Human activity and animal movement: are they connected?

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Introduction and Methods

Movement of 41 individual white-tailed deer (*Odocoileus virginianus*) (17 males and 24 females) was monitored in a natural area preserve located about 25 km (15 miles) northeast of central Philadelphia, Pennsylvania, near Bryn Athyn College and in the adjacent suburban areas. The preserve is managed by the Pennypack Ecological Restoration Trust (PERT), which is a private, non-profit conservancy. PERT manages 3.3 km² (809 acres) of mature forests, regenerating woodlands, riparian forests, and fields of cool- and warm-season grasses in the Pennypack Creek. The area is surrounded with built up areas with different density of households. A precise description of the study area was given elsewhere (Potapov et al. 2013). The deer were individually trapped by a modified Clover trap (Clover, 1954) under Pennsylvania Game Commission permits, and fitted with Tellus GPS/GSM collars (Followit, Sweden), which transmitted spatial and temporal data at 5 minute intervals for periods of 3 to 6 months. Some individuals had collars collecting 5 minute fixes for 2 week periods interrupted by 2-4 week periods during which fixes were collected at 6 hour intervals. In such instances, only the 5 minute fix intervals were used for this study. A total of 549,485 GPS fixes were collected from the monitored deer, with an average of 13,402 fixes per individual.

Intensity of human visitation to PERT grounds was monitored by six people counters (EZ-Counter, Burghill, OH) placed at the entrances to PERT. The counters collected a total of 53,446 hours of data and registered a total of 80,277 human visitations. The total human visitations were summed by hour, weekday, and calendar day.

We have collected the timestamps of both human and animal visitations at two trapping locations located near buildings within the PERT grounds. Traps were baited with corn in late afternoon, from September to May. We deployed 2 types of cameras: conventional wifi web cams and trailcams (Leaf River Outdoor Products, MS). The cameras took pictures when triggered by movement, recording a total of 60,040 pictures. The wifi-enabled cameras uploaded pictures to an ftp site, whereas the conventional trail cameras stored pictures on an SD card, from which we downloaded the pictures onto a computer. Animals were visually identified and sorted by species. The number of pictures of each species were counted using R (R Core Team, 2017) and exifr, plyr, insol, ggplot and data.table packages. The dates and times of each picture were read either from json exif information, or from the picture name by a script written in R. In total we collected 48,972 images of deer, 2,261 humans, 1,310 bird, 18 cats, 1 rabbit, 189 foxes, 11 groundhogs, 1,068 racoons, 2 skunks, and 2,179 squirrels.

We compared a histogram constructed from deer movement data to a frequency histogram constructed from picture data. For species other than white-tailed deer, frequency histograms from the picture information were constructed.

All times used were unadjusted for daylight savings time.

Results

Tracking data from collared deer showed maximum deer movement occurring at dawn and dusk with the minimum during daytime (Figs. 2,4). Camera data revealed that activity during daytime near buildings was practically none (Fig. 3), but collar data show that movement is still occurring away from the camera locations (Fig. 4). Visitation at the trapping locations peaked soon after bait was replaced, then dropped off rapidly with corn depletion. The overnight increase in activity near cameras followed a similar pattern to collar tracking data. Seasonal data shows that this pattern is consistent across seasons, but with more intense visitation occurring at sunset in the winter months (Fig. 1). During the rut period, from October-December, there was more activity near buildings during the daytime than in other months. Human visitations, as recorded by the cameras, peak at 1pm (Fig. 5), which is very similar to the activity registered by the people counters at trails (Fig. 6). It appears that the human visitations pushed deer activity into the night hours, however, this trend in not evident during the twilight hours.

Humans tend to visit the PERT grounds less frequently in the morning hours (Figure 9) than in the evening. Seasonally, the visitations were less frequent in winter months compared to spring (peaks in March and May) and during summer.
The human presence, as indicated by the trail counters, had a profound effect on racoon visitation to the feeding station. The racoon and fox visits were, in general, confined to the dark hours, but they also had a pronounced peak at the sunset and sunrise hours (Figs. 7, 8).

Bird activity was constrained by daylight hours and was not different from the human counter results, except the latter also registered dark hour human visits, which were non-existent in birds.

Discussion

The pattern of deer movements indicates that the deer were moving both by daytime and nighttime, but as the trail cameras indicate, the daytime movement occurred away from the feeding station. This suggests that there is a temporal exclusion of the deer from the areas with frequent human visits.

Seasonal pattern of deer visitation to trapping stations indicate that visits are most concentrated in early winter months and early evening. Deer movement peaked in the last months of fall. This movement was not reflected by the trail camera. This means the feeding station does affect deer movement in early winter months but does not disrupt movement behavior in spring, summer, and fall.

Visits of foxes and racoons to the feeding station indicate clear temporal exclusion of the species by humans.

In contrast to a difference in deer activity between trailcams and collar data, trailcams and people counter data were consistent for recording human activity.

Conclusions

Although the photos of deer taken at a feeding station somewhat reflect the overall activity pattern of deer movement, during the rut period there is a notable difference in the frequency of visitation. Comparison with the movement data reveals the activity which was not recorded by the trail camera. In general, it appears that the trail cameras provide biased statistics and cannot be used to monitor activity of animals in a setup where human activity is apparent.

References

Clover, M. R. 1954. A portable deer trap and catch-net. California Fish and Game Journal, 40:367–373.

Potapov, E., A. Bedford, F. Bryntesson, S. Cooper, B. Nyholm, and D. Robertson. 2013. White-Tailed Deer (*Odocoileus virginianus*) Suburban Habitat Use along Disturbance Gradients. American Midland Naturalist, 171:128-138.

R Core Team, 2017. R Development Core Team. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing; R Core Team: Vienna, Austria, 2017. Available online: http://www.R-project.org (accessed on 31 January 2018).

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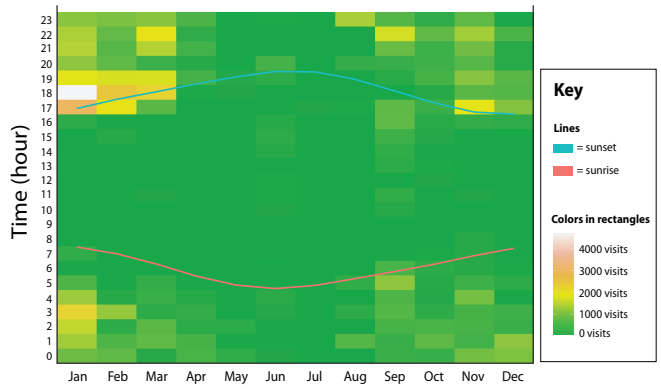

Figure 1. Hourly distribution of deer visits to the feeding station.

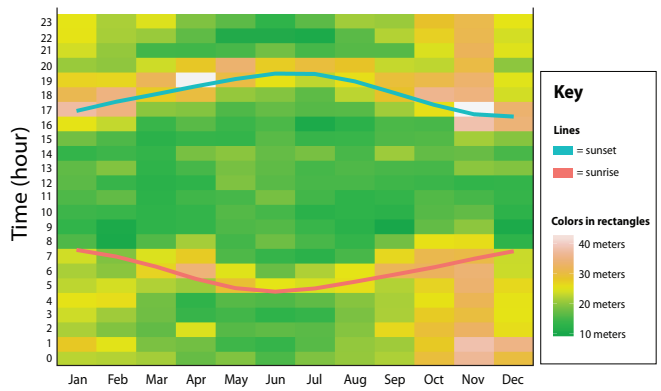

Figure 2. Average distance (meters) traveled by male and female deer between 5-minute GPS fixes.

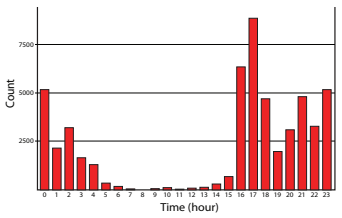

Figure 3. Distribution of deer visits to the feeding station.

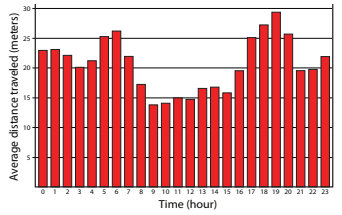

Figure 4. Hourly distribution of distances traveled by deer.

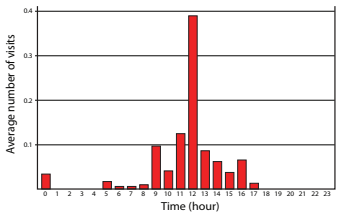

Figure 5. Hourly distribution of human visits to the trapping station.

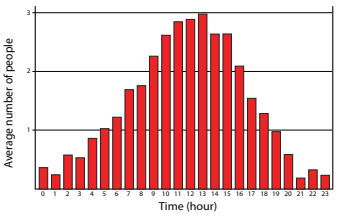

Figure 6. Hourly distribution of people on trails, counted by people counters.

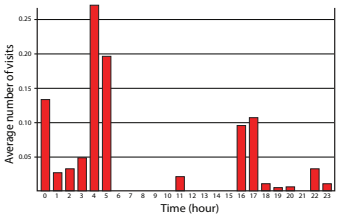

Figure 7. Hourly distribution of fox visits to the trapping station.

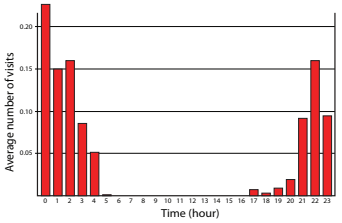

Figure 8. Hourly distribution of racoon visits to the trapping station.

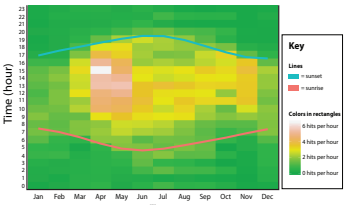

Figure 9. Hourly distribution of human visits to PERT across a calendar year.