Foraging frequency of juvenile Mountain Plovers (*Charadrius montanus*) among three Colorado habitat types

By Alan H. Harrington and Paul F. Doherty, PhD
Colorado State University

Abstract

Mountain Plover populations in North America have been subject to increasing population decline for more than 40 years. This decline has prompted scientists to further investigate habitat relationships in this species. During the summer of 2011 I examined the foraging frequency of juvenile Mountain Plovers among three habitat strata (prairie dog colonies, rangeland, and agricultural fields). Observations took place on private lands around Karval, Colorado, where a large breeding population of Mountain Plover exists. Due to an ongoing chick mortality study by Colorado Parks and Wildlife, I was able to collect data from chicks equipped with radio transmitters throughout the brood rearing season. My objective was to assess the habitat-specific and age-specific foraging rates of chicks. I found foraging rates did differ among habitat types, but not by age of chicks. Chicks in grassland habitat had the highest foraging rate, and chicks in agriculture habitat had the lowest foraging rate. I discuss my results without regards to prey availability and predation pressures. Understanding habitat use and foraging ecology of juvenile Mountain Plovers will provide important conservation implications for this species, and will contribute to the needs of further investigations.

Introduction

The Mountain Plover (*Charadrius montanus*) has been the focus of Endangered Species Act (ESA) listing activity for over two decades.[1,2] With this attention, previous studies have been undertaken to consider Mountain Plover ecology and to determine potential conservation measures needed. Of particular concern is juvenile survival and habitat use. A large amount of research has been done to look at chick survival. Examining various stages of development and associated juvenile growth and survival rates is crucial for identifying causes of declines in a species. Collecting such data with precocial, cryptic young is difficult.[3] Studies have also looked at habitat use of Mountain Plovers. Dreitz (2009) found that Mountain Plover chick survival and brood movements were influenced by habitat. This study more deeply examines the foraging frequencies of these juvenile birds among different habitat types, and as a function of chick age.

During the breeding season, Mountain Plovers have been shown to occupy three different habitat types: black-tailed prairie dog (*Cynomys ludovicianus*) colonies, grasslands without prairie dogs, and dryland agriculture.[4] Dreitz (2009) predicted that plover chick movement and survival would be highest on prairie dog habitat where prey density and biomass are greatest. The availability of the prey in these habitat types during the brood-rearing period is hypothesized to provide an explanation for chick survival and brood movement activity. Plover chicks' foraging opportunities may be affected by changes in food availability among habitats. Optimal foraging habitats are advantageous for the development of chick body mass.[5] Body mass has a positive effect on juvenile survival of Mountain Plover.[6] Based on previous studies, I predict chick survival will be highest where the foraging availability is greatest and juvenile plovers are able to gain maximum body mass.

Breeding habitat may provide the best foraging availability or broods may disperse to other habitat types. Dreitz (2009) found that plovers that nested in prairie dog habitat, containing the highest survival of chicks, moved to other habitat types and did not remain only in prairie dog habitat. Breeding habitats that minimize the energetic costs of foraging and reduce an organism's exposure to predators are the most suitable for survival.[7] Individuals that are able to decipher between habitat types and the quality of those habitats will have greater survival and reproduction potential. Similar to the ability of individuals to select optimal habitat, the probability of chick survival also increases with age.[8] A chick that is able to survive to 11-13 days will triple its probability of surviving the entire first year.[1] Thus, parents that select for optimal habitats and raise chicks past 11-13 days should be the most effective at raising chicks to fledging. Understanding the use of different habitat types by young birds may have important conservation implications due to the fact that the survival of young is reflective on the population dynamics of that species.[9] Conservation efforts that assess and reverse avian population declines demand reliable information on population status and habitat requirements.[10] Examining foraging frequencies of juveniles and the use of different habitat types, may inform managers on the population status of this species. This study describes chick foraging frequency among grassland, agricultural, and prairie dog habitats in the pre-fledging period of juvenile plovers. I propose that foraging rates will be highest in black-tailed prairie dog habitat and that the frequency of foraging will increase with age of plover chicks.

Methods

Study area and study species

The study took place near Karval, Lincoln County, CO (U.S.) (Figure 1). Lincoln County contains a high breeding population of Mountain Plovers. The area consists of dryland agriculture fields and cattle ranchlands. Populations of Mountain Plover are supported by the fertile short grass prairie ecosystem. There is limited public land within the study area. The region has three defined habitats. Active black-tailed prairie dog colonies, grassland habitat without prairie dogs, and fallow and active dryland agricultural fields will all be considered.

Mountain Plovers (Figure 2) are a migratory species native to shortgrass

prairies ranging from the Canadian border to northern Mexico. Mountain Plovers possess similar ecological and physical demographics as Killdeer (*Charadrius vociferous*).[11] Breeding birds choose to nest on bare ground with sparse vegetation. Adult males will select multiple sites for the nest and scrape at the ground to indicate location to the female. The female may lay two separate clutches during the breeding period where both the male and female will incubate in separate nests. The incubation process lasts from 28-31 days and chicks hatch within 24 hours. Once hatched, chicks are immediately able to find food and move along the ground until they fledge at 34-36 days. The Mountain Plover is an insectivore and obtains 100% of its water supply through its diet. For this reason, this species can persist in dry and arid locations, away from water sources.[12]

Field methods

I focused on areas where broods had been detected on the previous day as part of an ongoing chick mortality study.[6] I then located individual birds using telemetry, as the ongoing chick mortality study equipped adults and chicks with transmitters (Figure 3). All observations took place from All Terrain Vehicles (ATV) between 06:15 and 16:50. I kept a distance of at least 0.16 km from the brood so as not to disturb the birds. At the beginning of an observation period I recorded the habitat (grassland, prairie dog colony, agriculture) and the time of day. After a chick was detected, I confirmed the specific telemetry frequency of the chick by pointing the antennae at the bird and listening for the loudest response on the receiver among all of the possible frequencies. I observed the chick with binoculars and I counted, using a hand tally counter, every foraging attempt (i.e., peck at the ground or foliage). I assumed that each foraging attempt was successful. Counting took place for as long as I could observe the chick without obstruction. If a chick went out of my line of vision, I subtracted that amount of time from the total observation time to the nearest minute. Once a chick was either no longer in my sight or too far away to make accurate observations, I completed that observation by recording the time of day and total number of forage attempts for that chick. If another chick from the brood were visible, I would repeat my observation process. Once all observations were completed, I would immediately leave the area. The ongoing Mountain Plover chick mortality study provided me with the exact age of each of the chicks due to nest monitoring measures that took place.[6]

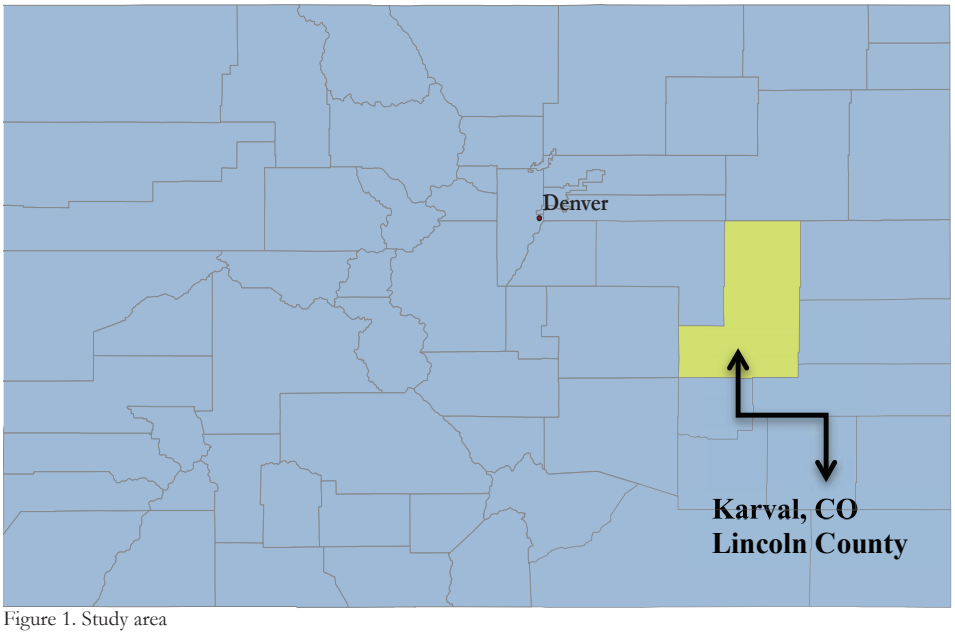

Figure 1. Study area


Figure 2. Adult Mountain Plover


Figure 3. Juvenile Mountain Plover with backpack transmitter

Analysis Methods

I defined foraging rate per individual as the number of foraging attempts per total minutes of observation. I compared foraging rate per habitat and per age of chick using an ANCOVA statistical test.[13] Foraging rate was a dependent variable and habitat type and age of chick were independent variables. I performed all analyses using Excel and considered tests with results of $p < 0.05$ to be significant.

Results

Results for foraging rate per habitat, showed a significant difference among strata. ($P=0.002$, $F(2,32)= 7.47$) (Table 2). Grassland had the largest average foraging rate of 0.88 attempts/minute and the greatest number of observations among strata. ANCOVA analysis was used to examine foraging rate and average age of chick for all habitats combined and among habitats. No significant differences were found among strata ($P= 0.78$, $r^2= .003$) (Figure 4).

Strata	Total Chicks/ Strata	Time Watched/ Strata (min)	Average Minutes of Observation/Day
Grassland	11	317	21.133
Prairie Dog	6	261	23.73
Agricultural	4	88	9.78

Table 1. Summary of juvenile Mountain Plover observations.

Strata	Average Foraging Rate (Attempts/min)	Standard Deviation
Grassland	0.877	0.247
Prairie Dog	0.455	0.498
Agricultural	0.19	0.461

Table 2. ANCOVA results for foraging rate per strata.

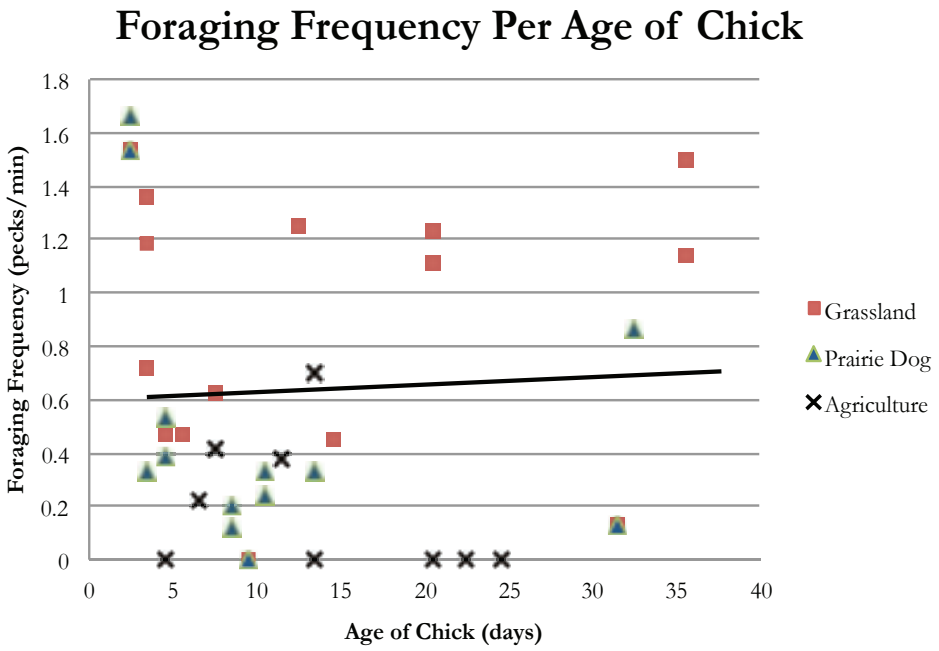

Figure 4. Foraging frequency among habitats and per age of chick.

Discussion

Our results did not support the hypothesis that foraging frequencies would be highest in black-tailed prairie dog habitat. Grassland habitat foraging frequencies were significantly greater. However, Schekkerman and Beintema (2007) note that prey resources can aggregate during the breeding season and among years as resources fluctuate. The quality of grassland habitat during the summer of 2011 could have supported greater resources. Other studies on shorebirds have suggested that broods will move to and remain in habitats that support the highest chick survival.[14,15] Dreitz (2009) showed that Mountain Plover broods have moved to areas with lower chick survival in the past. Potentially optimal foraging habitat has no direct correlation to chick survival in this species. Further studies should take this quandary into consideration.

Our results differ from other precocial juvenile chick foraging studies that show a significant increase in foraging rate as chicks increase in age.[16] I was unable to determine if each foraging attempt by juvenile plovers was successful. With my assumption that all attempts were successful, further studies should consider accounting for the differences in successful and unsuccessful foraging attempts. I assumed that chicks did not move among strata per observation and that individuals were identified and recorded correctly. I may have overlooked correlations among chick age, habitat, and foraging rate that were not demonstrated in this study.

If studies were to be conducted in the future, allocating efforts equally among strata, increasing the sample size, and observing chicks at different ages equally would greatly benefit the validity of foraging data. Differences in foraging activity may be due to prey resources as opposed to some other component of the three defined habitat types. Collecting information on food resources in each habitat type may enable researchers to determine if prey availability or ease of capture is contributing factor in foraging activity. A further understanding of the use of different habitat types by juvenile plovers may inform managers of the population status of Mountain Plover. Managing for optimal foraging habitat by juvenile Mountain Plovers may greatly contribute to the conservation of this species.[17]

Acknowledgements

I would like to thank the private landowners who allowed access to their lands. This research would not have been completed without assistance from Dr. Victoria Dreitz, Maggie Riordan, Lindsey Messinger, and Colorado Parks and Wildlife who hired me as a field technician for the Mountain Plover chick mortality study. My mentor, Dr. Paul Doherty, gave insurmountable advice to me with his recommendations and guidance.

References

[1]Dinsmore, S. (2000). Endangered Animals: a reference guide to conflicting issues. Greenwood Press. Pg 213-218.

[2]N.A. (2011). "Mountain Plover." U.S. Fish and Wildlife Service Endangered Species. U.S. Fish and Wildlife Service. <http://www.fws.gov>. (Accessed 08/30/2011).

[3]Miller, B. and Knopf, F. (1993) "Growth and Survival of Mountain Plovers." Journal of Field Ornithology. 64.4. Pg 500-506.

[4]Dreitz, V. (2009). "Parental Behaviour of a Precocial Species: Implications for Juvenile Survival." Journal of Applied Ecology. 46.4. Pg 870-878.

[5]Knopf, F. (1998). "Foods of Mountain Plovers Wintering in California." The Condor. 100.2. Pg 382-384.

[6]Dinsmore, S., White, G. and Knopf, F. (2003). "Annual Survival and Population Estimates of Mountain Plovers in Southern Phillips County, Montana." Ecological Applications. 13.4. Pg 1013-1026.

[7]Poysa, H., Elmberg, J., Sjoberg, K. and-Nummi P. (2000). "Nesting Mallards (Anas platyrhynchos) Forecast Brood-stage FoodLimitation When Selecting Habitat: Experimental Evidence." Oecologia. 122.4. Pg 582-586.

[8]Graul, W. (1975). "Breeding Biology of Mountain Plover." Wilson Bulletin. 87.1. Pg 6-31.

[9]Anders, A., Dearborn, D., Faaborg, J. and Thompson, F. (1997) "Juvenile Survival in a Population of Neotropical Migrant Birds." Conservation Biology. 11.3. Pg 698-707.

[10]Tipton, H., Doherty, P. and Dreitz, V. (2009). "Abundance and Density of Mountain Plover (Charadrius montanus) and Burrowing Owl (Athene cunicularia) in Eastern Colorado." Auk. 126.3. Pg 493-499.

[11]Sibley, D. (2000). The Sibley Guide to Birds. Alfred A. Knopf, Inc. Pg 167.

[12]Knopf, F. (1996) "Mountain Plover (Charadrius montanus)." In: Poole, Alan and Gill, Frank, eds. The Birds of North America, Inc. Pg 1-16.

[13]McDonald, J. (2009). "Handbook of Biological Statistics." Sparky House Publishing. Pg 232-237.

[14]Lengyel, S. (2006) "Spatial Differences in Breeding Success in the Pied Avocet (Recurvirostra avosetta): Effects of Habitat on Hatching Success and Chick Survival." Journal of Avian Biology. 37. Pg 381-395.

[15]Schekkerman, H. and Bientaema, A. (2007). "Abundance of Invertebrates and Foraging Success of Black-tailed Gotwit (Limosa limosa) Chicks in Relation to Agricultural Grassland Management." Ardea. 95. Pg 39-54.

[16]Schekkerman H,. and Boele, A. (2009). "Foraging in Precocial Chicks of the Black-tailed Godwit (Limosa limosa): vulnerability to weather and prey size." Journal of Avian Biology. 40.4. Pg 369-379.

[17]Dinsmore, S., Wunder, M. Dreitz, V,. and Knopf, F. (2010). "An Assessment of Factors Affecting Population Growth of the Mountain Plover." Avian Conservation and Ecology. 5.5. <http://www.ace-eco.org>. (Accessed 8/30/2011)