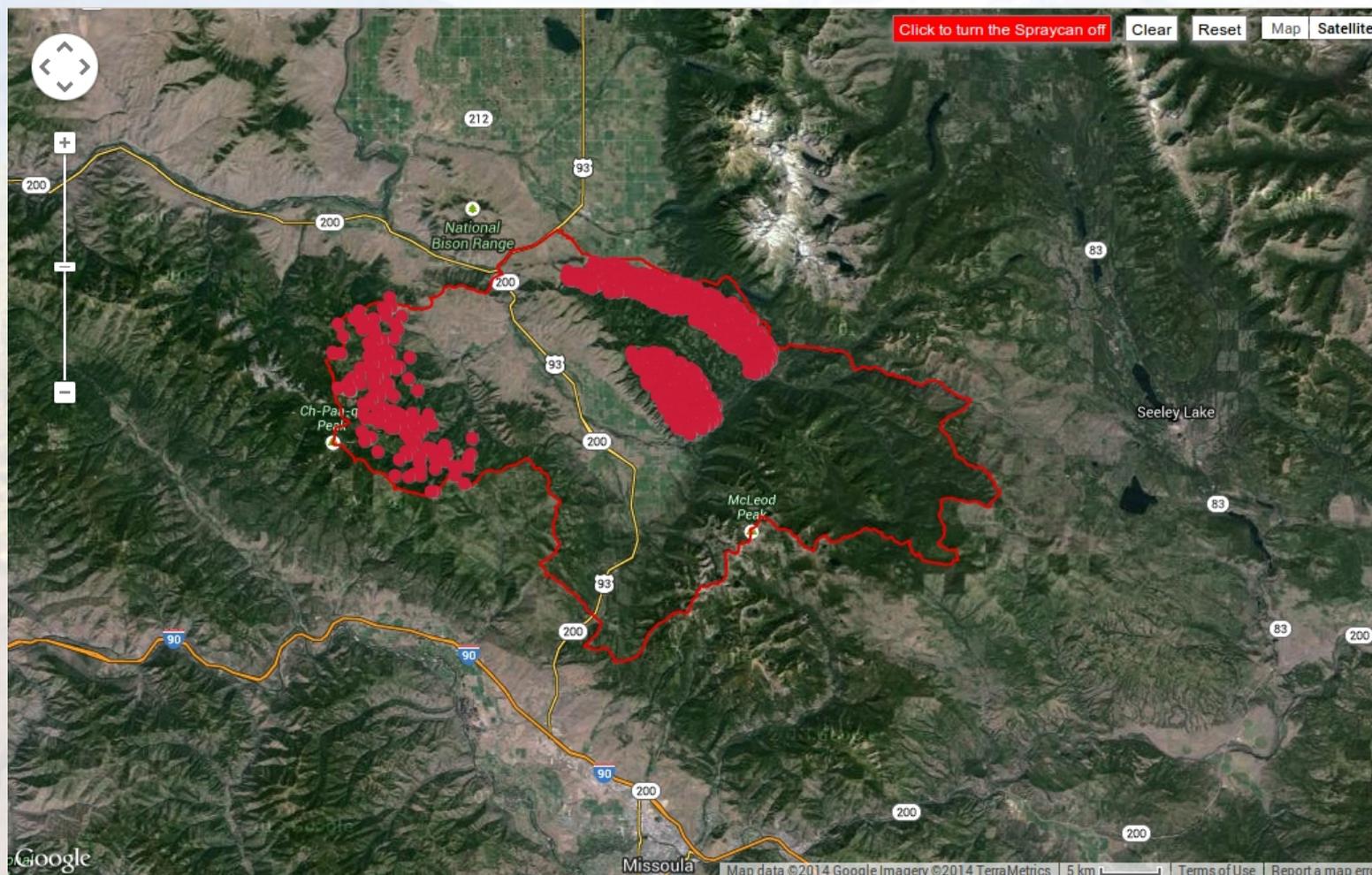


Components of an on-line PPGIS: map server

- Controls the display of geospatial data through the network.



Example: Map-Me PPGIS



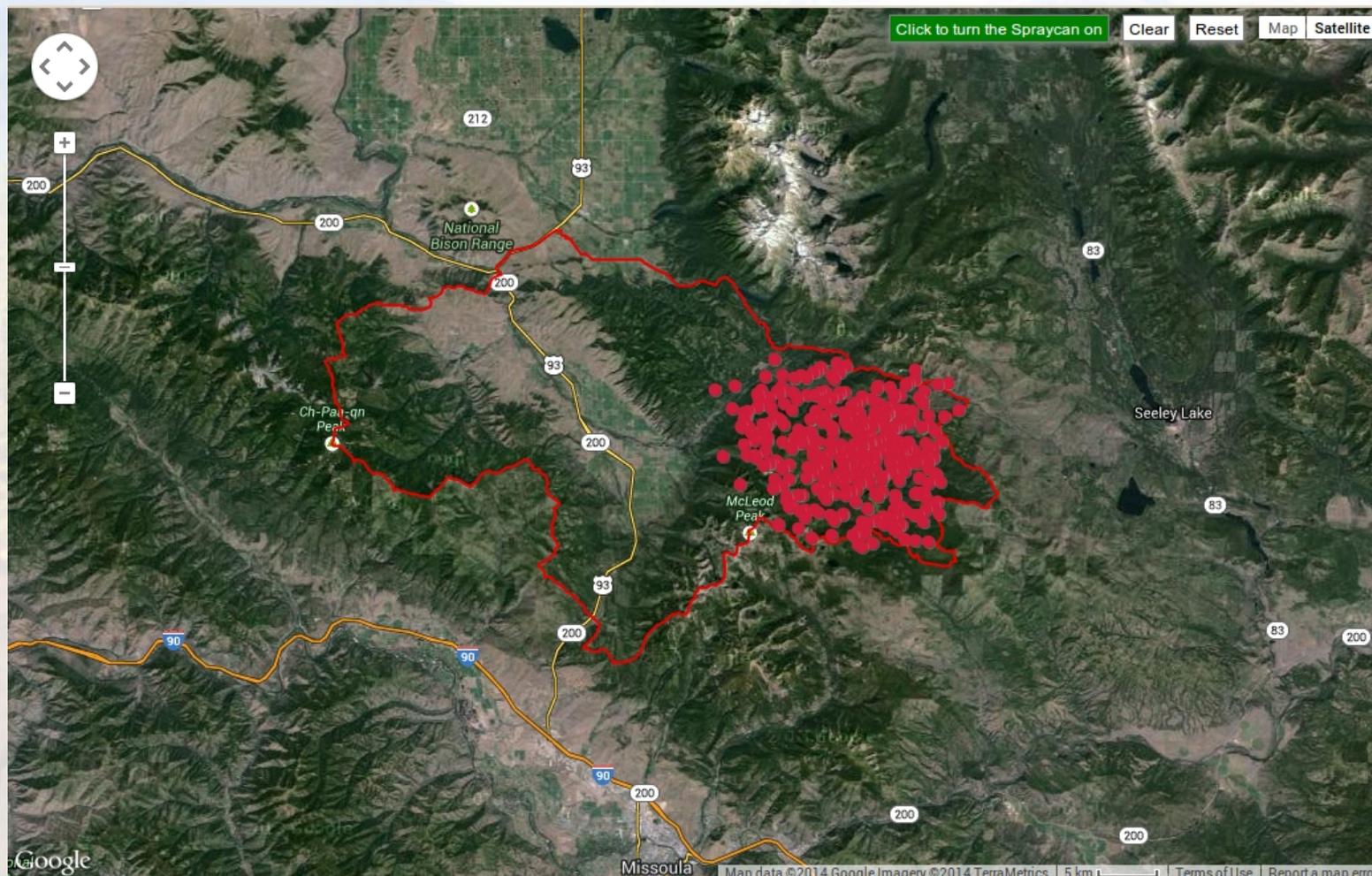
The area outlined in red is the Jocko Landscape. Please indicate an area that you believe has changed over the years.

What did this area used to be like and what is the source of your knowledge?

What is the area like now and what do you believe has caused the change from what it used to be like?

What would you like this area to be like in the future and why?

Example: Map-Me PPGIS



The area outlined in red is the Jocko Landscape. Please indicate an area that you believe has changed over the years.

What did this area used to be like and what is the source of your knowledge?

Woodlands used to be much more open. I've been gone to this place since the 1960's. Also from Elders

What is the area like now and what do you believe has caused the change from what it used to be like?

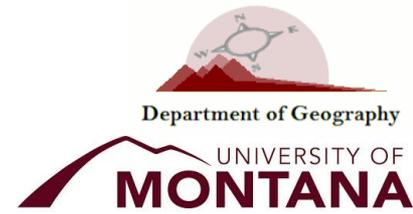
Oversized forest. Closed canopy. Unhealthy. They have to thin.

What would you like this area to be like in the future and why?

Thinned forest, for fauna and flora to be in equilibrium. That's how it used to be.

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Conducting research using PPGIS data

Stages on conducting PPGIS-based research

1. Literature review and familiarity with the case study
2. Survey design
3. Data collection
4. Data analysis and results
5. Report of results

1. Literature review and familiarity with the case study

- 1.1. Review the history, theory, methods and applications of the PPGIS approach.
- 1.2. Review case studies similar to yours, paying special attention to their goals, objectives, research process and results.
- 1.3. Meet with stakeholders and discuss their views on the problem and on the application of the PPGIS approach.
- 1.4. Produce a synthesis of the review.

2. Survey design

- Sampling should preferably be random but stratified:
 - This gets around biased samples at the stratum level (i.e. all strata are represented). Examples of strata: age ranges, managers/non-managers, ethnic groups...
 - Randomness is preserved, though, on sampling each stratum.
- Questionnaires should avoid involved questions and secure concise responses keeping to the point.
- If possible, a pilot survey would first be carried out, out of which feedback can be obtained to design the final version of the survey protocol.

3. Data collection

a) Off-line without digital support:
data collection by analogical
means and subsequent
digitization by a specialist. ←



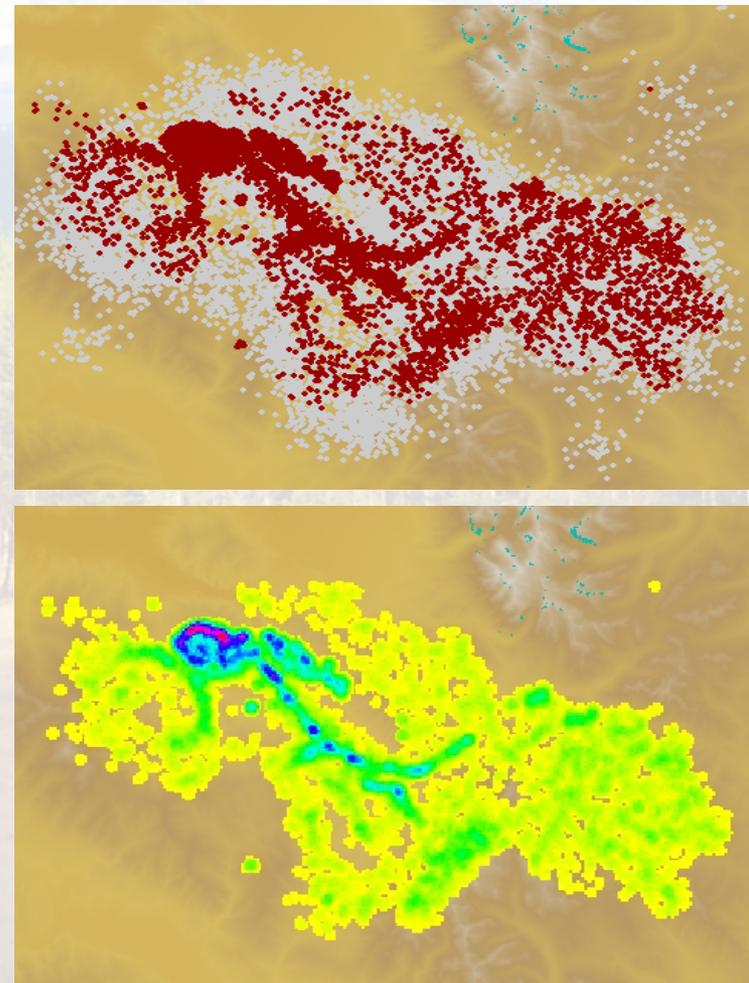
b) Off-line with digital support:
data collection by a
disconnected terminal.

c) On-line PPGIS: remote
introduction of data and
storage in a centralized
database.



4. Data analysis and results

- Mapping of answers.
- Application of spatial statistics: could answer locations depend on landscape properties? (e.g. land use, land rights, taboo areas).
- **Tip:** implication of stakeholder representatives in the analysis process and a joint discussion of results is desirable, as it helps to get clues on interpreting results and to re-formulate hypotheses.

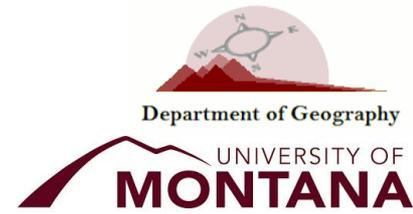


5. Report of results

- Should include an outline of the whole research process, including survey design, characteristics of the sample and the equipment used over the process
- Adhere to mapping standards! Use legend, scale, titles, metadata details...

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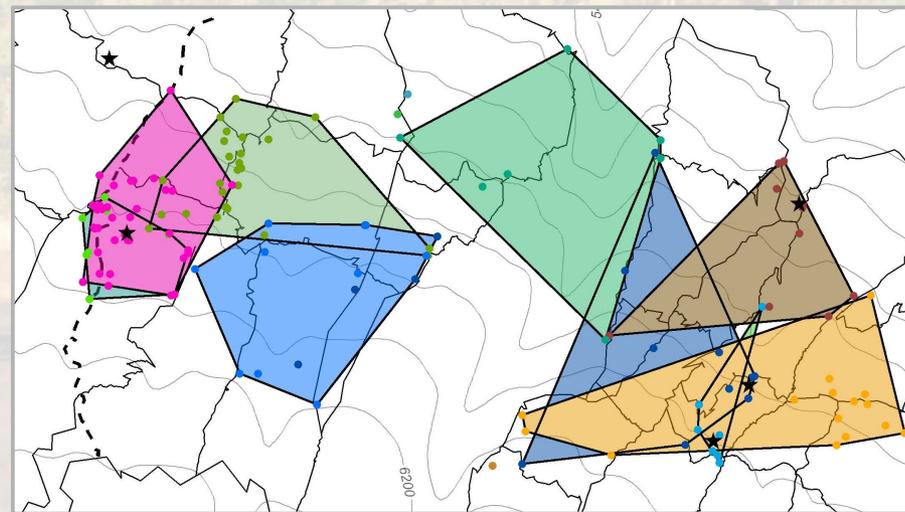
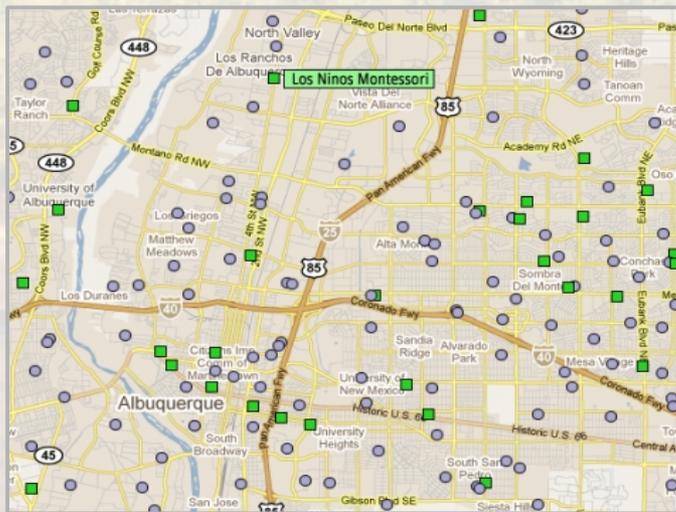
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Advanced topics in PPGIS data analysis

Data models for the location of events

Exact models: assume that locations of tagged phenomena are known with certainty.



Issues in the analysis of PPGIS data

Text tends to produce much larger volumes of data than measures, but their information is unevenly distributed among text units and could even be superfluous.

What are the benefits of these areas?

I really do not know. I guess they preserve some biodiversity that otherwise would disappear, specially endemic species and the like

What are the benefits of these areas?

.....|

Spray on the map those places you think are wilderness areas

What makes them a wilderness?

What are the threats facing them?

What are the benefits of these areas?

Back

Spray Again

Next

Issues in the analysis of PPGIS data

Linguistic registers and patterns may not be uniform among participants (dialectal modes, specialist vocabulary, jargon, misspellings, typos, Internet typing slang) so methods are needed to find similar ideas in text.

What are the benefits of these areas?

You can do a bunch of pretty cool stuff up there, like hiking or canoeing

What are the benefits of these areas?

They offer a range of leisure services whose availability depends, nevertheless, on the protection of local habitats

Spray on the map those places you think are wilderness areas

What makes them a wilderness?

What are the threats facing them?

What are the benefits of these areas?

Back

Spray Again

Next

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Issues in the analysis of PPGIS data

Verbalized definitions may be semantically fuzzy, e.g. include polysemy, alternative textual entailments, conceptual generalizations (abstraction) or references to a whole by one or several of its parts.

What are the threats facing them?

Logging and the effects of diseases on the tree health

What are the threats facing them?

The proliferation of pathogens on the tree bark and branches, along with industrial activity of the timber sector

Spray on the map those places you think are wilderness areas

What makes them a wilderness?

What are the threats facing them?

What are the benefits of these areas?

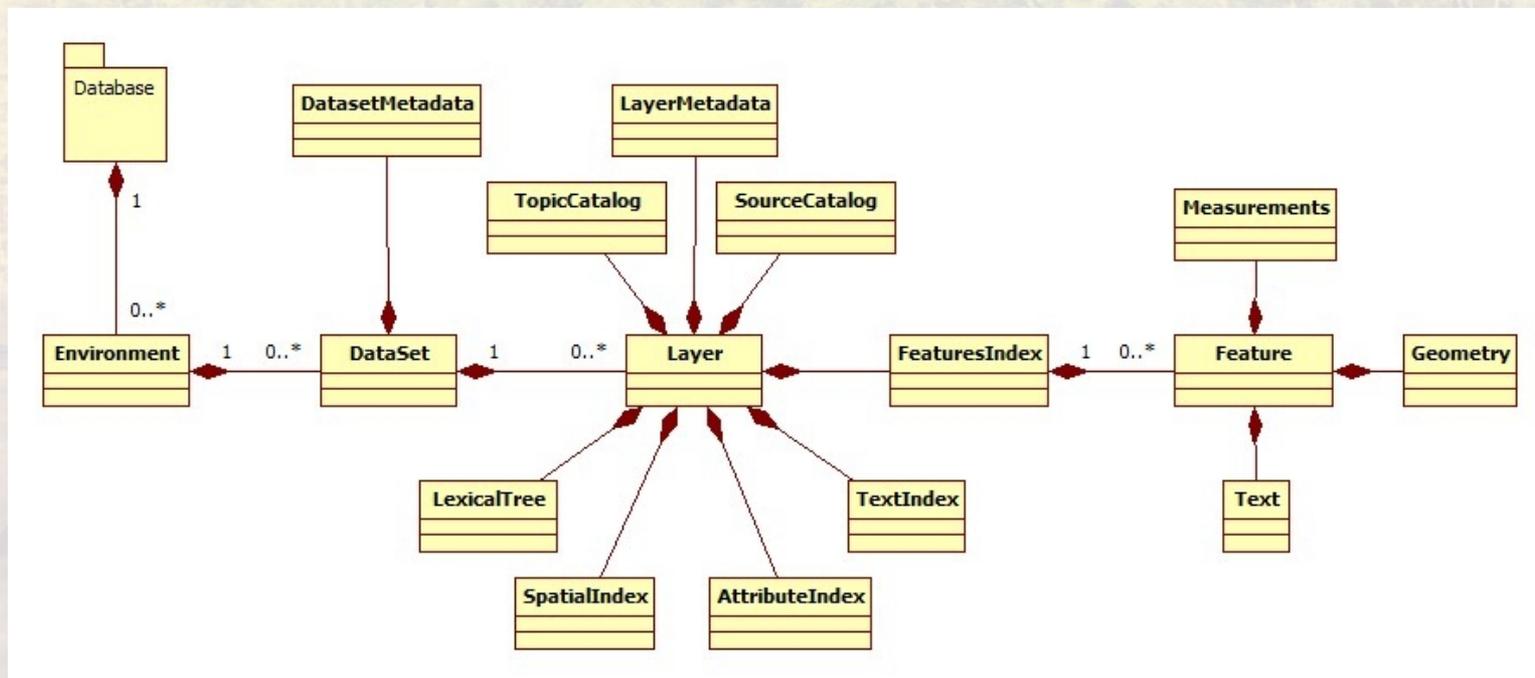
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Spray Again

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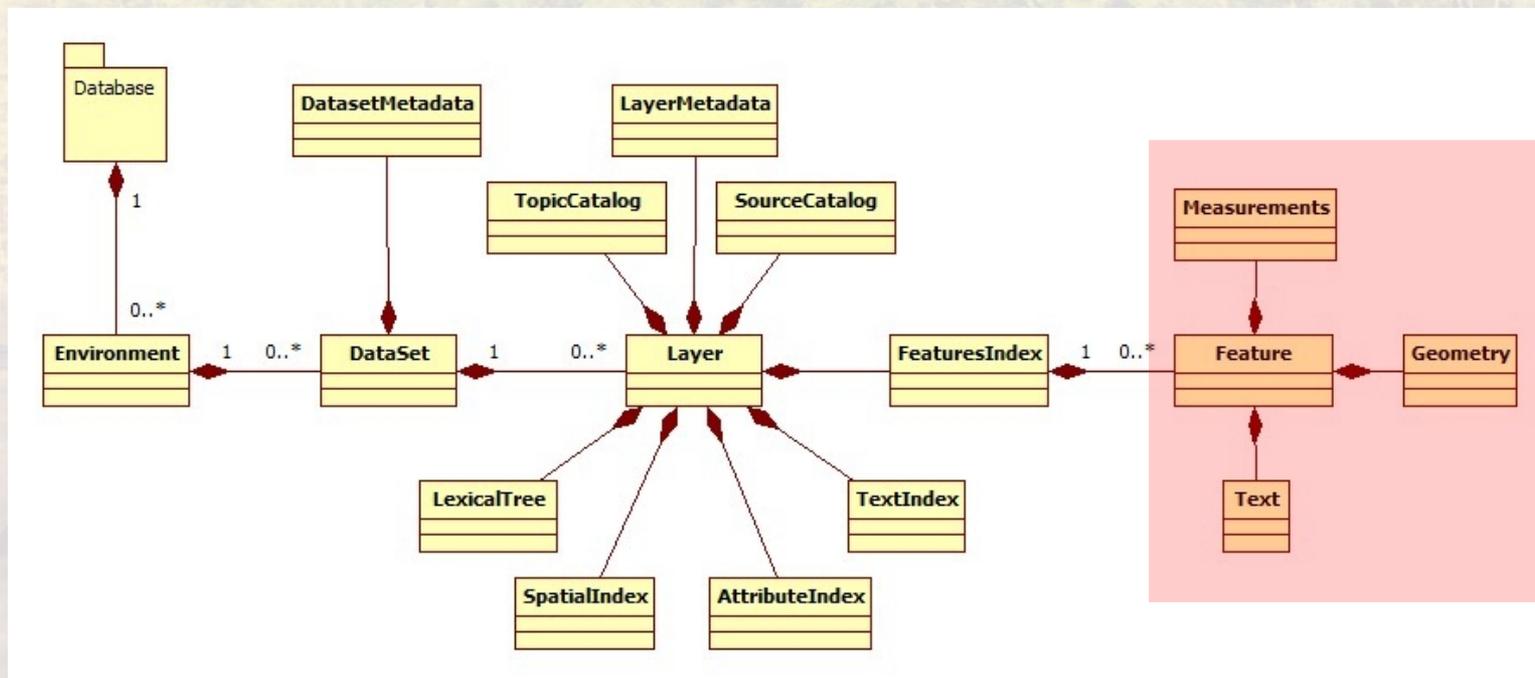
Data organization: the composite database model

An Object-Oriented database is suitable for dealing with the complexity and heterogeneity of PPGIS features.



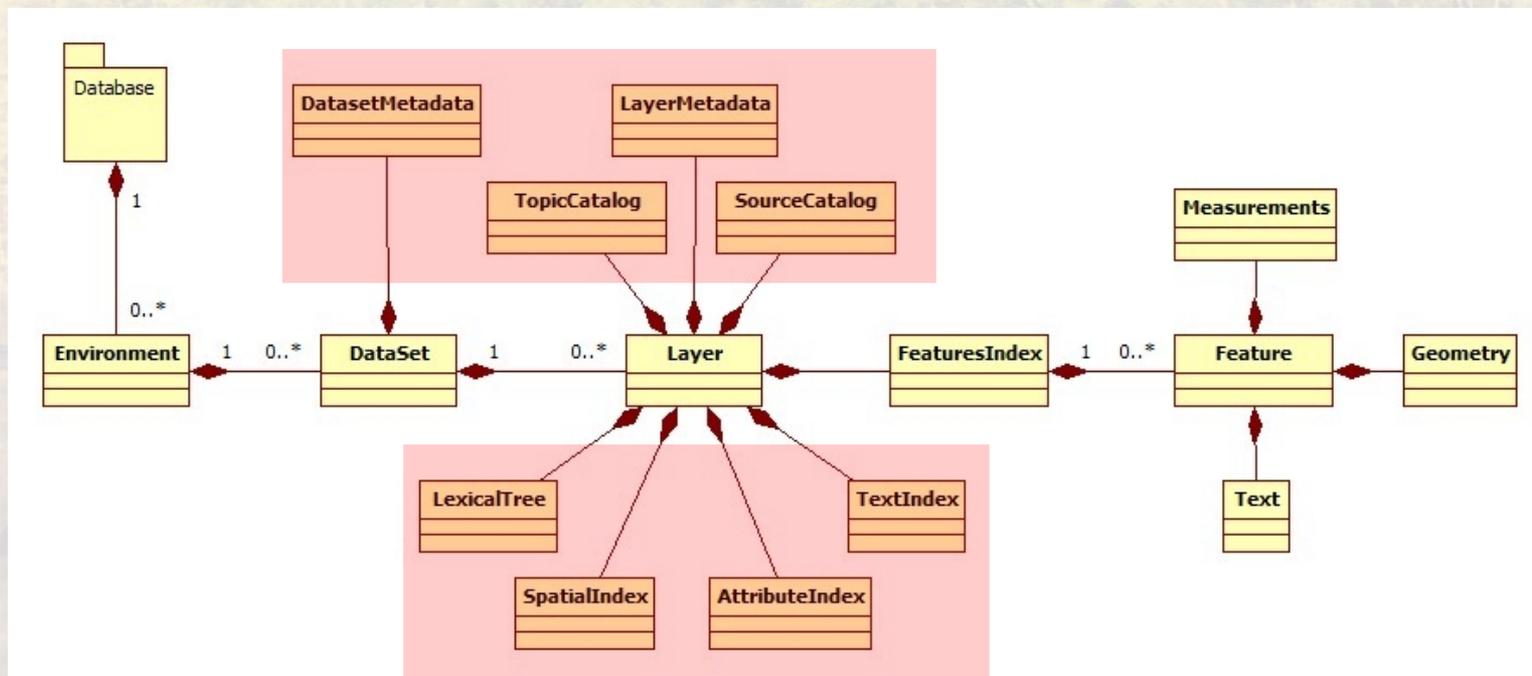
Data organization: the composite database model

PPGIS features may comprise composite data vectors with spatial, temporal, measure and text components.



Data organization: the composite database model

Additional modules take on functionality for the improvement of queries of the composite database and the archiving of ancillary information about features.



Information retrieval: a naturalized query language

Natural Language Programming (programming with natural language expressions, e.g. standard English) provides theoretical principles for the synthesis, retrieval, mapping and management of composite data vectors, also facilitating query formulation.

```
select features from layer 2013 in dataset tpk where text  
has noun pine or a synonym,
```

```
then map them as overlays with these parameters: xres as 100  
and yres as 100
```

Information retrieval: a naturalized query language

Natural Language Processing turns out suitable for the interpretation and patterning of human language text data by means of fully- or partially automated mechanisms.

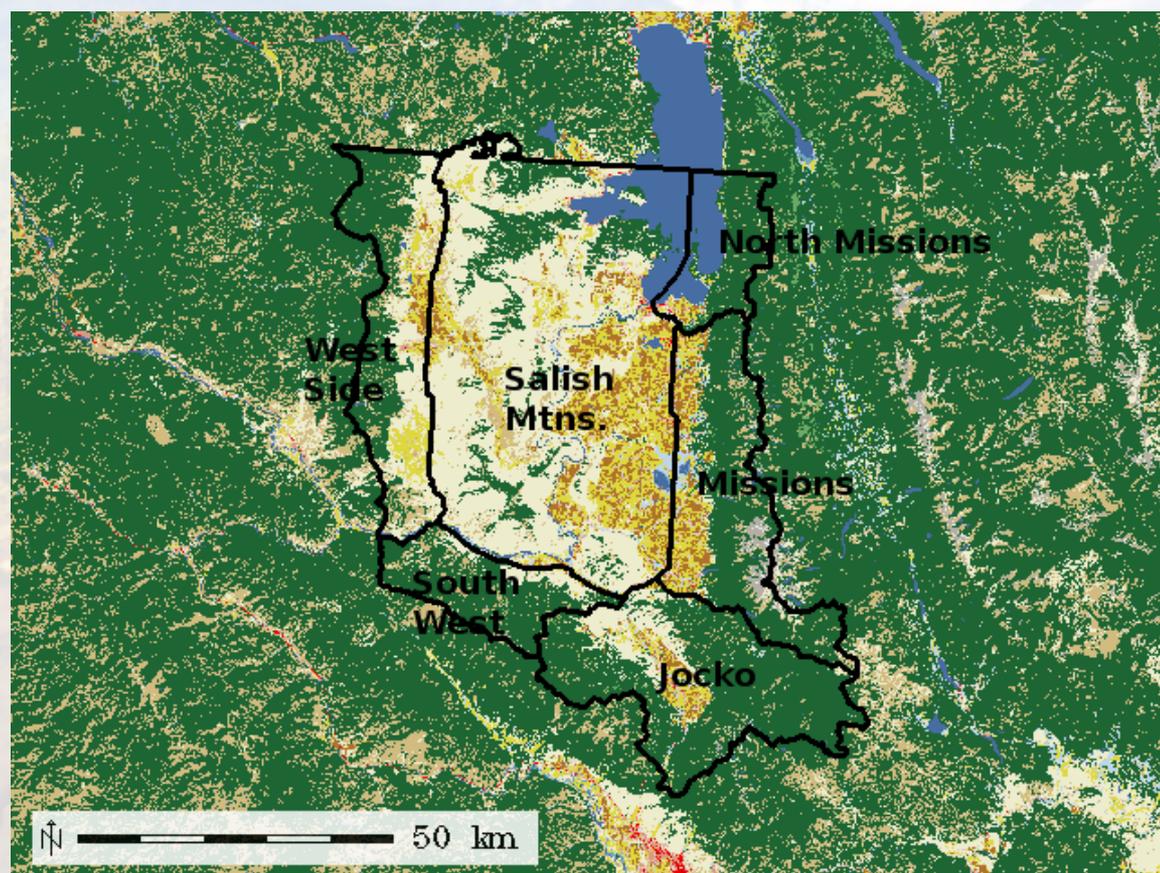
```
select features from layer 2013 in dataset tpk where text  
implies that use of fire has good effects on forests
```

Case studies on the Flathead Indian Reservation

**Principal Investigators: Roian Matt, Forest Management
Department, CSKT; Alan Watson, Also Leopold
Wilderness Research Institute, RMRS**

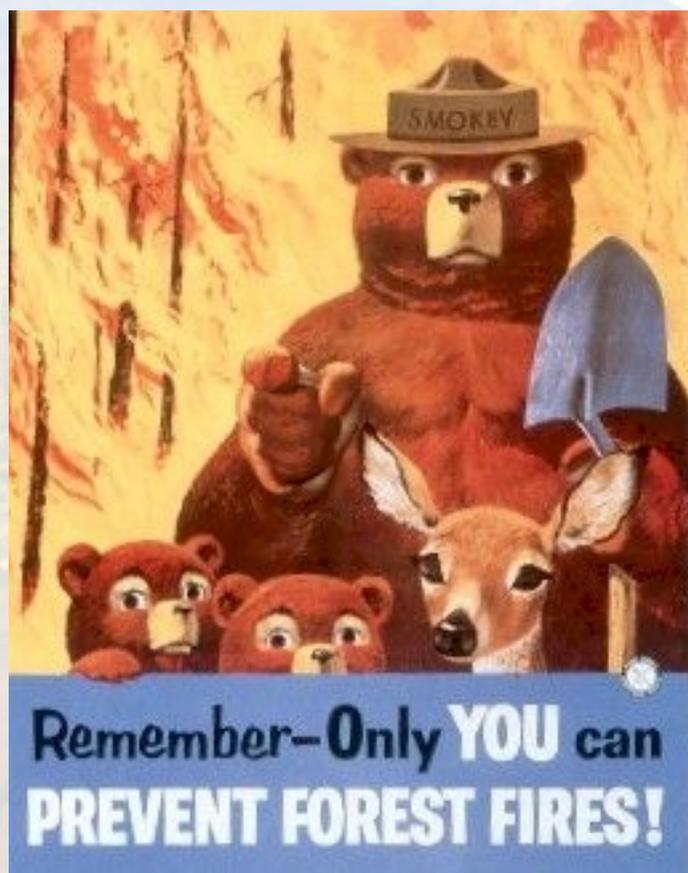
Section co-edited with Dr. Brooke McBride, College of Forestry
& Conservation, University of Montana

Landscape units on the Flathead Reservation



- Northwest Montana.
- Confederated Salish and Kootenai Tribes of the Flathead Reservation.
- Composed of portions of Lake, Sanders, Missoula and Flathead counties.

Issue: has fire suppression had a negative effect on the fire-adapted ecosystems of the Mission mountains?



- Over the 20th century use of fire was largely banned in forests of the USA in order to prevent the effects of fire hazards.
- As a consequence, traditional techniques of prescriptive fire are no longer common practice on the Reservation.

Effects of fire suppression



- Oversized tree communities.
- Anomalous accumulations of dead wood on the forest floor.
- Dense understoreys of brush and young trees.
- Closed forest canopies.

Effects of fire suppression

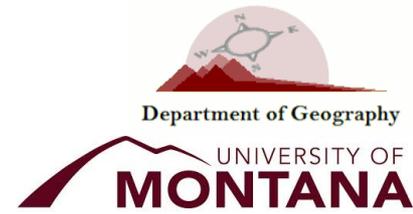


- Susceptible to destructive wildfires.
- Reduction of soil moisture.
- Decrease in sunlight to the forest floor.
- Proliferation of plant pathogens and disease.



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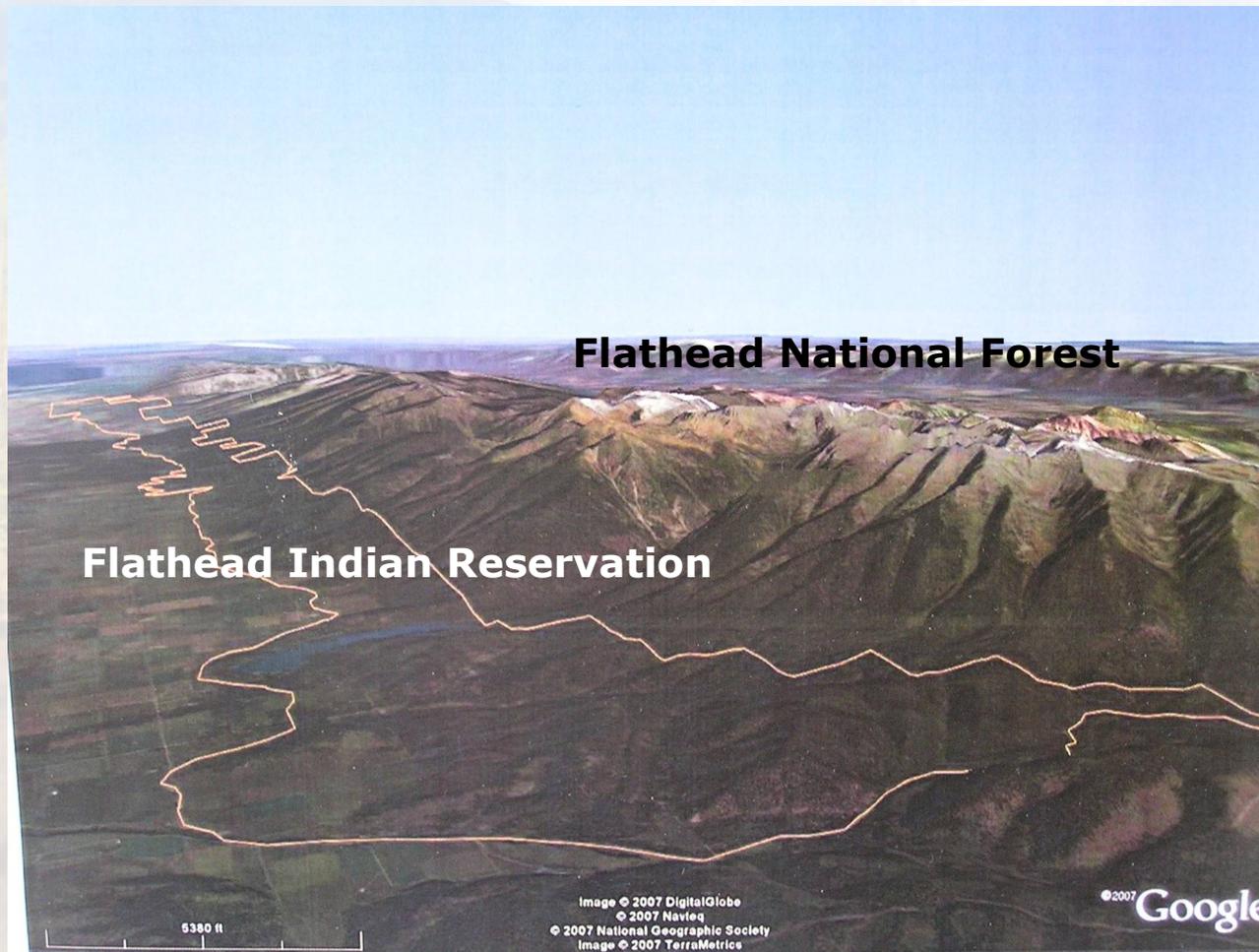
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The Mission Mountains Tribal Buffer Zone



Mission Mountains Tribal Buffer Zone (est. 1987)



- Interface area between Mission Mountains Tribal Wilderness and non-wilderness valley floor; multiple uses.
- **What meanings do tribal and non-tribal residents place on this protected landscape?**

Meanings attached to the Buffer Zone (5 themes)

- Interviews with knowledgeable key informants led to identification of 5 themes of meanings.
- 1) Wilderness Protection, 2) Wildlife Habitat & Water Quality, 3) Recreation & Scenic Values, 4) Access & Functional Benefits, 5) Personal & Cultural.
- Themes were used as basis for a PPGIS survey using a fuzzy tagger.

PPGIS interface

Recreation and Scenic Value

Please show on the map those areas that are most important to you for recreational activities and scenery.

1. Choose a spray paint size and spray over the areas that are important to you. The more you spray over an area, the more important it is.

Scroll down to see all the map.

2. In the boxes on the right side, type in why you think these areas are important.

3. Type what threats you think affect these areas.

4. Press "Send Everything".
Your areas and comments will be sent to us.

If you want to do spray paint more than one area, press the "New Area" button.
If you make a mistake, press "Erase".

Notes:

If you want to skin this man, click here:

Spray Can size

Small

Large

Erase

New Area

Paint all

Send Everything

1. Define on the map where the areas are

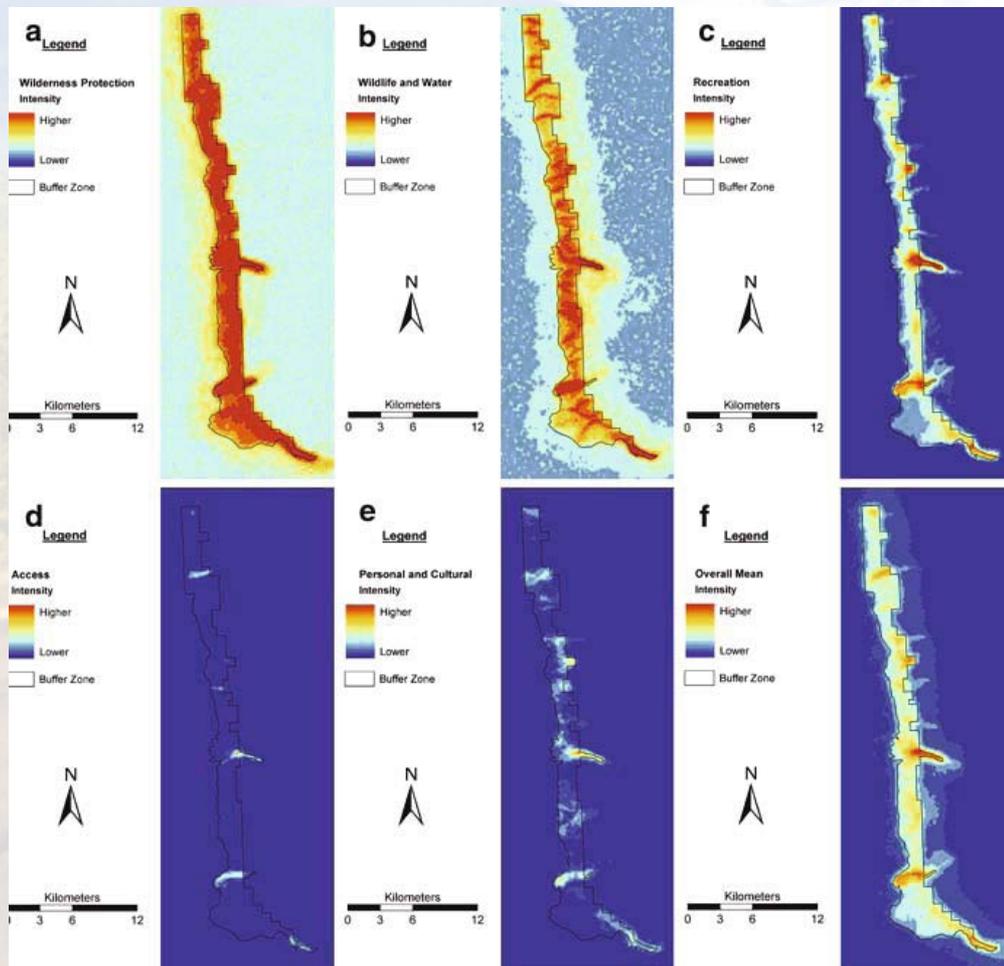


Write about these areas:

2. Type in why these areas are important

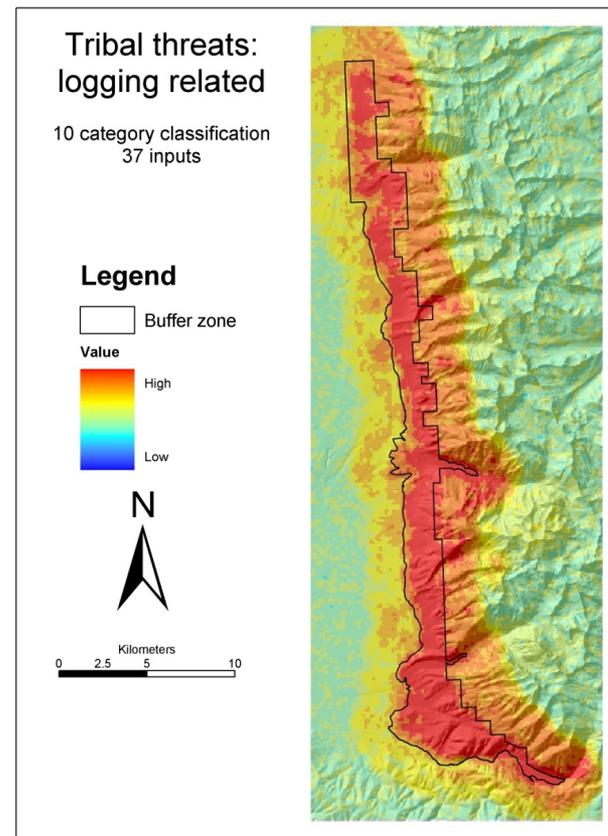
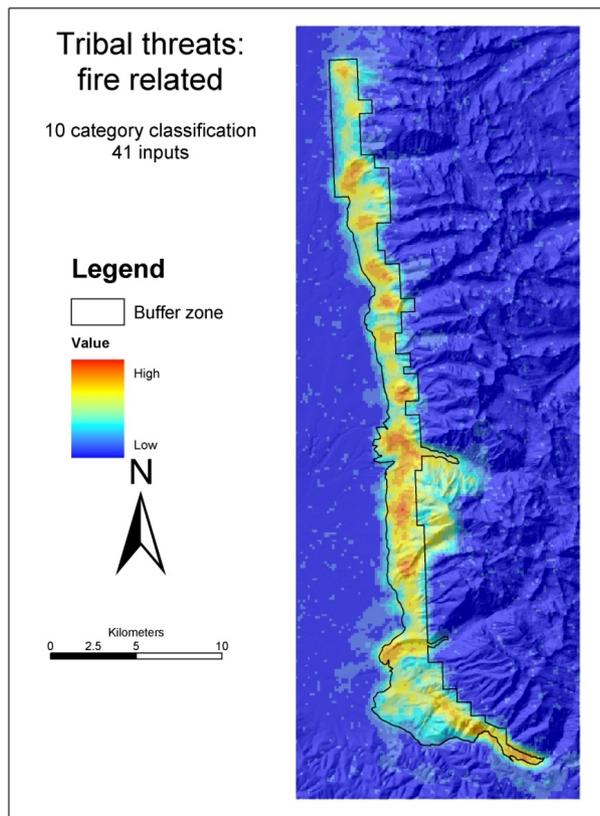
3. What are the threats to these areas?

Heat maps by themes



- 34 participants created spray patterns for each of the 5 themes.
- A composite map of all responses was also created.

Threats perceived by tribal members



- Perceived threats from fire are spatially heterogeneous but widely distributed.
- Perceived threats from logging are stationary, more intense and more broadly distributed.

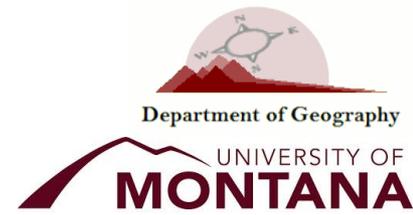
Implications for management



- If managers can work with tribal members to manage trade-offs and establish acceptable limits, appropriate management initiatives can move forward.

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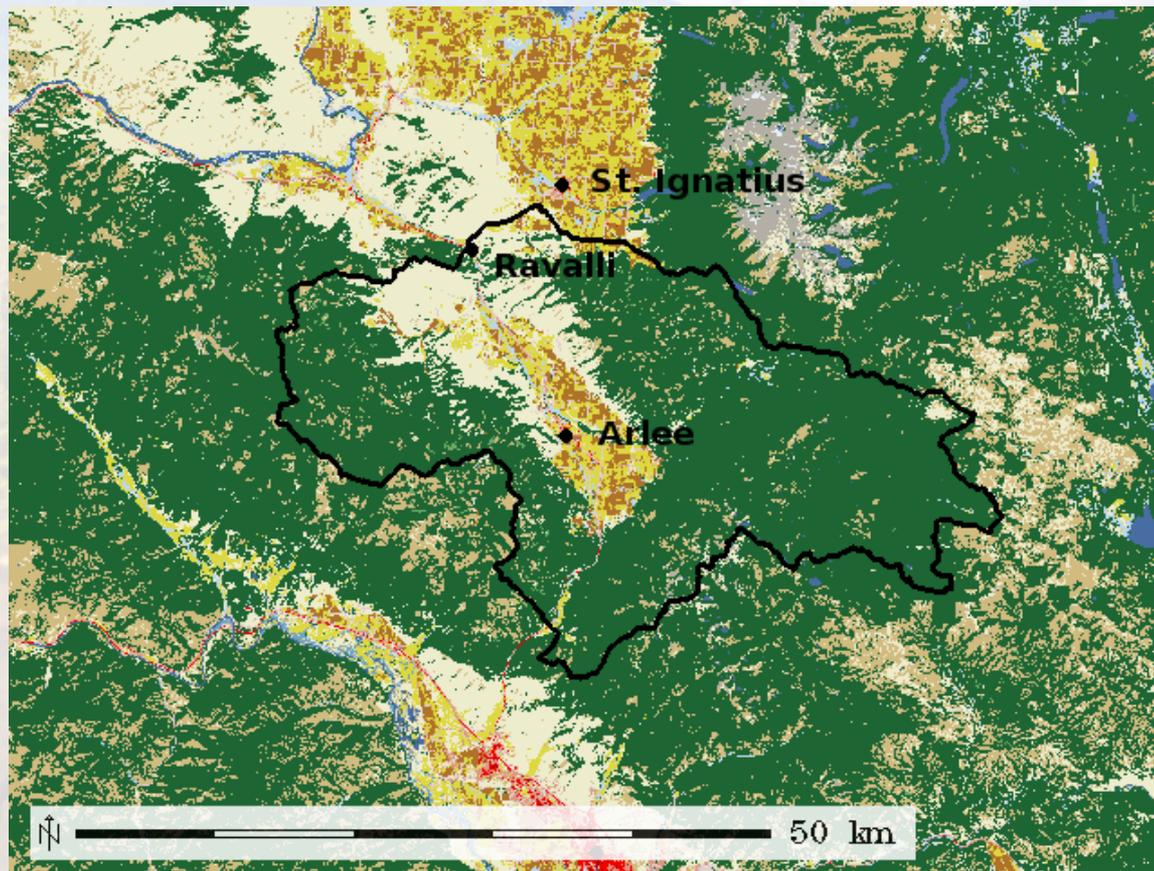
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The Jocko Landscape Unit



The Jocko landscape unit

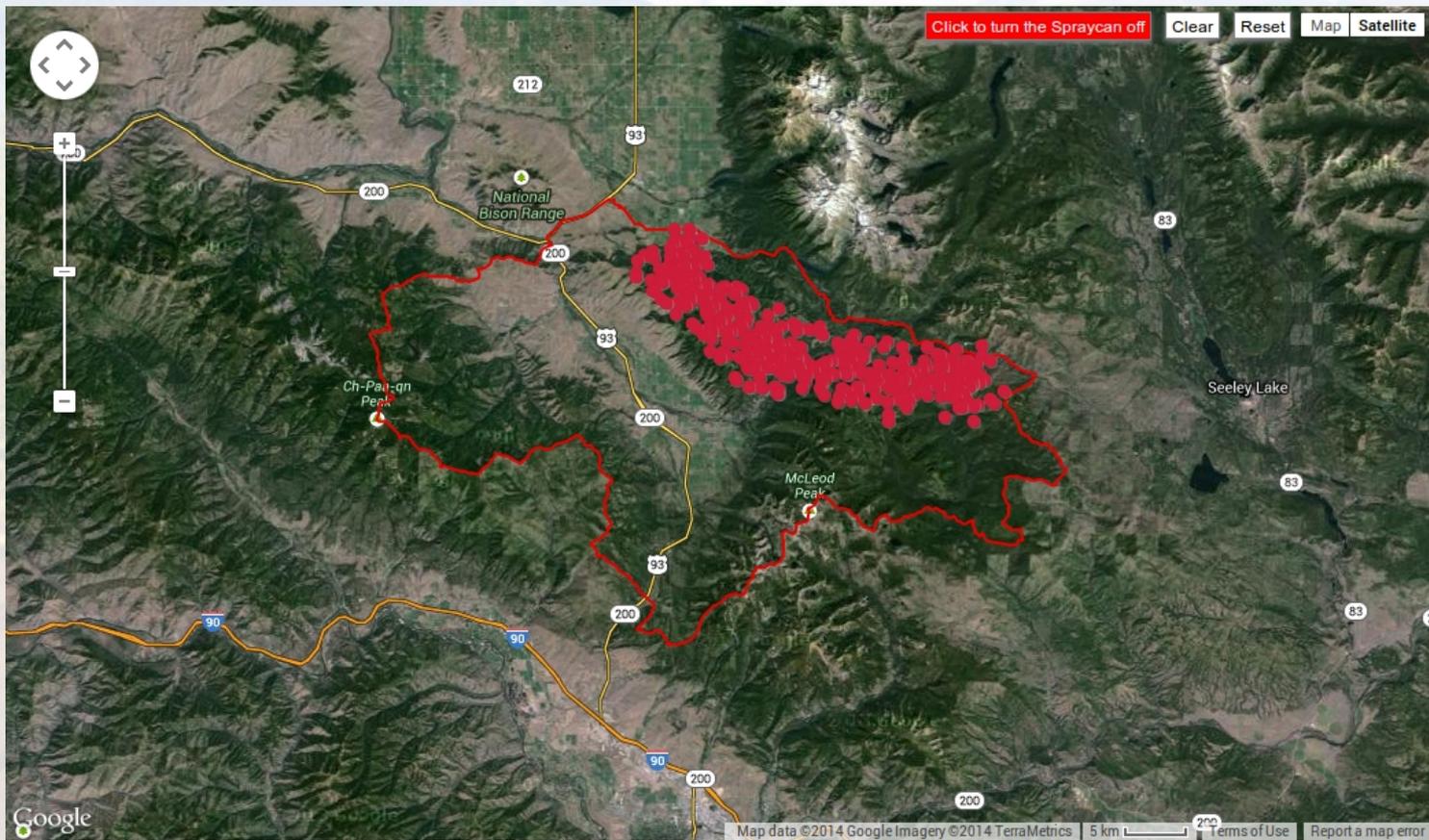


- Southernmost unit on the Reservation.
- ~ 700 people (CDP's of Arlee and Ravalli).
- Mostly ranges and woodlands surrounding the valley of the Jocko River.

Objectives

- Determine perceived climate change impacts to resources in the Jocko landscape unit, by incorporating knowledge and opinions of residents and natural resource managers.
- Analyze output to illustrate both cultural and biophysical attributes of the landscape based on participants' responses.

Map-Me PPGIS survey



Click to turn the Spraycan off Clear Reset Map Satellite

The area outlined in red is the Jocko Landscape. Please indicate an area that you believe has changed over the years.

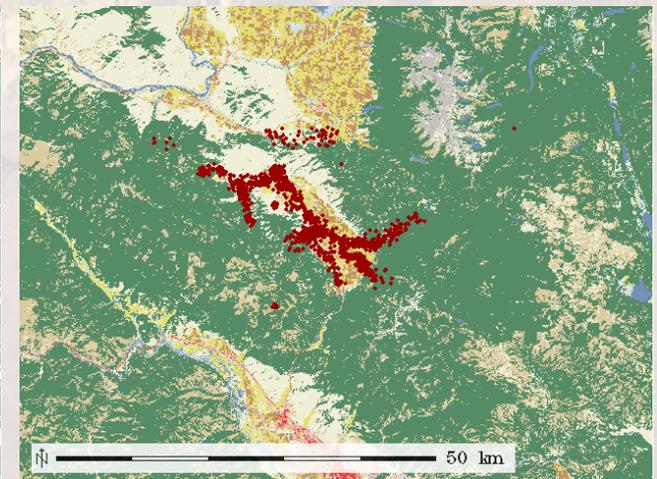
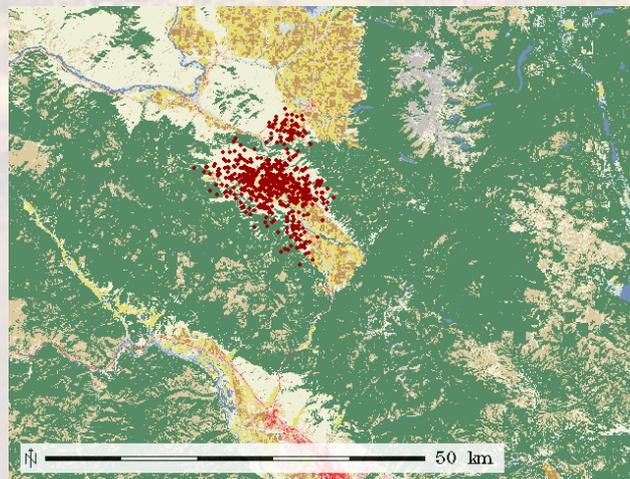
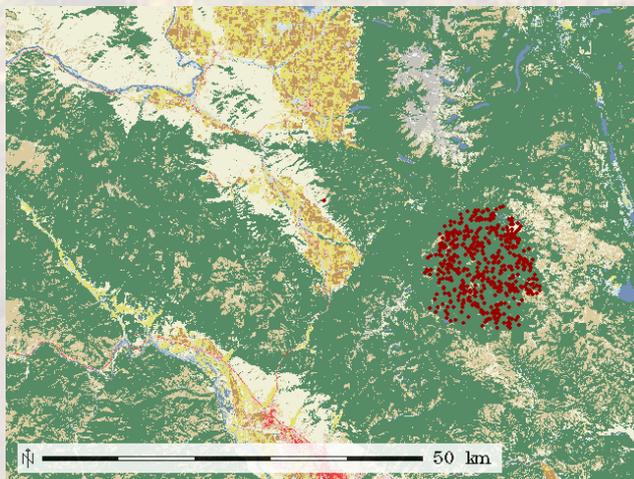
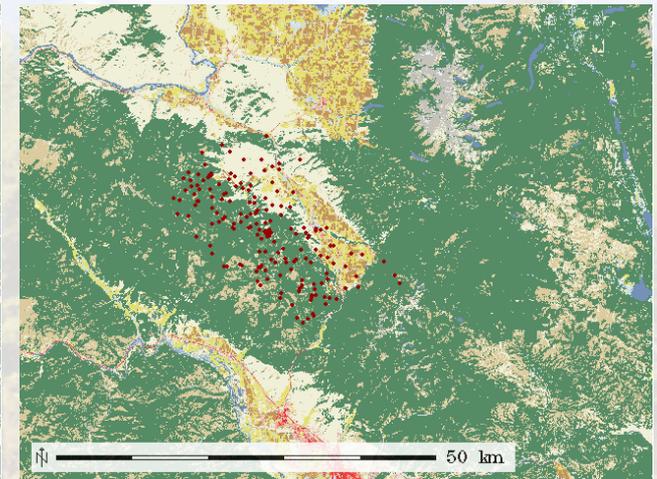
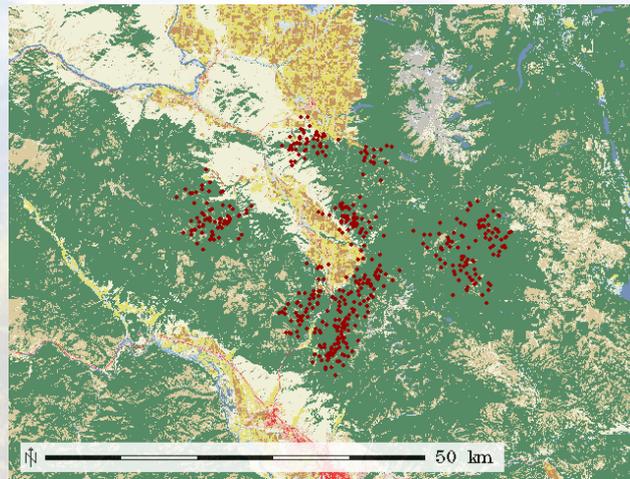
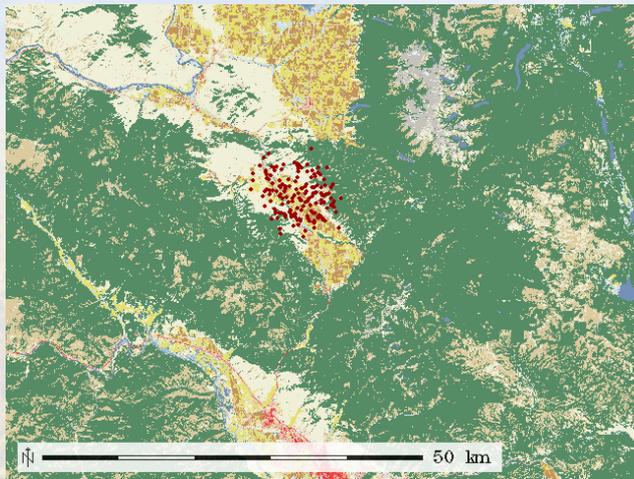
What did this area used to be like and what is the source of your knowledge?

What is the area like now and what do you believe has caused the change from what it used to be like?

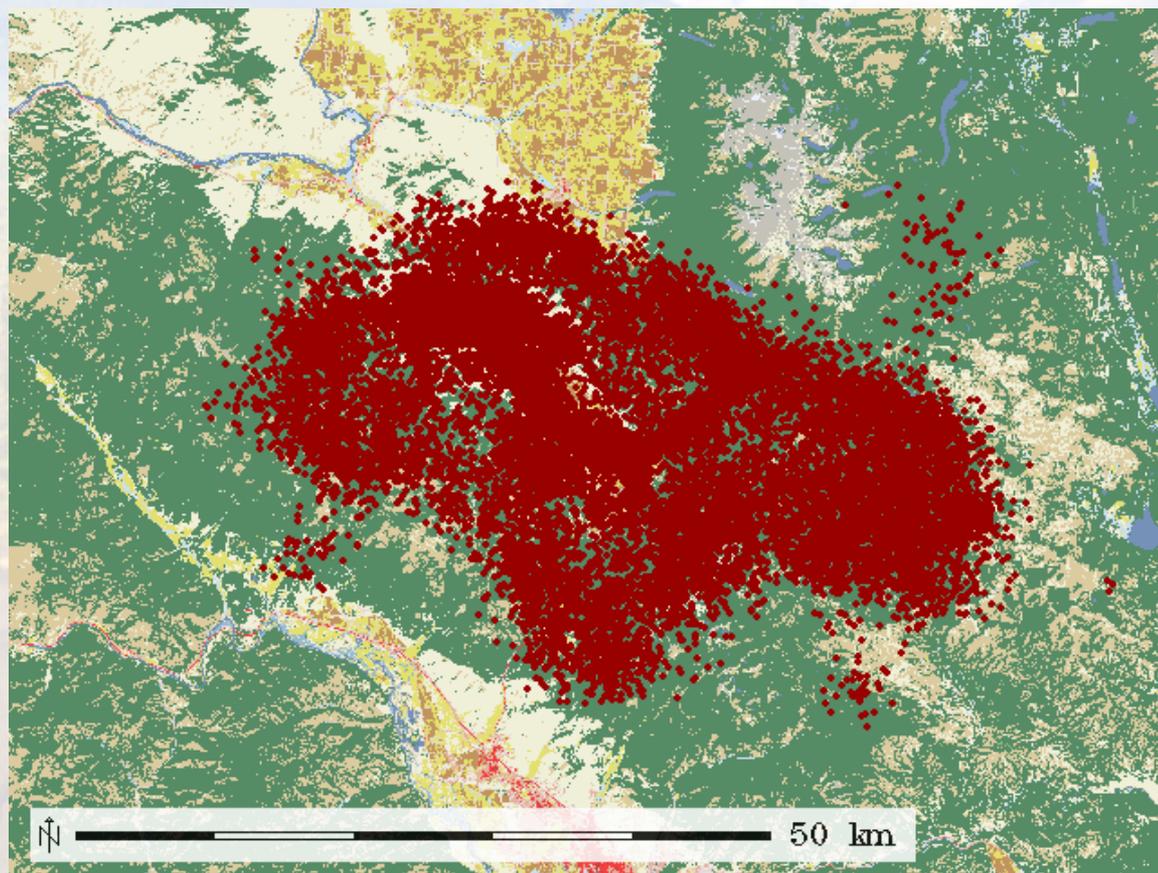
What would you like this area to be like in the future and why?

Google
Map data ©2014 Google Imagery ©2014 TerraMetrics | 5 km | Terms of Use | Report a map error

Spray patterns locating environmental changes in the last decades (some individual responses)

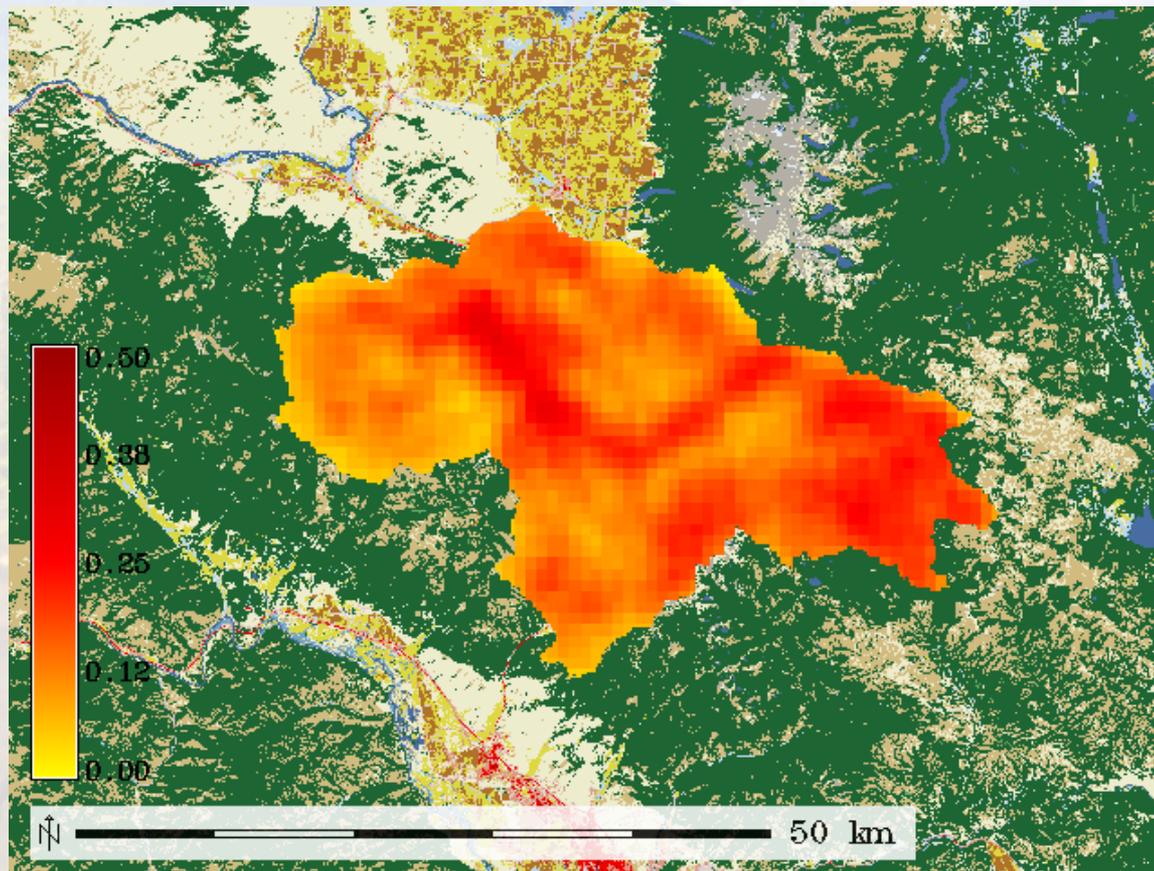


Spray patterns locating environmental changes in the last decades (all)



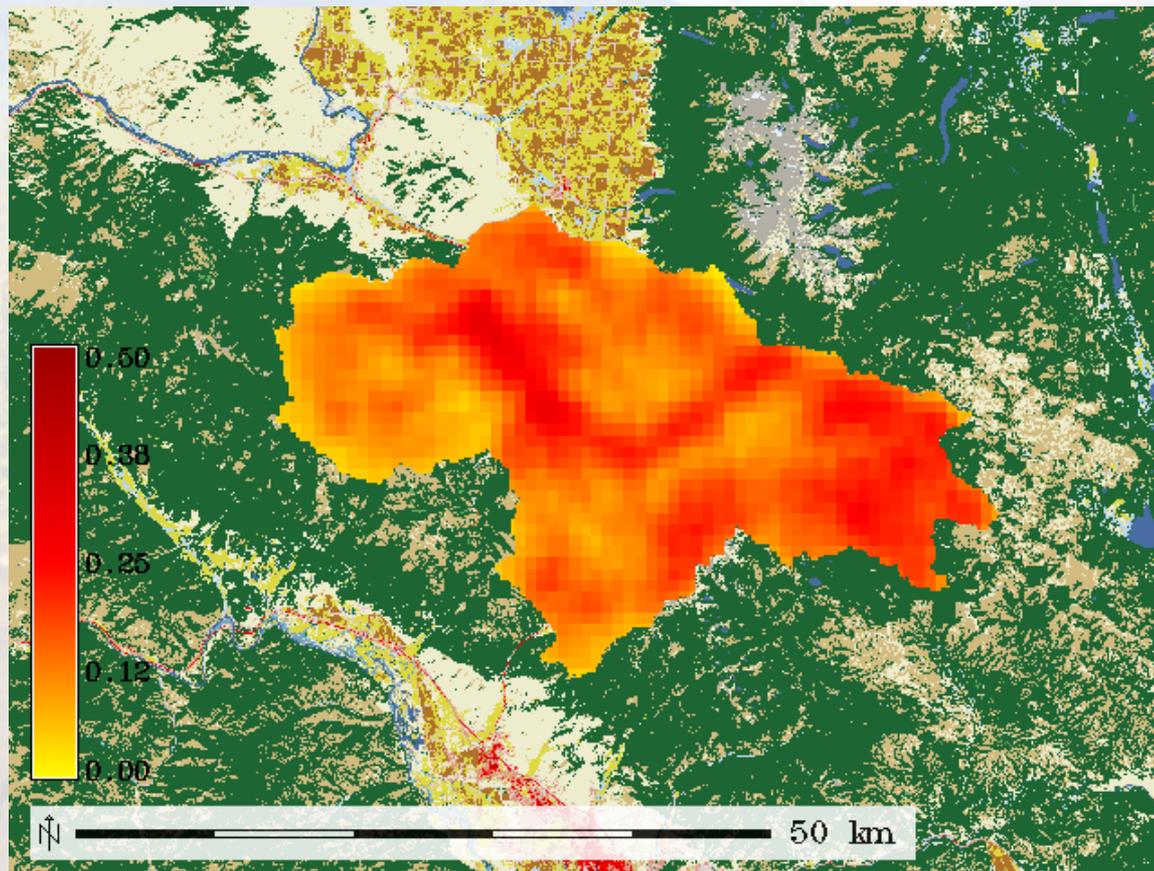
- More than 20,000 single blobs.
- 40 comments providing details about specific environmental changes.
- 29 spray patterns (so 11 comments were given without locations being tagged).

How frequently in the survey is every location tagged as a place that has undergone recent environmental changes?



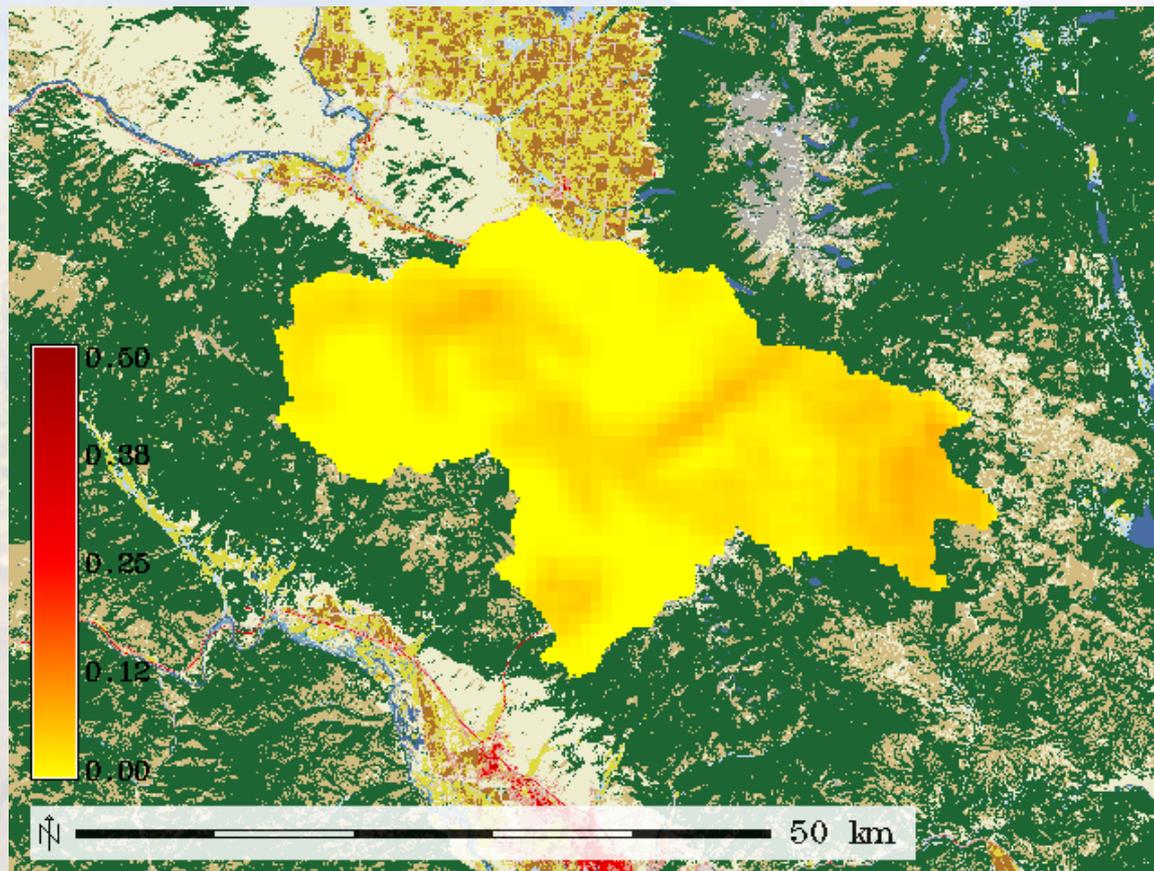
- Cell value = Number of overlapping spray patterns / Total number of spray patterns.
- Maximum number of overlapping spray patterns in a given location is 36 % of total number of spray patterns.

How frequently in the survey is every location tagged as a place that has undergone recent environmental changes?



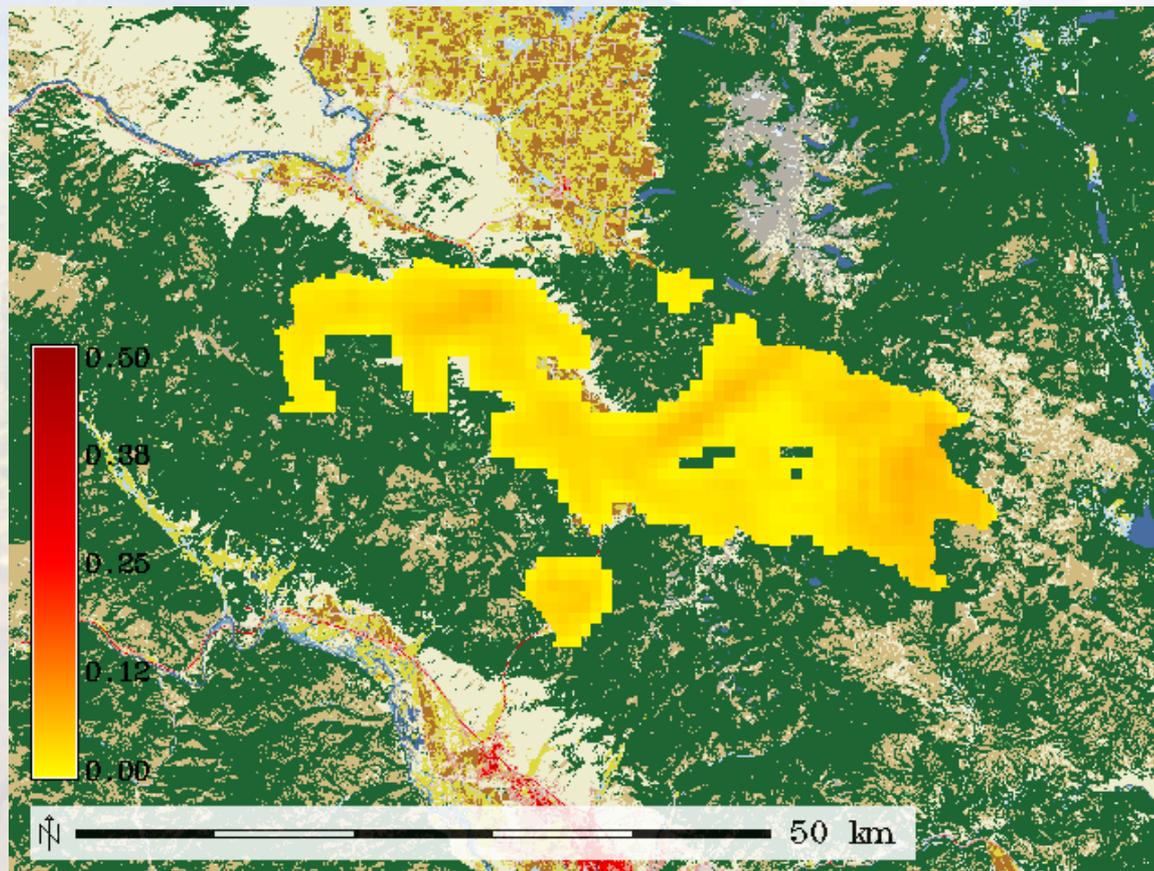
- Places where interviewees agree in having observed changes concentrate along the Jocko river and in the primitive area of the Mission Mountains.

How frequently do tagged places have comments supporting *in situ* use of prescribed fire?



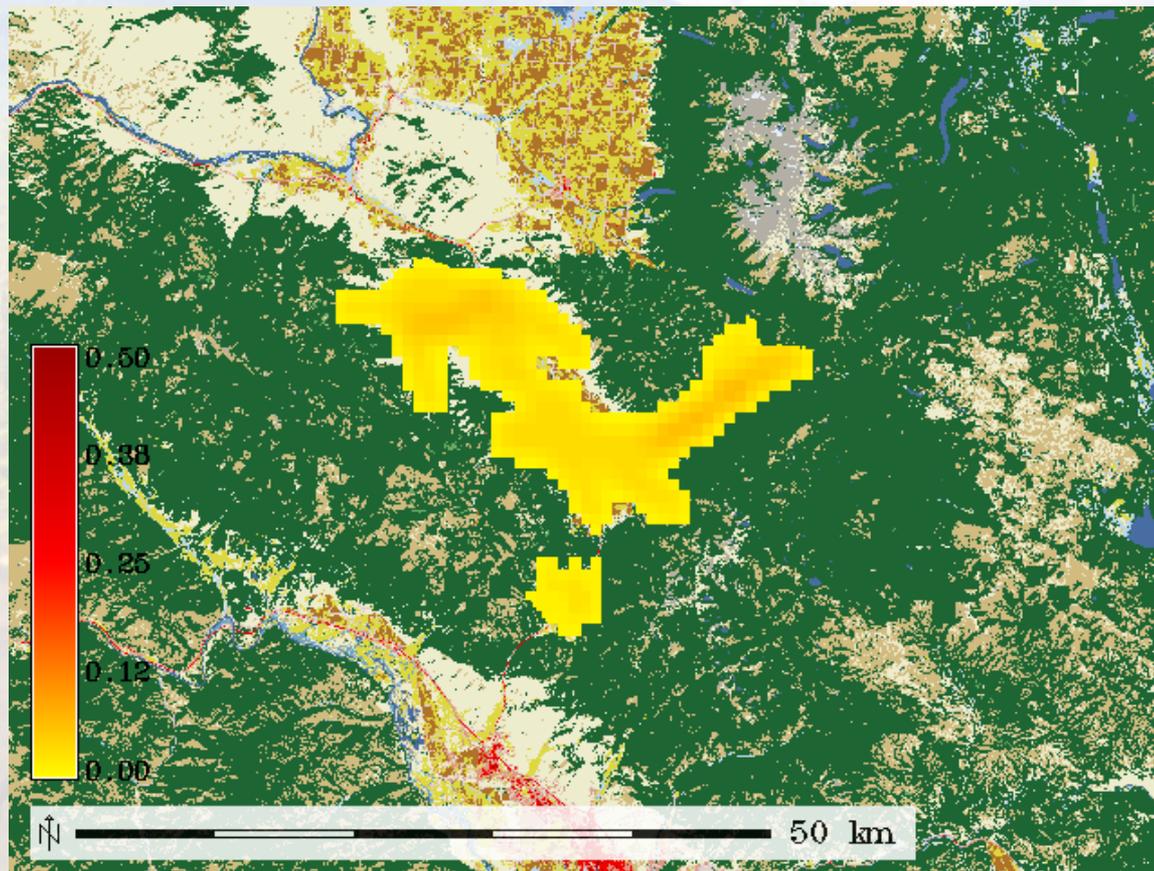
- 31 % of spray patterns support the use of prescribed fire in tagged spots.
- Maximum number of overlapping spray patterns in a given location is 12 % of all spray patterns.

How frequently do tagged places have comments supporting *in situ* use of prescribed fire? (frequency > 0)



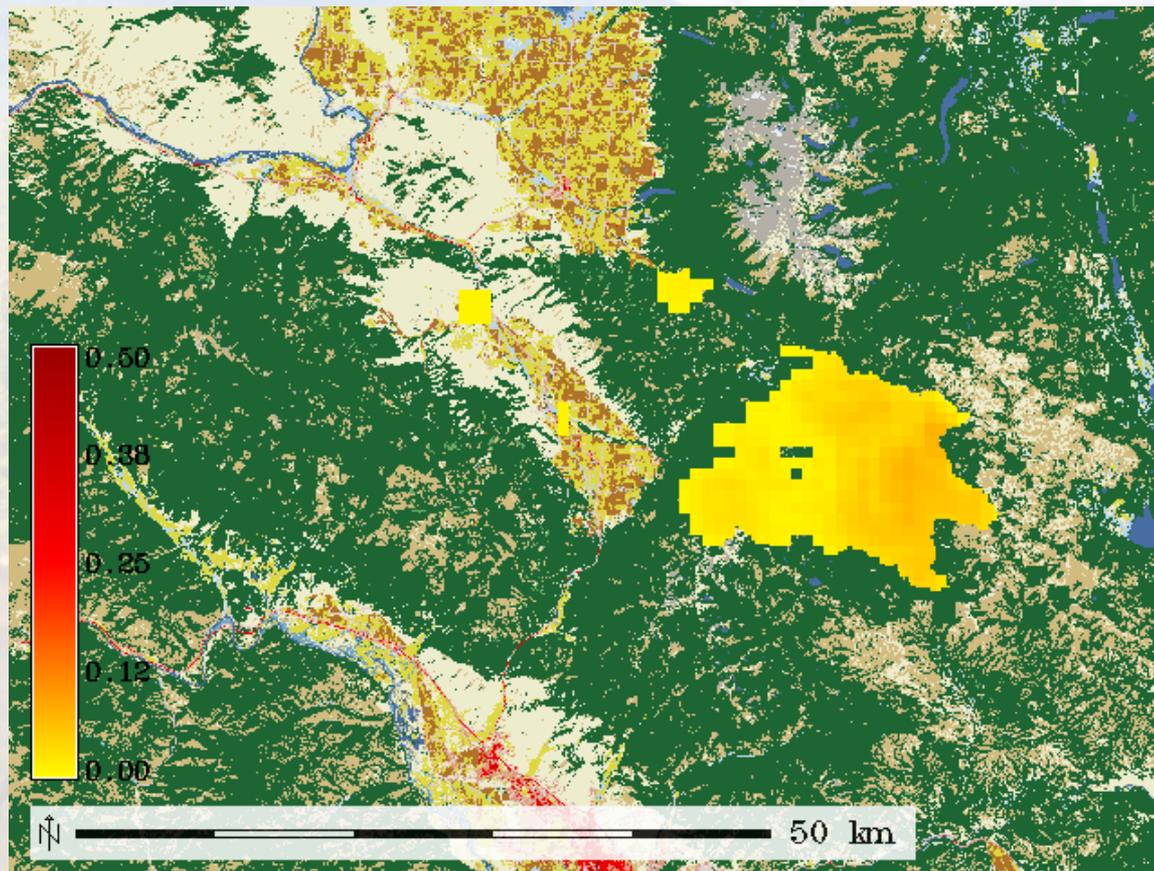
- 31 % of spray patterns support the use of prescribed fire in tagged spots.
- Maximum number of overlapping spray patterns in a given location is 12 % of all spray patterns.

How frequently do tagged places have comments supporting *in situ* use of prescribed fire? (non tribal)



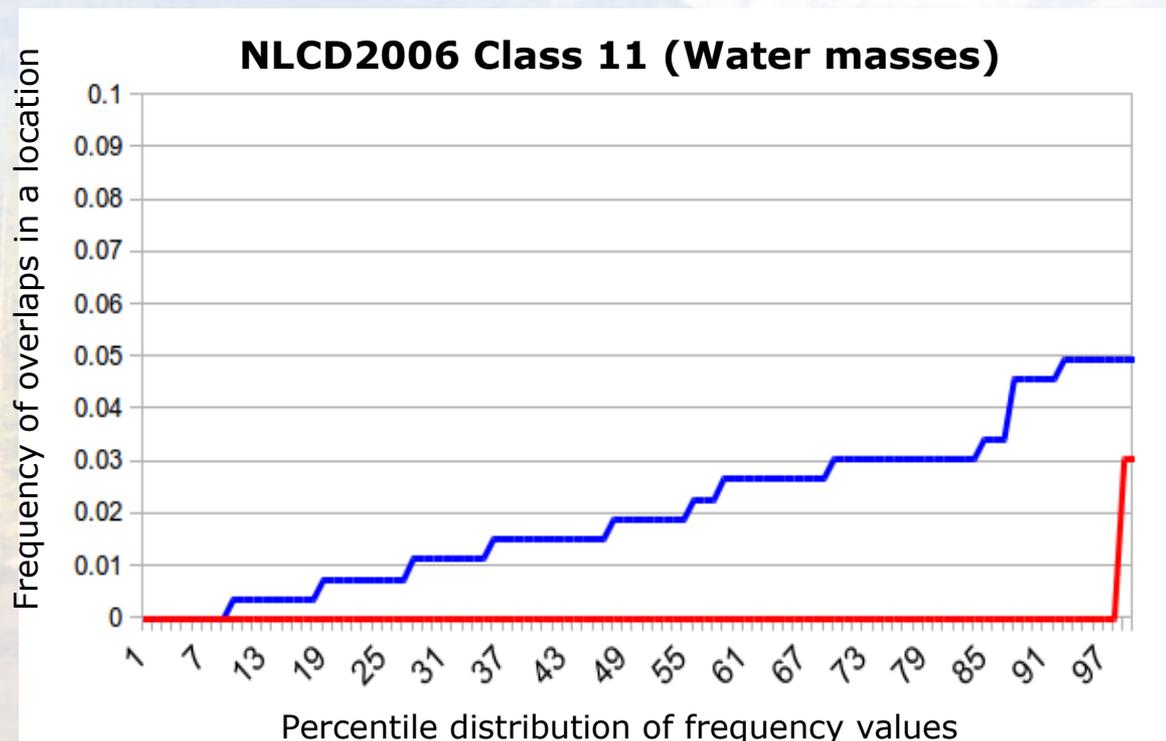
- Spots most frequently tagged by non-tribal people concentrate along the Middle Jocko and in herbaceous lands between the basin and higher woodlands.

How frequently do tagged places have comments supporting *in situ* use of prescribed fire? (tribal)



- Spots most frequently tagged by tribal members concentrate in the mountain woodlands and summits of the eastern primitive area.

What is the spatial association between support of prescribed fire and land-use classes?

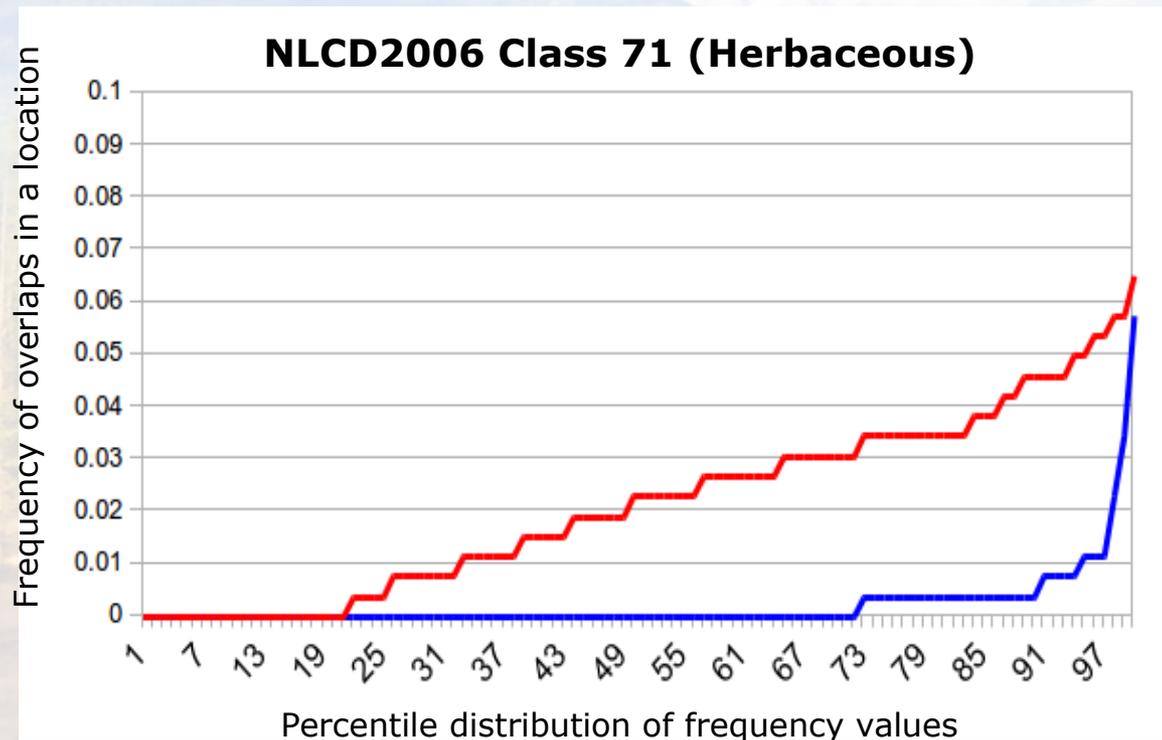


The frequency of respondents tagging this land-cover class rises regularly among tribal members, being negligible among non-tribal people.

Red: non-tribal members

Blue: tribal members

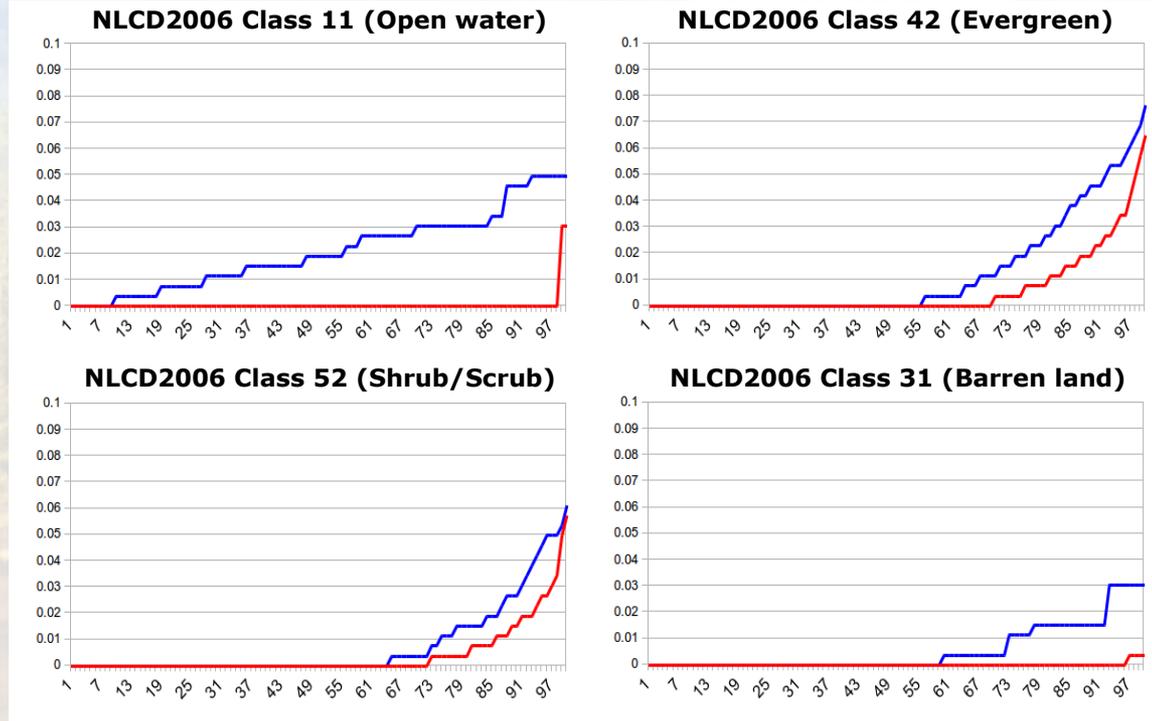
What is the spatial association between support of prescribed fire and land-use classes?



Red: non-tribal members
Blue: tribal members

The frequency of respondents tagging this land-cover class rises regularly among non-tribal people, being negligible among tribal members.

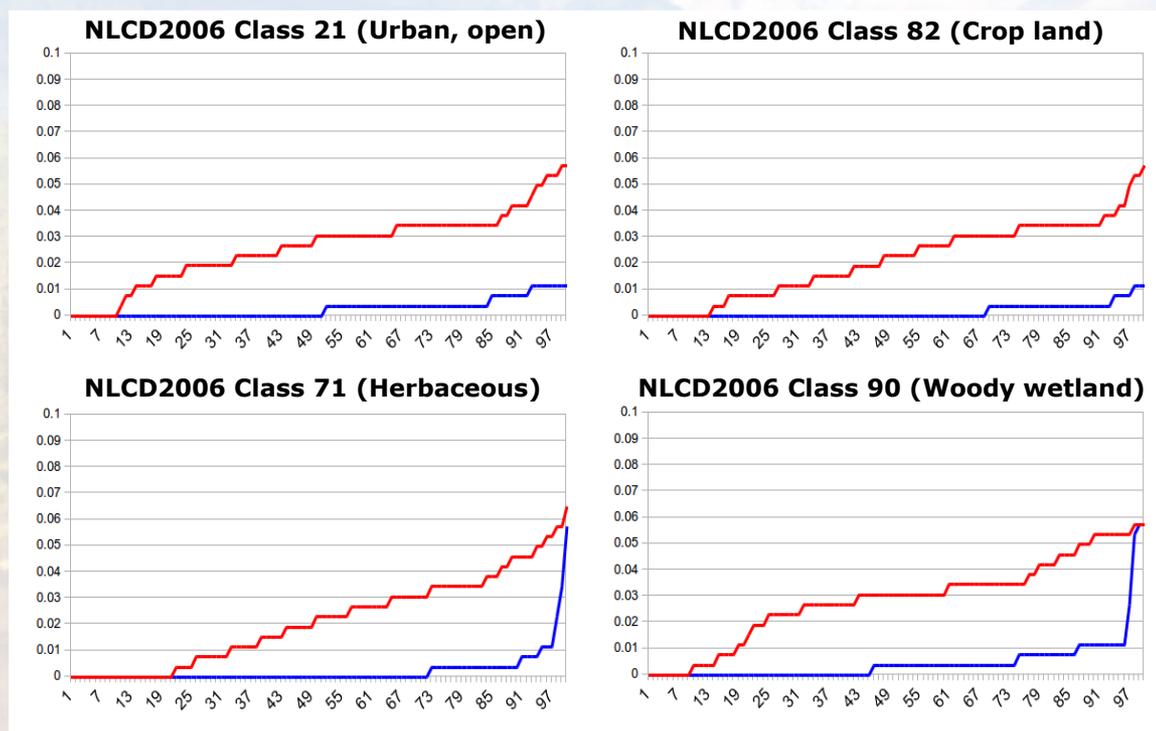
What is the spatial association between support of prescribed fire and land-use classes?



Red: non-tribal members
Blue: tribal members

Most tagged land-cover classes among tribal members are mountain lake spots, evergreen forest, scrub land and moors.

What is the spatial association between support of prescribed fire and land-use classes?



Most tagged land-cover classes among non-tribal people are open spots in developed areas, woody crops, pastures and woody wetlands along the Jocko.

Red: non-tribal members
Blue: tribal members

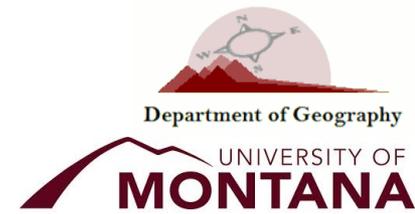
Next steps

What is the probability of these spatial associations with specific land-use classes to be the product of chance?

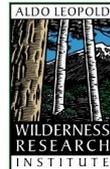
- Testing of randomness hypotheses with:
 - Simulation of random spray patterns.
 - Bootstrapping (reshuffling the allocation of spray patterns to interviewees).
- Analysis of candidate covariates other than land cover (e.g. evolution of fire regimes, land status).
- Testing of substratum effects on the geometry of the spray patterns by spatially-aware regression models.

GIS Guest Lectures

Public Participation GIS in environmental research and planning



Thank you



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