

JON D. NELSON<sup>1\*</sup>, MATTHEW ORR PHD<sup>2</sup>, AND EMILY C. WEIDNER<sup>3</sup><sup>1</sup>OREGON DEPT. OF TRANSPORTATION; <sup>2</sup>OREGON STATE UNIVERSITY-CASCADES; <sup>3</sup>DEPT. OF FISHERIES AND WILDLIFE, OREGON STATE UNIVERSITY

## INTRODUCTION

- Heterospecific competition for carrion may influence community structure; organisms generally use heterospecifics to avoid predators or to find food (Seppänen et al. 2007).
- Dominant species are predicted to exploit subordinate, social species to gain access to resources (Goodale et al. 2010).
- Carcasses attract diverse guilds of scavenging species, which offers an opportunity to evaluate the above predictions (Cortes-Avizanda et al. 2010).

## HYPOTHESES

In this study, we tested the following hypotheses concerning transfer of information between heterospecifics:

- H1: Raptors use ravens (*Corvus corax*) to locate carrion.
- H2: Raptors benefit ravens by tearing open a carcass and providing access to meat.
- H3: Ravens intentionally recruit raptors to open carcasses for them.

## METHODS

## BAITS

Initial trial baits were five steer heads, where we found raptors arrived shortly after ravens.

- We then tested H1 - 3 using road-killed mule deer (*Odocoileus hemionus hemionus*).
- Carcasses were placed >150 yards from roads and were separated spatially by >5 miles and/or temporally by >14 days (Figure 1).
- Motion-activated Bushnell Trophy Cam® was placed approximately 15 feet from each carcass. Cameras took three photographs per detection with 15 second intervals between subsequent activations.
- Some carcasses were experimentally opened to remove the possible incentive to recruit raptors.

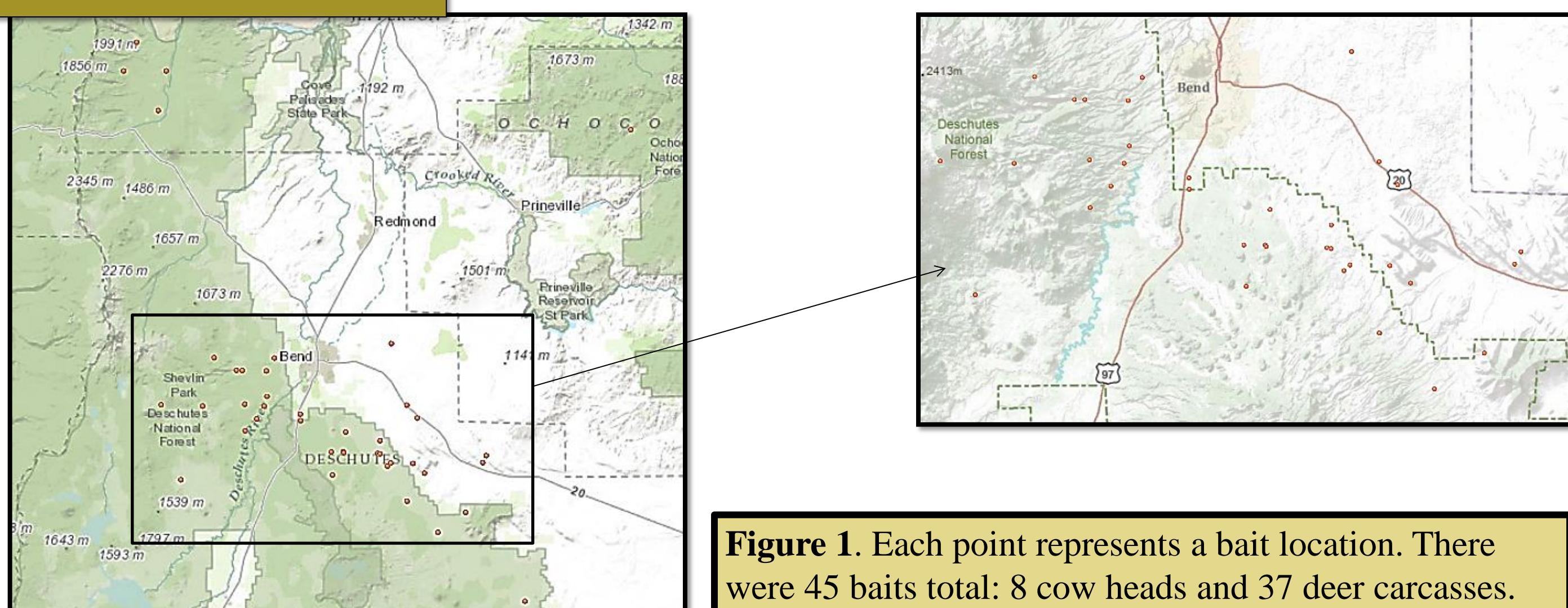
## PHOTO ANALYSIS

- For H2, 50 raven feeding locations (head, anus, or muscle/viscera) were recorded before and after raptor arrival, scan-sampling once per minute.

## STATISTICS

- H1: Linear regression for raven vs. raptor arrival times correlation.
- H2: Chi-square analysis for raven feeding location (anus & head vs. muscle) before and after raptor arrival.
- H3: T-test to compare raptor arrival times after ravens at open versus closed carcasses.

## STUDY AREA

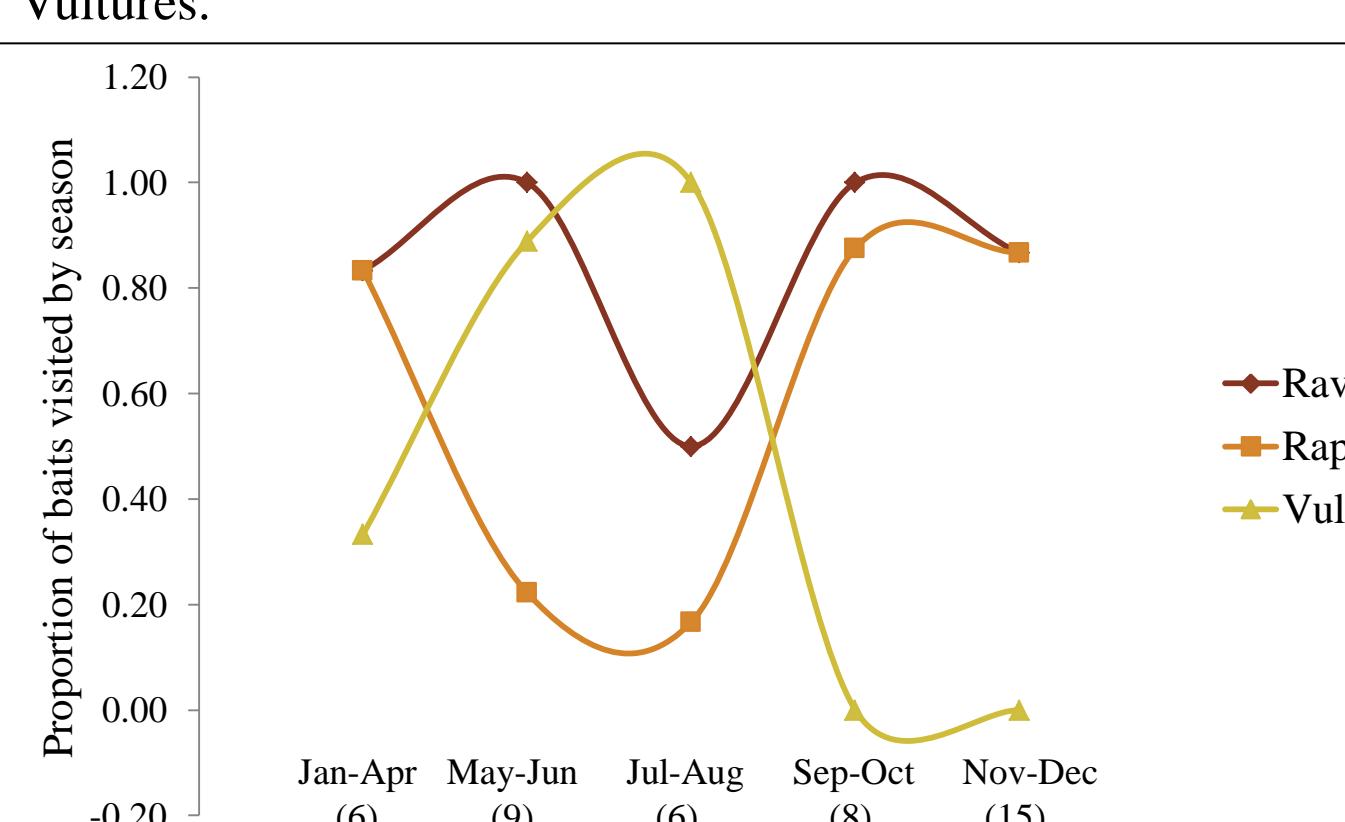


## RESULTS

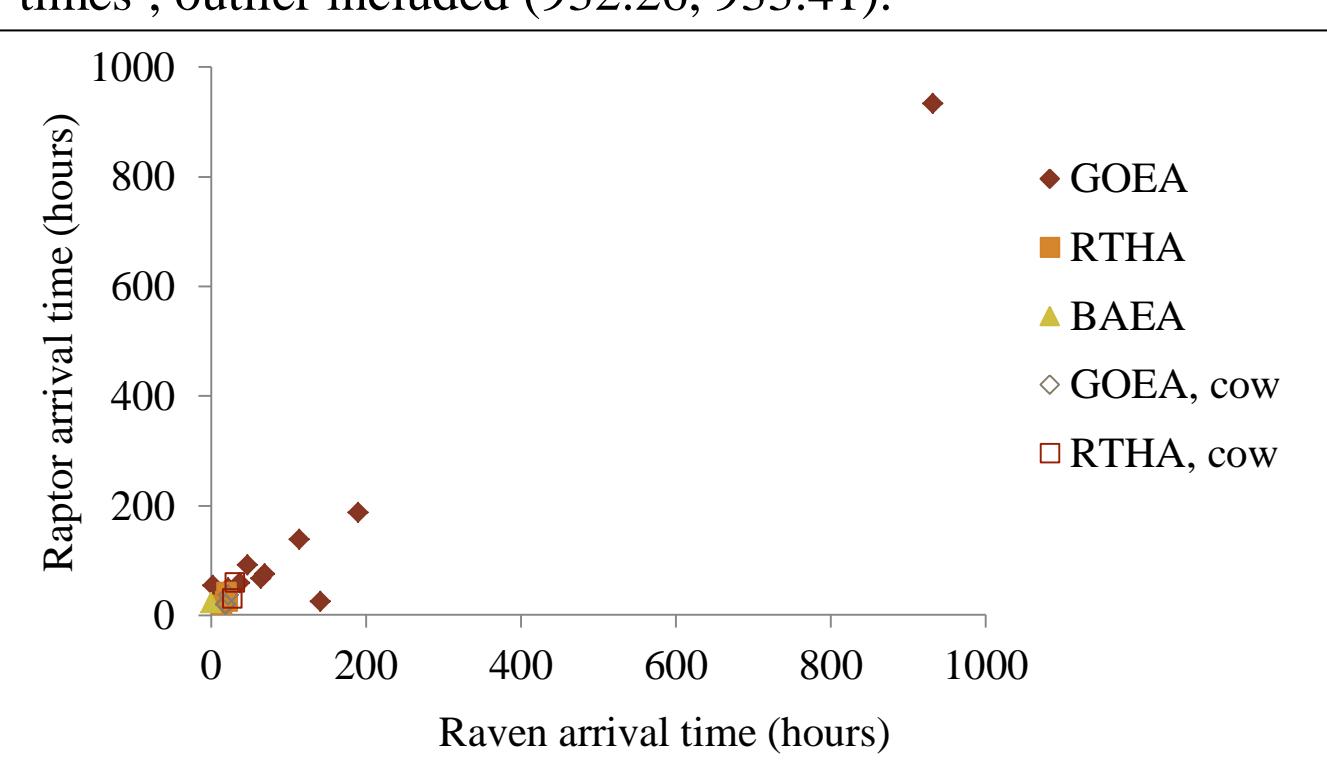
- Carcass utilization by ravens and raptors tended to overlap and differed from seasonal use by Turkey Vultures (*Cathartes aura*) (Figure 2).
- In 22 of 24 carcasses (cow or deer), the first raptor arrived at a carcass after ravens, as shown by points above line. Approximately 48% of the variation in raptor arrival time at deer carcasses was explained by raven arrival time ( $R^2$  adj. = 0.48; df = 1,17; F = 15.8; P < 0.001) (Figures 3 & 4).
- At four out of five experimentally opened carcasses ravens did not change feeding location before and after raptor arrival. In contrast, at all six closed carcasses ravens changed feeding location (extremities to muscle/viscera) after raptors arrived (Table 1).
- Time required for first raptor to arrive after first raven did not differ between experimentally pre-opened deer carcasses (19.7 + 16.3 hr; median 22.2 hr) and intact deer carcasses (103.7 + 268.4 hr; median 23.5 hr; T = -0.48, df = 16, P = 0.63) (Figure 5).

\*Abbreviations for Figures 3 & 4: GOEA – Golden Eagle (*Aquila chrysaetos*); BAEA – Bald Eagle (*Haliaeetus leucocephalus*); RTHA – Red-tailed Hawk (*Buteo jamaicensis*).

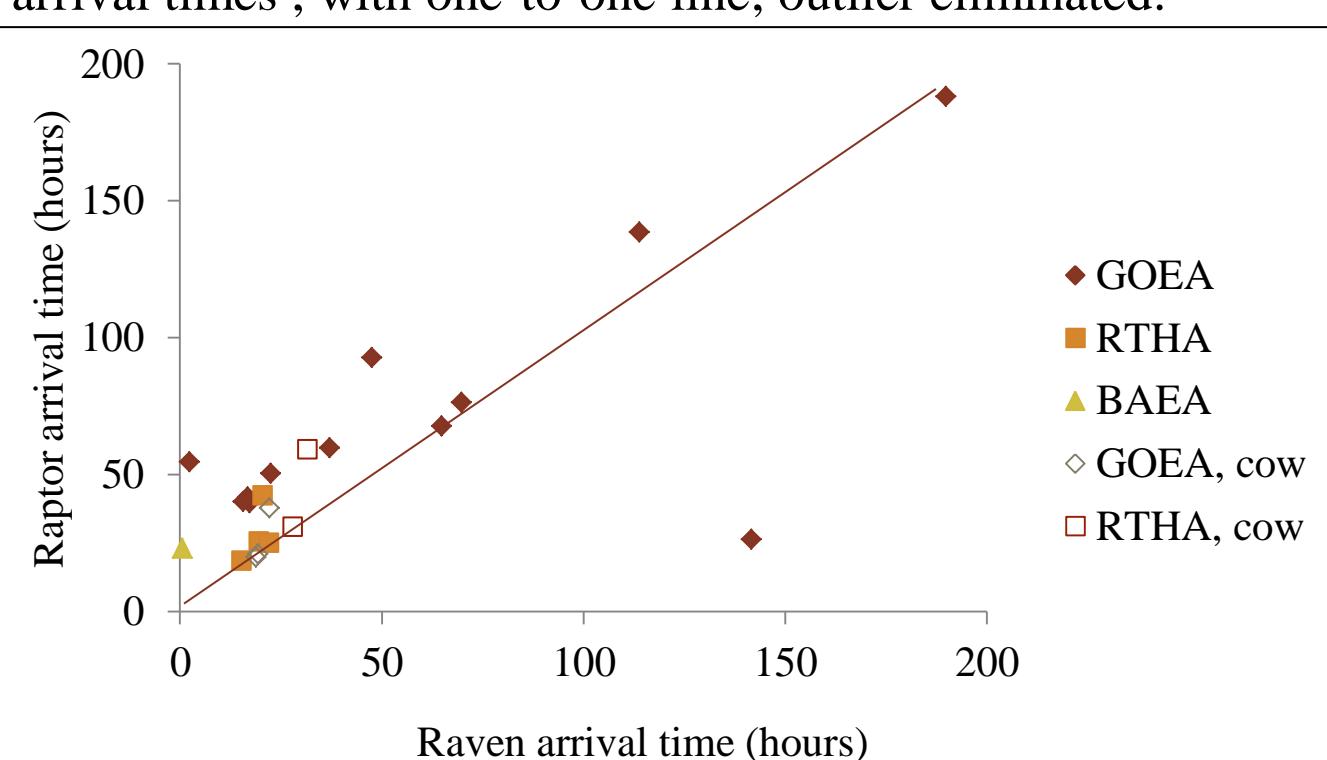
**Figure 2.** Seasonal distribution for ravens, raptors, and Turkey Vultures.



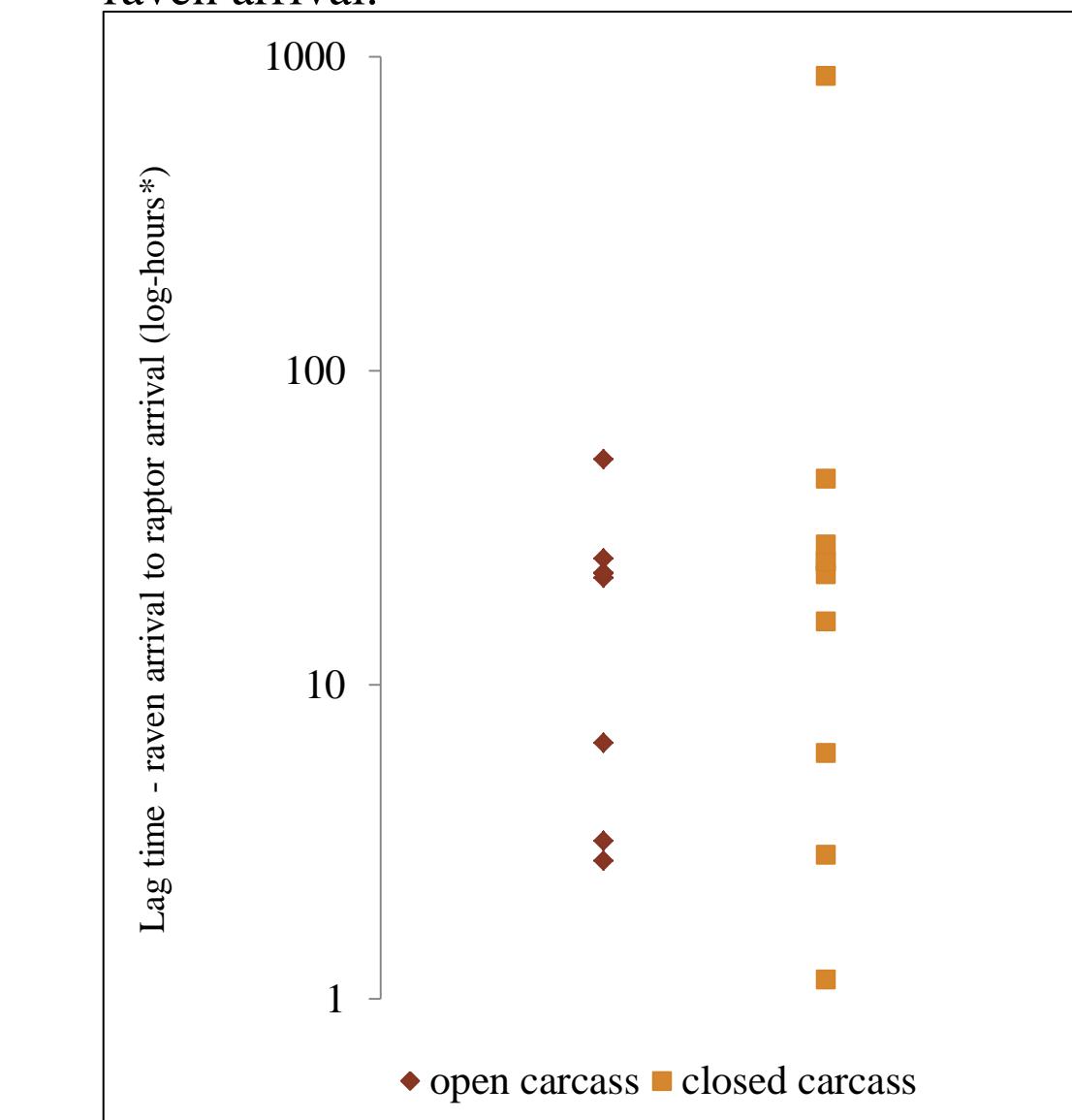
**Figure 3.\*** Scatterplot of raptor arrival times vs. raven arrival times ; outlier included (932.26, 933.41).



**Figure 4.\*** Scatterplot of raptor arrival times vs. raven arrival times , with one-to-one line; outlier eliminated.



**Figure 5.** Lag time of raptor arrival after raven arrival.



## DISCUSSION

Initial analyses suggest the following:

- H1: While there is a correlation between raptor arrival time and raven arrival time we did not analyze how other variables might influence the relationship.
- H2: There were significant shifts in raven feeding locations after a carcass was opened by raptors. Based on a limited number of carcasses (n=11), chi-square analysis suggests ravens may benefit from the presence of raptors at closed carcasses. Additionally, on baits where carcasses were experimentally opened, ravens were less likely to spend time feeding on extremities of the carcass.
- H3: Lag raptor arrival times did not differ between open and closed carcasses , which signifies that ravens may not actively recruit raptors to carrion resources.

## ADDITIONAL OBSERVATIONS

- Eagles were ubiquitous on carcasses from September to April with majority of utilization occurring in the cold seasons. Carrion is likely underrepresented in dietary analyses of golden eagles and it is possible that carrion, in certain areas, plays an important role in overwinter survival of eagles (Blázquez et al. 2009 & Sánchez-Zapataa et al. 2009). Further research is needed in order to quantify the importance of carrion in the diets of bald and golden eagles.



## SELECTED REFERENCES

- Blázquez, Miguel, J.A. Sánchez-Zapata, F. Botella, M. Carrete, and S. Eguía. 2009. Spatio-temporal segregation of facultative avian scavengers at ungulate carcasses. *Acta Oecologica* 35: 645–650.
- Cortes-Avizanda, A., M. Carrete, and J.A. Donazar. 2010. Managing supplementary feeding for avian scavengers: guidelines for optimal design using ecological criteria. *Biological Conservation* 143: 1707–1715.
-