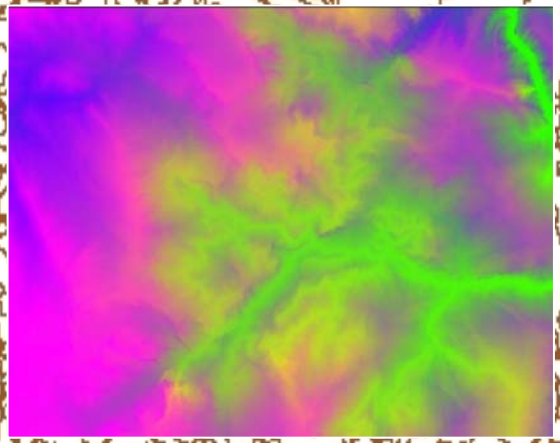
The Ecological Impacts of Roads and Traffic



Douglas S. Ouren, USGS, Fort Collins Science Center

Raymond D. Watts, USGS RMG Science Center

Overview

- Wildlife responds to roads, traffic, and humans
- STIMULUS → RESPONSE
- Roads and their physical presence
- Roads and their use
- Ecological effects of roads

Framework for study

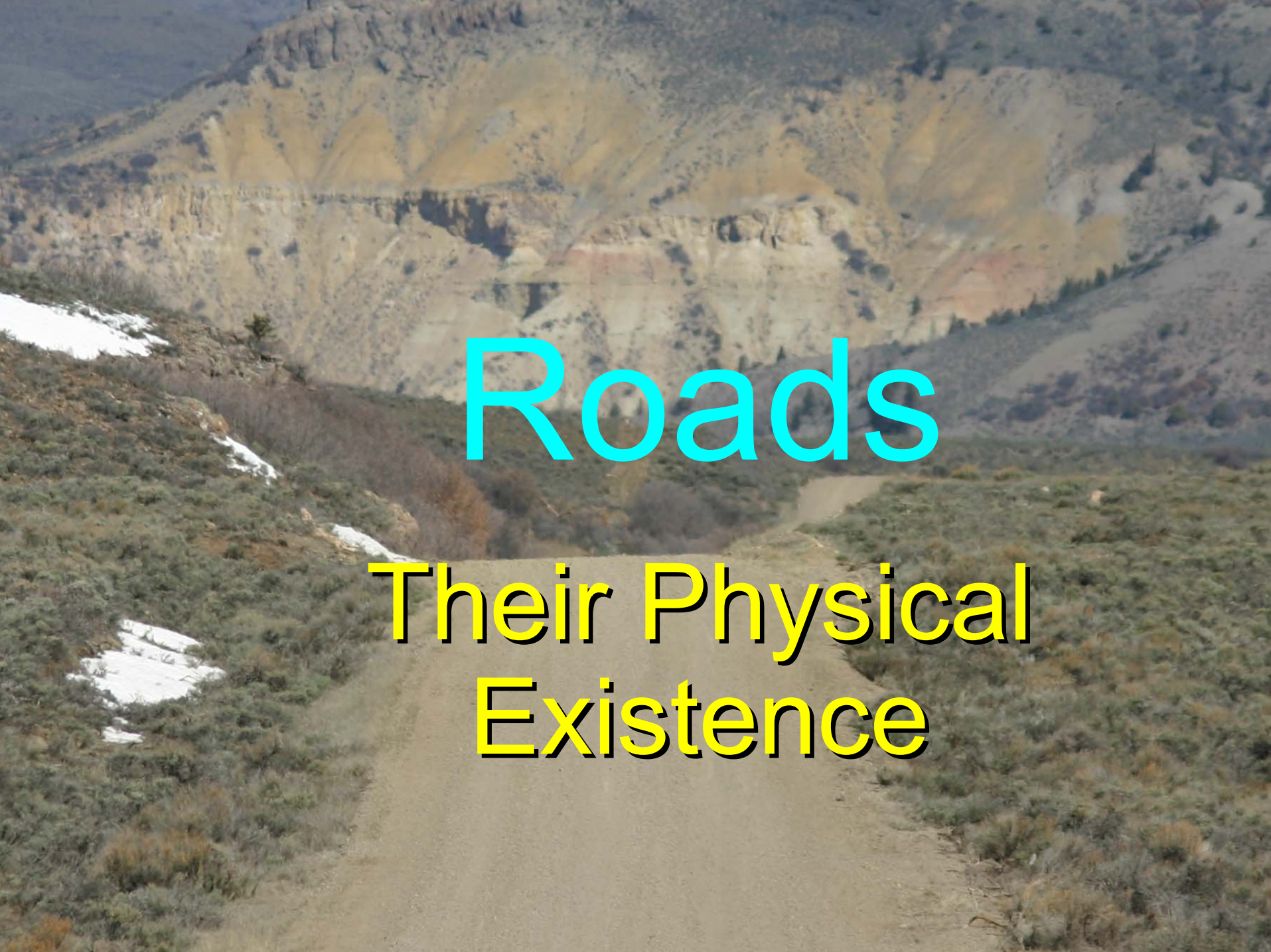
- Wildlife responds to roads, traffic, and humans
- Human presence is enhanced by accessibility (roads, trails, ATV trails, and travel regulations)
- Roads and humans cause other ecological change

Our experience

- Multiple years of monitoring traffic on public lands
- Multiple years of monitoring wildlife movements with GPS technology
- Evaluation of maps and other geographic data; protocols for improving data
- Extension and interpretation of geographic data with GIS modeling
- Work at scales from watershed to national

Our study questions

- What are the best indicators of roads, traffic, and human presence?
- Can we quantify—and then model—environmental responses?
- What are the best observational approaches?
  - Documenting human “footprint”
  - Documenting ecological responses



Roads

Their Physical Existence

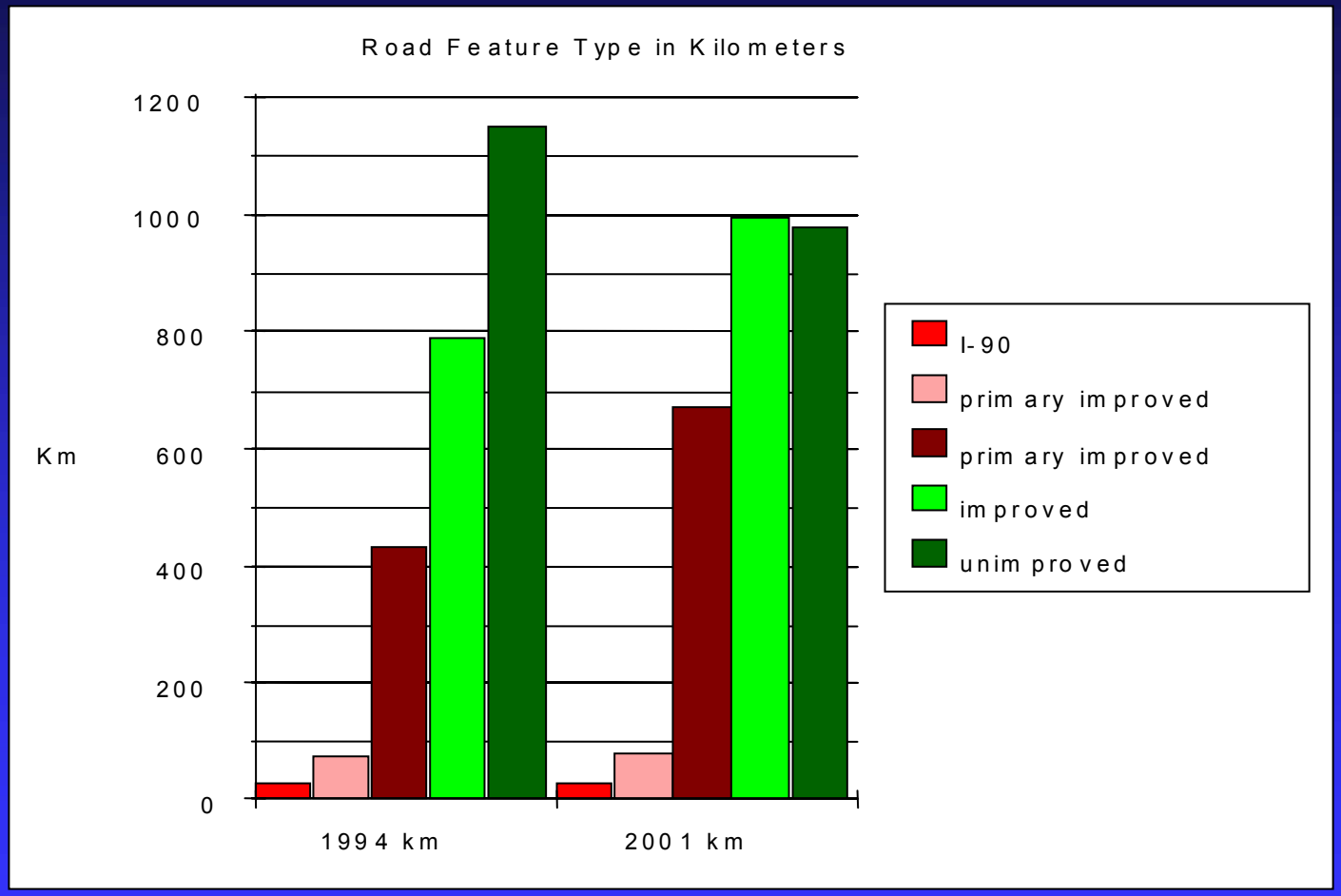
Descriptions of Roads

- Road Networks
- Road Densities
- Distances to Roads

The national picture

- National Overview Road Metrics (NORM)
- Distance to nearest road is completed as first indicator (see poster)
- We work to tie national indicators to local and regional DOI concerns
  - These serve as a reality check
  - At this scale we can actually <u>monitor</u>

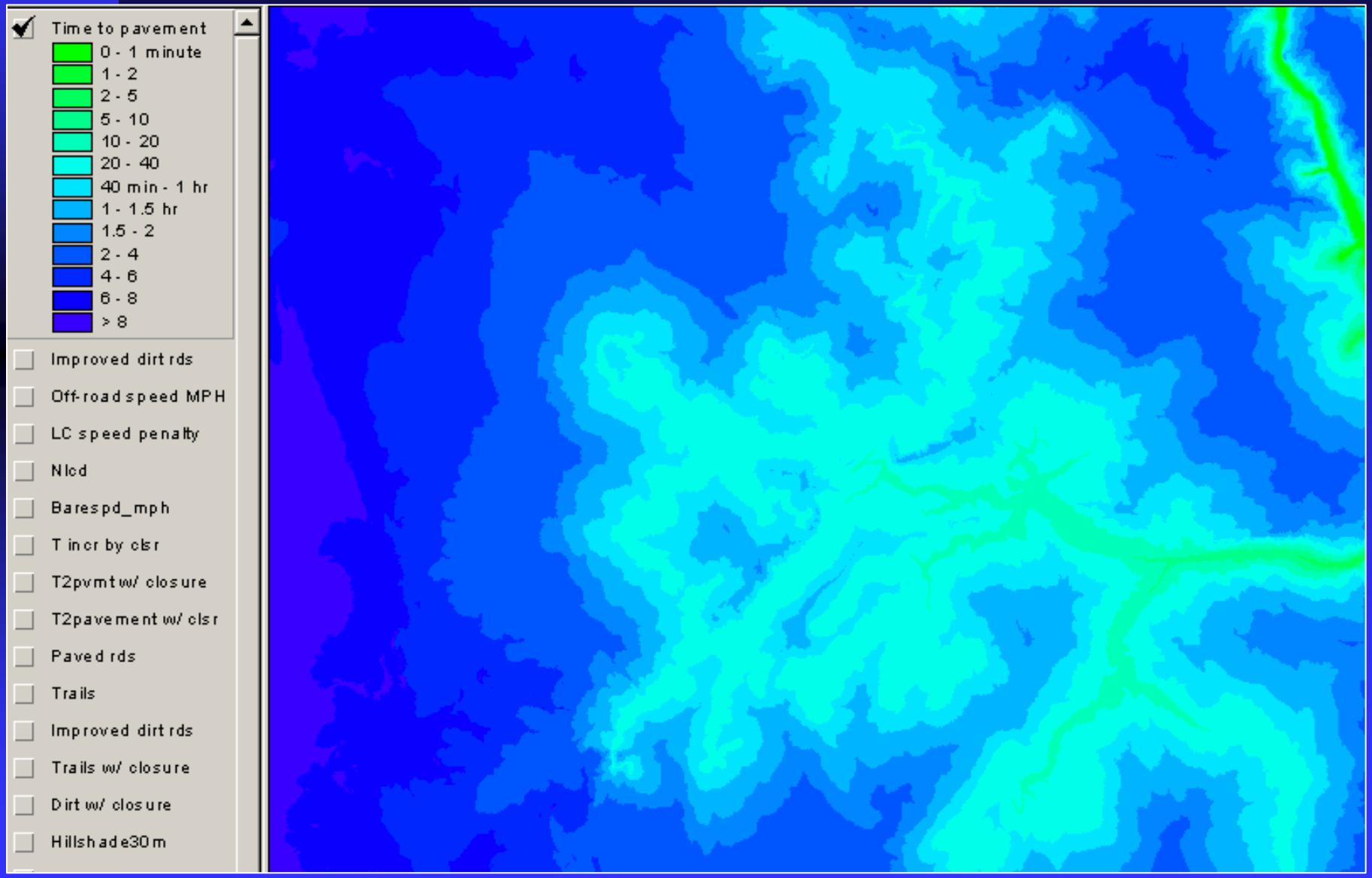
Monitoring of road status Powder River Basin CBM lease area



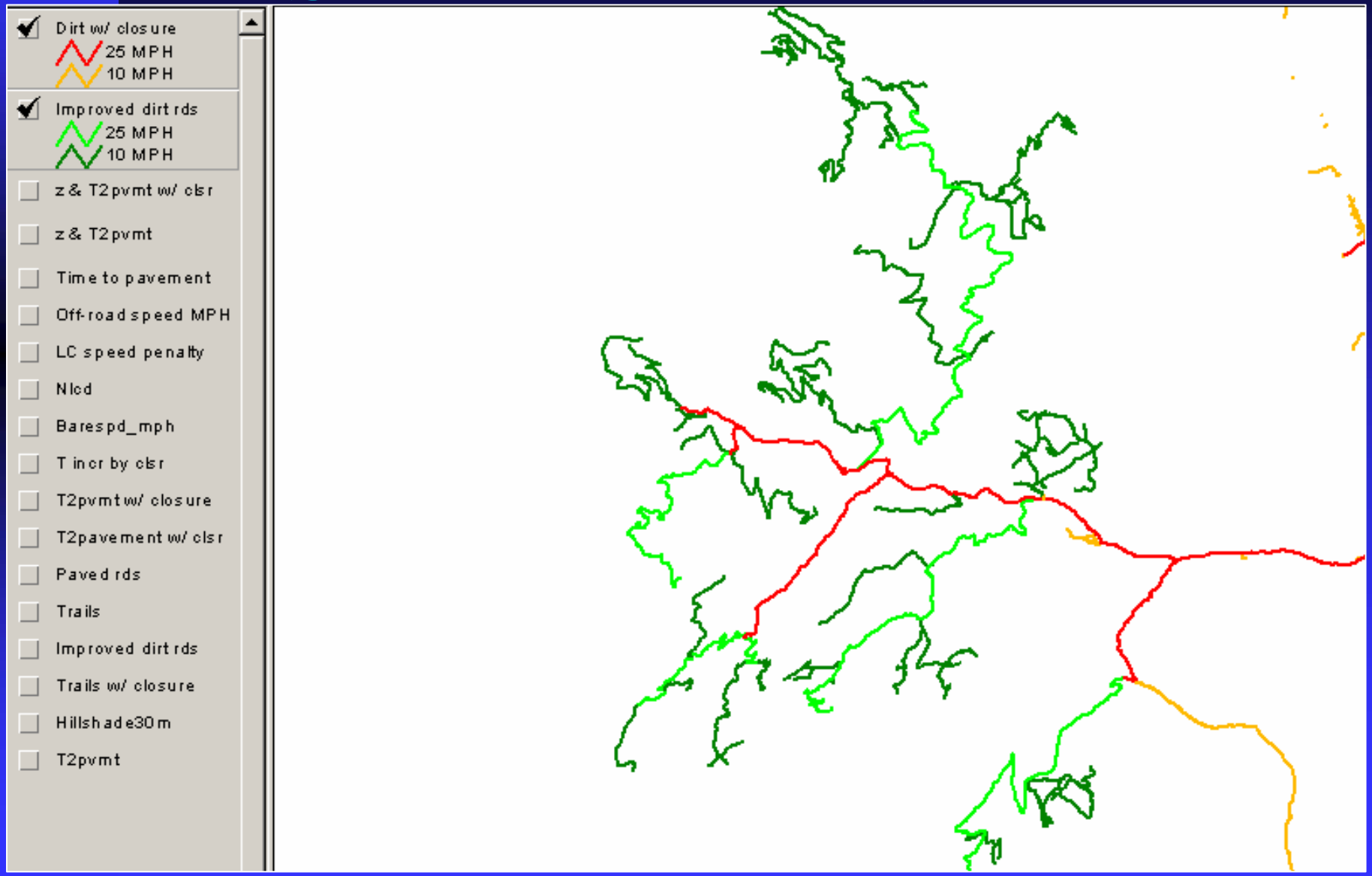
Results from Jamie McBeth, photo interpretation by Roger Compton USGS

Estimated time from pavement

Driving/walking, terrain & land-cover adjusted

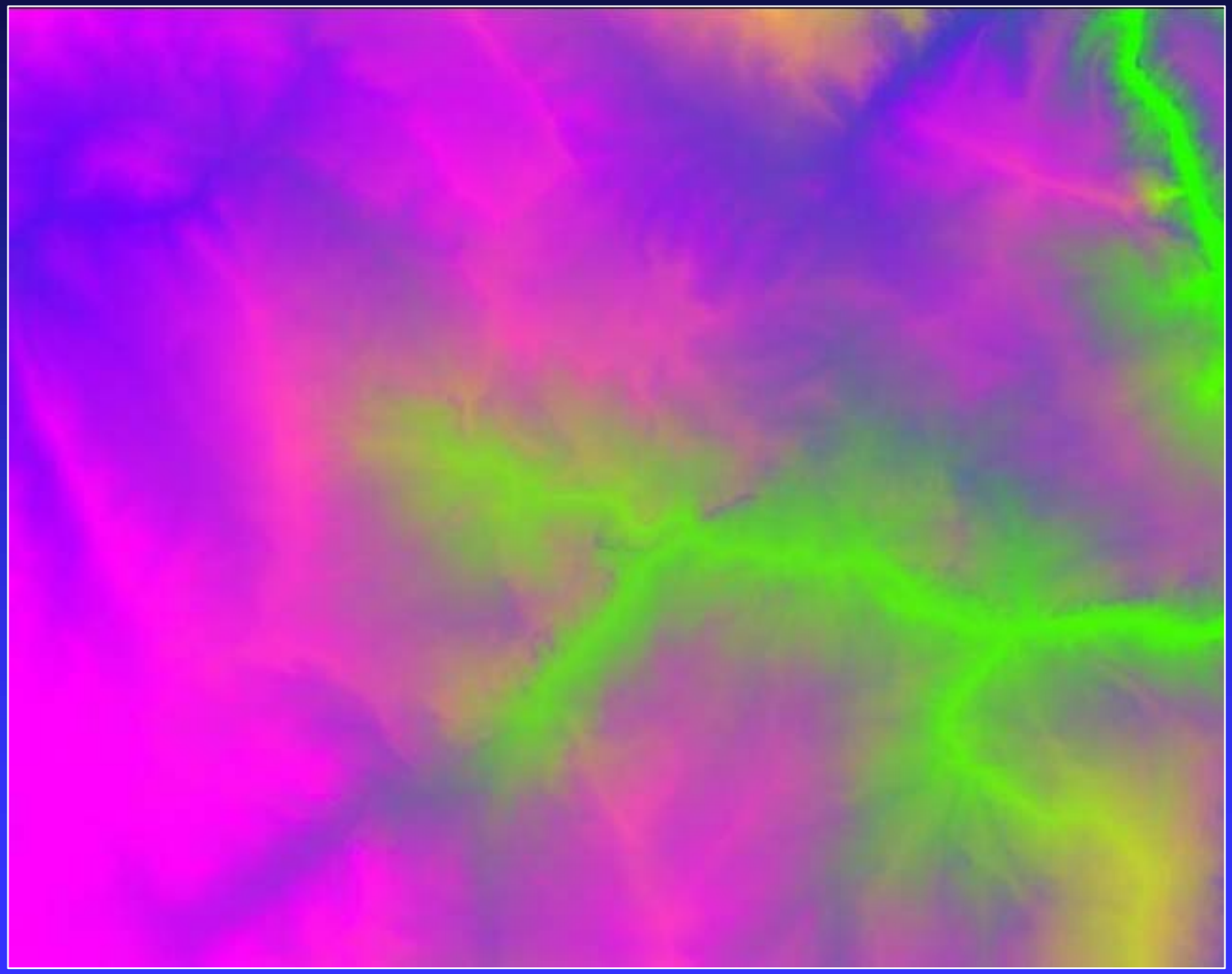


Closing gates
(green roads →trails)

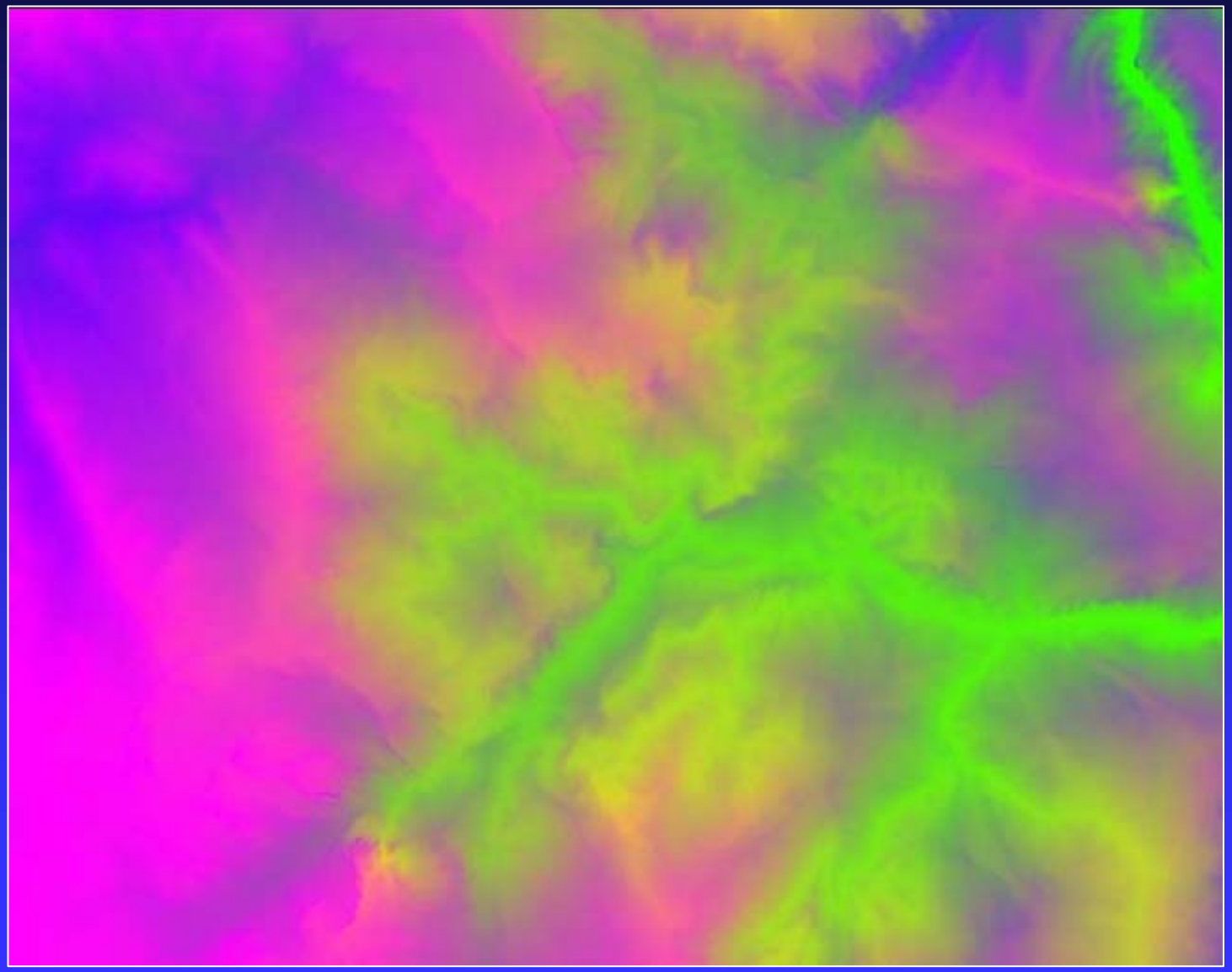


Accessibility & elevation (gates closed)

Green: Low + accessible
Blue: Low + inaccessible
Yellow: High + accessible
Magenta: High + inaccessible



Gates open



What does travel-time mean?

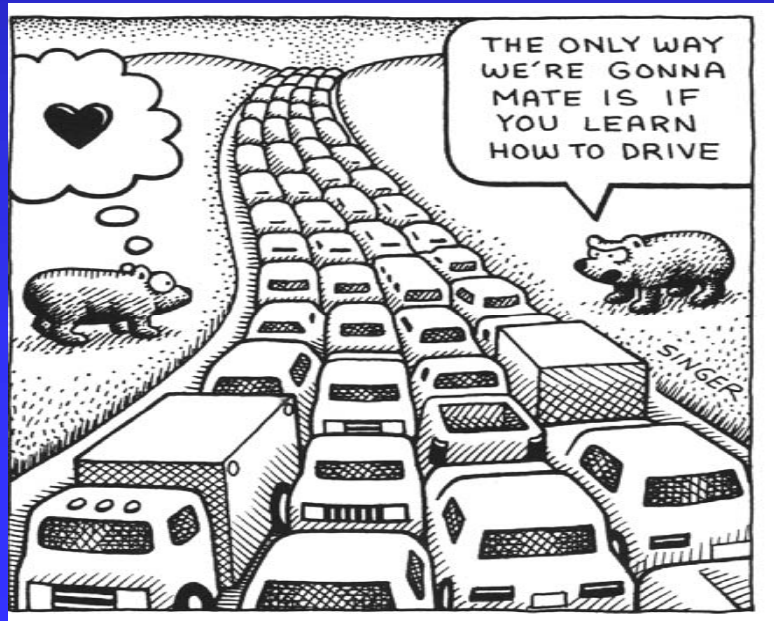
- Are vehicle and pedestrian travel times equivalent?
- Are other travel modes important?
  - (horse, ATV, dirt bike, etc.)
- Is there a better metric?
  - (energy expenditure; vehicle-exit correction…)

Roads

Their Use

Ecological Effects of Roads and their Use

- Habitat Fragmentation (Physical and Temporal)
- Introduction and Spread of Invasives
- Air and Water Quality Issues
- Erosion
- Noise
- Genetic Variability



Human-use indicators

- Open road density
- Numbers of vehicles
- Domestic livestock grazing permits
- Trail head counts
- Campground occupancy

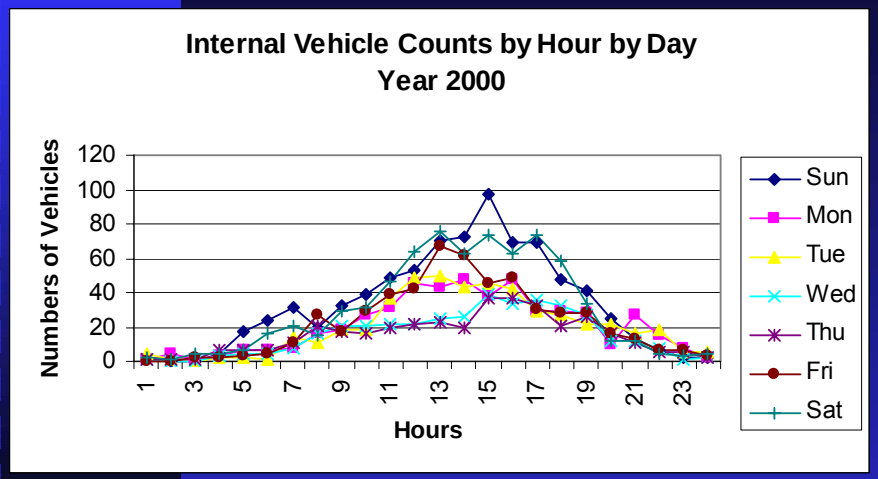
Road Use

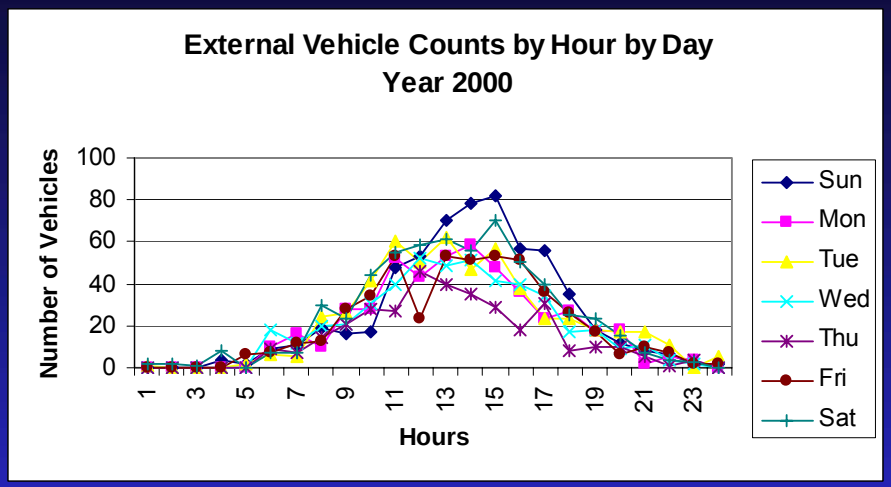
- Monitoring of Motorized Vehicle Use
  - Time of Day
  - Speed
  - Vehicle Type
  - Direction

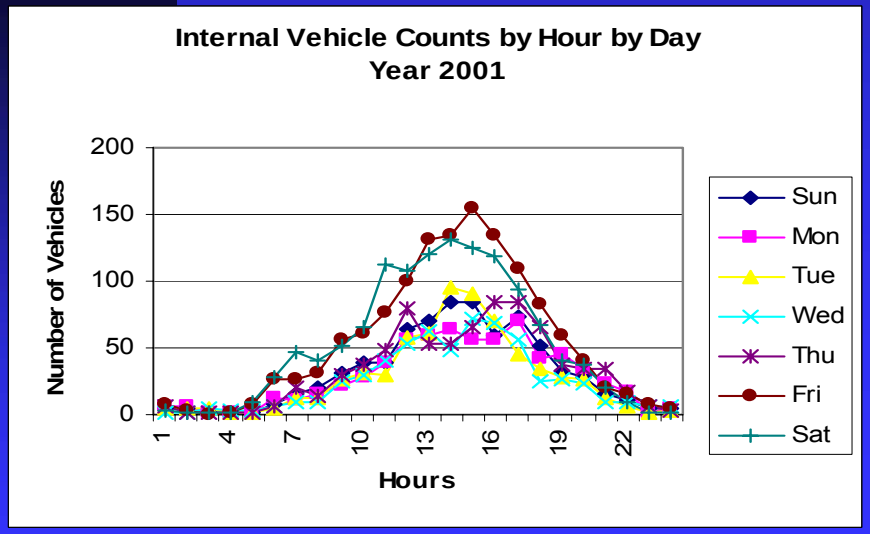
Types of Vehicle Counters

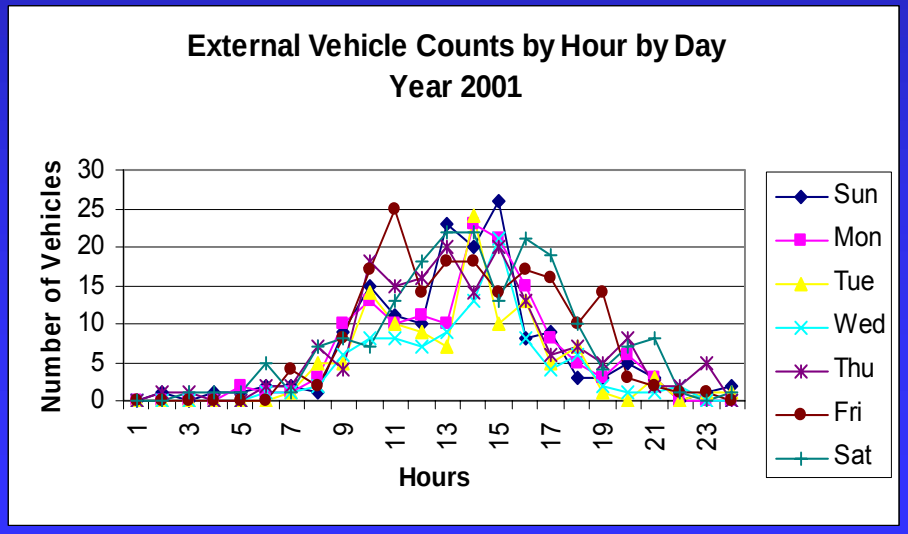
- Pneumatic
- Infrared
- Magnetic
- Seismic

Vehicle Counts by Hour by Day

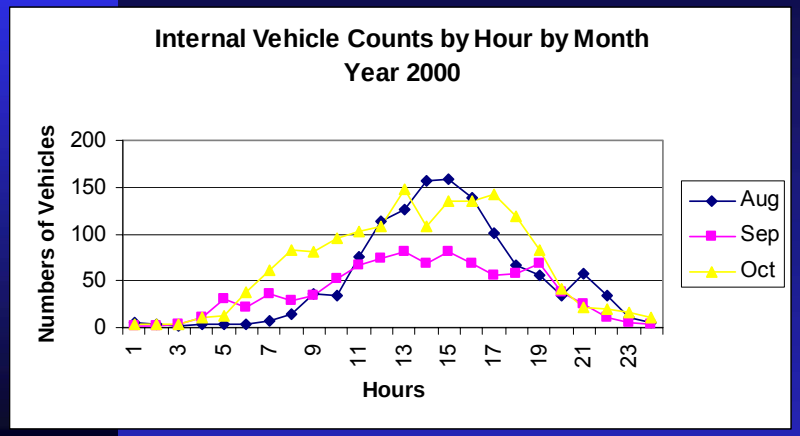


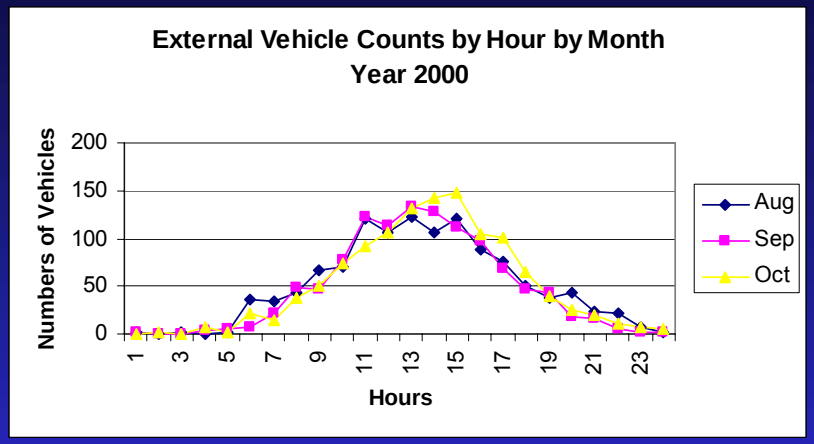


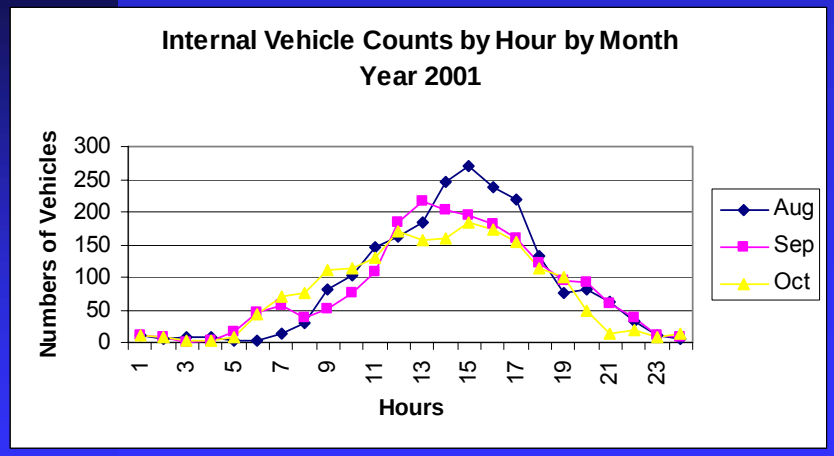


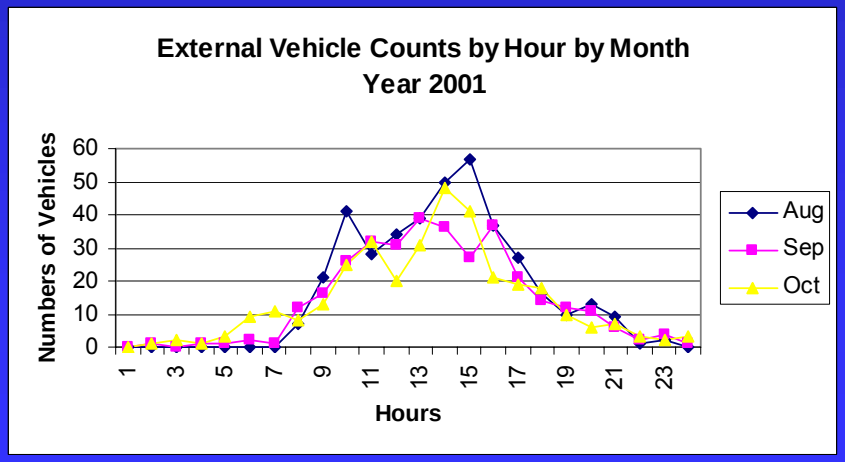


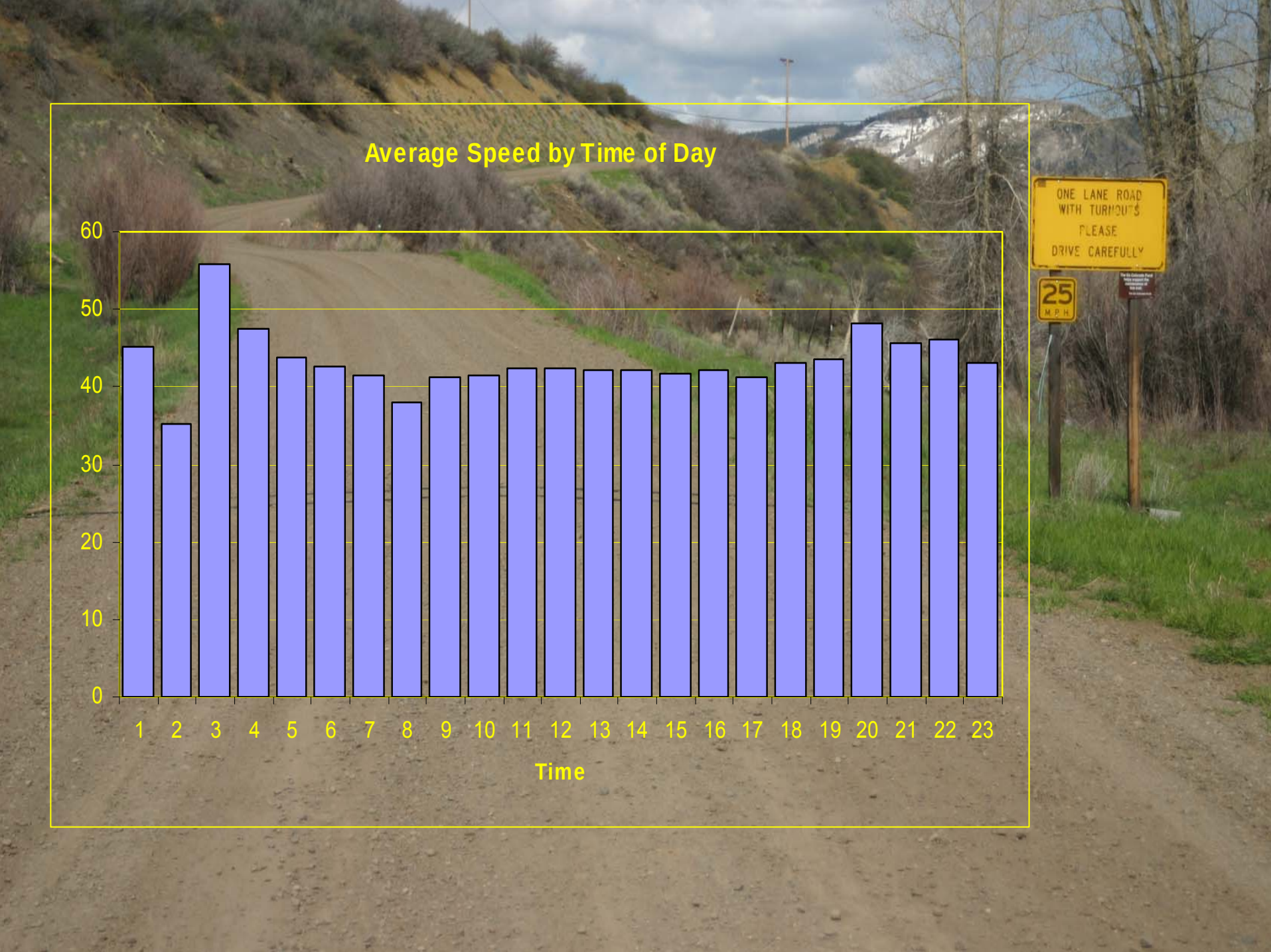
Vehicle Counts by Hour by Month







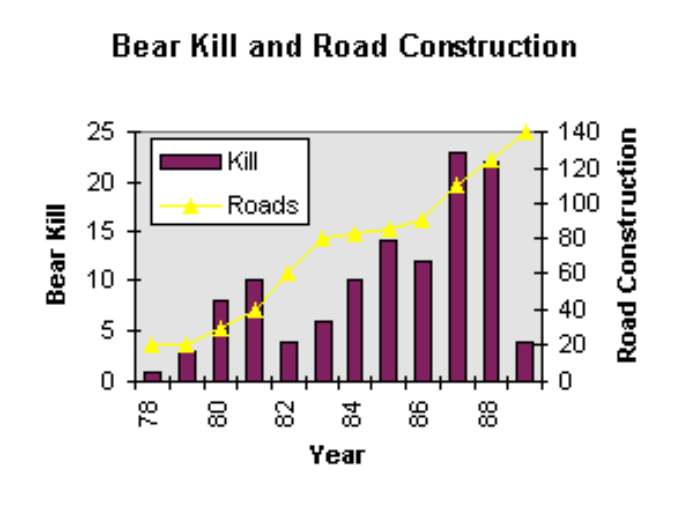



Average Speed by Time of Day
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
ONE LANE ROAD
WITH TURNOUTS
PLEASE
DRIVE CAREFULLY
25
M.P.H.

Effects of Roads and their use on Wildlife habitat selection…

Effects of Roads and their use on Wildlife habitat selection…

- Effects of the Physical presence of roads
- Effects of road use at various temporal scales
- Effects of Road Construction
- Simultaneous Monitorin



GPS vs VHF

GPS Advantages

- All-weather, round-the-clock data collection
- Fewer over-flights
- Programmable duty cycles
- Lower cost per location
- Way more locations

GPS Disadvantages

- Higher per-unit cost
- New technology

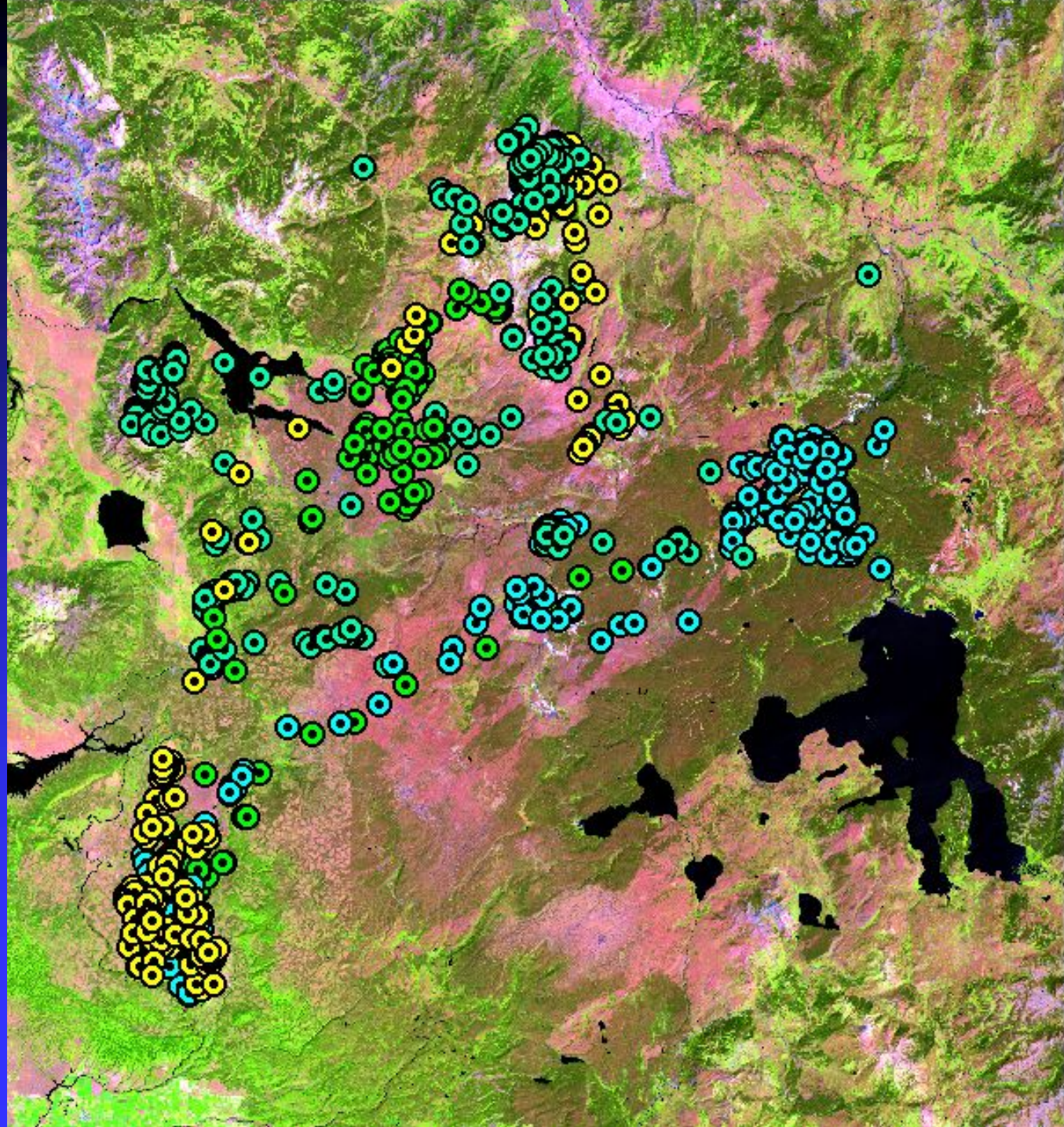
Movements of Bear 373

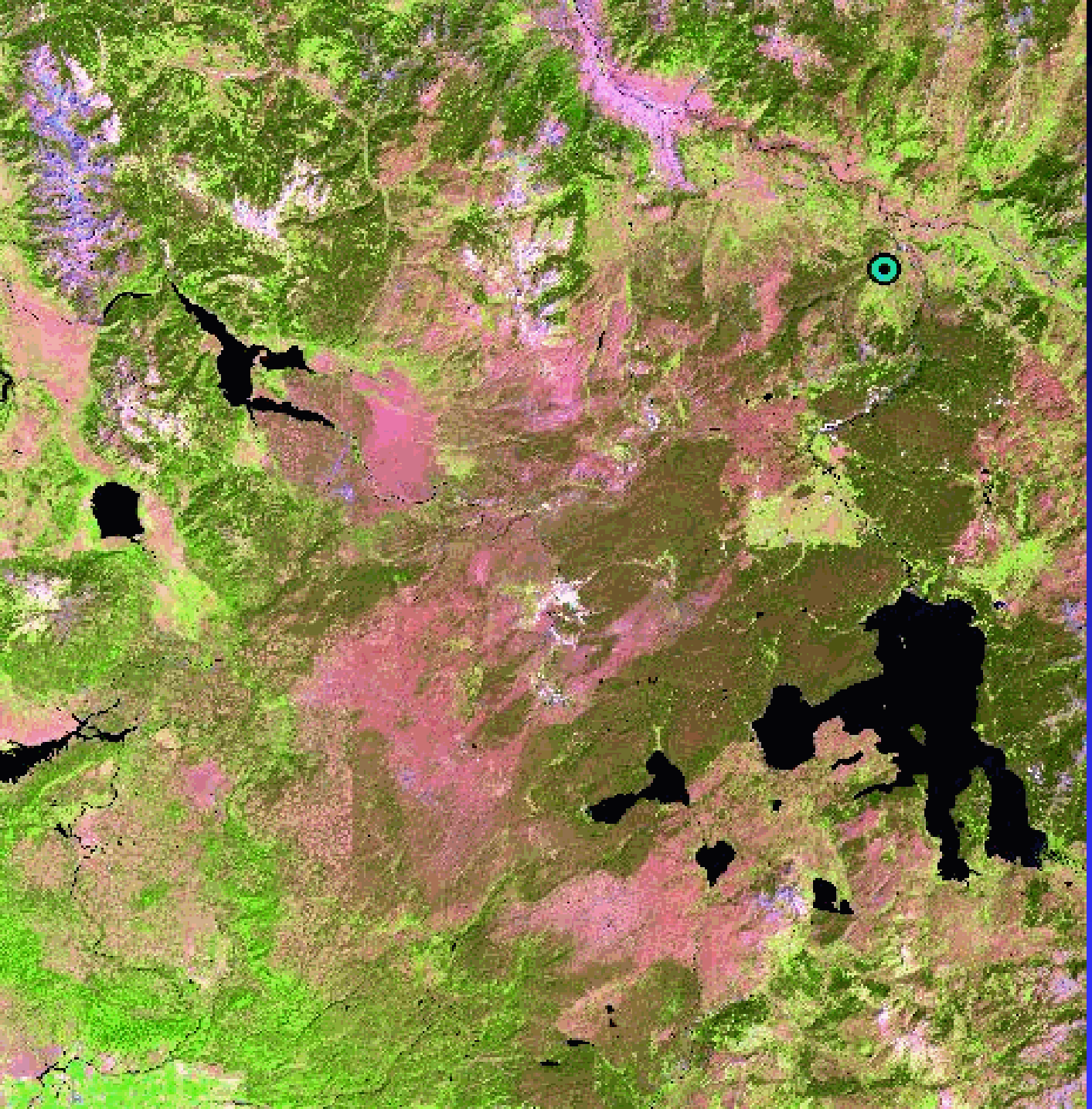
Intervals: 3 hrs. 25 mins.

Period of Record:

September 9, 2000

October 3, 2001





Movements of Bear 373

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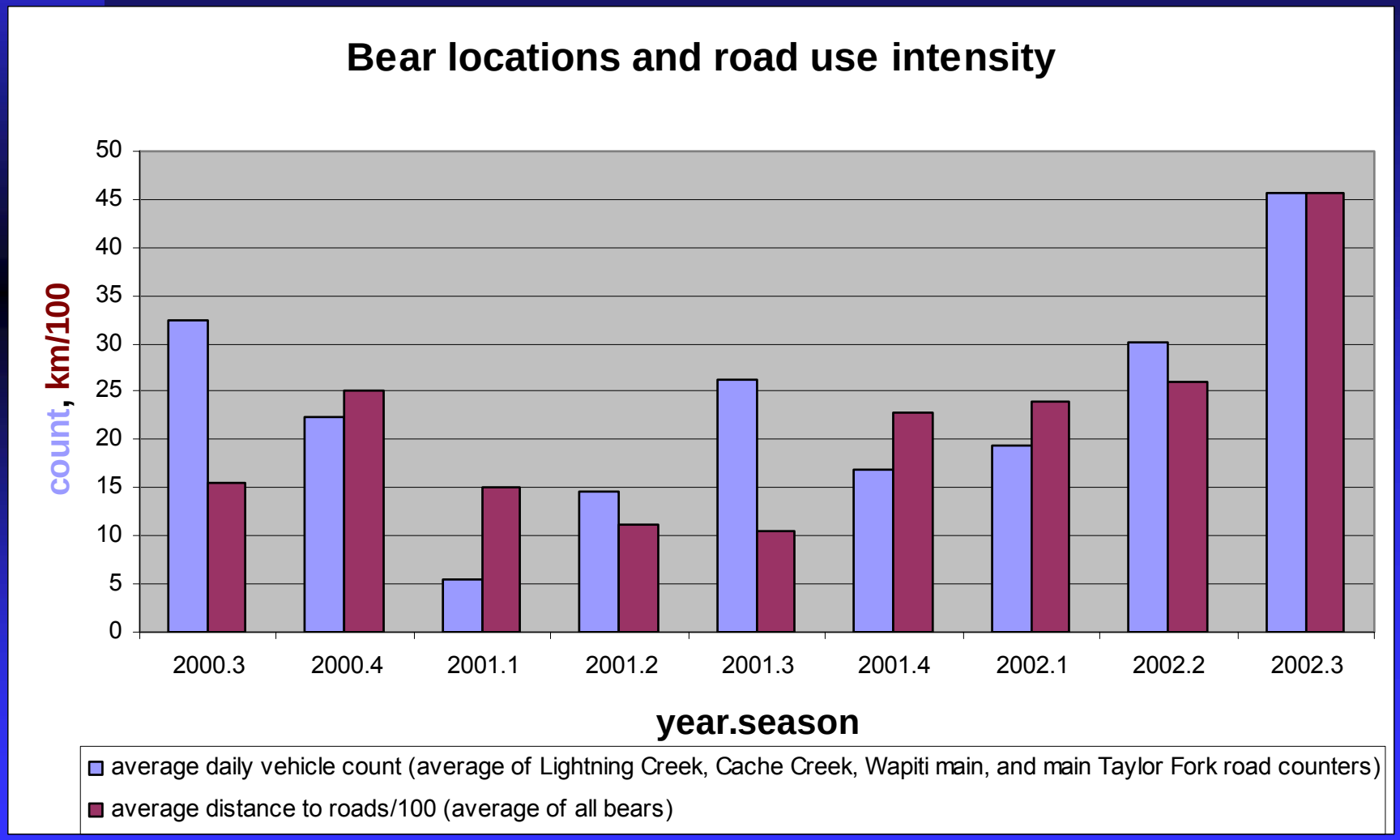
Distance to Roads and Road Use



Between-location statistics

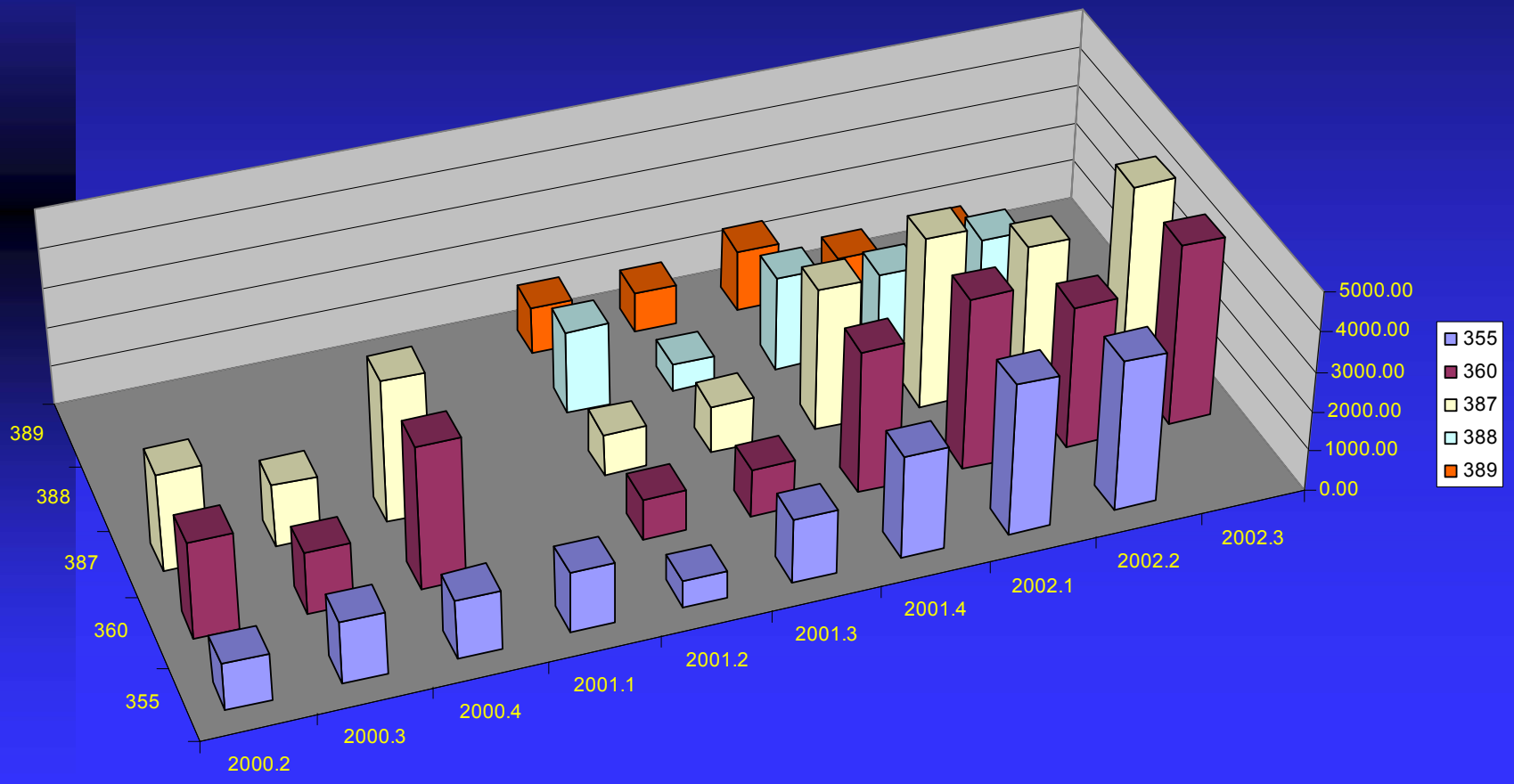
Metric	Min.	Mean	Max.	Std Dev
TBL - hours	0.07	4.27	92.26	3.54
DBL - meters	0.27	1662.23	19946.87	2163.31
ROTBL - K's/hr	3.95	4.50	6.60	6.22

TBL = time between locations

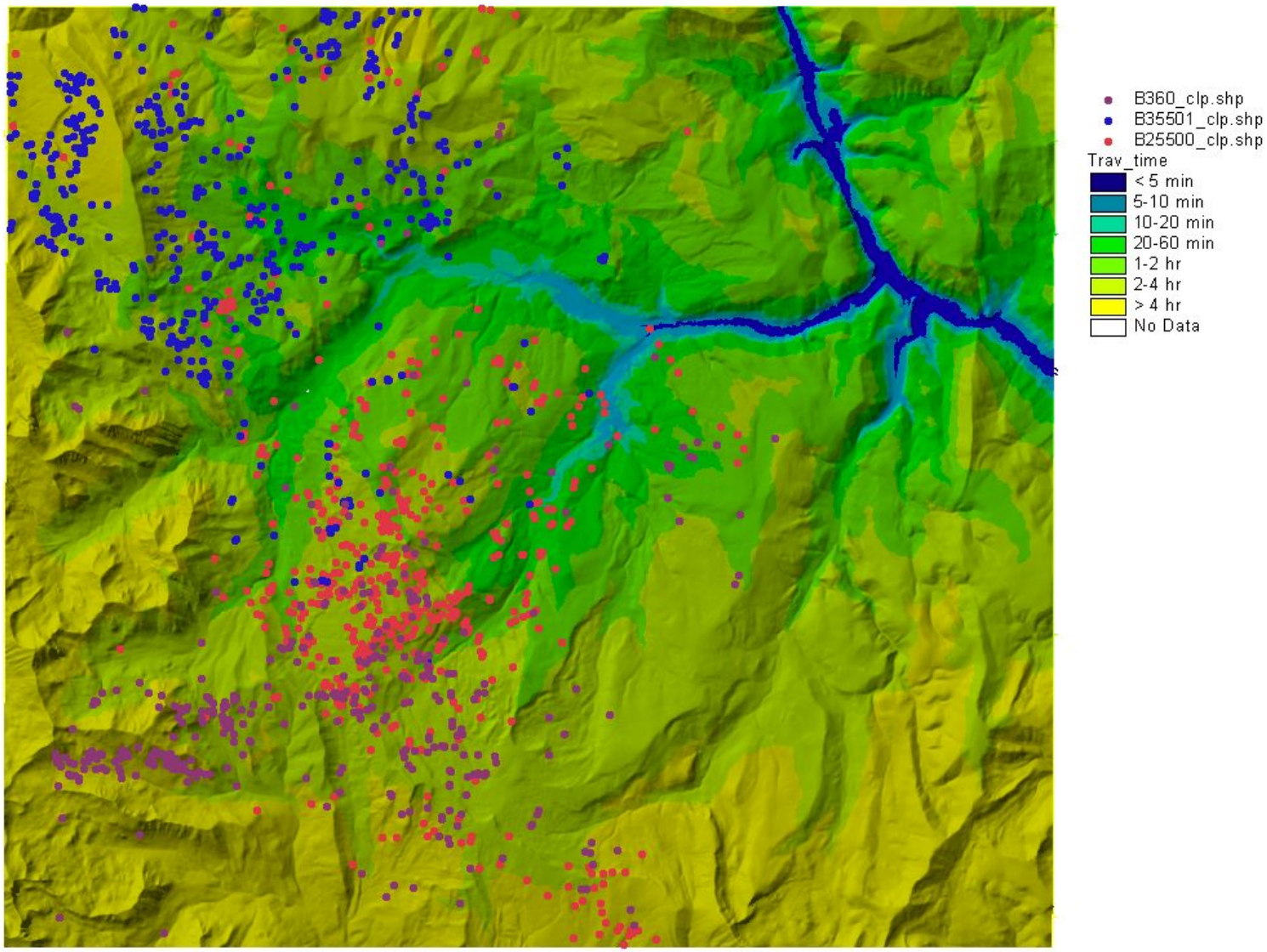
DBL = distance between locations

ROTBL = rate of travel between locations

Distance to Roads by Season by Bear by Year



Travel Model with Bears



Species we have worked with

- Grizzly Bears
- Elk
- Gunnison Sage Grouse

What have we learned?

- Vehicles have a tendency to spawn
- Fragmentation is multi dimensional
- Monitoring use is an important part of management and research
- Involving a variety of stake holders increases the strength of question
- Distance to roads is more than just a straight line
- Modeling…..

Products

- Fact Sheet
- Open File Report
- Roads and Wildlife Bibliography

Roads and Wildlife Bibliography

- 1500+ citations
- Time period: 1960 to 2005
- 17 topics covered including
  - **Monitoring & methodologies**
  - **Temporal fragmentation**
  - **Crossing behavior**
  - **Road density**
  - **Habitat fragmentation effects and population responses**

BLM OHV Bibliography

- **Extensive bibliography of literature (from 1960 forward) pertaining to impacts of OHV travel on the fundamentals of land health**
- **Narrative report**
- **Completed by the end of FY06**

Project Collaborators

- Colorado Division of Wildlife
- Bureau of Land Management
- National Park Service
- U.S. Forest Service

Federal Land Management Road Related Issues

- Energy development, roads & traffic
- Recreational access including OHV
- Habitat management
- Travel and Transportation Mangement

Discussion and Questions

Thanks for coming !