

Avian Communities' Changes in a Riparian Habitat

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ABSTRACT.

The degradation, alteration, and depletion of riparian habitats from human development and cattle grazing are among leading concerns for land managers and conservation biologists since they support some of the highest levels of avian diversity and density. When cattle are excluded from riparian habitats, the associated changes in habitat structure can also change the composition of the local avian communities. The Allegra Collister Nature Preserve, Boulder County, Colorado, is an example of a riparian habitat that has experienced such a change. In addition, the Allegra Collister Nature Preserve is associated with a 50-year bird banding record that provides information on species richness, relative abundance and sex as well as physical characteristics (e.g. body fat, weight and age) that can be used to infer migration behaviors. This study utilizes the long-term bird banding data to study how the avian community composition has changed since the establishment of the cattle exclosure. These data indicated that the majority of the species observed at this site had no significant difference in abundance pre- or post- cattle exclosure. Those species that appeared to benefit from the cattle exclosure include urbanized communities as well as those species of concern such as the brewer's sparrow. Pine siskin's were the only species that appeared to have a negative response to the cattle exclosure. Further investigations in life history traits may further provide insight as to the patterns observed at ACNP.

INTRODUCTION.

Riparian habitats are considerably limited in the western United States as many riparian corridors are fragmented or degraded by human development and cattle grazing (Fletcher Jr. and Hutto 2008, Farley et al. 1994, Marzluff and Ewing 2001, Hinojosa-Huerta et al. 2008). It is estimated that 95% of the riparian habitats in the western United States have been degraded or destroyed by human activities (Ohmart 1994). Thriving riparian habitats host some of the highest levels of avian diversity and density because they are highly dependent on these areas as feeding, breeding and migratory stopover habitats. As such the Allegra Collister Nature Preserve, Boulder, CO, is an example of an intact riparian habitat surrounded by riparian areas under the influence of grazing.

ACNP is located in a riparian habitat and is bordered north and south by cattle and horse ranches (Figure A). This area is unique because it was initially part of the cattle grazing lands that surround the current habitat, but was set-aside in the latter half of the last century as a nature preserve. Since 1959 bird banding and monitoring have been occurring in the area through volunteer effort. The data collected at the site include, species, age, sex, body fat, weight, tail length, time of capture, hours of banding and recapture. Volunteers have been continuously collecting bird banding data at this location since 1959, with a small break in banding activity between 1985 and 1990 when the area was used for intermittent grazing (V. Dionigi personal communication, 2010). Originally these data were collected year round, however in 1978 banding events were split between spring and fall. Spring banding usually occurred between the end of April to the second week of June and fall usually began in the middle of August and continued to the end of October. While other locations in Colorado have long-term avian point count data sets, the data at ACNP are the *only* data that provide seasonal bird banding information for a continuous 50-year period. The data collected from avian point counts are limited in the information they can provide to land managers because it is often difficult to extrapolate population fitness through recruitment, reproduction, and survivorship (Bock and Jones 2004) from those data.

The data from ACNP include body condition and recapture occurrences which can be used to infer whether birds are utilizing the area as a migration stopover or whether they are staying to breed. It is a primary goal of this study to transfer all of the handwritten data to an electronic database, which will thus

allow for a more formal and complete data analysis to be conducted, as it will provide a more complete picture of the avian species composition and body condition dynamics over time.

In addition to assessing the changes in the avian species community, another goal is to determine how the habitat vegetation structure has changed over time. Similar to previous studies, (Hinojosa-Huerta et al. 2008, Brand et al. 2008, Dobkin et al. 1998), this study will test if the establishment of the cattle enclosure altered avian species community diversity and abundance at ACNP.

METHODS.

In order to determine how the avian communities have changed over time at ACNP the bird-banding data encompassing approximately 50-years was transcribed from original paper to an electronic format. This process of data transcription comprised approximately 250 hours of effort. The data were then imported into a Microsoft Access 2007 database for storage and to facilitate data management. This task comprised approximately 100 hours of effort to establish. Upon receiving the entire paper versions of the data it quickly became apparent that more data have been collected than what appear on the bird-banding data sheets. These data include further indications of level of effort as well as weather data and bird sightings. These data are currently in the process of being added to the database since they are considered important and necessary information but were not anticipated and therefore not included in the original budget of hours for the project.

The volunteer effort has been continuous since 1959, however the level of effort has varied. Prior to the number of banding days varied from 1 banding day in 1959 to 104 banding days in 1969. Since the level of effort prior to 1978 is highly variable including these data in an accurate analysis of the species composition at this site is difficult. However, since 1978 the level of effort indicated no significant difference in the number of banding events occurring between 1978 and 2010 (p -value < 0.05). These data indicate that level of effort has remained consistent since 1978. The only years to which data are available as to time of day an individual is captured or hours of banding effort per day were since 1991, banding effort per year was determined on number of banding days per year as well as banding days per season. As a result when analyzing the site for changes in species composition the data utilized in the analyses were since 1978.

The avian communities were categorized into three primary groups: 1) Species occurring only after the enclosure (since 1991), 2) Species occurring only before the cattle enclosure (1978-1985), and 3) Species occurring both before and after the establishment of the cattle enclosure. These categories allowed me to determine how the avian community has changed. Simple t -tests were conducted to compare the three categories to each other as well as bi-variate analyses were performed to determine the how individual species abundance has been affected. The significantly different individual species trends were then compared to the population trend data for Colorado (Sauer et al 2007) in order to determine if trends at ACNP differed from the overall population trend reported in Colorado.

Changes in riparian habitat condition at ACNP were examined utilizing archival aerial photographs obtained from the CU Benson Earth Sciences Library along with a ground survey of the current habitat condition. The archival aerial photographs obtained from the CU did not provide a high enough resolution of the area that any change in habitat could be discerned. While it was clear that vegetation has continued to exist the area when the area was not protected, I was not able to discern whether the vegetation was significantly different. A ground vegetation survey was conducted in June 2010 along an east-west transect of the habitat with circular vegetation plots with 11.3-m radii every 50 m along the full length of the ACNP study area (Dickson et al. 2009). At each circular vegetation plot tree, identification and size (diameter at breast height (DBH)) was recorded (Dickson et al. 2009) as well as ground cover types (forbs, grass, bare rock, bare ground water, etc.) and foliage height (Dobkin et al. 1998). This data continue to remain unanalyzed since there are no other time points to provide a comparison.

RESULTS

As a result of the effort to transcribe the 50-year bird banding data set to an electronic format

approximately 18,353 unique individuals have been captured representing 185 different species. Of the species represented at this site 29 comprise 81% of all the unique individuals captured, with the remaining 156 species comprising less than 1% each. Since 1978 no significant difference was determined in the number of banding events (p -value > 0.05). The banding years were divided into two categories pre-exclosure (1978-1985) and post-exclosure (1991-2010). Results of a paired t -test assuming unequal variances indicated that there was no significant difference in the number of banding days pre- and post- exclosure (p -value > 0.05). However the paired t -test assuming unequal variances did indicate that the number of individuals captured during both timeframes was significantly different (p -value <0.05).

For all species that were captured more than 2 years t -tests were conducted comparing pre-exclosure (1978-1985) individual species presence to post-exclosure (1991-2010) individual species presence. Of the 185 species represented 162 species comprised the 1978-1985 and 1991-2010 timeframes. Of these 162 species 29 species demonstrated a significant difference in occurrences between pre- and post- exclosure conditions (p -value < 0.05) (Table 1). Bivariate analyses of fit indicated that overall of the 29 species that indicated a significant difference in occurrences between pre- and post- exclosure, most of those species demonstrated an increase in population since 1978, including brewer's sparrows, except for pine siskins and white-crowned sparrows (p -values < 0.05). Species that were not present prior to the cattle exclosure include American kestrel, blue-gray gnatcatcher, blue jay, European starling, flicker intergrade, house sparrow, sage thrasher, and swamp sparrow. While these species appear after the exclosure, only the blue jay's trend shows a significant increase (p -value < 0.05) since 1991. The other species' that were not present prior to 1991 do not show significant increasing or decreasing trends.

DISCUSSION.

Riparian habitats are among one of the most crucial habitats for avian populations as they provide some of the most concentrated occurrences of avian diversity and density. As such proper management of these areas is critical. While it appears that many species have increased in abundance in the area since the exclosure was established in 1991 species that prosper in more urban settings such as blue jays, house sparrows and European starlings are also prospering at ACNP. This indicates that during the intermittent exposure to cattle grazing between 1985 and 1991, provided an opportunity for these and similar species to inhabit this highly valued area. According to the results of (Sauer et al. 2008) the population trends of house sparrows is decreasing in Colorado while ACNP indicates that this species is increasing at this site. However, while some urbanized species appear to be increasing at ACNP more sensitive species such as the brewer's sparrow are also benefiting at ACNP. According to the (IUCN 2010) and Sauer et al. (2008) brewer's sparrow populations are declining, however ACNP brewer's sparrow populations demonstrate a significant increase. This species is currently on the National Audubon Society's watchlist. At ACNP this species has been captured during both spring and fall banding events. The significant increase in occurrence at this site for this species indicates that ACNP is providing necessary habitat for species of concern.

The results from this study support the findings of Dobkin et al. (1998), who found an increase in species abundances on habitat that had been recently excluded from grazing. While the abundance trends at ACNP appear to support the overall population trends reported by Sauer et al. (2008) some species appear to be exhibiting different trends at ACNP than reported regionally; specifically brewer's sparrows and pine siskins. These notable changes are most likely interrelated to life history factors. Pine siskin's have been shown to demonstrate eruptive breeding cycles that are synchronous with boreal tree seed production cycles (Koenig 2001). While brewer's sparrows appear to prefer greater shrub cover and height (Chalfoun and Martin 2007), this indicates that the understory vegetation at ACNP has continued to flourish since the cattle exclosure was established. These two species represent an example of how life history traits may interrelate to observed abundance trends at ACNP. Further analyses are continuing to be conducted to determine other species life history traits that may explain population trends at ACNP.

The results presented here merely begin to unravel the story of the avian community at ACNP. Utilizing the database that was developed in this study, next will be an examination of species with the highest occurrence of recaptures, species migration lengths, and other life history traits. These data will continue to

be compared with what has been reported regionally in order to determine habitat factors of ACNP that make it a unique location for avian communities. The results of these further analyses will help land managers in determining how to adaptively manage conservation easements for targeted avian communities.

ACKNOWLEDGMENTS.

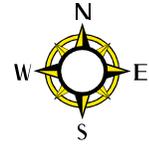
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Figure A

STUDY SITE MAP.

Map of Allegra Collister Nature Preserve (green outline), Boulder County, Colorado.

Located 40°10'30.17" N, 105°15'00.89" W. Image taken from GoogleEarth 2010.



Species Common Name	Species Scientific Name	t-test p-value	1978-2010 trend	1978-2010 p-value	1978-1985 trend	1978-1985 p-value	1991-2010 trend	1991-2010 p-value
American Goldfinch	<i>Carduelis tristis</i>	0.172	+	NS	-	NS	-	NS
American Kestral	<i>Falco sparverius</i>	0.101	+	NS	0	NA	-	NS
Black-capped Chickadee	<i>Poecile atricapillus</i>	0.008	+	NS	-	NS	-	0.0059
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	0.001	+	0.0005	0	NA	+	0.0513
Blue Jay	<i>Cyanocitta cristata</i>	0.001	+	0.0035	0	NA	+	NS
Brewer's Sparrow	<i>Spizella breweri</i>	0.002	+	0.0047	-	NS	+	NS
Bullock's Oriole	<i>Icterus bullockii</i>	0.009	+	NS	+	NS	-	NS
Cedar Waxwing	<i>Bombycilla cedrorum</i>	0.0369	+	NS	+	NS	-	NS
Downy Woodpecker	<i>Picoides pubescens</i>	0.048	+	NS	-	NS	+	NS
Dusky Flycatcher	<i>Empidonax oberholseri</i>	<<0.05	+	0.0038	-	NS	+	NS
European Starling	<i>Sturnus vulgaris</i>	0.0358	+	NS	0	NA	-	NS
Flicker Intergrade	<i>Colaptes auratus auratus x cafer</i>	0.0493	+	NS	0	NA	-	NS
Gray Catbird	<i>Dumetella carolinensis</i>	<<0.05	+	0.0022	-	0.0113	+	NS
Green-tailed Towhee	<i>Pipilo chlorurus</i>	0.0449	+	NS	-	NS	+	NS
House Sparrow	<i>Passer domesticus</i>	0.0216	+	NS	0	NA	-	NS
House Wren	<i>Troglodytes aedon</i>	<<0.05	+	0.0415	-	NS	-	NS
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	0.009	+	NS	+	NS	-	NS
Orange-crowned Warbler	<i>Vermivora celata</i>	0.003	+	0.034	-	NS	-	NS
Pine Siskin	<i>Carduelis pinus</i>	0.0092	-	<<0.05	+	NS	-	NS
Ruby-crowned Kinglet	<i>Regulus calendula</i>	0.047	+	NS	-	NS	-	NS
Red-shafted Flicker	<i>Colaptes auratus cafer</i>	0.0369	+	NS	+	NS	-	0.0366
Sage Thrasher	<i>Oreoscoptes montanus</i>	0.0298	+	NS	0	NA	+	NS
Song Sparrow	<i>Melospiza melodia</i>	0.00437	+	NS	-	NS	-	NS
Swamp Sparrow	<i>Melospiza georgiana</i>	0.021	+	NS	0	NA	-	NS
Trail's Flycatcher	<i>Empidonax alnorum/trailii</i>	0.0302	+	NS	+	NS	-	NS
Vesper Sparrow	<i>Poocetes gramineus</i>	0.0033	-	NS	-	NS	+	NS
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	0.0332	+	0.0008	-	NS	+	NS
Western Meadowlark	<i>Sturnella neglecta</i>	0.0137	+	NS	+	NS	-	NS
Wilson's Warbler	<i>Wilsonia pusilla</i>	0.0037	+	NS	-	NS	+	NS

Table 1. The 29 species that demonstrated a significant difference in occurrences between pre- and post- enclosure establishment. All other species captured at ACNP showed no significant difference in occurrences between pre- and post- enclosure. NS means non-significant p-value resulted from bivariate fit of analyses tests. NA means the species did not occur during that time period at ACNP.