

## Spatial Ecology of a Free-Roaming Horse Laboratory 9

Animal behaviorists have been using Global Positioning Systems (GPS) technology since the early 1990's to track wildlife and domestic livestock. GPS information is used to determine home ranges, resource site usage, migration routes, and habitat preferences. Over the last 15 years substantial improvement has been made to the accuracy of positional fixes, battery life, frequency of logging and ease of data download and handling. Modern GPS receivers weigh ounces, collect data for weeks or months and can store millions of positional fixes on SD or other card devices. We were interested in determining if we could use high frequency GPS locations on horses to discern behavioral activities such as: grazing, resting, walking with intent, and running. Since resting traditionally includes standing still, lying upright and lying prone which are impossible to discern with only GPS fix information, we recognized that our spatial information is somewhat different than observational data collected using focal animal sampling techniques. GPS does, however, provide information that a human observer often misses such as accurate positioning at night and recording of very high-speed/short-duration events.



Figure 1. . The Roaring Springs Horse Study location shown as a red dot.

Our grazing study was done in southeastern Oregon in late March 2009. The study pasture used for this investigation is located on the Catlow Rim of Harney County, Oregon (42.436108° N, 118.789723° W) and consisted of a series of longitudinal valleys drained by Skull Creek and Echart Creek (Figure 2). The area of the pasture is approximately 41.47 km<sup>2</sup> (24,614 acres). The upper portions of the pastures lie on a basaltic plateau (elevation ≈1600 m) with associated canyons descending as low as 1200 m. Climate of this site is continental and semi-arid with average annual precipitation of 320 mm (12 inches), 79 wet days/year, and approximately 99 freeze free days annually.

Our study site is dominated by mountain big sagebrush (*Artemisia tridentata* Nutt.), bottlebrush squirreltail (*Elymus elymoides* (Raf.) Swezey), Idaho Fescue (*Festuca idahoensis* Elmer), bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A. Löve) and Sandberg's Bluegrass (*Poa secunda* J. Presl). This pasture is typically used as range for domestic livestock (Figure 2).

Horses were fitted with collars that contained a GPS unit capable of collecting and recording positional fixes at 1-second intervals. The collared horses were part of a larger herd of 20 mares, geldings and a stud which were pastured together. GPS information was collected from 26 March 2009 to 1 April 2009. The animals with the GPS collars and those without were free-roaming throughout this period.

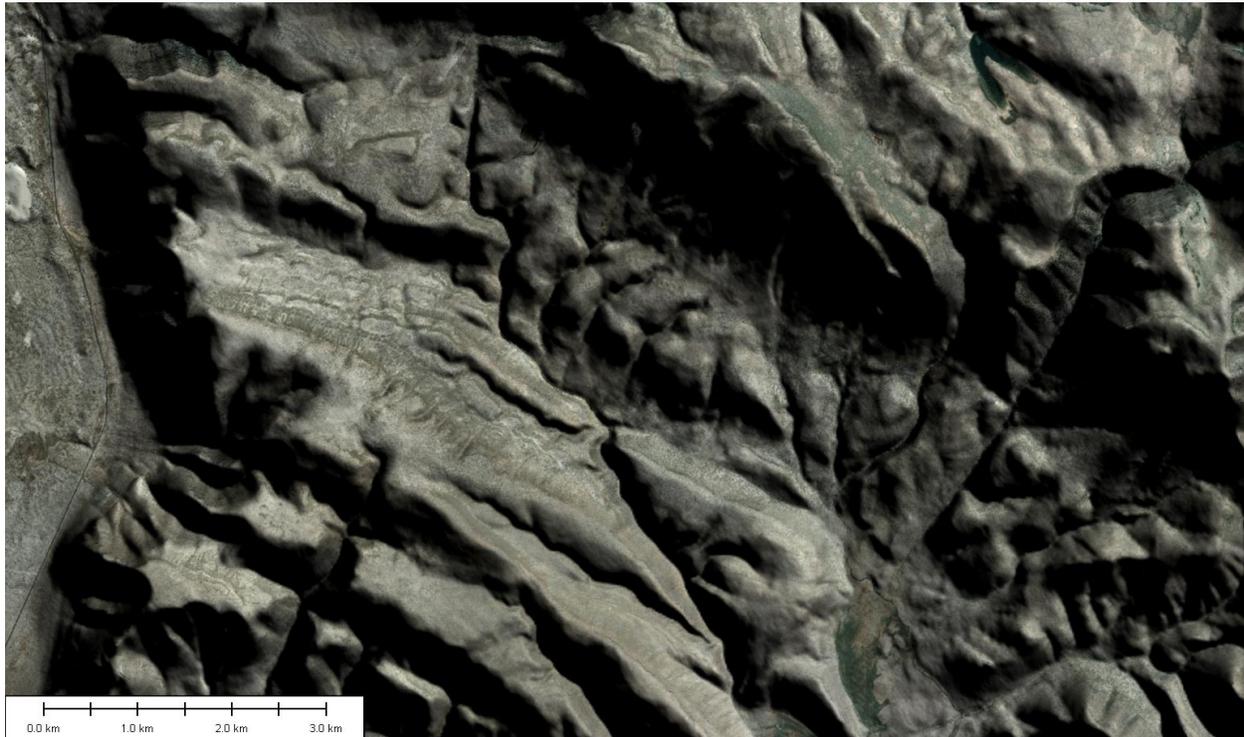


Figure 2. Topography of the Roaring Springs Horse Study Pasture.

Accuracy of the GPS unit was assessed by a static test with the unit in an open area placed at 1.5 m above the ground. Logging was continuous for 50,000 positions (833.3 minutes) which revealed a mean error of 4.78 m (std. dev. = 3.40 m), minimum error of 0.08 m, and a maximum error of 23.3 m.

Faster logging of position data gives a more complete estimate of where animals move than intermittent sampling at say 5 or 10 minute intervals. It also provides a more precise log of animal travel routes and the duration of travel and stationary episodes. Obviously, data volume increases with shorter logging intervals. A 1-second logging interval yields 86,400 lines of data/day while a 30-second logging interval produces 2,880 lines of data/day compared to 288 lines of data/day for a 5 minute logging interval. Another issue with high frequency logging is that GPS errors will accumulate when an animal is actually stationary which can lead to a substantial pseudo-travel distance. If we are measuring “travel distance” at high frequency and do not remove GPS errors when the animal is stationary, we will obviously overestimate movement.

During this exercise we will examine the spatial movement of a free-roaming horse in Harney County, Oregon for: 1) diurnal activity pattern (graph the velocity vs. time), 2) animal velocity (maximum velocity

each day and a histogram of velocities in 0.2 km/hour intervals), and 3) total travel distance. Your instructor will provide you with a data set from this study.

You should use Microsoft Excel or a comparable spreadsheet program to do your analysis. I have separated the data into 4 complete 24-hour periods by sorting so complete days can be used as observations. You may have to change the format of the Date/Time field to show year, month, day, hour, minute, second. You should plot the velocity in km/hr. vs. time so that periods of activity can be seen. Do this using a two variable (XY) plot so that time is correctly displayed.

Next find the displacement from 1 location to the next using the Pythagorean Theorem (the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides). Total distance traveled per day can be calculated by summing distance from sequential positions. This will probably overestimate movement because of GPS errors when animals are stationary. Try sorting your data and using only points with a recorded velocity to calculate distance traveled. Did this help your estimate?

Your task is to answer the following questions?

1. What was the daily maximum velocity, minimum velocity and average velocity values for this animal?
2. What does the activity pattern on Gus look like over the days you have data for?
3. How much time does this animal spend moving?
4. Does he move less at night?
5. What is his travel distance if you sum all the displacements for the 1 second data?
6. If you use only data points with a recorded velocity, what is his travel distance per day?
7. Are there any other ways you could estimate travel distance?