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THE INTERRELATIONSHIPS BETWEEN A
RIPARIAN AND HUMAN HABITATS AS EXPLORED
THROUGH AVIAN FORAGING STRATEGIES.

Interrelationships between a Riparian and
OSMP Studies 4339

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Independent Study



INTRODUCTION

Colorado and more specifically Boulder County has one of the most varied ecosystems in North America. This ecological diversity, ranging from alpine tundra to deserts, allows for a large amount of species diversification. While riparian ecosystems are relatively uncommon, they play an important role in the Colorado community. They act as thoroughfares between the different mountain ecosystems and the prairie ecosystems by way of a river or stream. This diversity is evident in the communities of birds that inhabit the riparian habitat.

In order to preserve riparian habitats it is helpful to understand the interrelationships of a natural riparian ecosystem with a variety of human ecosystems. This interrelationship can be explored through the examination of avian foraging strategies. Every possible stratification is utilized in the infrastructure used by birds foraging in this habitat. The diversity of foraging behaviors within the riparian habitat are evidence of the importance of the riparian habitat of plains ecology.

STUDY AREA

The study took place at the base of the front range of the Rocky Mountains in Boulder, Colorado. Boulder creek runs through the town of Boulder and into the Colorado plains. The study area consisted of approximately one mile along Boulder Creek within Boulder city limits on City of Boulder open space. The part of the creek studied runs between 47th and 55th streets. This site is bordered to the south by a large field used to graze cattle, and to the north by a business park. The western border is determined by a highway (47th street), the eastern border is determined by 55th street, a railroad track running east-west bisects the area and provided an excellent place for birds to forage. A bike path runs along the creek from the mouth of Boulder Canyon to the city limits. This particular site was chosen because of the diverse surroundings of the riparian habitat. This study will show a relationship between human development (i.e. agricultural and developmental) and the ecosystem in which it encompasses.

Tree species that occupy the upperstory include the

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Populus angustifolia (Narrowleaf Cottonwood) from 25' to 60' in height, and the Salix spp. (Willow) from 25' to 50' in height. The understory species include the Prunus americana (American Plum) from 0 to 10' in height, Populus tremuloides (Aspen) from 20' to 30' in height, Ribes cereum (Wax Currant) 4' in height, Alnus tenuifolia (Mountain Alder) from 20' to 30' in height. There were numerous ground dwelling grasses and flowers. The most common ground plants were the Helianthus annuus (Common Sunflower), Salsola iberica (Russian Thistle), Achillea lanulosa (Yarrow), Ambrosia trifida (Ragweed), Dipsacus sylvestris (Wild Teasel), Buchloe dactyloides (Buffalo-grass), and Digitaria sanguinalis (Crab-grass).

Common invertebrates included the larvae of Scatophaga stercoraria (Dung Fly), Forficula auricularia (European Earwig) and several beetles from the order Coleoptera. Other invertebrates included the Lycosa gulosa (Forest Wolf Spider), members of the class Diplopoda and Chilopoda (Millipede and Centipede, respectively), Armadillo spp. (Pill Bug), member of the family Cicadellidae (Leaf Hopper), and Lumbricus (Earthworm). The majority of these invertebrates were found under cow dung in the field but many were scattered throughout study site.

METHODS

From July of 1989 to March of 1990 a total of 17 different

species of birds were observed foraging in the study area (Table I). Information is provided on twelve different species that were observed regularly. Observations were recorded by methods used by MacArthur (1958); Cruz (1978, 1981, 1986, 1988); Cruz and Delannoy (1984). I observed as many birds as possible by moving through the study area. The foraging behavior of all the birds observed were recorded.

The forest stratification where the birds were observed were recorded (i.e. ground, stump, understory, and upperstory). The method of foraging was recorded and defined as; 1. gleaning (food item removed from a surface area while on that substrate), 2. probing (food item removed by inserting beak into substrate), 3. pecking (food item removed by first tapping then probing), 4. scaling (scratching substrate to uncover food item), 5. dabbling (submerging only head to forage), 6. diving (submerging whole body underneath the water) and 7. rock gleaning (gleaning aquatic animals off of rock while on rock in stream).

The species of vegetation as well as the condition of the vegetation was recorded (i.e. live wood, dead wood). Also, the foraging height and the food item was recorded. The length of individual observations lasted from less than one minute to 10 minutes and the general foraging strategy was recorded. If a bird changed strategies then

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the change was recorded as a separate observation. When a flock was observed foraging the individuals were counted and if all were using the same method of foraging each individual counted for one observation. Observations were made in a large range of weather conditions, from sunny to snowing. Observations were made during the evening and afternoon hours [1400-1800]. The study lasted throughout the fall and winter of 1989-1990.

A percentage analysis was used for the description of the use of the different habitats (Table II). The riparian and surrounding habitats include the river, forest floor, trees, railroad tracks, and the human environment that consisted of lawns and parking lots.

The data was also arranged into 32 different categories. These categories are the combination of the food item, live wood or dead wood, forest stratification and the foraging strategy (Table III). The total number of times birds were observed foraging in each category was used in a percentage basis for the estimation of frequencies of use in the different categories (Table IV). Some foraging techniques contain two different categories (i.e. pecking involves probing to extract the food); therefore, the larger category will be counted in the analysis. Some species use a combination of different categories in their foraging behaviors. These sequence will be counted equally among the sequence categories.

RESULTS

A total 662 observations were collected. The majority of these observations were made within large flocks of birds. Only observations of > 2 will be discussed.

Foraging zones. There are species-specific interactions between the forest stratification and the foraging behavior of different species (Table II).

The field provided a wide array of foraging possibilities. Species that tend to flock such as the Starling (n=300), Canada Goose (n=206), and the Common Crow (n=62) were found foraging in the field 100% of the times observed. The field was also a popular foraging zone for the Magpie (n=23) 61% of the times observed. The Common flicker (n=9) was also observed foraging in the field, 11% of the times observed. The field was used by 31% of the foraging bird species (n=13).

The railroad tracks included the gravel and the vegetation at the base of the tracks. This vegetation was clear burned three months into this study. The Red-winged Blackbird (n=7) frequented this area 100% of the times observed foraging. This area was not the primary foraging area for the Common Grackle (n=5) however it played an important role with 20% of the observed times foraging at the tracks. The R.R. tracks were used by 23% of the foraging bird species (n=13).

The human environment, including lawns and pavement, was used only by the Common

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Grackle. Other birds did frequent this area but the Grackle was only observed foraging. The common Grackle (n=5) frequented the human environment to forage 60% of the times observed.

Within the riparian ecosystem there were three main components; trees, river and the forest floor. Two species foraged in the river exclusively, the Dipper (n=4) and the Mallard Duck (n=17). They consist of 15% of the foraging bird species (n=13)

The forest floor provided a foraging ground for many birds. The Black-capped Chickadee (n=7) spent 85% of observed times in this zone. The Dark-eyed Junco (n=11) spent 73% of observed times foraging in this zone. The Mountain Chickadee (n=3) spent 33% of observed times foraging on the forest floor. 38% of species foraged in this zone (n=13).

The forest trees were the most popular zone of foraging within the riparian community. The Brown creeper (n=7) used the trees within this community exclusively. This zone was also the most popular for foraging by the Common Flicker (n=9), 78%. The Mountain Chickadee (n=3) spent 67% of observed times in this zone. The Dark-eyed Junco (n=11) was observed to spend 27% of time foraging within the forest trees. The Common Grackle (n=5) spent 20% foraging in this zone. The trees were used by the majority of species (n=13), 54%.

Foraging strategies. Foraging characters can be found in table III. Birds foraging in

the Boulder Creek area often use a sequence of foraging behaviors (Table IV).

The Common Grackles most common foraging strategy was to glean off of the ground for animals (60%). The Red-winged Blackbird spent the majority of foraging time ground gleaning for animals (37%). The Common Flicker used the sequence of ground gleaning for animals and ground probing for animals 22% of times observed.

The flocking birds in this study preferred to forage as a sequence of ground gleaning and ground probing for seeds. The Common Crow and the Starling preferred to use this sequence 100% of the time. The Canada Goose spent the majority of time ground gleaning for seeds and grasses (100%). This was also an important foraging strategy for the Red-winged Blackbird (37%). The Magpie used the sequence of ground gleaning for seeds and ground probing for animals 52% and 56% of times observed respectively.

The Black-capped Chickadee used stump gleaning for seeds as their main foraging strategy (86%). The Dark-eyed Junco also used stump gleaning for seeds as their main foraging strategy (54%). Red-winged Blackbirds used this strategy 25% of times.

Understory gleaning for seed was used by the majority of times by the Mountain Chickadee (33%). This strategy was also important for the Dark-eyed Junco and the Black-capped Chickadee (36% and 14% respectively). The Mountain Chickadee also spent 33% of observed times foraging in the

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live understory and upperstory using probing methods.

The Brown Creeper and the Common Flicker both used a sequence of live upperstory probing and live upperstory scaling as a foraging strategy (86% and 44% respectively). The Common Flicker also used live upperstory pecking and dead upperstory pecking frequently (11% and 12%).

The aquatic birds that used aquatic foraging strategies were the Dipper and the Mallard. The Mallard used dappling 100% of times observed in Boulder Creek. The Dipper used a sequence of dappling, diving and rock gleaning 100% of times.

DISCUSSION AND CONCLUSION

Foraging zones. The results of the analysis demonstrated an important relationship between the foraging ecology of the avian community and the total ecosystem. This study showed that the riparian habitats' resources were used most by the avian community. The difference in the foraging assemblage of the avian community showed that the key habitat was the riparian habitat. The human habitats were used relatively little except by the flocking birds.

The railroad tracks disrupted the riparian habitat in an interesting way. The vegetation on 50' each side of the tracks were cleared burned each September. This did not allow ecological succession to happen. This opened up an avenue for different weeds, grasses, and young willows to

inhabit this area. Although the burning allows opportunistic plants to inhabit the area that may not be able to inhabit the originally, the foraging season is reduced. This allows for a constant variety of grasses and seeds for birds to forage for. The Red-winged Blackbird forages here exclusively. A small marsh acted as a breeding ground. This area consist of small diameter willows that attract the Red-winged Blackbirds from the breeding marsh. Strong (1987) also found this to be an important feature of Red-winged Blackbirds in a riparian environment.

Pastures are opportune places for many flocking birds to forage. They contain lower grasses with a different variety of plants provided by the cattle grain. Inherently they are open and serve as a good place for a flock to forage. This field also served a good place for raptors to hunt from. An American Kestrel was observed catching a Starling in this field. Many other hawks were observed perching in the Cottonwoods over the prairie dog town however the kills were not observed. The pasture was an important foraging place for the Canada Goose. After a snow a large gaggle would be foraging through the snow on grasses.

The human habitat contained lawns and a parking lot. The only visitors were Grackles. They were feeding on the lawn after a watering. This was the only activity that was observed. Any other human habitat mentioned would be more

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productive than this one.

The most productive foraging environment for the avifauna was the riparian habitat itself. The majority of birds did not forage out of this ecosystem. Clearly the vital link for the foraging birds is the riparian habitat. This study also showed that a community can exist if part of the original key ecosystem is not disturbed. It can also survive the change of habitats that surround the key ecosystem with out losing total diversity and perhaps failing. Johnson, Brown and Goldwasser (1983) also found this to be true of human disturbance around a riparian habitat. However, Rea (1983) suggests it is the amount and type of disturbance that dictates the amount of diversity lost. He goes on to say that the destruction of the natural surrounding habitat also has a role in determining the diversity if the area. Rea describes changes in birds migration habits i.e. birds coming or leaving the area at abnormal times, lower quantity of avifauna and a disturbed breeding cycle. Rea (et al.) described the importance of the riparian habitat as the key local habitat and it must remain in its natural state.

Foraging strategies. The avian community showed species specific use of the riparian resources. The forest infrastructure - ground, understory and upperstory were used, for the most part, by different species. Each of these birds have a special

adaptation for foraging in its zone. However there are some generalists- Magpie and Flicker that prefer to feed in certain zones but can be found in most.

The species that prefer to forage off of the ground often used a sequence of gleaning for seeds and then probing for seeds or animals. This was the most prominent foraging sequence. The avifauna that foraged on the ground almost fed exclusively on the ground. These birds were the different kind of blackbirds and the Flicker.

An important resource in the pasture was under the cow dung. Many insects survived the winter under the dung. Live insects were found after snows and frosts. This also provided a place for seeds to germinate and fresh food for the avifauna. Many birds used this resource. The magpie and the Flicker used this resource the most.

Three species frequently foraged on the stumps in the study area. They mostly gleaned or probed for seeds or animals. The Black-capped Chickadee and the Dark-eyed Junco spent the majority of time stump foraging. The smaller birds were observed foraging on stumps or in the understory. The Chickadees and the Juncos were observed to glean off the buds of the young willows. They also were observed gleaning off of the base of these willows for apparent seeds.

The upperstory was dominated by the Common Flicker and the Brown Creeper. Both used a sequence of upperstory probing

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and scaling. The Flicker also used upperstory pecking as a foraging strategy.

The Mallards and Dippers foraged in Boulder Creek exclusively. The Mallards mainly dappled for aquatic vegetation. While the Dippers used a variety of foraging techniques.

All of the foraging behaviors did not deviate from the general behavior described in Audubon et al. The availability of food during the winter did mold the foraging behavior somewhat. Insects did exist but were mostly under the cow dung. Seed foraging was observed the most during the winter as may be expected.

Individual foraging strategies.

Many of the avifauna had interesting or different foraging strategies.

I observed a Magpie scavenging of the carcass of a recently dead squirrel. The Magpie would peck at the skin with peak open to break through. After the Magpie had broke through it continued to peck with beak closed as to carve out meat. Then the Magpie went on to pull out the meat. This process went on until the bird was disturbed.

The Brown Creeper had an interesting foraging strategy. The birds would fly to the base of a tree trunk and scale and probe upwards in a corkscrew pattern. When the birds would get to a branch the birds would scale on the underside of the branch. When the branch ran out the birds would fly to the next branch up and land upside down and continue foraging. Then the

Creepers would fly to the base of the next tree and forage in the same manner from the base to the crown of the tree.

The Dipper had a very interesting foraging strategy. Usually the bird was seen rock foraging. Then they were observed to dive into the water and "fly". They were observed to go as far as ten feet underneath the water. In shallow water they would dapple in an erratic pattern. It would appear that they were chasing prey while running on the bottom or floating down the current. The Dippers spent much time pruning and sunning on the rocks in the middle of the creek. This strategy is consistent with Audubon's description.

The riparian habitat plays an important role in the ecosystem of Colorado. This study gives evidence that shows that there can be diversity in the avifauna if disturbance around the riparian ecosystem is limited. Also the degree of disturbance is important. The City of Boulder has an excellent green belt law. Perhaps it should be extended more to cover riparian habitats to prevent development that totally destroys the surrounding areas. Certainly the problem of water pollution has a great impact on the riparian ecosystem. These habitats are havens for wild life and must be preserved.

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LITERATURE CITED

Audubon Society, the. 1977. The
Field Guide to North
American Birds. 338-768
Cruz, A. 1978. Adaptive
evolution in the Jamican

Blackbird. *Ornis*.

Scand. 9:130-137

.1980. Feeding ecology
of the Black-wiskered Vireo
and associated gleaning
birds in Jamaica. *Wilson*
Bull. 92:40-52

.1981. Bird activity
and seed dispersal of a
montane forest tree.

Biotropica 13:34-44

. and Delannoy. 1984.
Feeding ecology of the
Elfin

Woods Warbler and assoicated
insectivorous birds in
Puerto Rico. *Carib. j. Sci.*
20:153-161

.1986. Avian community
organization in a mahogany
plantation on a neotropical
island. 286-296

Johnson, Brown, Goldwasser.

1983. Avian use of
Quitabaquito Spings Oasis.
Technical report University
of Arizona, Tucson. 1-13

MacArthur, R.H. 1958.

Population ecology of some
warblers of notheastern
coniferous forest. *Ecology*
39: 599-619.

Rea, M. A. 1983. Once a river.
76-110.

Strong, T.R. 1987. Bird
communities in the riparian
habitats of the Huachuca
Mountains and vicinity in
Southeastern Arizona. Ph.D
thesis, Univ. of Colorado at
Boulder.

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Table I.- Scientific and English names of birds foraging at Boulder Creek.

<u>Pica pica</u>	Black-billed Magpie
<u>Parus gambeli</u>	Mountain Chickadee
<u>Parus atricapillus</u>	Black-capped Chickadee
<u>Junco hyemalis</u>	Dark-eyed Junco
<u>Passer domesticus</u>	House Sparrow
<u>Cyanocitta cristata</u>	Blue Jay
<u>Picoides pubescens</u>	Downy Woodpecker
<u>Colaptes auratus</u>	Common Flicker
<u>Certhia familiaris</u>	Brown Creeper
<u>Agelaius phoeniceus</u>	Red-winged Blackbird
<u>Quiscalus quiscula</u>	Common Grackle
<u>Corvus brachyrhynchos</u>	Common Crow
<u>Sturnus vulgaris</u>	Starling
<u>Cinclus mexicanus</u>	Dipper
<u>Anas platyrhynchos</u>	Mallard
<u>Branta canadensis</u>	Canada Goose
<u>Falco sparverius</u>	American Kestrel

Table II.-Foraging zones for birds at Boulder Creek.

	Field	R.R.Tracks	Human	Tree	River	Floor	N=
Magpie	61%	13%	0	4%	0	22%	23
Mountain Chickadee	0	0	0	67%	0	33%	3
Black-capped Chickadee	0	0	0	14%	0	85%	7
Dark-eyed Junco	0	0	0	27%	0	73%	11
House Sparrow	0	0	0	0	0	100%	2
Blue Jay	0	0	0	100%	0	0	2
Downy Woodpecker	0	0	0	100%	0	0	2
Flicker	11%	0	0	78%	0	11%	9
Brown Creeper	0	0	0	100%	0	0	7
Red-winged Blackbird	0	100%	0	0	0	0	7
Common Grackle	0	20%	60%	20%	0	0	5
Common Crow	100%	0	0	0	0	0	62
Starling	100%	0	0	0	0	0	300*
Dipper	0	0	0	0	100%	0	4
Mallard	0	0	0	0	100%	0	17
Canada Goose	100%	0	0	0	0	0	206
Kestrel	100%	0	0	0	0	0	1

* Approximate figure because of large flock size.

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Table III.-List of characters used in the description of foraging strategies.

Character	Code
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TERRESTRIAL

Ground gleaning for animals	GGA
Ground gleaning for seeds/fruits/grasses	GGS
Ground probing for animals	GPA
Ground probing for seeds/fruits	GPS
Stump Gleaning for animals	SGA
Stump Probing for animals	SPA
Stump gleaning for seeds	SGS
Understory gleaning for animals	UGA
Understory gleaning for seeds/fruits	UGS
Understory gleaning on live wood	UGL
Understory gleaning on dead wood	UGD
Understory probing in live wood	UPL
Understory probing in dead wood	UPD
Understory pecking on live wood	UKL
Understory pecking on dead wood	UKD
Understory scaling on live wood	UCL
Understory scaling on dead wood	UCD
Upperstory gleaning for animals	PGA
Upperstory gleaning for seeds/fruits	PGS
Upperstory gleaning on live wood	PGL
Upperstory gleaning on dead wood	PGD
Upperstory probing in live wood	PPL
Upperstory probing in dead wood	PPD
Upperstory pecking on live wood	PKL
Upperstory pecking on dead wood	PKD
Upperstory scaling on live wood	PCL
Upperstory scaling on dead wood	PCD

AQUATIC

Dappling in river	DAP
Diving in river	SUB
Rock gleaning	RG
Foraging on shore	LND
Foraging on vegetation	V
Foraging on animals	A

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Table IV.-Description of foraging strategies of birds at and in Boulder Creek. **

	N=	<u>FORAGING CATAGORIES</u>								
		GGA	GGs	GPA	GPS	SPA	SGS	UGS	UGL	UPL
Magpie	23	0	52% s	56% s	13%	4%	0	0	4%	0
Mountain										
Chickadee	3	0	0	0	0	0	0	33%	0	33%
Black-capped										
Chickadee	7	0	0	0	0	0	86%	14%	0	0
Dark-eyed										
Junco	11	0	9%	0	0	0	54%	36%	0	0
House Sparrow	2	0	100%	0	0	0	0	0	0	0
Blue Jay	2	0	0	0	0	0	0	0	100%	0
Downy										
Woodpecker	2	0	0	0	0	0	0	0	0	0
Flicker	9	22% s	0	22% s	0	0	0	0	0	0
Brown Creeper	7	0	0	0	0	0	0	0	0	0
Red-winged										
Blackbird	8	37%	37%	0	0	0	25%	0	0	0
Common										
Grackle	5	60%	20%	0	0	0	0	0	0	0
Common Crow	62	0	100% s	0	100% s	0	0	0	0	0
Starling	300	0	100% s	0	100% s	0	0	0	0	0
Canada Goose	206	0	100%	0	0	0	0	0	0	0

	N=	<u>FORAGING CATAGORIES cont.</u>									
		UKL	UKD	UCL	PGS	PGL	PGD	PPL	PKL	PKD	PCL
Magpie		0	0	0	4%	0	0	0	0	0	0
Mountain											
Chickadee	0	0	0	0	33%	0	0	0	0	0	
Downy											
Woodpecker	100% s	0	100% s	0	0	0	0	0	0	0	
Flicker	0	0	0	0	0	0	44% s	11%	22%	44% s	
Brown											
creeper	0	0	0	0	0	0	86% s	0	0	86% s	
Common											
Grackle	0	20%	0	0	0	0	0	0	0	0	

	N=	<u>AQUATIC FORAGING CATAGORIES</u>					
		DAP	SUB	LND	RG	A	V
Dipper	4	100% s	100% s	0	100% s	-	-
Mallard	17	100%	0	0	0	0	100%

**s denotes a foraging behavior that is part of a sequence. A sequence is calculated as one behavior.