Human Impact and the Nesting Success of the American Robin (*Turdus migratorius*) in Two Riparian Areas of Boulder County

Environmental, Population and Organismic Biology
Honors Thesis

Soley B. Snyder

Advisor: Dr. Carl Bock
Committee Members:
Dr. Carl Bock
Dr. Alexander Cruz
Dr. Igor Gamow

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Abstract

North American songbird populations have decreased in the last decade, partly because of factors affecting nesting success. In order to preserve songbird populations, it is important to determine which factors are playing the most significant roles in nesting success. Humans may adversely affect nesting success simply through their presence, altering nesting behaviors of birds as well as causing habitat fragmentation, loss and degradation. This study examined the nesting success of the American Robin (*Turdus migratorius*) in two riparian areas with significantly different levels of human impact in Boulder County, Colorado. During the summer of 1994, nests were monitored until success or failure of the nest could be determined. Significant differences in success rates were observed on the two sites. On the more heavily impacted site, the Bobolink trail, 0.00% nesting success was observed, while on the less impacted site, Coal Creek, 53.85% nesting success was observed. Though other factors differ between the sites, such as average tree size, human impact clearly affected nesting success.

Introduction

In recent years there has been a documented decrease in the populations of several North American songbirds (Haven & Johnson 1992, Knopf 1994). This decrease indicates a need to test population trends within songbird species to determine possible causes for this trend. Because the nesting season is critical for the maintenance of bird populations, and because riparian corridors offer critical nesting habitat, nesting success in these areas can be a good indicator of population trends. Studies of the nesting success of generalist bird species in riparian areas may indicate what is happening to song bird populations on a larger scale.

Riparian corridors have been noted as the most productive and valuable wildlife habitat in the Western United States (Knopf 1994), which is primarily composed of fragmented grassland and forest habitats connected by riparian corridors which provide narrow strips of prime habitat. Because of their long and narrow construction, inhabitants of riparian corridors may experience pressures associated with edge effects. This edge effect in fragmented habitats may be an important determinant of nesting success in riparian areas.

The nesting season is critical for birds, and many factors play a role in determining if nesting attempts will be successful. In his 1993 study, Martin identifies several characteristics of nesting habitats - from the availability of nesting sites, the structure of the vegetation in the nesting area, or the type of nest built, to the density and composition of predator species - which can contribute to a nest's chance of success. The availability of nest sites along with the density and distribution of nests in an area may affect nesting success in an area as well. If suitable nest sites, well hidden and near food sources, are scarce or unavailable, birds nesting in the area are likely to have low nesting success. Nest density, distribution, and location may also determine whether nests are successful, or become the victims of depredation. Martin (1993*a*) also notes

that nest predation appears to be higher in areas with high densities of nests, and lower in areas with more potential nest sites. Areas with high nest densities are easier for predators to search, as the chances of randomly finding a nest increase as nest density increases. However, if there are many suitable nest sites in an area, predators must search more potential sites for nests, thus reducing the efficiency with which nests are found (Martin 1993c). Dense canopy and ground vegetation also helps to protect nests by guarding nests from a predator's view. Martin has found that nests with greater concealment had lower predation rates in 29 of 36 studies (Martin 1993c).

The type of nest also may contribute to the success of the nest: in shrub and grassland habitats, ground nests have been found to have lower overall success than arboreal nests (Martin 1993a), and open cup nests have been shown to have lower success than cavity nests (Martin 1992).

Humans may affect bird nesting success in several ways, ranging from habitat destruction to the introduction of new predator species. Habitat fragmentation may cause direct loss of nesting habitat features needed by breeding birds. Habitat loss may lead to a decrease in potential nest sites which affects nesting success as birds are forced to use unsuitable nest sites (Martin 1993c). As human settlements sprawl throughout the West, valuable riparian habitats are destroyed by development or invaded by humans seeking passive recreational activities such as walking, biking, or exercising pets. These seemingly harmless human activities may have largely unnoticed detrimental effects on the nesting success of breeding birds. Some song birds will flush off of the nest when approached in an attempt to divert attention from the location of their nest. As humans pass by nesting birds, they may cause this flushing behavior, which may key predators in to the location of the nest. Frequent flushing events may cause the parent birds to

leave the nest unattended and unprotected as they attempt to divert attention from their nest site. Significant human presence may also disrupt feeding and incubating, causing parent birds to expend valuable energy guarding their nest and disrupting normal nesting behaviors (Cooke 1980, Knight 1984, Martin 1992a, 1993b, Miller 1994).

Habitat type, whether in its natural state or impacted by humans, not only determines the availability of nesting sites and food resources, but also influences predator composition and density. Areas with little ground cover and high log densities tend to attract small mammalian predators which use these as pathways in searching for nests (Leimgruber 1994). Human settlements increase the density of domestic predators such as domestic dogs (*Canis familiaris*) and cats (*Felis domesticus*). Scavengers such as raccoons and birds in the family Corvidae (jays, crows, magpies, ravens), both of which are frequent nest predators, may increase in density near human settlements or recreational areas, as humans often leave behind scraps of food or other objects these scavengers may desire (Andren 1992, Picman 1994). Five predation studies reviewed by Paton (1994) identified corvids as the primary predator in an area. Predation rates have been shown to increase significantly with the presence of a breeding pair of Black-billed Magpies (*Pica pica*), which supports the theory that avian predators are often the most dominant nest predators (Paton 1994). Because North American corvids appear to thrive in agricultural, suburban, and urban habitats (Craig, personal communication), riparian corridors surrounded by agricultural land may offer excellent habitat for these predators resulting in high corvid densities in these areas.

Because predation can be responsible for an average of 80% of nest failure (Andren 1992, Martin 1993a), determining the factors influencing predator type and density provides essential information about nesting success. Habitat type and patch size are closely related to edge effects

as edge habitats may support a greater diversity and density of predator species than unfragmented areas. High densities of these influential predators may significantly impact nesting success in riparian corridors. Many studies have focused on different factors influencing predation rates. Andren found in his 1992 study in Sweden that the density of corvids increased as forests became fragmented and intermixed with agricultural land. Andren suggests that this increase in corvid density is due to reliable food sources that can be found around agricultural fields and human settlements (Andren 1992). The study also found that as predator density increased, predation rates on artificial ground nests increased. Several studies have demonstrated that nest predation rates are greatest within 50 meters of an edge, and that predation rates increase near edges and with increases in nest and predator density.

These significant edge effects have been found in forested as well as non-forested areas, and are higher in urban than rural forest fragments regardless of patch size (Paton 1994). Though most nesting success and edge effect studies have been performed in forested areas, the edges created in forested areas are structurally much the same as the edges surrounding riparian corridors. Vegetation composition may differ between forest and riparian corridors but because edge effects are similar in both ecosystems, theory developed in forested areas may be applied to the fragmented habitats provided by riparian corridors. These and other studies provide evidence that habitat fragmentation has a significant impact on the nesting success of many bird species as predators increase along edges (Martin 1993c).

In this study, the nesting success of the American Robin (*Turdus migratorius*) was examined in two riparian areas. Riparian areas were chosen because of their importance as critical nesting habitat for many songbirds. We chose two sites with very different levels of human disturbance to study the effect this factor may have had on depredation rates. The American Robin was

selected because as a generalist species it may act as an indicator of what is happening within the ecosystem as a whole, and since Robins nest in many different types of habitats, studies can be repeated in other habitats and compared to riparian areas. Additionally, American Robin nests are relatively easy to find, and I was relatively certain that most nests in an area were located. Because human impact may create a disturbance to nesting birds, loss of suitable nesting habitat, and increased predator densities, I expected to see higher rates of predation in the area with more human impact, and higher nest success in the less impacted area.

Study Area and Methods

Study Area

This research was conducted in two riparian corridors and their surrounding areas near Boulder, Colorado. Potential nest predators at both sites included these corvids: Black-billed Magpies *(Pica pica)*, Common Ravens *(Corvus corax)*, American Crows *(Corvus brachyrhnchos)*, and Blue Jays*(cyanocitta cristata)*). Other predators were Common Grackles *(Quiscalus quiscula)*, owls, squirrels, raccoons, domestic cats, and snakes.

Site 1 (High Impact)

The first site was a one-mile stretch of the Bobolink Trail, approximately 75 meters wide, between Baseline Road and South Boulder Road, Boulder, CO ($40^0$00', $105^0$13'- $39^0$59', $105^0$12'45"). The primary canopy tree species were plains and narrowleaf cottonwood (*Populus deltoides, Populus angustifolia*), willow (*Salix fragilis*), and Russian olive (*Elaeagnus angustifolia*). The woody understory contained canopy tree saplings and shrub species including snowberry (*Symphoricarpos albus*), tamarisk (*Tamarix pentandra.*), green ash (*Fraxinus pennsylvanicus*), locust (*Robinia pseudoacacia*), poison ivy (*Toxicodendron rydbergii*), and gooseberry (*Ribes inerme*). The remaining ground cover was grass, sedge, and rushes.

Adjacent land, primarily pastures and wet meadow grasslands, has been preserved for breeding Bobolink (*Dolichonyx oryzivorus*) and managed for hay and livestock grazing after the breeding season. At a few points, the study area was within 150 meters of a community recreation center and private houses. On the Bobolink Trail, which runs the entire length of the study area, dogs were allowed off leashes, and people often walked off the trail. The trail has 300,000 visitors a year (Clint Miller, Wildlife Biologist, Boulder County Open Space, personal communication).

Site 2 (Low Impact)

The second study site was a one-mile stretch approximately 45m wide, of Coal Creek, south of Boulder along State Highway 93 ($39^0$55', $105^0$13'30" - $39^0$54', $105^0$13"). Again, the primary canopy species at this site were willow, cottonwood, Russian olive, and a few aspen (*Populus tremuloides*). The woody understory was primarily hawthorn (*Crataegus macracantha*), wild plum (*Prunus americanus*), and canopy species saplings. Ground cover was primarily grass. There was very little public recreation at this site which was managed for cattle grazing, with an adjacent gravel pit.

Methods

Preliminary Observations

From mid-May to late July 1994, I searched for and monitored active American Robin (*Turdus migratorius*) nests with the assistance of David P. Craig, a doctoral candidate in EPO Biology at the University of Colorado, Boulder. We searched for nest sites by observing the following bird behaviors: carrying nesting material, exhibiting nervous behaviors, and vocalizing (Martin and Geupel 1993). If a bird was spotted with nesting material, the bird was followed and

observed until it disappeared into a tree, bush, or shrub. That tree or bush, and surrounding vegetation, was then carefully searched until a nest was discovered. Often we found a nest after observing a female foraging rapidly or exhibiting a nervous behavior such as beak wiping, tail and wing flicking, or hopping rapidly between trees. Listening for vocalizations was key in identifying the general area of a nest and was used to find birds before they could be seen. Care was taken to minimize disturbance to adult birds so as to avoid disrupting the nesting process and attracting predators.

Records of Nest Success

We took detailed notes regarding nest location so that each nest could be found again, noting approximate distance from obvious landmarks, nest tree species, and a general description of the area. A female American Robin incubating eggs, a pair of birds carrying materials (grass, twigs, food, or fecal sacs) to or from a nest, or nestlings, indicated active nests. A nest was determined to be successful if one or more chicks fledged from the nest. A detailed log of field observations was kept for each visit to a nest. Included in the log were the date of the visit, presence and behaviors of adults, and the number of eggs or nestlings. Active nests were monitored at least three times a week until the fate of the nest was determined.

A nest was determined to have failed if it was abandoned or depredated. A nest was considered abandoned if no visits by adult birds were made to the nest and no activity was observed in the area before the expected hatching date for three or more visits.

Based on observations at the nest site, David Craig and Clint Miller, Wildlife Biologist for Boulder County Department of Open Space attempted to determine the type of predator responsible for depredation of each nest.

Vegetation Analysis

Vegetation was analyzed in order to determine and compare the general vegetation characteristics of each site. Randomly selected plots with a 10-meter radius were selected at both sites. Within each plot, all trees (any stem at least 3 meters tall and with a diameter at breast height (DBH) of at least 5 centimeters) were counted and measured for DBH. All saplings (any stem less than 3 meters tall and with a DBH of less than 5 cm) were also counted. Patches of shrubs (any woody stem smaller than a sapling) were measured using a standard measuring tape, to determine the approximate area of ground within the plot covered by shrubs.

Data Analysis

The chi-square contingency statistic was applied to the nesting data, to test for independence of site and frequency of nesting success versus failure. Standard t-tests were applied to the vegetation data to determine similarities and differences in vegetation characteristics.

Results

American Robin Nest Success Summer 1994

	Depredated	Abandoned	Fledged	Total	% Success
Bobolink	16	1	0	17	0.00
Coal Creek	6	0	7	13	53.85
	22	1	7	30	23.33

Open Cup Nest Success Summer 1994

	Depredated	Abandoned	Fledged	Total	% Success
Bobolink	16	1	0	17	0.00
Coal Creek	8	0	12	20	60.00
	24	1	12	37	32.43

Table 1

A total of 17 American Robin nests were found on study site 1, the Bobolink trail. Of these 17 nests, 16 were depredated and 1 was abandoned, and zero fledged at least one young,

resulting in 0.00% nest success. On site 2, Coal Creek, a total of 13 American Robin nests were found. Of these nests 6 were depredated, 0 were abandoned and 7 fledged at least one young, resulting in 53.85% nest success. The results showed that the predation was the most significant source of nest failure and that failure was significantly more common along the Bobolink trail (chi-square = 11.96, df = 1, $p < 0.0001$).

The results were similar when open cup nests of all species were included. At Bobolink the results were identical, as no open cup nests of other species were found. When additional open cup nests at Coal Creek are included in the data there were 20 total nests of which 8 were depredated, 0 abandoned, and 12 fledged at least one young, resulting in 60 % total nest success. Again predation was the major source of nest failure and failure was significantly more common along Bobolink Trail (chi-square = 15.07, df =1, $p < 0.0001$).

Vegetation Composition

	Bobolink (n=8)		Coal Creek (n=10)		
Tree Abundance	x=8.63	SD=10.95	x= 7.80	SD=9.04	t=0.18
Diameter at Breast Height	x=19.46	SD=8.84	x=13.49	SD=12.09	t=3.45 p<0.001
Sapling Abundance	x=22.13	SD=21.5	x=3.70	SD=5.76	t=2.61 p=0.0188
Shrub Area	x=60.0m	SD=64.26	x=62.9	SD=74.51	t=0.08

Table 2

The data show that there was no significant difference in tree abundance ($t = 0.18$) or area covered by shrubs ($t = 0.08$) between the two sites. However the trees at Bobolink have significantly larger diameters at breast height than the trees at Coal Creek ($t = 3.45$, $p < 0.001$), and there are significantly more saplings ($t = 2.16$, $p<0.0188$) at Bobolink as well.

Discussion

When I began this project, I expected that the American Robins at the Bobolink site would have lower nesting success than those at Coal Creek, but I did not expect no nest success at all. Though at this point it is not possible to determine the exact reasons for the drastic difference in success, the results indicate significant problems affecting the nesting success of the American Robin along the Bobolink trail. In the interest of conservation, more research is needed to determine what factors are playing the most significant roles in the lack of nesting success, and these factors should then be controlled for in order to provide a suitable breeding habitat.

It should be noted that one pair of Robins with two fledged young were observed, and their nest was located after fledging, along a drainage ditch that runs perpendicular to South Boulder Creek near the Bobolink site. However, the nest was not found before the young fledged, which occurred very early in the breeding season. This was the only indication of a successful nest observed on this site, and no other juveniles were observed in the area at any time during the study. Both sites had unexpectedly few nests, possibly because the weather in July and August was extremely hot (several consecutive days of temperatures over 95^0 F) and dry which may have limited second nesting attempts. Based on the number of birds and apparent nesting behaviors, my nest-finding experience, the ease of finding American Robin nests, and David Craig's assistance, I would estimate that most of the active nests were found on both sites.

The difference in nesting success between the Bobolink site and Coal Creek has interesting conservation implications because of the importance of the human impact factor. Human recreational impacts on Coal Creek are much less significant than at Bobolink. There are several miles of social trails, created by visitors hiking off the designated trail, and a large designated trail at Bobolink; at Coal Creek there are no designated or social trails within the study site (see

Fig.A-B). There is nearly constant human activity along the Bobolink trail from dawn to dusk; however I had only one encounter with another person at Coal Creek during the study season. The disturbance caused by human presence and habitat degradation at Bobolink contrasted with minimal human impact along Coal Creek may account for the significantly different rates of nesting success.

Because human impact is not the only factor that differs between the two study sites, the difference in nesting success cannot be described as a result of human impact alone. Though species composition of vegetation was similar on both sites, vegetation structure differed between the sites. The vegetation at Coal Creek was less dense along the creek, and the species composition of the understory structure was different than Bobolink. Coal Creek had several dense stands of hawthorn bushes, and surrounding land was primarily grassland. Vegetation data also showed that the trees at Bobolink were significantly larger than those at Coal Creek and that there were significantly more saplings along Bobolink. Intuitively it does not make sense that the area with larger trees and more saplings would have lower nesting success. It would seem that larger trees and more saplings would provide better nesting sites and act to better conceal nests from predators. However, the large trees may have acted as observation posts for avian predators, and the sapling cover may have offered cover for approaching mammalian predators. On the other hand, if the larger trees and greater number of saplings do provide a more suitable habitat, it may be that the increased human impact along the Bobolink trail is so significant that even with better habitat, changes in nesting behaviors and predator assemblages outweigh this benefit. The landscape also differed: Bobolink was more in the flat plains, while Coal Creek was bordered by a large hill to the East and was in a small valley. This difference in landscape may also be a determinant of predator assemblage, which could impact nesting success.

Not only were there differences in the vegetation between the two sites, but there were also observed differences in the structure of the avian communities at each site. Avian species richness was greater at Coal Creek than at Bobolink; 41 species were observed at Coal Creek in June and July, while only 32 species were observed at Bobolink during the same period. However, total bird density was greater at Bobolink than Coal Creek (Miller, personal communication). This difference in density may have been due to the large numbers of European Starlings (*Sturnus vulgaris*) found along the Bobolink trail. The presence of the Starling should not directly affect the nesting success of the Robin, as they do not compete for the same nesting resources. However, the great density of Starlings may have an impact on the general species diversity of the area, thereby affecting the types and numbers of nests found in the area. If there is a limited diversity of nest types in the area, predators may be able to develop an efficient search image leading to an increase in nest depredation.

Despite these habitat differences, due to the great difference in nesting success rates (0% versus 54%), and the significant difference in the level of human impact, this factor should not be ignored, as human recreation can have a variety of impacts on nesting birds. Because Robins may not be able to differentiate between non-predatory humans and other predators, when humans or their dogs come near a nest while walking off trail, they may disrupt normal nesting behaviors. Birds are very protective of their nests and will not return directly to the nest after foraging if they are aware of a predator/ human watching them or their nest. Instead they will wait in a near by tree or attempt to distract the predators attention from the area of the nest. High densities of humans in an area may cause parent birds to spend a disproportionate amount of time away from the nest and interrupt normal parenting and nest defense. If this occurs

frequently, predators may be able to use these disruptions, as well as flushing, as clues for locating nests.

Artificial nest experiments performed by David Craig (unpublished) during the nesting season produced some interesting results. He found that artificial nests along the Bobolink trail experienced 50% depredation, while the same type of artificial nests at Coal Creek had only 31.73% success. These results contradict the results found for real nests in these areas, the difference in results simply may be related to physical and placement differences between natural and artificial nests. Another factor may be the absence of a parent bird on artificial nests. If predators are using parental flushing behavior as a clue to finding nests, and this behavior is absent from artificial nests, predators may not be able to find them as easily as natural nests. If birds are flushing in the presence of humans, human recreation may have a significant impact on nesting success. A final important factor that may be at work on the Bobolink site is that the artificial nests were placed south of South Boulder Road, whereas my study occurred north of South Boulder Road where human activity appeared to be more concentrated.

I also observed what appeared to be a southward migration by the American Robins along Bobolink as the season progressed. Early in the nesting season, birds were abundant throughout the Bobolink study site. One of the first nests we found was high in a large cottonwood tree near the Bobolink trail head. As the season progressed, there were significantly fewer sightings of American Robins anywhere on the northern half of the study site. The birds appeared to be moving south along the trail, and by the end of the season there were very few sightings anywhere in the study site. Those Robins that were observed were seen in the southernmost areas. Some birds were observed foraging in the site, and taking the nesting material and food to the riparian area across South Boulder Road. When I went to the riparian area south of South

Boulder Road, I observed several American Robins foraging and darting around with other Robins, in what appeared to be a playful manner, in the fields and trees. The birds were not banded, so I cannot be certain that these were birds that had migrated from my study site, just north of this area, but I am speculating that at least some of them had done so.

One reason for this possible migration may be the difference in human impact between the two areas of the Bobolink trail. In my study site there was nearly constant use of the trail from early morning to late evening. Many visitors used this area to exercise their dogs, and allowed them to run off leash and off trail. There are several miles of social trails that have been created by visitors who walk along the creek off of the designated trail (Miller, personal communication). However, on the section of the Bobolink trail south of South Boulder Road, dogs are not allowed at all, and vegetation along the creek is much more dense, which discourages visitors from walking off of the designated trail. This section of trail also has fewer visitors than the northern section where my study site was located (Miller, personal communication). American Robins may have been migrating into a less impacted habitat after a failed nesting attempt or when suitable nesting sites could not be found.

Further research I would be interested in pursuing would be to compare real nest success between the two sections of the Bobolink trail. I would be interested in monitoring real nests both north and south of South Boulder Road to determine if the data from this year are typical, and if there is significantly higher nest success south of South Boulder Road. To determine the extent of human impact, it would be necessary to monitor the exact amount and type of usage of each site. Banding of birds would also help to investigate if they are migrating into more suitable habitat from the northern section of the trail to the southern section.

Conservation Implications

The results of this study suggest that human recreational impacts and land use may have a significant effect on the nesting success of open cup nesting birds. If this is indeed the case, human recreation must be monitored and managed so as to minimize disturbance to nesting birds. This management may include seasonal closures of certain nesting areas, stricter regulations to confine people and their pets to designated trails and away from potential nest sites, and education to inform the public of birds' sensitivity to disturbance during the nesting season. Predator assemblage and density may also be directly related to human presence and land use. Determining and accounting for human impacts in management decisions may help to stop the decline in populations of the American Robin and other songbirds in North America.

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This thesis is dedicated to the memory of my step-father, Jon Jezek, who taught me to love and learn from nature.

Trails

ACCESS ROAD

DESIGNATED TRAIL

SOCIAL TRAIL

DESIGNATED TRAIL

H_lake

Wetlands

H_creek

H_ditch

Roads.

City_os

St_fed

Cnty_os

City_pk

City_mp

Cl_bldr.

BOULDER CITY LIMITS

Cl_louis.

Key for Figures A and B

Maps courtesy of City of Boulder Open Space - Produced by T. Stonich and the GIS lab, 5/9/94

Figure A
Bobolink

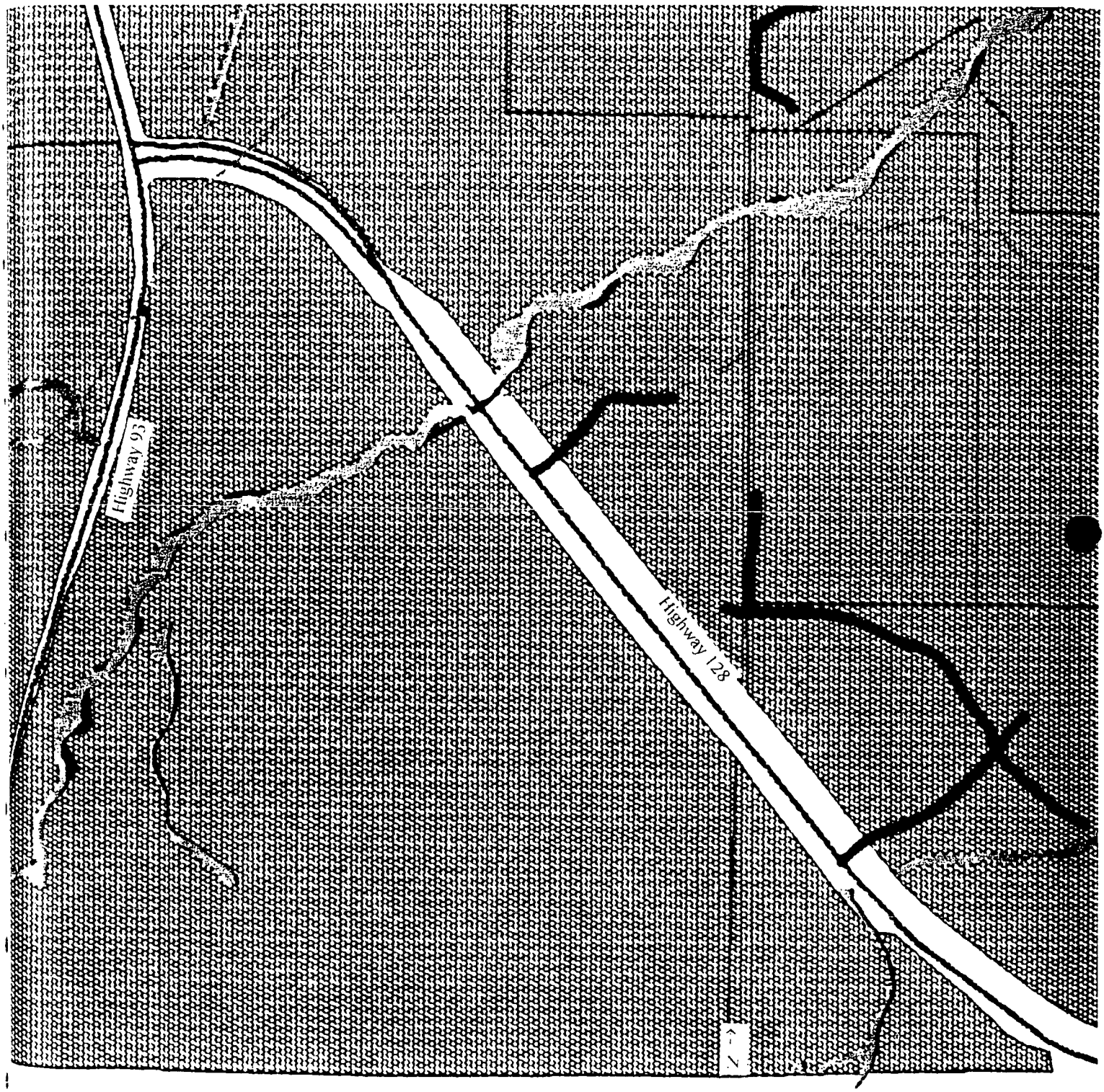

Figure B

Coal Creek

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Personal Communications

Craig, David P. Graduate Student, University of Colorado, Boulder. Department of Environmental, Population and Organismic Biology. Boulder, Colorado 80309.

Miller, Clinton K. Wildlife Biologist, City of Boulder, Department of Open Space. 66 Cherryvale Rd. Boulder, Colorado 80303.