

Using GPS to Track Livestock on the Landscape



Rangeland Applications for Spatial Technologies

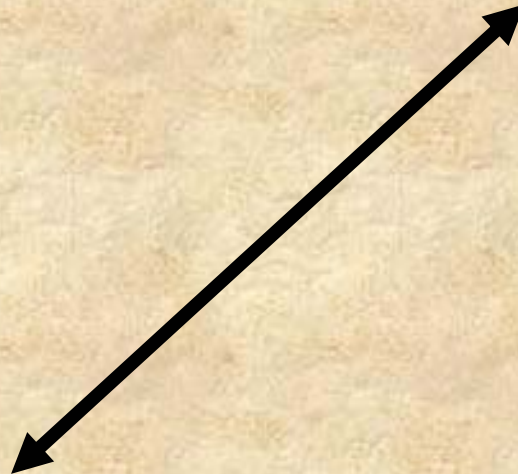
Pat Clark

USDA-Agricultural Research Service
Northwest Watershed Research Center
Boise, Idaho

Disturbance Ecology



Fire



Re-Introductions



Invasives



Climate



Herbivory

Water, Fire, and Cattle



Problem

Effects of prescribed-fire vegetation treatments on post-fire cattle distribution and activity patterns in sagebrush-steppe are largely unknown.



Study Areas

Reynolds Creek Experimental Watershed
Owyhee Mountains, SW Idaho

Breaks



Whiskey Hill



Lotek 2200 GPS Collar

Location accuracy:

95% C.I. = +/- 5 meters

Typical = +/- 1 meter

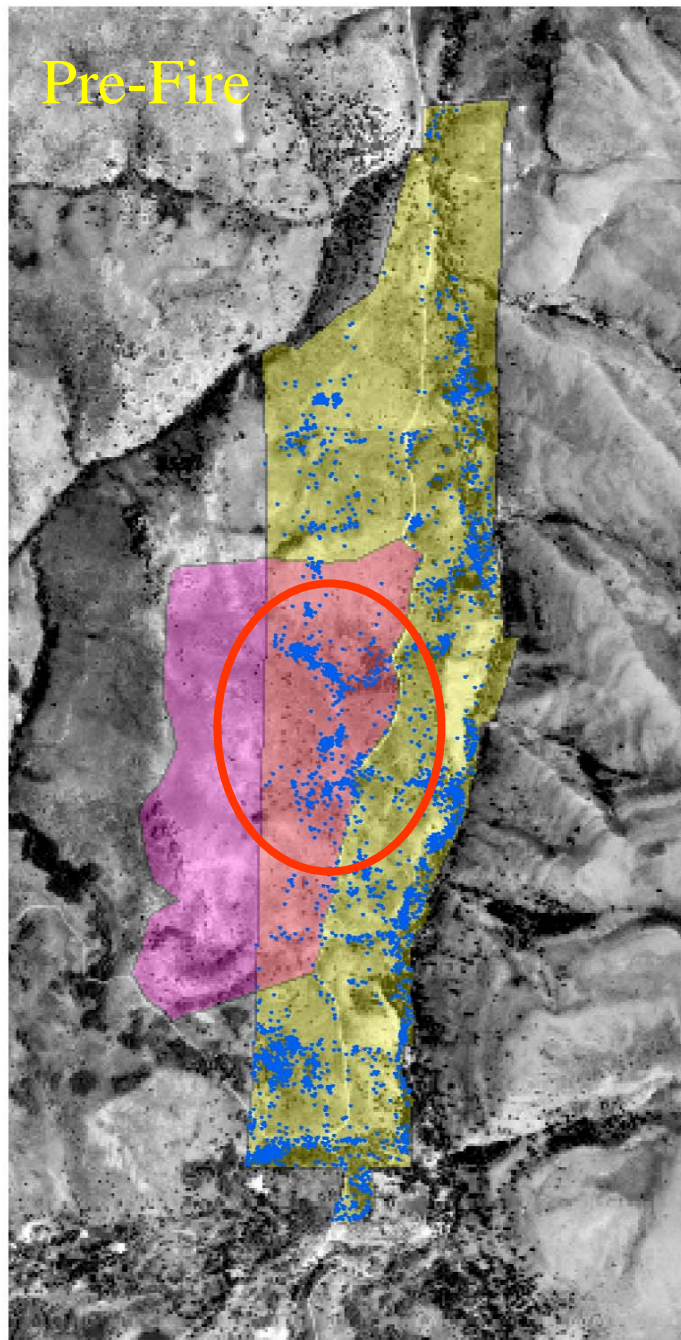
\$5,000 ea



Air temperature sensor

Two-axis activity sensor

Pre-Fire



0 125 250 500 750 1,000
Meters

Cattle Distribution Breaks Study Area

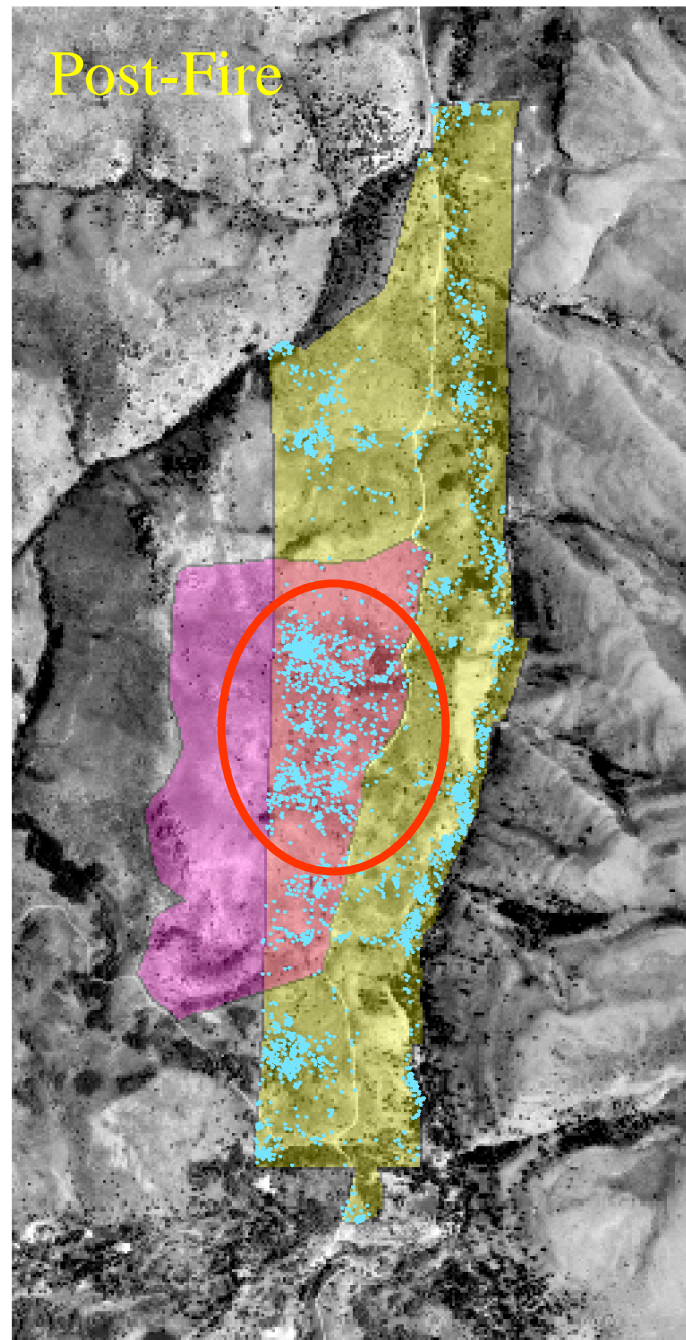
Pre-fire	Post-fire
July 2002	July 2003

Legend

- Pre-fire locations (1 cow)
- Post-fire locations (1 cow)



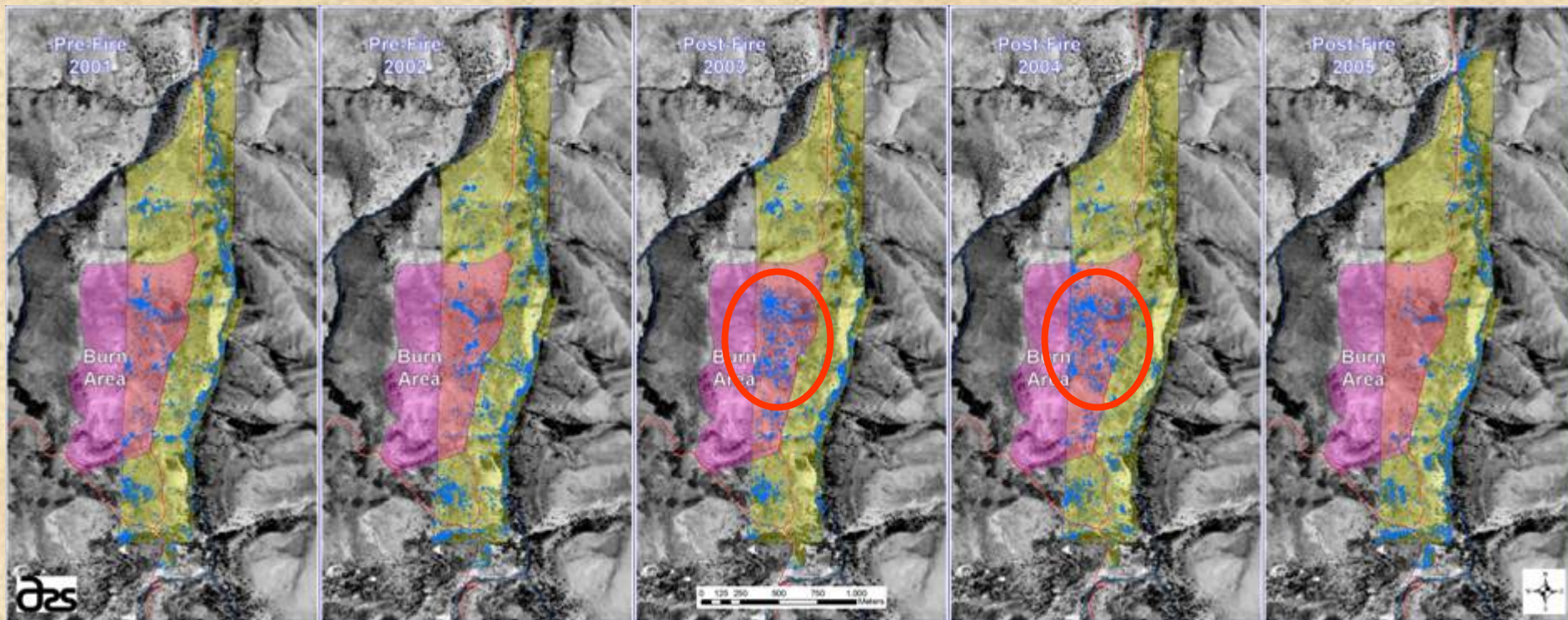
Post-Fire



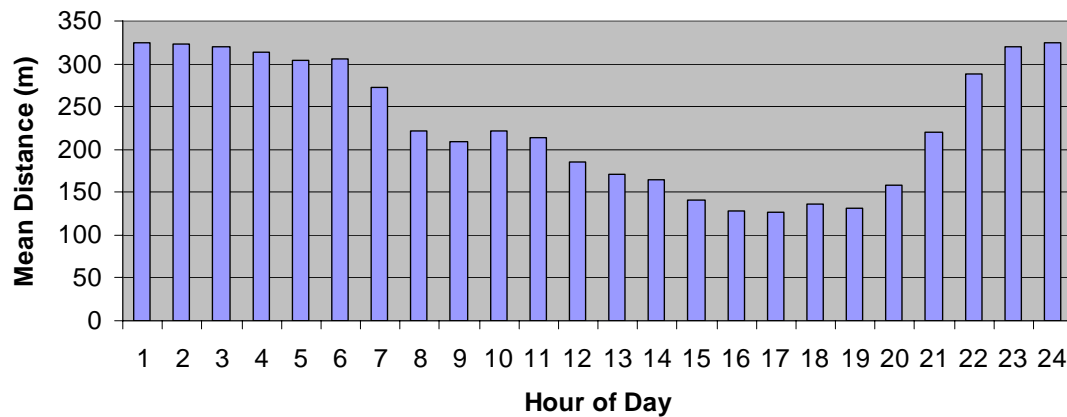
0 125 250 500 750 1,000
Meters

-----Pre-Fire-----

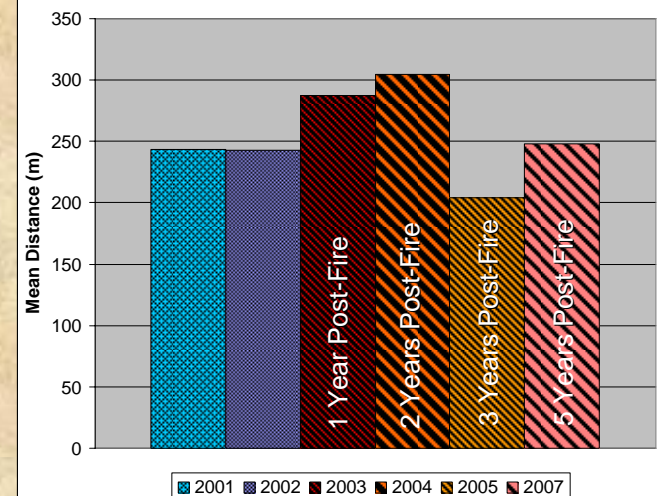
-----Post-Fire-----



Cattle Activity - Breaks Study Area (July 2001)
Distance from Perennial Streams
Mature cows (n=7)

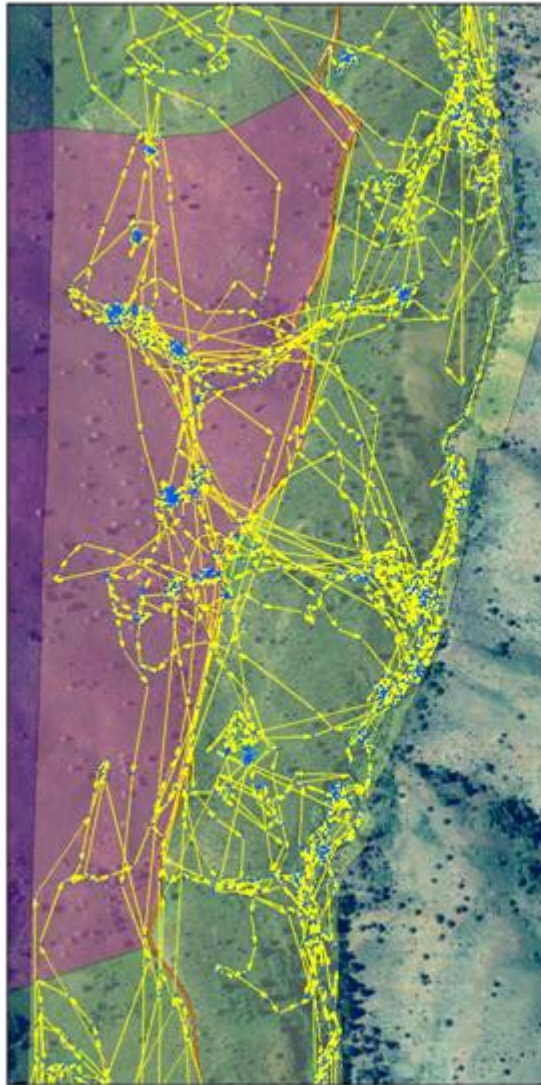


Mean Distance from Streams



Pre-Fire

2nd Yr Post-Fire (2004)



Fire-Treated Area (Zoom) Pre-Fire Use

GPS Tracking Trials
Mature Beef Cows, 10/trial
30-day trial each year (July)
10-minute sampling interval

Legend

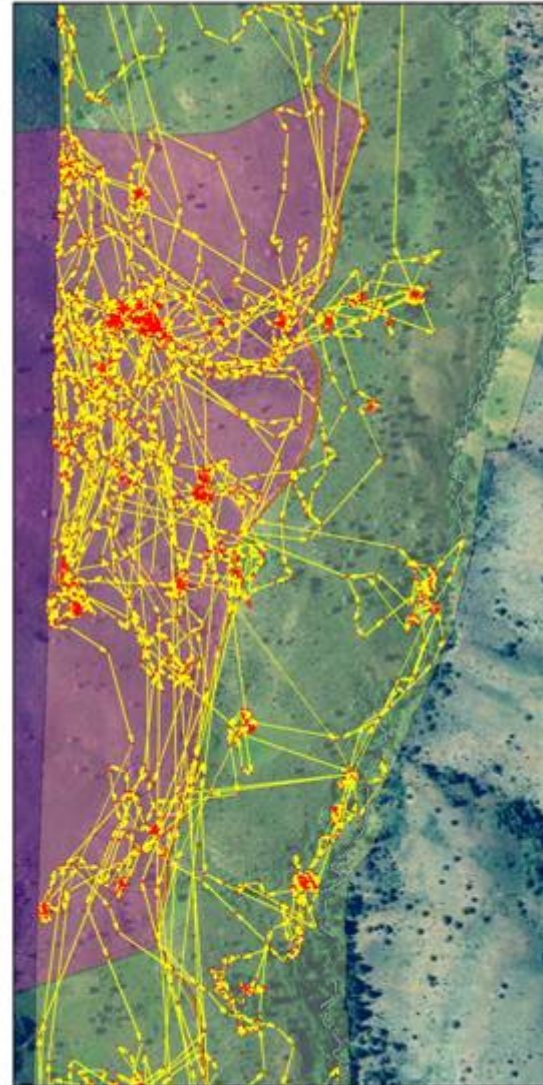
- Pre-fire 2002 (Collar 196)
- Movement paths
- Roads, unimproved
- Streams, perennial
- Fire treated area
- Pasture, fence (176 ha)

Note: The example data set shown represents data from 1 cow tracked for 30 days.

Collar 196 = 4,147 locations displayed



0 50 100 200 300 400
Meters



Fire-Treated Area (Zoom) Post-Fire Use

GPS Tracking Trials
Mature Beef Cows, 10/trial
30-day trial each year (July)
10-minute sampling interval

Legend

- Post-fire 2004 (Collar 790)
- Movement paths
- Roads, unimproved
- Streams, perennial
- Fire treated area
- Pasture, fence (176 ha)

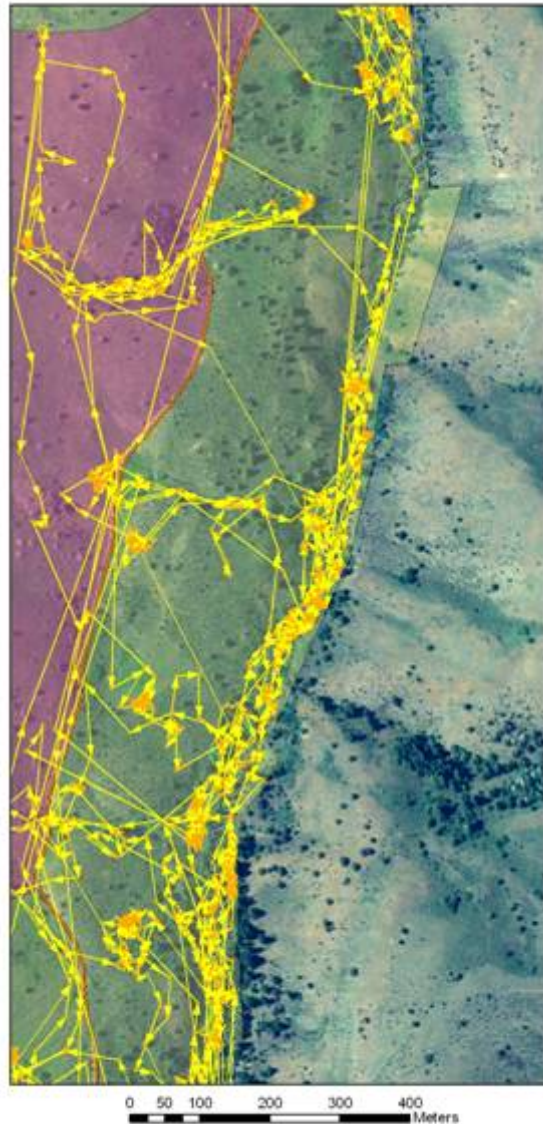
Note: The example data set shown represents data from 1 cow tracked for 30 days.

Collar 790 = 4,033 locations displayed



0 50 100 200 300 400
Meters

3rd Yr Post-Fire (2005)



Stream Use (Zoom)
July 2005
3 Years Post-fire
GPS Tracking Trials
Mature Beef Cows, 10 trial
30-day trial each year (July)
10-minute sampling interval

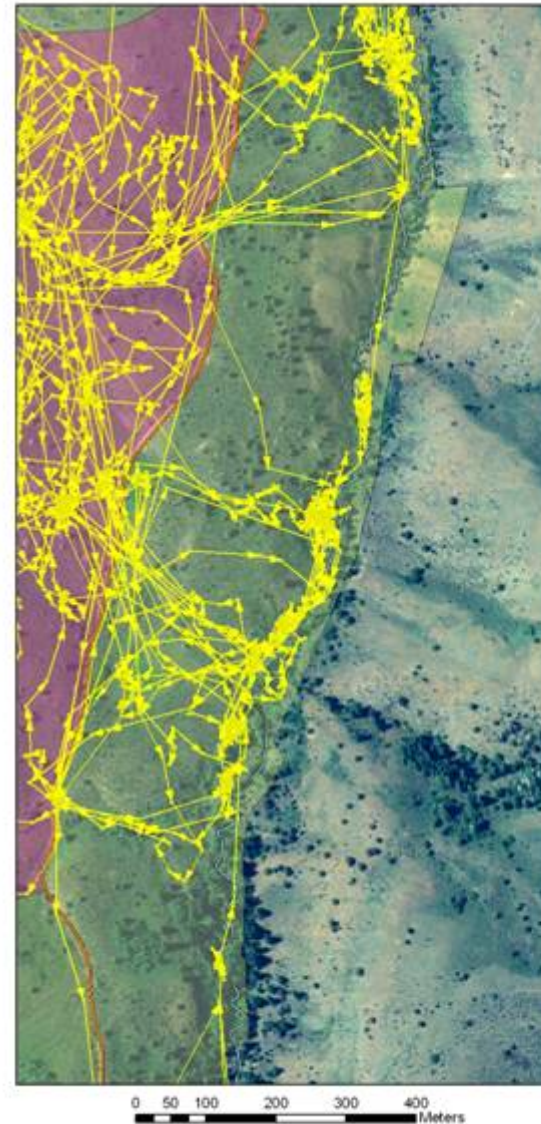
Legend

- Post-fire 2005 (Collar 795)
- Movement path
- Roads, unimproved
- Streams, perennial
- Fire treated area
- Pasture, fence (176 ha)

Note: This dataset represents
from 1 cow tracked for 30 days.



5th Yr Post-Fire (2007)



Stream Use (Zoom)
July 2007
5 Years Post-fire
GPS Tracking Trials
Mature Beef Cows, 10 trial
30-day trial each year (July)
10-minute sampling interval

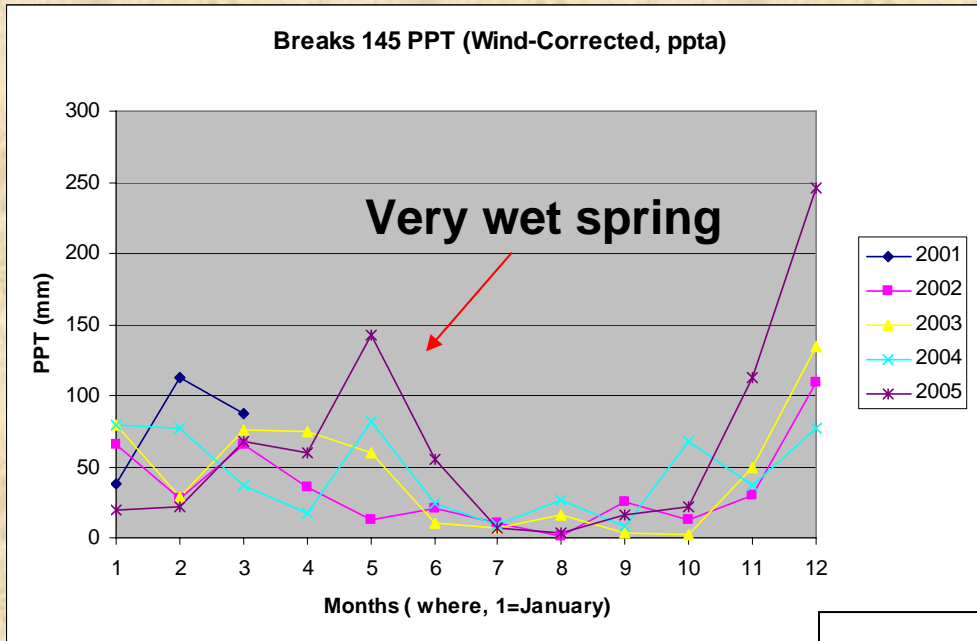
Legend

- Post-fire 2007 (Collar 797)
- Movement path
- Roads, unimproved
- Streams, perennial
- Fire treated area
- Pasture, fence (176 ha)

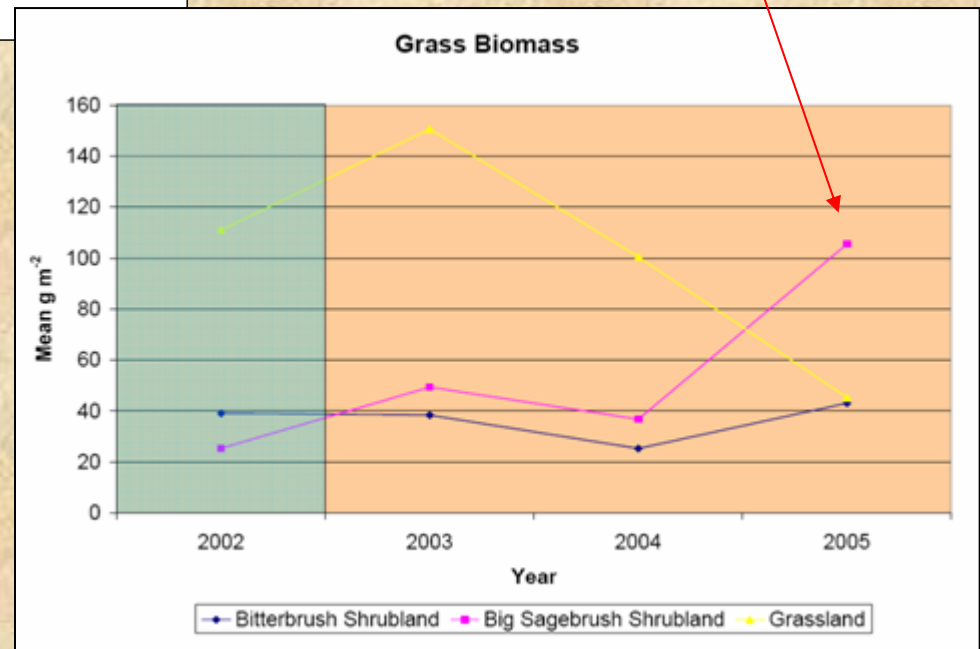
Note: This dataset represents
from 1 cow tracked for 30 days.



2005 – 3rd Year Post-Fire

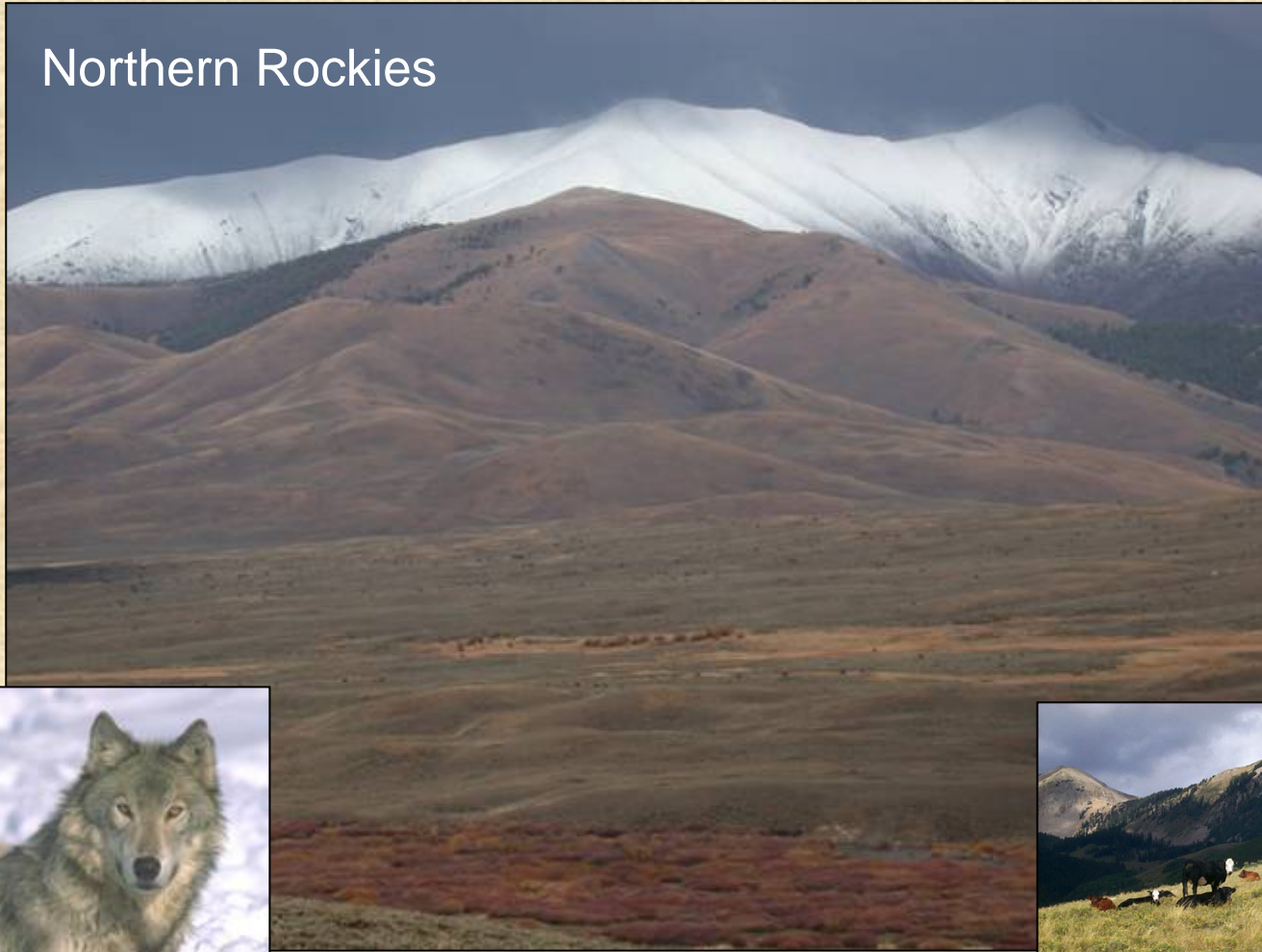


**B. Sage Shrublands
- Higher grass biomass**



Water, Wolves, and Cattle

Northern Rockies



Pat Clark
USDA-Agricultural Research Service
Boise, Idaho

Problem

Effects of re-introduced gray wolves on range cattle productivity and resource-use patterns are **unknown**.



Potential Cascade of Indirect Effects

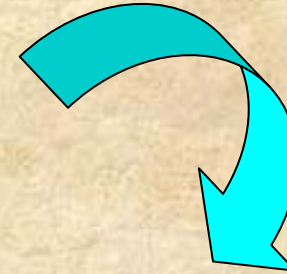
Increased Encounters



Vigilance



Stress



Altered Habitat & Activity Patterns



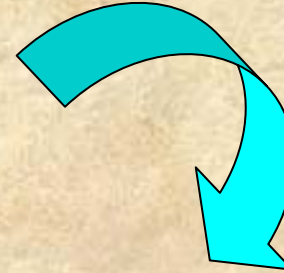
Bedding



Foraging



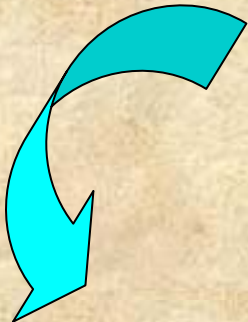
Diet Quality Shifts



Body Condition &
Weight Gain/Loss



Altered
Reproductive Success



Impacts on Water and Vegetation



Riparian occupation time

- Frequency
- Duration
- Impacts on vegetation

Water Quality

Altered pollutant levels

- Sediment
- Coliforms



Riparian Systems

GPS Tracking

Clark GPS Tracking System

- SD and Micro-SD card data storage.
- 3-axis Accelerometer activity sensors.
- Battery power management capable of delivering 1 year of 5-min GPS locations.

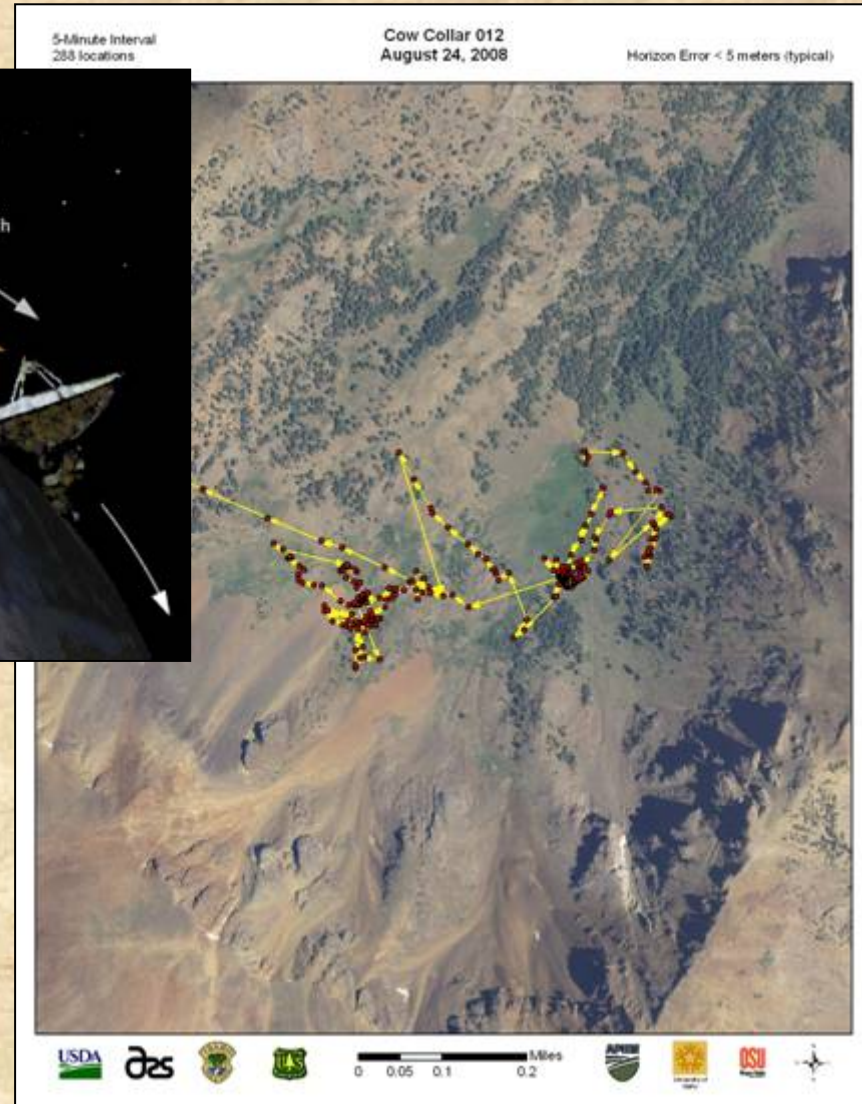
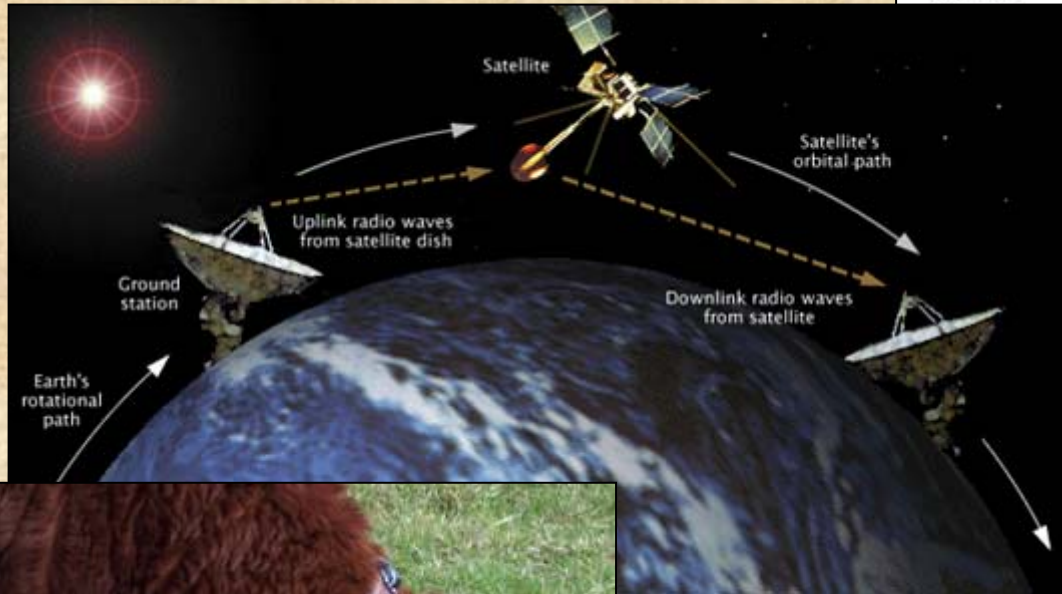


Clark GPS/SATCOMM Tracking System

24/7 Real-time GPS Tracking

Anywhere on the Globe

Iridium Short Burst Data Transmission



Two-Way Email Communication with Deployed Collars

The screenshot shows a Microsoft Outlook window titled 'Incoming SBD - Microsoft Outlook'. The left sidebar displays the 'Mail' folder structure, including 'Inbox in Personal Folders', 'Deleted Items (132)', 'Drafts', 'Inbox', 'MessageScreen Quarantine', 'Junk E-mail (1)', 'Outbox', 'Sent Items', 'Search Folders', 'Archive Folders', 'Personal Folders', and 'READ'. The main pane shows a list of incoming messages from 'sbdservice@sbd.iridium.com' with subject lines like 'SBD Msg From Unit: 300034012634580'. The selected message is displayed on the right, showing the sender, subject, and a list of attachments. One attachment is highlighted: '300034012634580_000212.sbd (444 B)'. A red arrow points from the text 'Text message attachment' to this attachment icon. Below the email view, a Notepad window is open, displaying the raw data of the attachment: '04/02/08,21:29:14,4338.9862N,11626.8003W,3,2.8,1.8,2.1,778.5M,0.0,344.5,5.98,2.420,1.446,M0,R4,L'. The taskbar at the bottom shows various open applications, including 'Incoming SBD - ...', 'C:\MyFiles\COL...', 'Adobe Acrobat ...', 'Jasc Paint Shop ...', and '30003401263...'.

Text message attachment

- Download collar GPS data emailed **from** deployed collars
- Change collar parameters by sending email **to** deployed collars.

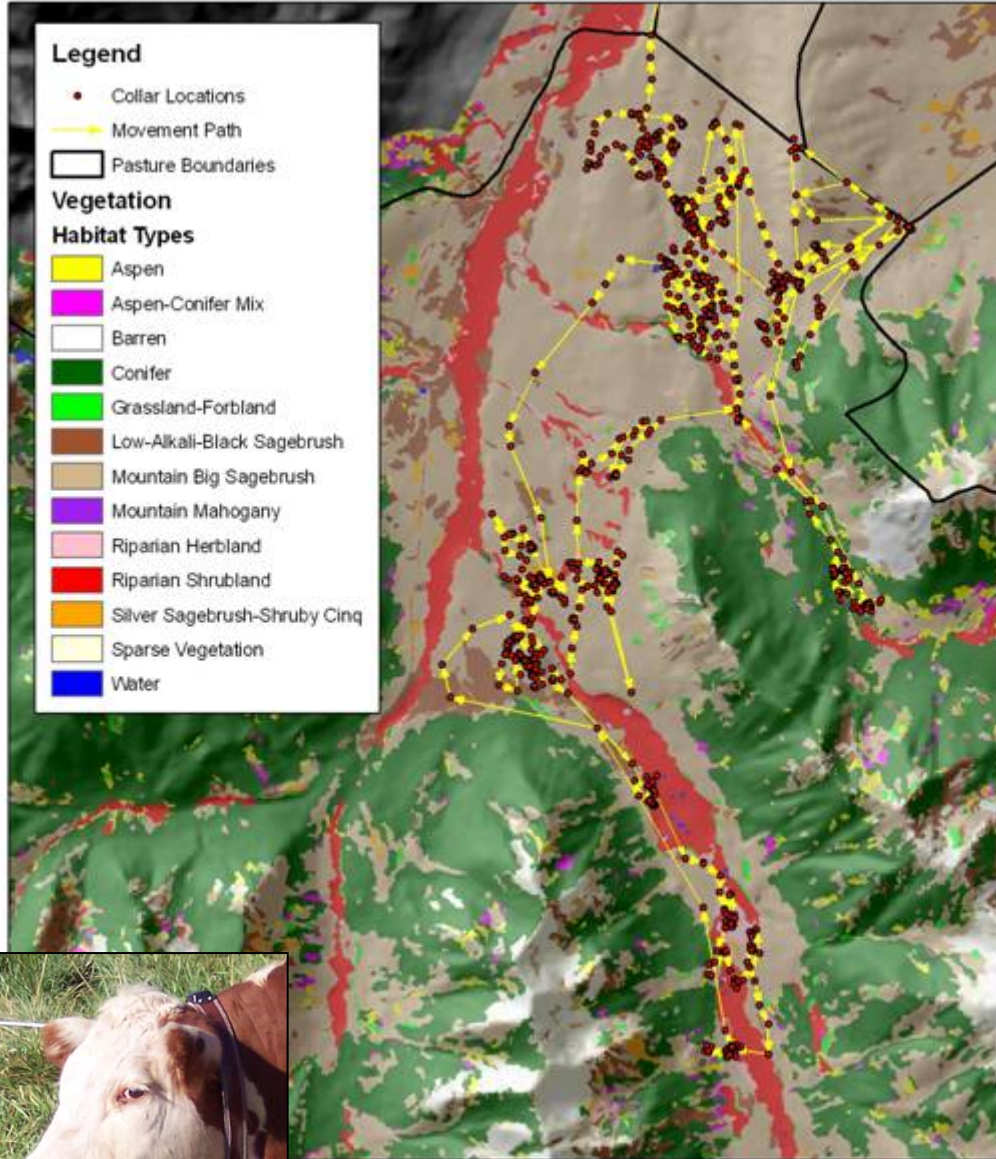
30-Minute Interval
1,288 locations

Cow Collar 791
September 2-29, 2006

Horizon Error < 5 meters (typical)

Legend

- Collar Locations
- Movement Path
- ▭ Pasture Boundaries
- Vegetation**
- Habitat Types**
- Aspen
- Aspen-Conifer Mix
- Barren
- Conifer
- Grassland-Forbland
- Low-Alkali-Black Sagebrush
- Mountain Big Sagebrush
- Mountain Mahogany
- Riparian Herbland
- Riparian Shrubland
- Silver Sagebrush-Shrubby Cinq
- Sparse Vegetation
- Water



Near-Stream Habitats

- Use of near-stream habitats **varied** between pastures.
- **Use > Availability** in some pastures.
- **Use = Availability** in other pastures.
- Differing **topography** and **riparian composition** may play a substantial role.



Upland
Day-Bed Site



Riparian area

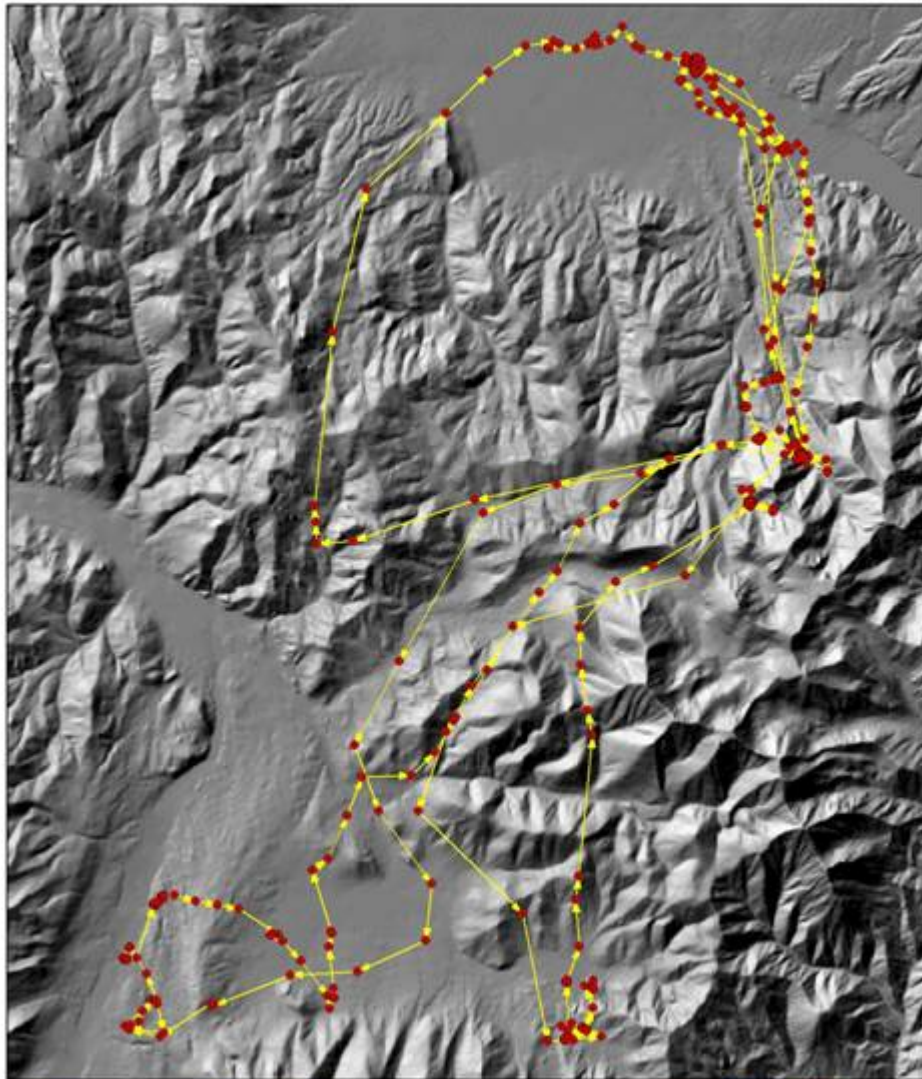
Cow collar 4529
24-hr Movement path

Upland
Night-Bed Site

15-Minute Interval
776 locations

Wolf Collar CBW016
May 11 to May 29, 2006

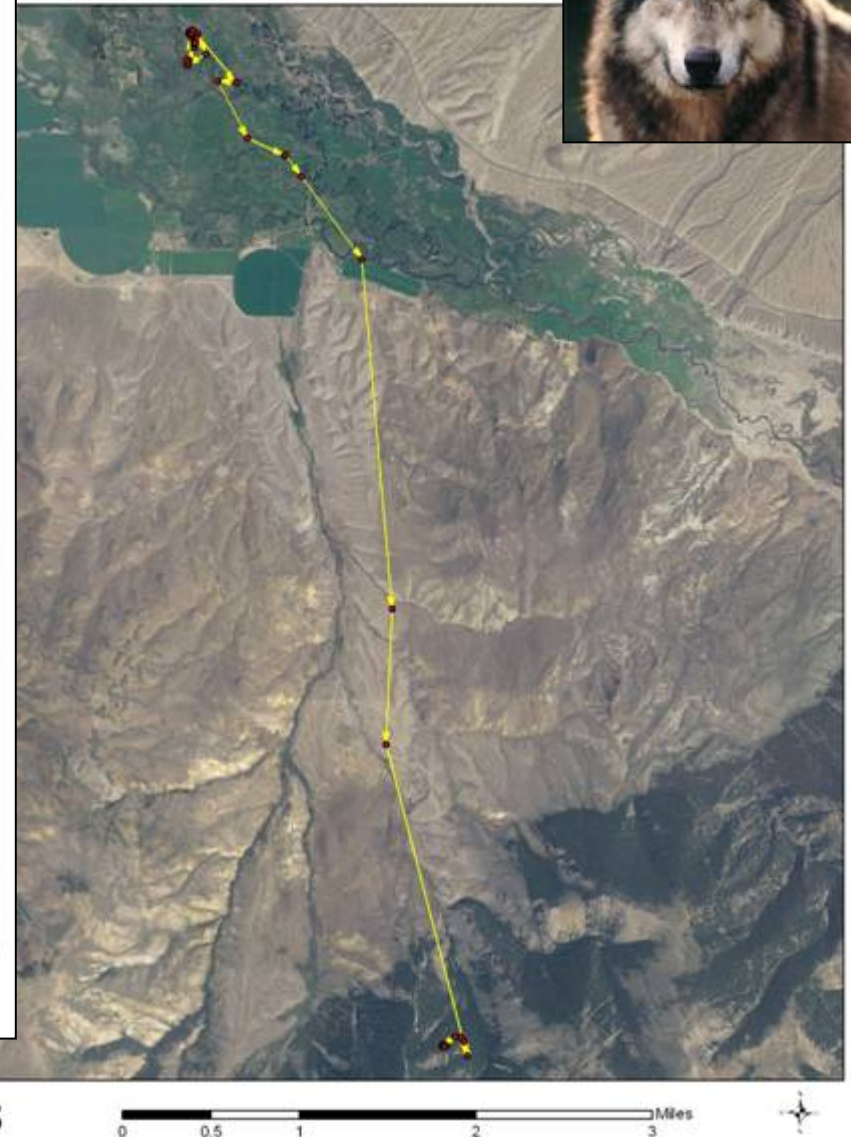
Horizon Error < 5 meters (typical)



3 Weeks of 15-min samples

May 24th Only

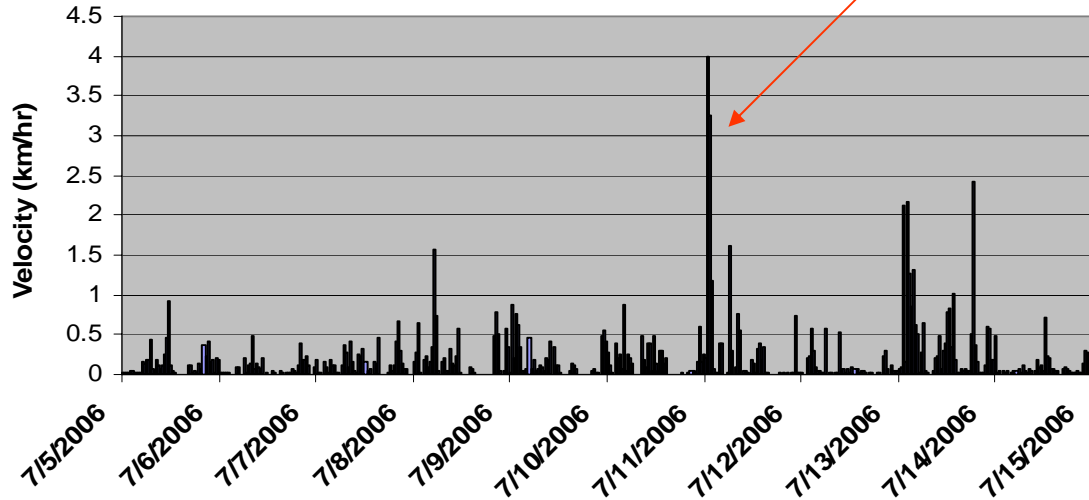
Wolf -- CBW016
May 24, 2006



Other responses

Collar 791
7-5 to 7-15-06

Possible
Flight Event



Collar 791
July 11, 2006

Horizon Error < 5 meters (typical)

Possible
Bunching Event

2 km

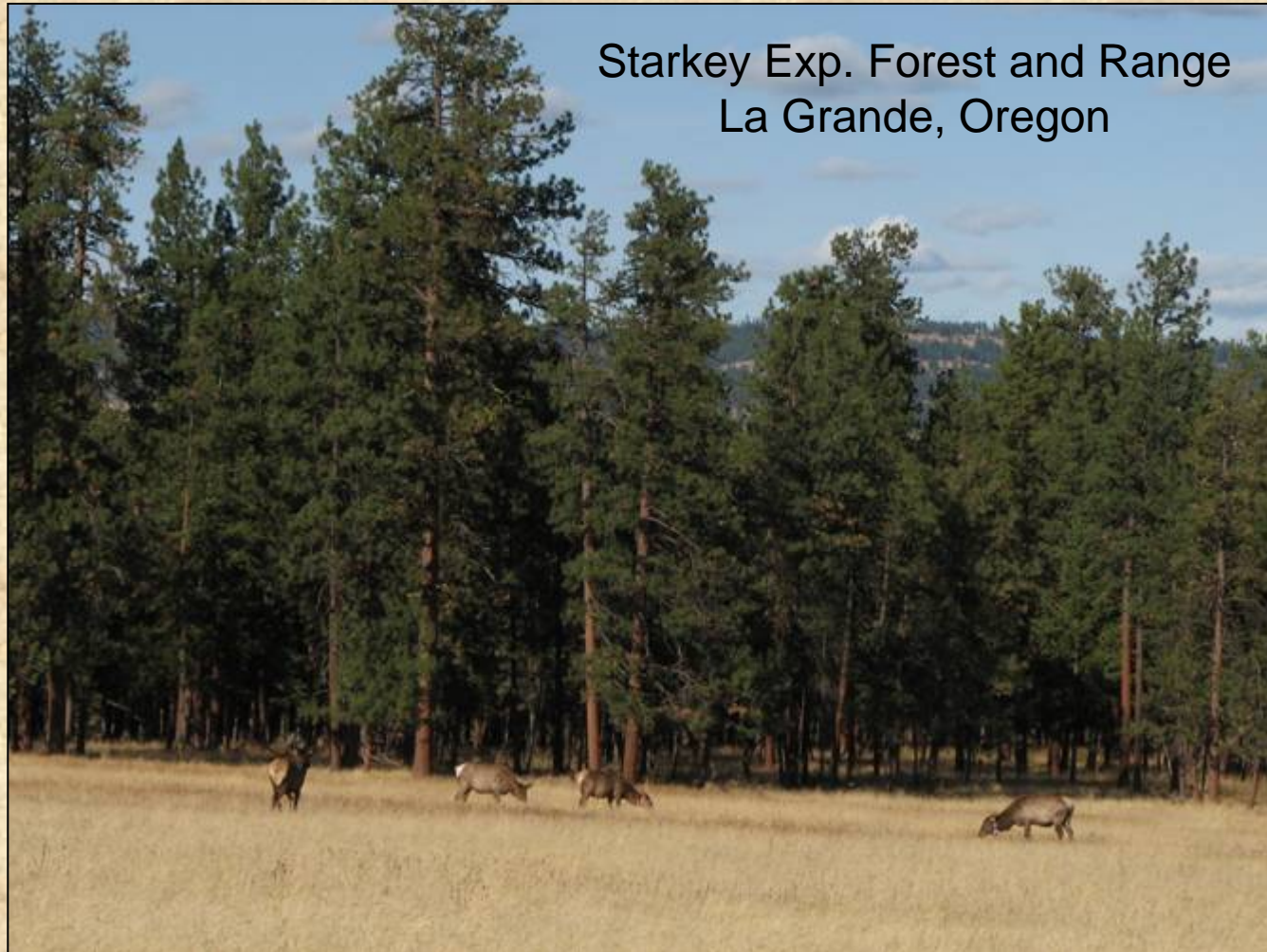


July 11, 2006

Same site

- July 11, 2006 (GPS)
- July 17, 2006 (Direct Obs.)

Habitat Use and Activity Patterns Cattle and Elk

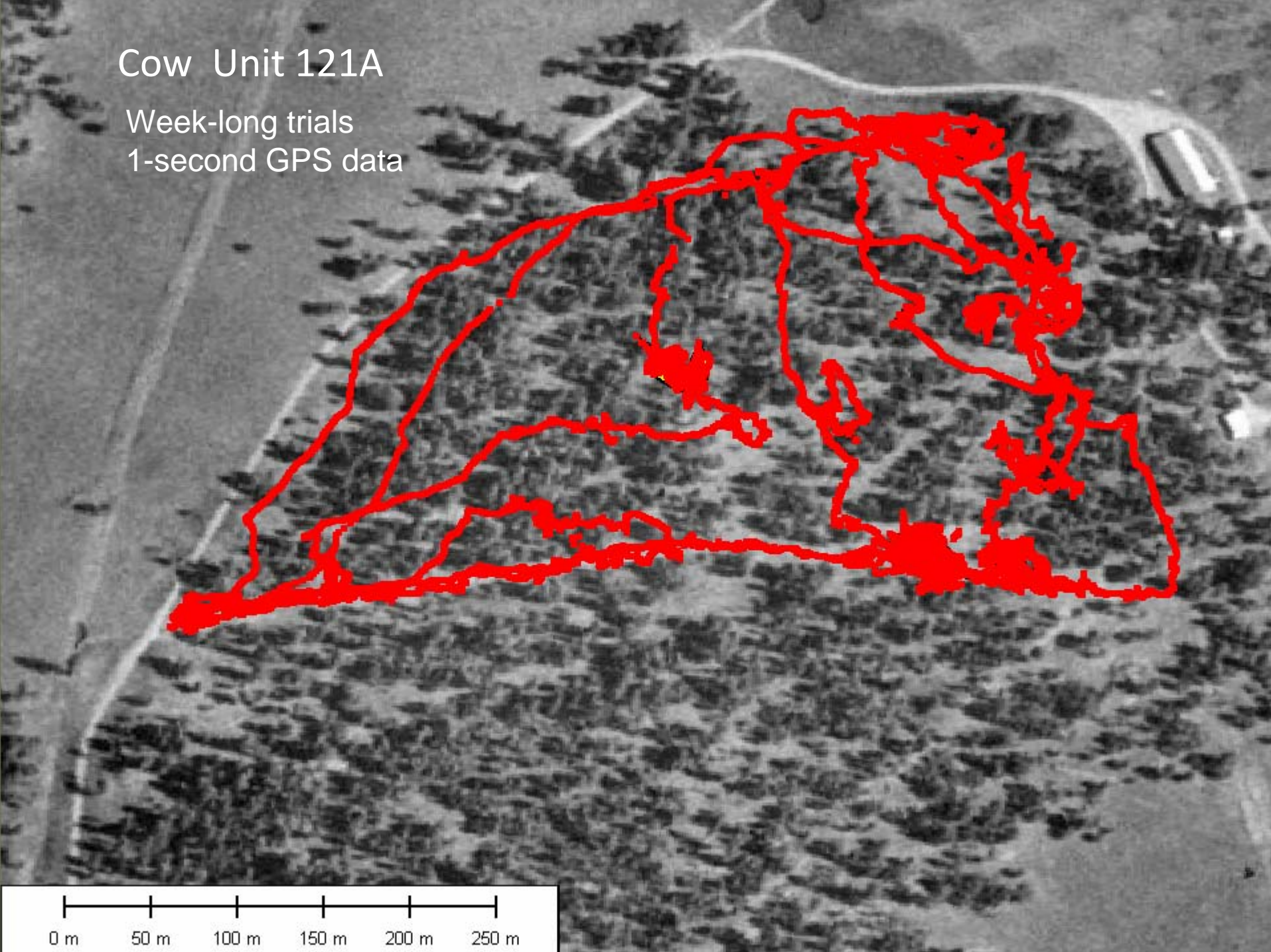




Cow Unit 121A

Week-long trials

1-second GPS data



0 m 50 m 100 m 150 m 200 m 250 m



Cattle - Summer



Elk - Summer



Cattle - Fall



Elk - Fall

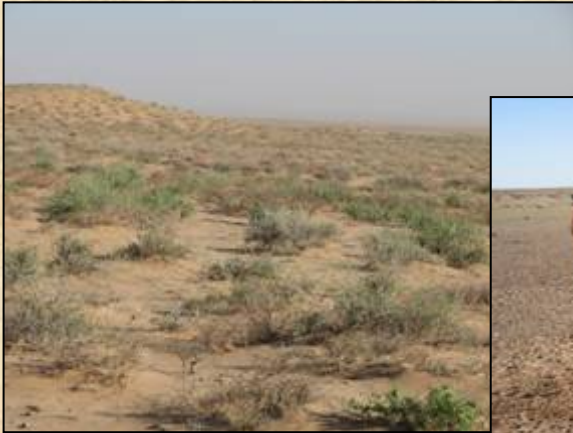
Water, Khulan, and Livestock



Gobi Desert, Mongolia



Dornogovi Aimag



Livestock Watering-Well Rehabilitation

Interspecific Competition and Resource Impacts?



Project renewal proposal:
The World Bank

Interactions

Herded Livestock - Endangered Ungulates

Cattle



Asiatic wild ass (Khulan) – Red listed



Bactrian camel



Fat-tailed sheep



