Reptile Survey and Identification of Critical Areas on City of Boulder Open Space

Kyle G. Ashton

Department of E. P. O. Biology

University of Colorado

Boulder, CO 80309

ABSTRACT

During 2000 I conducted a reptile survey on City of Boulder Open Space Lands. The main objectives of this project were 1) to collect data on the geographic distribution of each species, 2) to identify critical habitat areas, and 3) to make management recommendations for specific sites. I primarily collected data from 16 Open Space localities using visual encounter surveys to record the presence of all species. I found two species of turtles, two species of lizards, and at least five species of snakes. I found five individuals of one genus of snakes (*Thamnophis*, garter snakes), but was only able to identify one individual to species (*T. radix*, plains garter snake). I also report recent records for two other species of snakes, and one introduced species of turtle (ornate box turtle, *Terrapene ornata*). I did not find individuals of four species (softshell turtle, short-horned lizard, smooth green snake, and lined snake), all of which are considered uncommon. I summarize the species found at each locality, management recommendations for each locality, generalities evident from distribution maps for species in Boulder County, and compare my survey with previous surveys performed in 1992 and 1996.

INTRODUCTION

There are many goals to conservation biology (Warren and Goldsmith 1983; Soule 1986; Spellerberg 1992; Wilson 1992; Primack 1993). However, the main goal is the preservation of species diversity (Primack 1993). For example, Primack (1993) states that "government agencies and conservation organizations have clearly articulated the protection of rare and endangered species as their top priority."

For conservation in practice, the first step is to set aside protected areas, usually with the conservation of particular species or communities in mind (Primack 1993). The next step is to perform a species inventory of that area (Spellerberg 1992; Heyer et al. 1994). This includes identifying the occurrence and distribution of species in the protected areas. Once these data are gathered, a conservation plan can be developed for the protected areas. Another goal should be the identification and preservation of keystone resources – sources of food, protection, water or other resources for many species (Primack 1993).

Conservation in the city of Boulder is a high priority to the public. Accordingly, many large parcels of land have been set aside. One of the goals of the City of Boulder Open Space Department is the conservation of native animals. However, open space lands are subject to several pressures. In order to achieve a balance between the pressures on open space (e. g. conservation and recreation), it is important to have information on

species occurrence and distribution on these lands. This has resulted in the system wide biological inventory report that is being compiled by the City of Boulder Open Space Department (C. Richardson, pers. comm.).

Seventeen species of reptiles have been reported from Boulder County (Hammerson 1982; Livo et al. 1996). However, limited data on distribution and abundance of these species on City of Boulder Open Space lands are available. Livo (1997) presented some information for reptiles obtained primarily using visual encounter surveys and made recommendations for future studies. Rand and Smith (1993, unpublished) presented observations of reptiles near the National Center for Atmospheric Research, Boulder County. This report suggested hibernation areas for some species of snakes. More data on the distribution and status of species of reptiles on City of Boulder Open Space lands are greatly needed.

OBJECTIVES

This project had three main objectives. First, to collect distribution data for species of reptiles that occur on City of Boulder Open Space. Second, to identify critical habitat areas. Third, to make management recommendations for specific Open Space properties. Sampling was designed to follow up previous observations (Livo 1997; Rand and Smith 1993, unpublished) and to provide data on critical species. I combine my data

with that previously reported (Livo 1997) to produce up-to-date distribution maps for most species of reptiles on City of Boulder Open Space, compare the occurrence of species in this study with two previous years of sampling (1992 and 1996; Dale and Merritt 1993; Livo 1997), and also present data and recommendations for specific localities.

METHODS

This study focused on collecting data for all species of reptiles on City of Boulder Open Space. Extra effort was made to visit historical sites of species of special concern (C. Richardson, pers. comm.): short-horned lizard (*Phrynosoma hernandezi*), six-lined racerunner (*Cnemidophorus sexlineatus*), common garter snake (*Thamnophis sirtalis*), western rattlesnake (*Crotalus viridis*), smooth green snake (*Liochlorophis vernalis*), milk snake (*Lampropeltis triangulum*), lined snake (*Tropidoclonion lineatum*). Throughout this report scientific and common names follow Collins (1990), with two exceptions. The smooth green snake is assigned the genus *Liochlorophis* rather than *Opheodrys* following Oldham and Smith (1991) and the short-horned lizard is considered the species *Phrynosoma hernandezi* instead of *P. douglasi* following Zamudio et al. (1997). If a particular species has been divided into subspecies, the common name is based on the local subspecies.

Sixteen sampling locations on City of Boulder Open Space were chosen to survey for reptiles. I used the following criteria to select these sites: 1) sample most habitat types present on Open Space; 2) specific areas that may contain species of interest based on habitat preferences (Hammerson 1982); 3) newly acquired Open Space lands; 4) areas that contain proposed trails (C. Richardson, pers. comm.). The sampling locations were as follows: Axelson, Boulder Valley Ranch, Culver/White Rocks/ERTL II, Jewell Mountain Land Co. / Jeffco, Kolb II, Lewis, Lindsay, Mount Sanitas, Schneider, Suitts, Waneka, Warner Dexter Hartnagle, and Wonderland Lake. I also included three areas that are managed by Boulder Mountain Parks: Bear Canyon, Sawhill Ponds/Walden Ponds, and Skunk Canyon.

Visual encounter surveys were performed between 10 April – 10 June, and 4 –19 August 2000. The earlier period was chosen because it corresponds to spring emergence from hibernation for reptiles in Colorado (Hammerson 1982), which should maximize capture success because reptiles often remain near their hibernacula for several weeks after emergence (pers. obs.). In addition, sampling during this time period enables the location of hibernacula and possibly breeding areas for those species that breed in the spring. The second sampling session in late summer was designed to locate breeding areas for those species that breed later in the year.

Visual encounter surveys were performed for at least 10 total hours at each sampling location, spread over the two sampling periods. Visual encounter surveys consist of

researchers walking through an area for a specified amount of time and noting all animals encountered (Crump and Scott 1994). Reptiles are often found underneath rocks or logs (Fitch 1987; pers. obs.), and some species may only be encountered in this fashion (e. g. Livo 1997). Thus, during the surveys it was important to turn over rocks and logs in the area. I replaced each object in the exact position in which it was found. Some animals were captured to collect basic information (species, size, and reproductive status), however most were identified without capture. Turtles were only observed through binoculars. Lizards were captured by hand or by using a noose, both standard techniques (e. g. Stebbins 1985). Snakes were captured by hand or by using hooks and tongs.

Visual encounter surveys provide essential data (e. g. Livo 1997), however they may not record all species in an area. For example, nocturnal or very secretive species usually are not encountered with visual encounter surveys (Fitch 1987). Other sampling methods are often necessary to record all species found at a particular locality. However, at the request of the City of Boulder Open Space Department I did not use alternative techniques.

To obtain additional sightings of reptiles I contacted individuals that performed research on City of Boulder Open Space properties during 2000. From each researcher I requested the date, location, species, and any observations about the animal. These observations are included in the Appendices and are discussed throughout. I also include unpublished data from Rand and Smith (1993, unpublished).

RESULTS AND DISCUSSION

I found two species of turtles, two species of lizards, and at least five species of snakes. Five individual garter snakes (*Thamnophis* sp.) were seen but all but one (plains garter snake, *T. radix*) were not identified to species. Unpublished observations that were not included in Livo (1997) provided locations for two additional snake species and another record of an introduced turtle (ornate box turtle, *Terrapene ornata*). The only native species that I do not have new records for are spiny softshell turtles (*Apalone spinifera*), short-horned lizards (*Phrynosoma hernandezi*), smooth green snakes (*Liochlorophis vernalis*) and lined snakes (*Tropidoclonion lineatum*) (see Livo 1997 for locality information on these species). New localities for the observed species are detailed in Appendix 1. I also plotted all localities for each species on maps of Boulder County (Appendix 2).

Distributions

Based on collection localities, the most widespread species of reptiles in Boulder County appear to be the plains garter snake (*Thamnophis radix*), racer (*Coluber constrictor*), and bullsnake (*Pituophis catenifer*), with the latter two ranging to higher elevations than the former (Appendix 2). Several species appear to be restricted to certain

habitats or regions in Boulder County (Appendix 2). Snapping turtles and pond turtles are both only found near permanent bodies of water. Six-lined racerunners (*Cnemidophorus sexlineatus*) are probably only today found along White Rocks in NE Boulder County (there is one historical record to the west of this locality). The only other species of lizard commonly found in Boulder County is the red-lipped plateau lizard (*Sceloporus undulatus*) and is restricted to rocky habitats along the foothills. The prairie rattlesnake (*Crotalus viridis*) is found in the foothills and also in grasslands to the north and south of the city of Boulder. This distribution is probably because of human caused mortality, current and past, near populated areas. Otherwise, this species would likely be distributed throughout Boulder County. The milk snake (*Lampropeltis triangulum*) is an uncommon snake found primarily at the base on the foothills. Northern water snakes (*Nerodia sipedon*) are found only along creeks and streams or near lakes or ponds. Plains blackhead snakes (*Tantilla nigriceps*) are uncommon and have only been found along the foothills to the west and north of Boulder. One individual ornate box turtle (*Terrapene ornata*) was found on Kaufman Open Space, however this is likely an introduced individual because this species does not appear to be native to Boulder County (Livo et al. 1998, pers. comm.).

Time series

To evaluate changes in species composition in Boulder County, I compared the species noted in this study (2000) with those from 1992 and 1996 (Livo 1997). Eight species were observed during all three sampling periods, two species were observed in only 1996 and 2000, two species were observed in 1996 and possibly in 2000, two species were only observed in 1996, and three species have not been observed during any of these sampling periods (Table 1). The two species that were not observed in 1992 are the prairie rattlesnake (*Crotalus viridis*) and the plains blackhead snake (*Tantilla nigriceps*). The lack of these snakes in the 1992 survey is probably because both species have limited distributions and the latter species is uncommon. The two species that were only observed in 1996, short-horned lizard (*Phrynosoma hernandezi*) and milk snake (*Lampropeltis triangulum*), appear to be very uncommon (only one and two individuals, respectively, were captured during 1996; Livo 1997) but likely continue to be present in the Boulder area, albeit in small numbers. The spiny softshell turtle (*Apalone spinifera*) was not observed during any of these surveys and has only been recorded historically from extreme eastern Boulder County (Hammerson 1982). If this species was present on City of Boulder Open Space it is likely than one of these surveys would have detected its presence. Two species that are more likely to occur in the area, but have not been observed between 1992-2000, are the smooth green snake (*Liochlorophis vernalis*) and

the lined snake (*Tropidoclonion lineatum*). Both of these species have historical records in western Boulder (Livo 1997). My sampling during the summer of 2000 was near localities reported for both species but I did not find either of them. It is possible that these two species still occur in the area, but like some other species (short-horned lizard, milk snake), do so in very low abundance.

Locality reports

Axelson Open Space. This site was chosen to evaluate the impact of a proposed trail on the resident reptiles. I visited this site on 26 April and 5 August 2000. On the first visit, I did not find any reptiles. However, I did note a very large prairie dog colony. On the latter visit I found one juvenile prairie rattlesnake (*Crotalus viridis*) in a wood pile next to a two-track dirt road about 500 m west of 55th street and Monarch Rd. I did not find any other reptiles and there are no areas that appear to be critical habitat to reptiles (with the exception of prairie dog burrows that may be used as retreat sites for reptiles). Therefore, the proposed trail through Axelson to the North Rim trail will likely have a minimal impact on the reptiles of the area, however I strongly recommend that the trail be built to the east of the prairie dog colony because of the impact of disturbance on the behavior of prairie dogs. This trail placement would also avoid the area of the one rattlesnake sighting at this location.

Boulder Valley Ranch. This site was visited on 31 May and 8 August 2000. No reptiles were found on either day. However, rattlesnakes have been sighted in this area, and it is likely that other snakes occur here as well. The lack of seeing any reptiles probably is because no lizards are found in this area, and snakes are secretive and uncommon.

Culver/ERTL II/White Rocks. As previously reported (Livo 1997), White Rocks is the only locality in the Boulder area where six-lined racerunners (*Cnemidophorus sexlineatus*) are found. These animals were seen from the White Rocks Conservation Easement (Livo 1997) to the end of the White Rocks outcrop on the ERTL II. No individuals were seen away from this outcrop. One bullsnake (*Pituophis catenifer*) and one northern water snake (*Nerodia sipedon*) were also observed along the canal on Culver Open Space. It is likely that racers (*Coluber constrictor*) and plains garter snakes (*Thamnophis radix*) also occur on this property. It is strongly recommended that no trails be constructed close to any part of the White Rocks area. The current trails (East Boulder and White Rocks) likely do not impact the lizard population because they are several hundred meters away.

Jewell Mountain Land Co./Jeffco. This is a recently acquired property, thus the objective was to collect any information on reptiles in the area. This property consists of mostly grazed short grasses, a small mesa flanked on the south by a pond, and Coal Creek on the western portion. I searched several sections of Coal Creek and the grasslands but

did not find any reptiles. It is possible that species found near creeks (e. g. northern water snakes, garter snakes) are found along Coal Creek. It is also possible that several of the widespread species of snakes (bullsnake, plains garter snake, prairie rattlesnake, racer) might occur sparsely in the grassland area. The only species of reptile observed at this site was a very large population of painted turtles (*Chrysemys picta*) found in the pond just south of the small mesa in the middle of the property. On 19 August 2000 I counted over 200 individuals basking along rocks on the west side of the pond. This appears to be the largest documented population of any reptile species on City of Boulder Open Space. I would recommend that any future trails on this area not encroach too closely to this pond because the turtles react quickly to any presence.

Kolb II. This site was chosen because it might contain species that are found near water. This location is a grazed grassland with irrigation ditches. On 23 May 2000 many frogs were calling from marshy areas in between irrigation ditches, however no reptiles were observed. On 6 August 2000 again I found no reptiles, however I did find one bullfrog (*Rana catesbeiana*). This site does not seem important for reptiles, however it does appear an important breeding area for amphibians. Therefore, I recommend that the areas that become marshes in the spring and early summer be conserved as breeding areas for amphibians.

Lewis. This locality consists of a grassland with a creek running through it. I chose this site because it might contain species that use both grassland and aquatic

habitats. However, no cover objects (rocks, logs, boards) or mammal burrows are present and no reptiles were observed. On 7 August 2000 I did capture two woodhouse's toads (*Bufo woodhousii*), one adult and one newly metamorphosed individual, and one chorus frog (*Pseudacris triseriata*). It is possible that reptiles also occur in the area, but none were found and it is unlikely that this site contains critical habitat for any reptile species.

Lindsey/Doudy Draw. This site was chosen to provide data for an area that is relatively unknown. On 9 June 2000 I found one large bullsnake (*Pituophis catenifer*) on the main dirt road along the water pipeline, to the north of Doudy Draw. I also found a juvenile racer (*Coluber constrictor*) on the main dirt road next to the pipeline on the Van Vleet/Jeffco property. Suitable reptile habitats are present on these sites, particularly north of Doudy Draw. Future research might intensively search more of this site.

Mount Sanitas. Several uncommon species have been collected in this area (lined snake, plains blackhead snake, smooth green snake). I did not find any of these species. However, I did find one bullsnake (*Pituophis catenifer*) and ten red-lipped plateau lizards (*Sceloporus undulatus*). A few of the lizards, and the snake, were captured adjacent to trails, therefore they appear to be somewhat tolerant of human disturbance. I did not identify any potential hibernacula or breeding areas at this site.

Schneider. This site was chosen because of reports of the prairie rattlesnake (*Crotalus viridis*). On 22 April 2000 I found three prairie rattlesnakes, one racer and two red-lipped plateau lizards at this site. All of these animals, except one rattlesnake, were

found near the crest of the foothill just west of the old Open Space house. It is likely that a hibernaculum for multiple species of snakes is found near the crest of the foothill. I suggest this because snakes are emerging from hibernation at this time of year, and because snakes are mostly solitary, finding multiple individuals of more than one species suggests a nearby hibernaculum. On 31 May 2000 I found two prairie rattlesnakes and one racer near the cistern ca. 50 m west of hwy. 36, just north of the old house. Then on 5 August 2000 I found a courting pair of prairie rattlesnakes under the edge of the cistern. These snakes likely hibernate near the crest of the foothill, then disperse towards lower elevations during the summer.

Suitts. In late May this site had many calling anurans in marshy areas between the canal and South Boulder Road near the old house and trailer. I did not see any reptiles, however with the abundance of anurans it is likely that garter snakes are present in this area. When I visited this site again on 6 August 2000 the marshy habitat was dry and no anurans were heard. I did find one garter snake (*Thamnophis* sp.) at the small pond between McGinn Ditch and Baseline Reservoir. This snake was likely a plains garter snake (*Thamnophis radix*) based on appearance, however I was unable to capture it for verification.

Waneka. This site is a grassland with a large prairie dog colony. However, I did not find any reptiles on two trips. I also did not notice any habitat (e. g. rock outcrops, ponds with vegetation) that appeared critical for reptiles.

Warner Dexter Hartnagle. I found two bullsnakes (*Pituophis catenifer*) near Teller Lake No. 5. I did not find any other reptiles at this site. Abundant rocky habitat lines the north side of the lake and undoubtedly serves as cover objects for bullsnakes and possibly other snake species.

Wonderland Lake. At this site I noted a racer (*Coluber constrictor*) and a garter snake (*Thamnophis* sp.) between Broadway and Wonderland Lake. The garter snake was possibly a common garter snake (*Thamnophis sirtalis*) however that is based solely on a quick glance at the individual as it retreated into a hole. I also found three red-lipped plateau lizards (*Sceloporus undulatus*) along a rock ridge on the hillside to the west of the lake. I expect that prairie rattlesnakes (*Crotalus viridis*) and bullsnakes (*Pituophis catenifer*) also occur at this locality.

Bear Canyon/Wells. On two trips I failed to find any reptiles in this area.

Skunk Canyon, Mountain Parks. This site was studied by Rand and Smith (1993, unpublished) and yielded records for several species. Two trips to the area yielded five red-lipped plateau lizards (*Sceloporus undulatus*). These were expected because Rand (1991) studied populations of this species in this area. No other reptiles were observed.

Sawhill/Walden Ponds, Mountain Parks. Although people heavily impact this area, many species of reptiles have been reported. I found one snapping turtle (*Chelydra serpentina*), ten painted turtles (*Chrysemys picta*), one racer (*Coluber constrictor*), two

northern water snakes (*Nerodia sipedon*) and one bullsnake (*Pituophis catenifer*) in this area. Common garter snakes (*Thamnophis sirtalis*) have also been observed frequently at this site (Livo 1997; A. de Queiroz, pers. comm.).

CONCLUSIONS

This report provides updated information on the distributions of species of reptiles on City of Boulder Open Space (Appendices 1 and 2) and this data can be incorporated into the system wide inventory report. From the distribution maps it is clear that while some species are widespread in the Boulder area, others have very specific habitat requirements. Fortunately, many of these species occur on protected areas (i. e. Open Space). However, it is important to collect specific information on population status and critical habitat areas in order to make wise decisions with regard to the use of public lands.

Hibernacula are one of the most important natural resources for reptiles in temperate environments (Gregory 1982, 1984). A particular hibernaculum may be used by several different species of reptiles as well as other vertebrates (Gregory 1982, 1984). Thus, hibernacula can be considered keystone resources and should be preserved. I have identified a probable hibernaculum for at least two species of snakes on Schneider Open Space that should not be disturbed. Because snakes tend not to disperse from hibernacula

until April or May, any locality reports during this time may indicate a nearby hibernacula. The home ranges of lizards tend to be relatively small, therefore any locality records of lizards probably indicate nearby hibernacula. Such sightings in the spring and early summer (see Appendix 1), particularly for snakes, should be followed up. Breeding areas also require protection because they are necessary for successful reproduction. In this study I report several areas where pregnant females have been collected. Because pregnant females of species of snakes and lizards move very little, particularly towards the end of gestation (e. g. Macartney et al. 1988), these localities can be considered breeding areas. As such, they should be protected from human impact. In fact, any sighting of a lizard probably indicates a breeding area nearby because they tend to have relatively small home ranges. Even light disturbance (e. g. hiking along trails) in otherwise protected areas can cause the extinction of reptile populations (e. g. Garber and Burger 1995). Thus, it may be necessary to divert or exclude recreation from certain critical areas. I have made recommendations regarding critical habitat and trail placement in the *locality reports* section of the results/discussion.

Several prospects deserve future study. First, some species of reptiles have not been observed during the last eight years, and others have been infrequently noted (Table 1). A priority should be to further examine potential locations for these species. It is possible that some may no longer occur in Boulder County, or at least on City of Boulder Open Space. Second, gaps in the distribution of each species should be studied. For

example, the red-lipped plateau lizard (*Sceloporus undulatus*) occurs on large rock outcrops along the foothills. However, several sites of likely occurrence have not been surveyed. Such studies would better document the distribution of species of reptiles.

Alternative methods of sampling may be necessary to find some of these species (e. g. Milton 1980). My study was based primarily on visual encounter surveys, with some road driving. Night driving is an option, however this is possibly a more productive method for amphibian sampling (see Livo 1997). Drift fences combined with funnel and pitfall traps appear to be the best way to capture some species of snakes and lizards (Corn 1994; D. Holland, pers. comm.; J. Boone, pers. comm.), and can provide estimates of abundance (Gibbons and Semlitsch 1981). The drift fence is used to force animals that encounter the fence to move along it into one of the funnel or pitfall traps. There are two major problems with the use of funnel, and particularly, pitfall traps. First, a large amount of soil must be displaced to accommodate the traps (5 gallon buckets). Second, they often capture other animals (e. g. shrews), and may lead to mortality of those animals. Another method that may be useful is turtle trapping, particularly in areas where the spiny softshell turtle (*Apalone spinifera*) may occur. This method has proven useful in Boulder County (Livo 1997).

Although more data on distributions of species of reptiles are needed, data on population abundance and stability are also greatly needed. This is particularly true for species with very limited distributions, such as the six-lined racerunner (*Cnemidophorus*

sexlineatus). I also think that the effects of trails on reptiles should be studied, as suggested earlier by Livo (1997). This is a topic of much research for birds, however little is known for reptiles.

ACKNOWLEDGMENTS

I thank the City of Boulder Open Space Department for funding, Cary Richardson for assistance with all aspects of this project, and Lori Craft for field assistance; Lauren Livo, Alan de Queiroz, and Hobart Smith for discussion of Boulder County reptiles; Matt Rand for a copy of his unpublished report; Rosanne Humphrey for information on specimens at the University of Colorado Museum; Susan Wahl and Cary Richardson for sightings from the City of Boulder Open Space database. Wade Cooper, Bill Merkle, Jeff Oliver, Katie Prudic, Beckie Rawlinson, and Chris Schadt kindly provided reptile sightings.

WORKS CITED

Collins, J. T. 1990. Standard common and current scientific names for North American amphibians and reptiles, 3rd ed. SSAR Herpetol. Circular no. 19, 41 pp.

Corn, P. S. 1994. Straight-line drift fences and pitfall traps. Pp. 109-117, *in* Measuring and monitoring biological diversity: standard methods for amphibians (Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster, eds.). Smithsonian Institution Press, Washington D. C.

Crump, M. L. and N. J. Scott, Jr. 1994. Visual encounter surveys. Pp. 84-92, *in* Measuring and monitoring biological diversity: standard methods for amphibians (Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster, eds.). Smithsonian Institution Press, Washington D. C.

Dale, C., and D. Merritt. 1993. Reptile and amphibian survey. Report, Boulder Open Space.

Fitch, H. S. 1987. Collecting and life-history techniques. Pp. 143-164, *in* Snakes: ecology and evolutionary biology (Seigel, R. A., J. T. Collins, and S. S. Novak, eds.). McGraw-Hill, New York.

Garber, S. D., and J. Burger. 1995. A 20-yr study documenting the relationship between turtle decline and human recreation. Ecological Applications 5:1151-1162.

Gibbons, J. W., and R. D. Semlitsch. 1981. Terrestrial drift fences with pitfall traps: an

effective technique for quantitative sampling of animal populations. Brimleyana 7:1-16.

Gregory, P. T. 1982. Reptilian hibernation. Pp. 53-154, *in* Biology of the reptilia, vol. 13 (Gans, C., and F. H. Pough, eds.). Academic Press, London.

Gregory, P. T. 1984. Communal denning in snakes. Pp. 57-75, *in* Vertebrate ecology and systematics: a tribute to Henry S. Fitch (Seigel, R. A., L. E. Hunt, J. L. Knight, L. Malaret and N. L. Zuschlag, eds.). University of Kansas Museum of Natural History Special Publication No. 10.

Hammerson, G. A. 1982. Amphibians and reptiles in Colorado. Colorado Division of Wildlife, Denver, Colorado.

Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution Press, Washington D. C.

Livo, L. J. 1997. City of Boulder 1996 amphibian and reptile survey. Report, City of Boulder Open Space.

Livo, L. J., K. Reichard, T. Duncan, H. M. Smith, and D. Chiszar. 1996. Herpetological microbiogeography of Colorado II: Documented and potential county records. Colorado Herpetological Society.

Livo, L. J., G. A. Hammerson, and H. M. Smith. 1998. Summary of amphibians and reptiles introduced into Colorado. Northw. Nat. 79:1-11.

Macartney, J. M., P. T. Gregory, and K. W. Larsen. 1988. A tabular survey of data on movements and home ranges of snakes. J. Herpetol. 22:61-73.

Milton, D. A. 1980. A comparison of three techniques used in a reptile survey of the Conondale ranges. Victorian Nat. 97:26-31.

Oldham, J. C., and H. M. Smith. 1991. The generic status of the smooth green snake, *Opheodrys vernalis*. Bull. Maryland Herpetol. Soc. 27:201-215.

Primack, R. B. 1993. Essentials of conservation biology. Sinauer Associates, Sunderland, Mass.

Rand, M. S. 1991. Behavioral function and hormonal control of polymorphic sexual coloration in the lizard *Sceloporus undulatus erythrocheilus*. Ph. D. dissertation, University of Colorado, Boulder.

Rand, M. S., and H. M. Smith. 1993. Summary of herpetological fauna of NCAR property. Unpublished research report to NCAR.

Soule, M. E. 1986. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland, Mass.

Spellerberg, I. F. 1992. Evaluation and assessment for conservation. Chapman and Hall, London.

Stebbins, R. C. 1985. Western Reptiles and Amphibians. Houghton Mifflin Co., New York.

Warren, A., and F. B. Goldsmith, eds. 1983. Conservation in perspective. John Wiley

and Sons, New York.

Wilson, E. O. 1992. The diversity of life. Belknap Press, Cambridge, Mass.

Zamudio, K. R., K. B. Jones, and R. H. Ward. 1997. Molecular systematics of short-horned lizards: biogeography and taxonomy of a widespread species complex. Syst. Biol. 46:284-305.

Table 1. Reptiles in Boulder County, Colorado. Data for 1992 and 1996 surveys based on Table 1 in Livo (1997). Records for 2000 are from this study and do not include observations from Rand and Smith (1993, unpublished). Only species native to, and recorded from, Boulder County are included. N = number of individuals for this survey only. * = museum specimen (UCM 60615). ? = possibly observed, but not with certainty.

Scientific name	Common name	1992	1996	2000	N
Apalone spinifera	Spiny softshell				0
Chelydra serpentina	Snapping turtle	X	X	X	2
Chrysemys picta	Painted turtle	X	X	X	> 211
Cnemidophorus sexlineatus	Six-lined racerunner	X	X	X	6
Phrynosoma hernandezi	Short-horned lizard		X		0
Sceloporus undulatus	Red-lipped plateau lizard	X	X	X	21
Coluber constrictor	Racer	X	X	X	9
Crotalus viridis	Prairie rattlesnake		X	X	10
Lampropeltis triangulum	Milk snake		X		0
Liochlorophis vernalis	Smooth green snake				0
Nerodia sipedon	Northern water snake	X	X	X	3
Pituophis catenifer	Bullsnake	X	X	X	14
Tantilla nigriceps	Plains blackhead snake		X	X	1*
Thamnophis elegans	Wandering garter snake		X	?	
Thamnophis radix	Plains garter snake	X	X	X	1
Thamnophis sirtalis	Common garter snake		X	?	
Tropidoclonion lineatum	Lined snake				0

APPENDIX 1: Species accounts

Provided are lists of the species observed during this study, localities recorded, and brief natural history notes as available. Accounts are listed first for turtles, followed by lizards and then snakes. Within each group, accounts are in alphabetical order by scientific name. Also included are unpublished data from Rand and Smith (1993, unpublished) and one museum specimen (plains blackhead snake, *Tantilla nigriceps*, UCM 60615).

***Chelydra serpentina* (snapping turtle)**

- 3 May 2000: basking in mud along south shore of Walden Pond
- several times in May 2000: 20 m W of 75th street, Kaufman Open Space

***Chrysemys picta* (painted turtle)**

- 20 April 2000: Walden Ponds

  One individual was observed basking on a log along the south shore of the main Walden Pond. Five additional individuals were found basking on a log in the northeast side of the pond just west of Walden Pond.
- 3 May 2000: on post along south shore of Walden Pond
- 30 May 2000: 20 m W of 75th street, Kaufman Open Space
- 6 August 2000: Walden Pond and Sawhill Ponds

- 19 August 2000: large pond ca. 1 km W of highway 93, Jewell Mountain Land Co./Jeffco Open Space

  Greater than 200 individuals were observed basking on rocks along the west side of the pond.

***Terrapene ornata* (ornate box turtle)**

- 30 May 2000: ca. 20 m W of 75 street, Kaufman Open Space

***Cnemidophorus sexlineatus* (six-lined racerunner)**

- 7 May 2000: just E of White Rocks Conservation easement, ERTL II Open Space

  I did not enter the White Rocks Conservation Easement property. Both individuals were heard moving in vegetation prior to seeing the specimens. Neither individual was captured.

- 11 August 2000: along rock outcrops E of White Rocks Conservation easement, ERTL II Open Space

***Sceloporus undulatus erythrocheilus* (red-lipped plateau lizard)**

- 22 April 2000: along summit of foothill directly west of Open Space House, Schneider Open Space

- 4 May 2000: along Mount Sanitas trail, Mount Sanitas Open Space

  I observed seven individuals along this trail, and captured four of them. Measurements are as follows: male, 64 mm SVL, 9.0 g; male, 60 mm SVL, 7.0 g; male, 61 mm SVL, 8.5 g; male, 59 mm SVL, 7.0 g

- 16 May 2000: W border of Matterhorn Open Space
- 7 June 2000: near water tower along Mesa trail just W of junction with NCAR trail, Boulder Mountain Parks

  One pregnant female was captured (74 mm SVL, 14.0 g) at this site.
- 9 August 2000: along ridge of Dakota Ridge Trail, Mount Sanitas Open Space
- 14 August 2000: along rock outcrops, W of Wonderland Lake, ERNI Open Space
- 16 August 2000: near water tower along Mesa trail just W of junction with NCAR trail, Boulder Mountain Parks
- 16 August 2000: along rock outcrops on N side of Skunk Canyon trail, E of junction with Mesa Trail, Boulder Mountain Parks

Coluber constrictor **(racer)**

- 11 May 1988: adult snake among rocks on west end of NCAR buildings (Rand and Smith)
- 3 June 1988: juvenile on rock outcrop near water tank, just W of NCAR, Boulder Mountain Parks (Rand and Smith)
- 15 July 1988: adult to north of NCAR, S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 6 August 1988: adult on grassy slope below rock outcrop on S facing slope adjacent to NCAR (Rand and Smith)

- 22 May 1989: adult on S facing slope of Skunk Canyon, Boulder Mountain Parks ((Rand and Smith)
- 2 June 1989: adult on S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 16 June 1989: adult on E end of mesa, just below NCAR buildings, Boulder Mountain Parks (Rand and Smith)
- 28 June 1989: juvenile on S facing slope of Skunk Canyon Boulder Mountain Parks (Rand and Smith)
- 23 May 1990: adult on grassy slope S of NCAR buildings, Boulder Mountain Parks (Rand and Smith)
- 31 May 1990: adult on road up to NCAR, western most extreme curve of road, Boulder Mountain Parks (Rand and Smith)
- 15 July 1990: adult on grassy field on mesa W of NCAR buildings, Boulder Mountain Parks (Rand and Smith)
- 23 July 1990: adult near trail on mesa ca. 40 m W of NCAR buildings, Boulder Mountain Parks (Rand and Smith)
- 23 April 1991: juvenile on S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 28 May 1991: adult on S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)

- 8 June 1991: adult near water tanks, W of NCAR building, Boulder Mountain Parks (Rand and Smith)
- 27 May 1993: juvenile just off Bear Canyon access road, Boulder Mountain Parks (Rand and Smith)
- 22 April 2000: 1/4 below summit of foothill directly west of Open Space House, Schneider Open Space
- 14 May 2000: Sawhill Ponds
- 31 May 2000: near cistern adjacent to Open Space House, just west of highway 36, Schneider Open Space
- 31 May 2000: near S Boulder Creek trail, S of hwy. 36, Van Vleet Open Space
- 5 July 2000: S of Left Hand Reservoir, Beech Open Space
- 17 July 2000: N of Wonderland Lake, near Utica Circle, Leach Arnold Open Space
- 22 July 2000: S of Left Hand Reservoir, Beech Open Space
- 14 August 2000: ca. 200 m W of Broadway, east of Wonderland Lake, A. Dunn Open Space

  One juvenile individual found in the grass.
- 17 August 2000: on dirt road adjacent to water pipeline, ca. 2 km NW of highway 93, Van Vleet/Jeffco Open Space

***Crotalus viridis* (western rattlesnake)**

- 7 May 1990: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 17 May 1990: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- August 1998: NCAR parking lot
- 22 April 2000: woodpile ca. 500 m west of Open Space House, at base of foothill, Schneider Open Space; 1/4 below summit of foothill directly west of Open Space House, Schneider Open Space; 100 m E of summit, foothill directly west of Open Space House, Schneider Open Space
- 30 May 2000: S of Left Hand Reservoir, Beech Open Space
- 31 May 2000: near cistern adjacent to Open Space House, just west of highway 36, Schneider Open Space

  One adult individual was observed near the cistern, and another individual (road-killed) was found next to highway 36
- last week of June: ca. 0.5 miles E of Broadway on South Boulder Creek, Fancher Open Space
- 23 July 2000: S of Left Hand Reservoir, Beech Open Space
- 5 August 2000: under boards, ca. 500 m W of junction Monarch Rd. and 55th Street, Axelson Open Space

  One juvenile individual was found

- 5 August 2000: near cistern, adjacent to Open Space House, just west of highway 36, Schneider Open Space

  I found a pair of courting individuals under the edge of the cistern. The male exhibited typical courtship behavior (chin rubbing along the back of the female). The snakes were observed for 20 minutes until courtship ceased. I was not able to see whether copulation took place. Both snakes remained at this site after ceasing courtship.

***Lampropeltis triangulum* (milk snake)**

- 16 August 1989: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)

  Found shed skin.

***Nerodia sipedon* (northern water snake)**

- 14 May 2000: Sawhill Ponds
- 11 August 2000: along canal west of 95th street, Culver Open Space

***Pituophis catenifer* (bullsnake)**

- 15 July 1988: adult on S facing grassy slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 12 August 1988: hogback at edge of Bear Canyon, Boulder Mountain Parks (Rand and Smith)

- 5 May 1989: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 16 June 1989: S slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith) Pregnant female.
- 21 March 1990: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 22 March 1990: W of NCAR buildings (Rand and Smith)
- 22 May 1990: S facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 6 August 1990: S facing slope of NCAR mesa (Rand and Smith)
- 23 April 1991: rocky outcrop E facing slope near Bear Canyon Boulder Mountain Parks (Rand and Smith)
- N facing slope of Skunk Canyon, Boulder Mountain Parks (Rand and Smith)
- 4 May 2000: in shade next to rock crevice along W side of Mount Sanitas trail, Mount Sanitas Open Space
- 7 May 2000: along canal west of 95th street, Culver Open Space

  Individual was found in long grass along canal. When approached it entered the water, swam to the other side of the canal, then remained stationary on top of vegetation along side of canal.
- 7 May 2000: roadkill along 95th street adjacent to Culver Open Space

- 10 May 2000: near junction of hwy. 93 and 128, Greenbelt Plateau Open Space
- 11 May 2000: NE of junction of East Boulder trail and railroad crossing, Hartnagle Open Space
- 22 May 2000: NE of junction of East Boulder trail and railroad crossing, Hartnagle Open Space
- 23 May 2000: along N side of Teller Lake, between Valmont Road and Teller Lake, Warner Dexter Hartnagle
- 26 May 2000: Fancher Open Space
- 26 May 2000: on trail between S Boulder Creek and Marshall Rd., Van Vleet Open Space
- 5 June 2000: NE of junction of East Boulder trail and railroad crossing, Hartnagle Open Space
- 9 June 2000: on dirt road, N of Doudy Draw, Lindsay Open Space
- 19 June 2000: N of Wonderland Lake, near Utica Circle, Leach Arnold Open Space
- 23 July 2000: S of Left Hand Reservoir, Beech Open Space
- 6 August 2000: Sawhill Ponds

***Tantilla nigriceps* (plains blackhead snake)**

- 27 August 1999: 3rd street and Evergreen, Boulder (University of Colorado Museum, specimen number 60615)

***Thamnophis* sp. (garter snake)**

- 24 June 2000: in hayfield just N of S Boulder Road, west of Cherryvale Road, Gebhard Open Space
- 23 July 2000: in hayfield just N of S Boulder Road, west of Cherryvale Road, Gebhard Open Space
- 7 August 2000: along N edge of pond, ca. 1000 m N of South Boulder Road, Suitts Open Space
- 14 August 2000: ca. 400 m W of Broadway, east of Wonderland Lake, A. Dunn Open Space

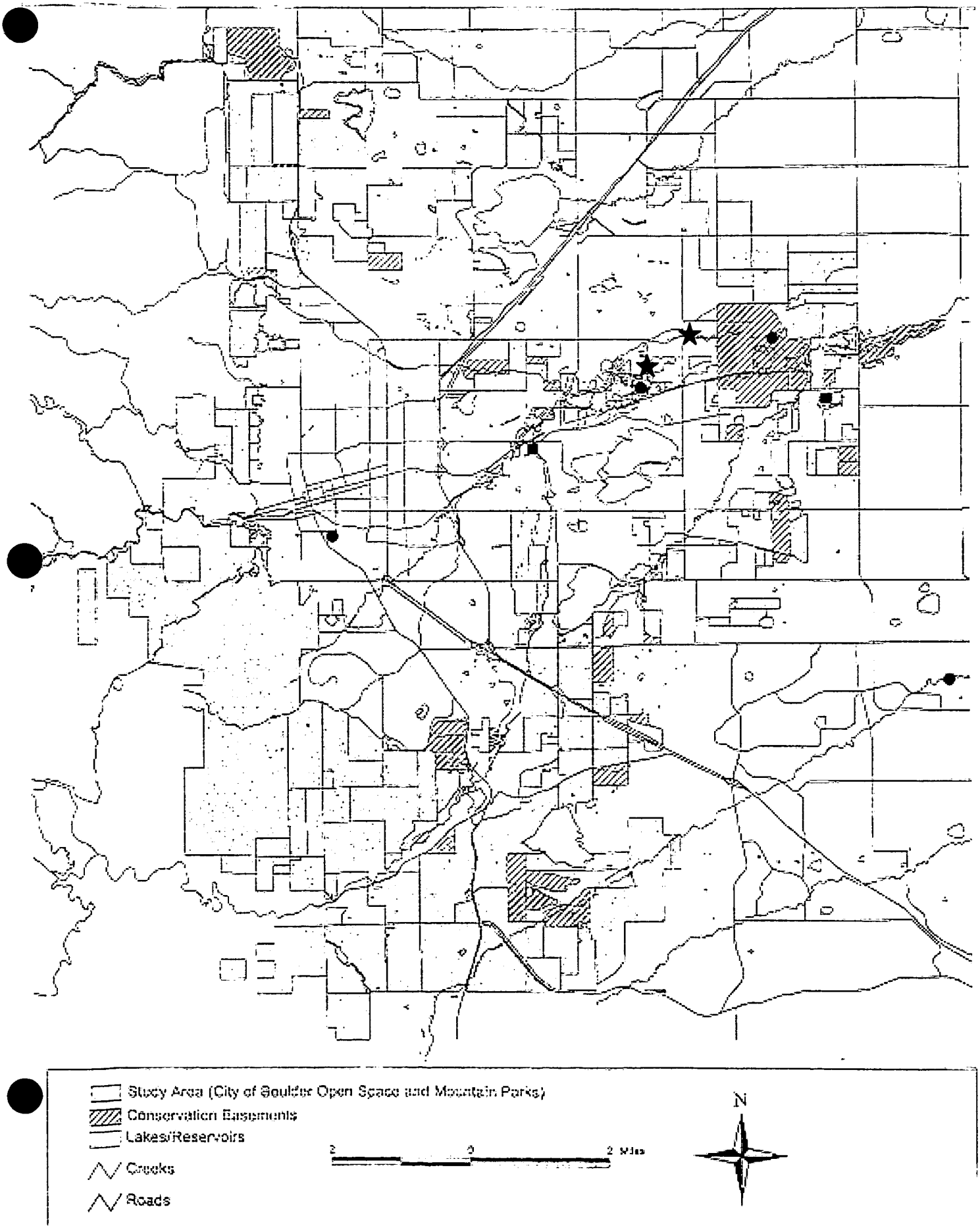
Thamnophis radix (plains garter snake)

- 24 May 2000: near S Boulder Creek trail, 150 m S of hwy. 36, Van Vleet Open Space

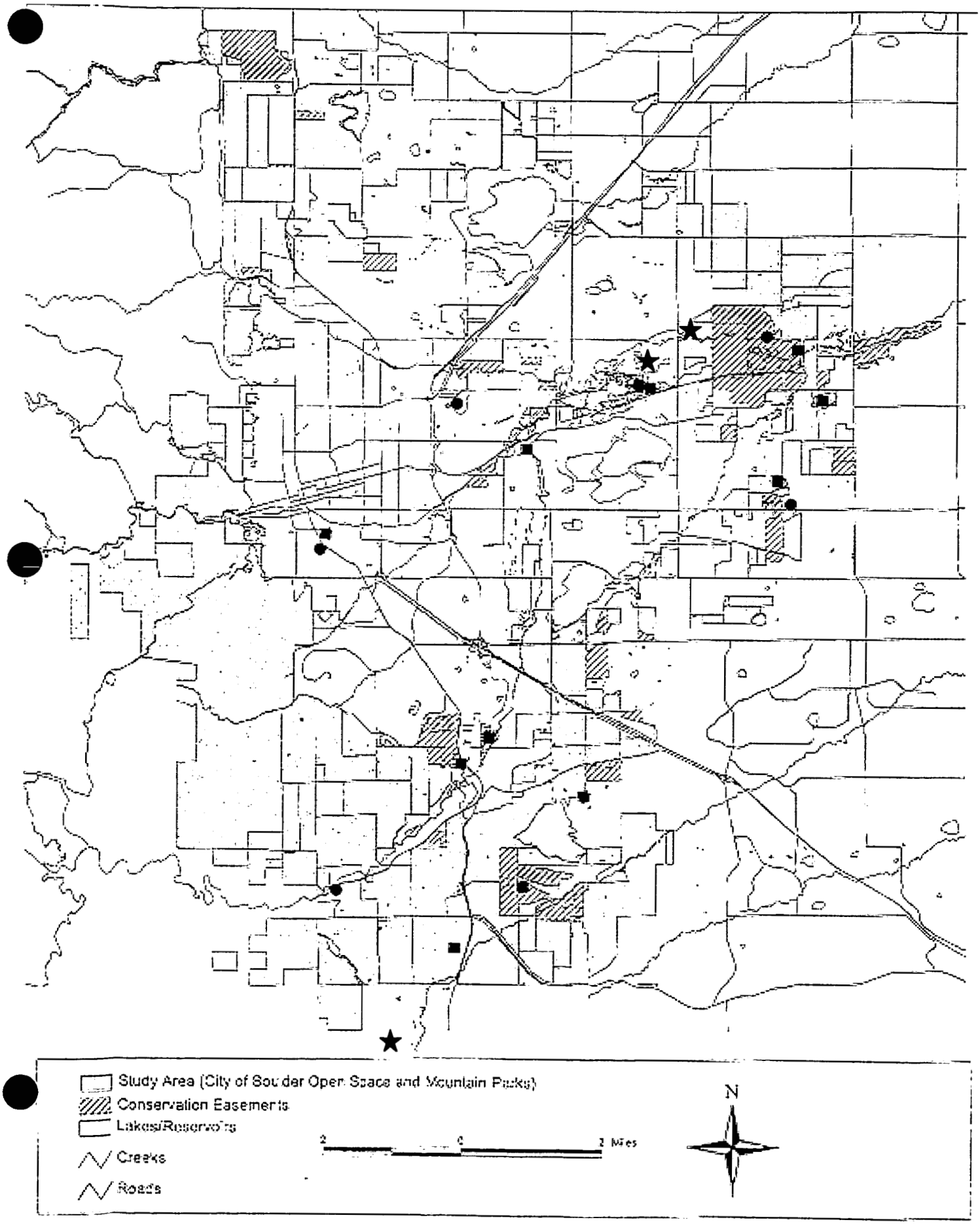
APPENDIX 2: Distribution Maps

Geographic distribution of localities for each species reported in this paper. Maps are modified from Livo (1997). I do not include maps for species for which no new locality records are reported; see Livo (1997) for distributions of these species. I also do not include a map for *Terrapene ornata* because this is an introduced species that has not established breeding populations in the county (Livo, pers. comm.). Circle = recorded prior to 1994 (Livo 1997); square = recorded in 1996 (Livo 1997); star = reported in this study.

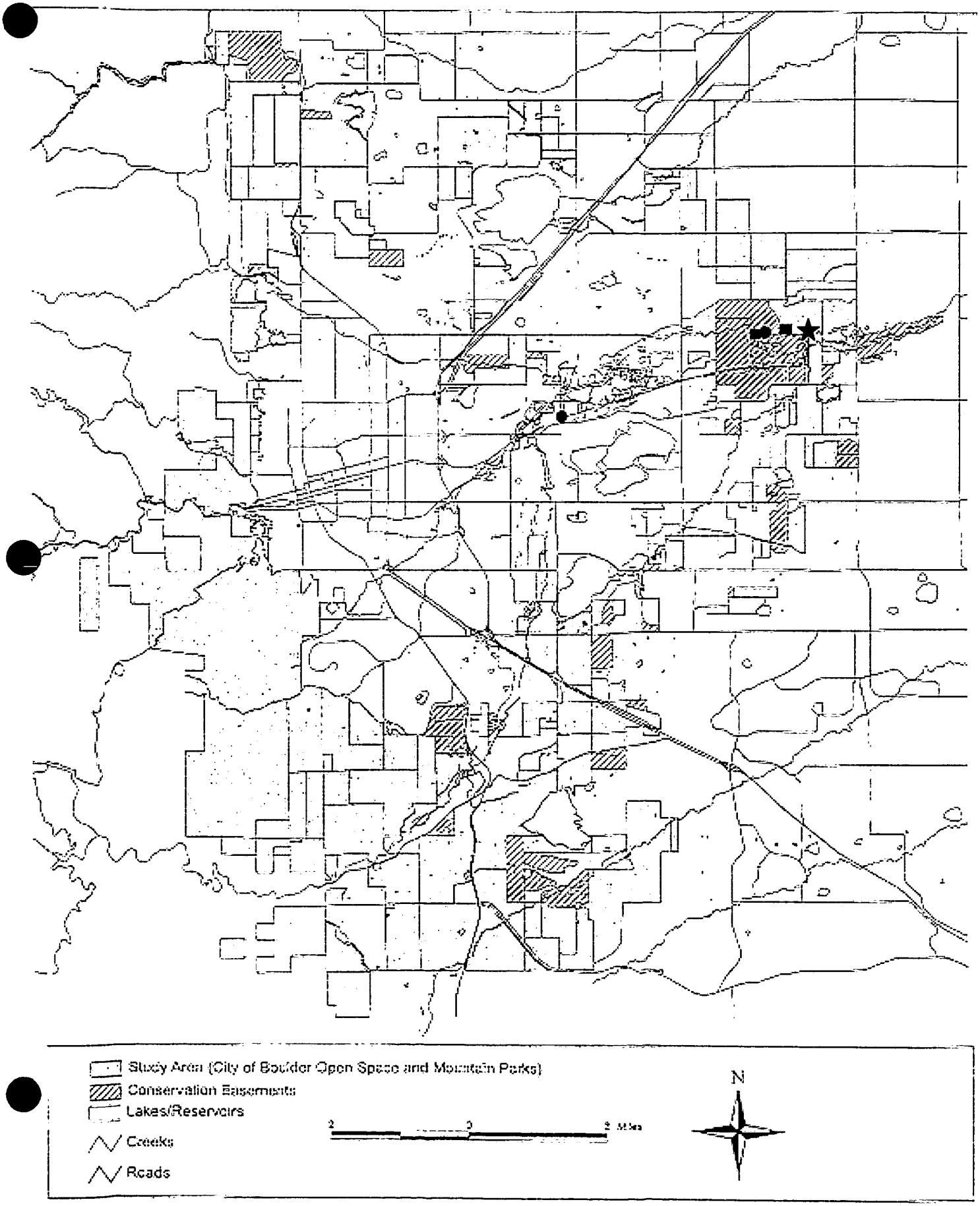
Chelydra serpentina



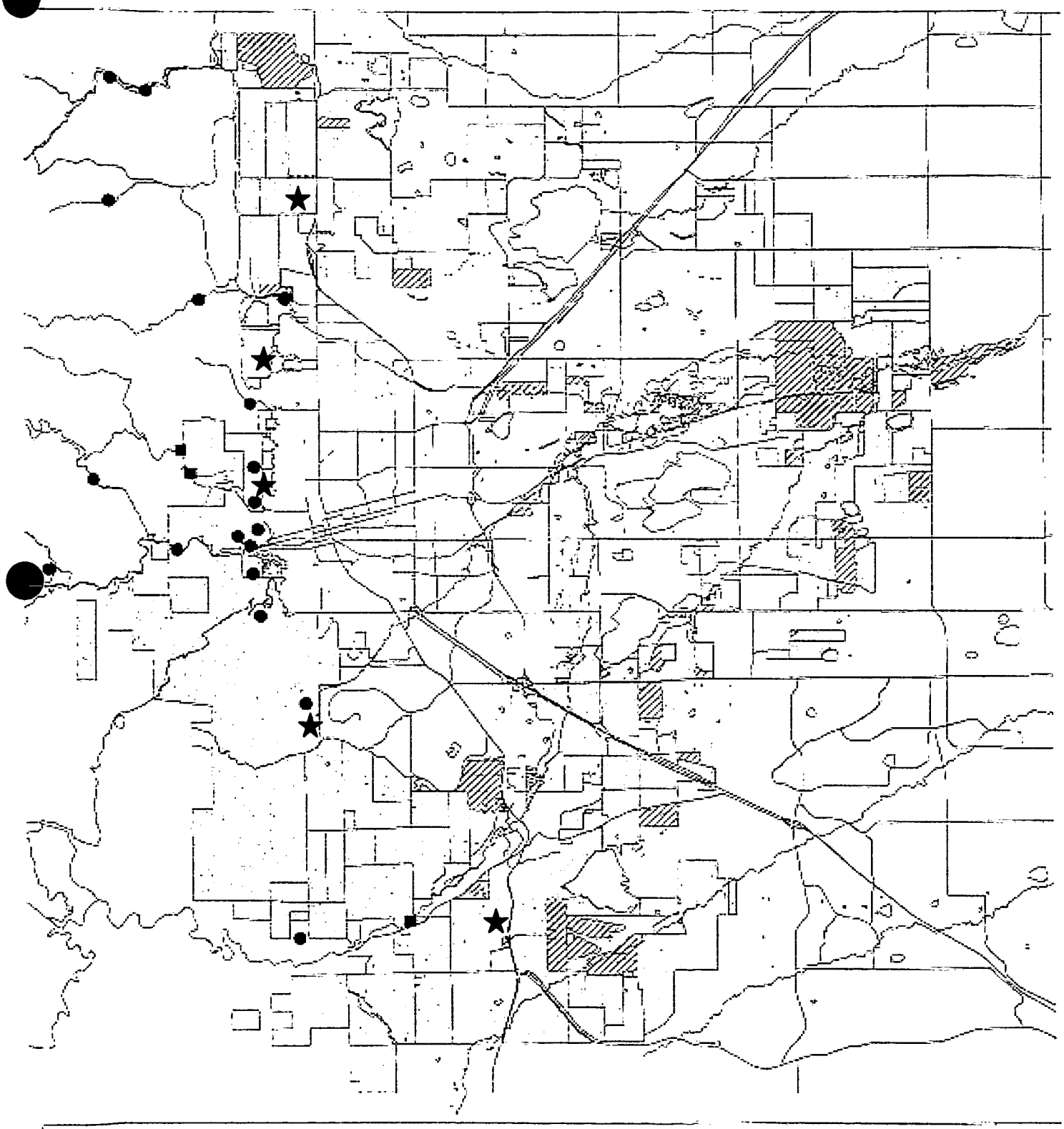
Chrysemys picta



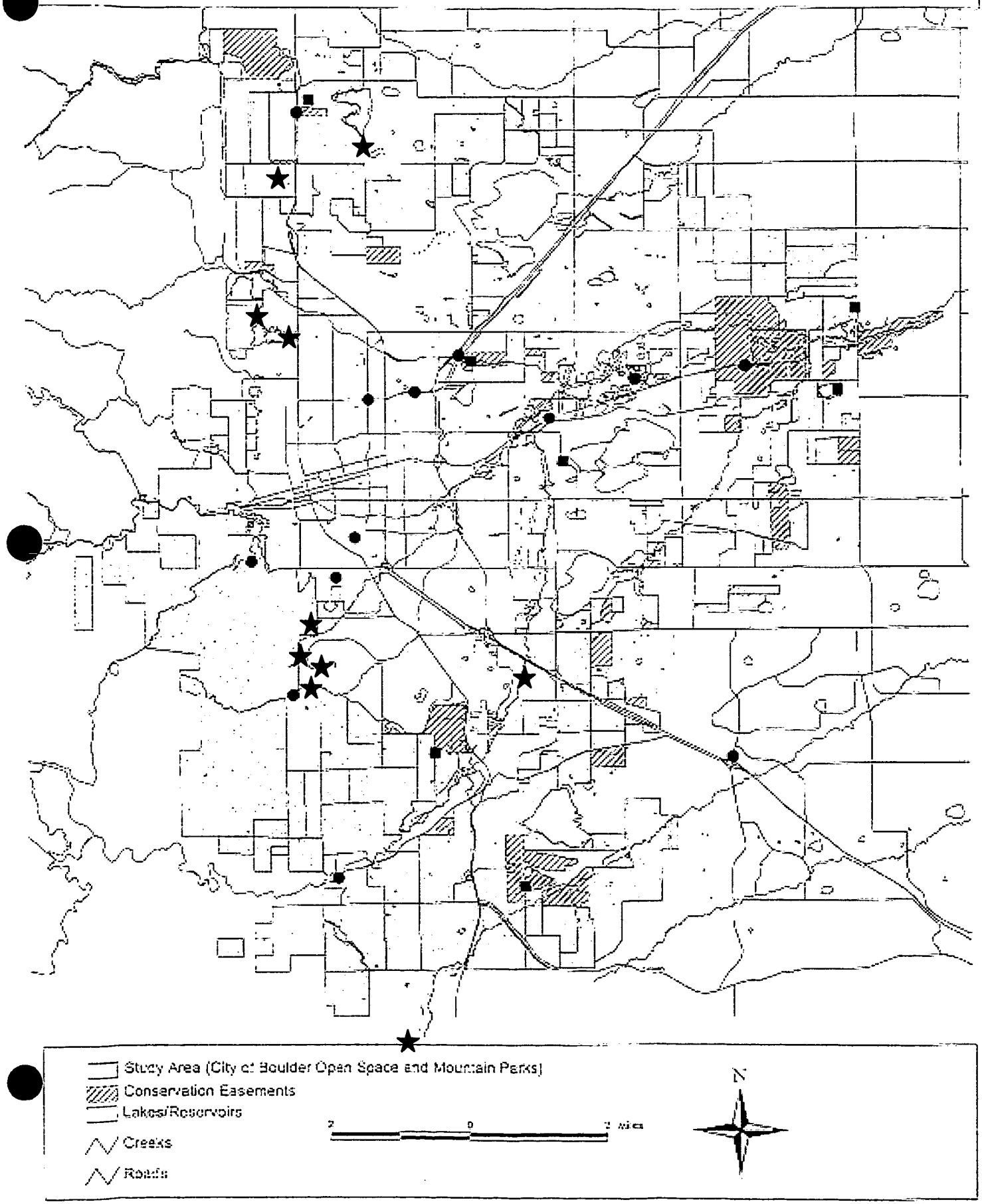
Cnemidophorus sexlineatus



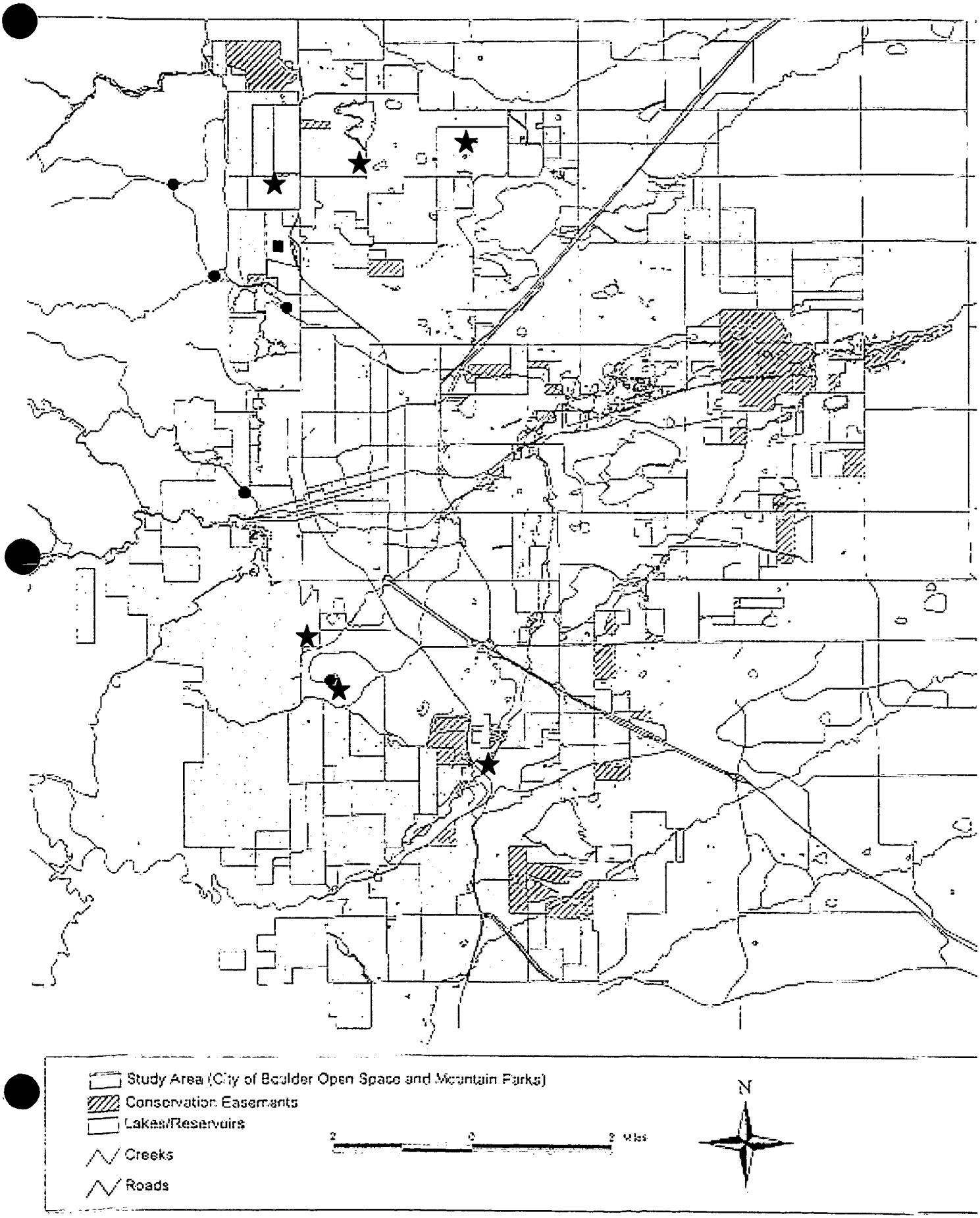
Sceloporus undulatus erythrocheilus



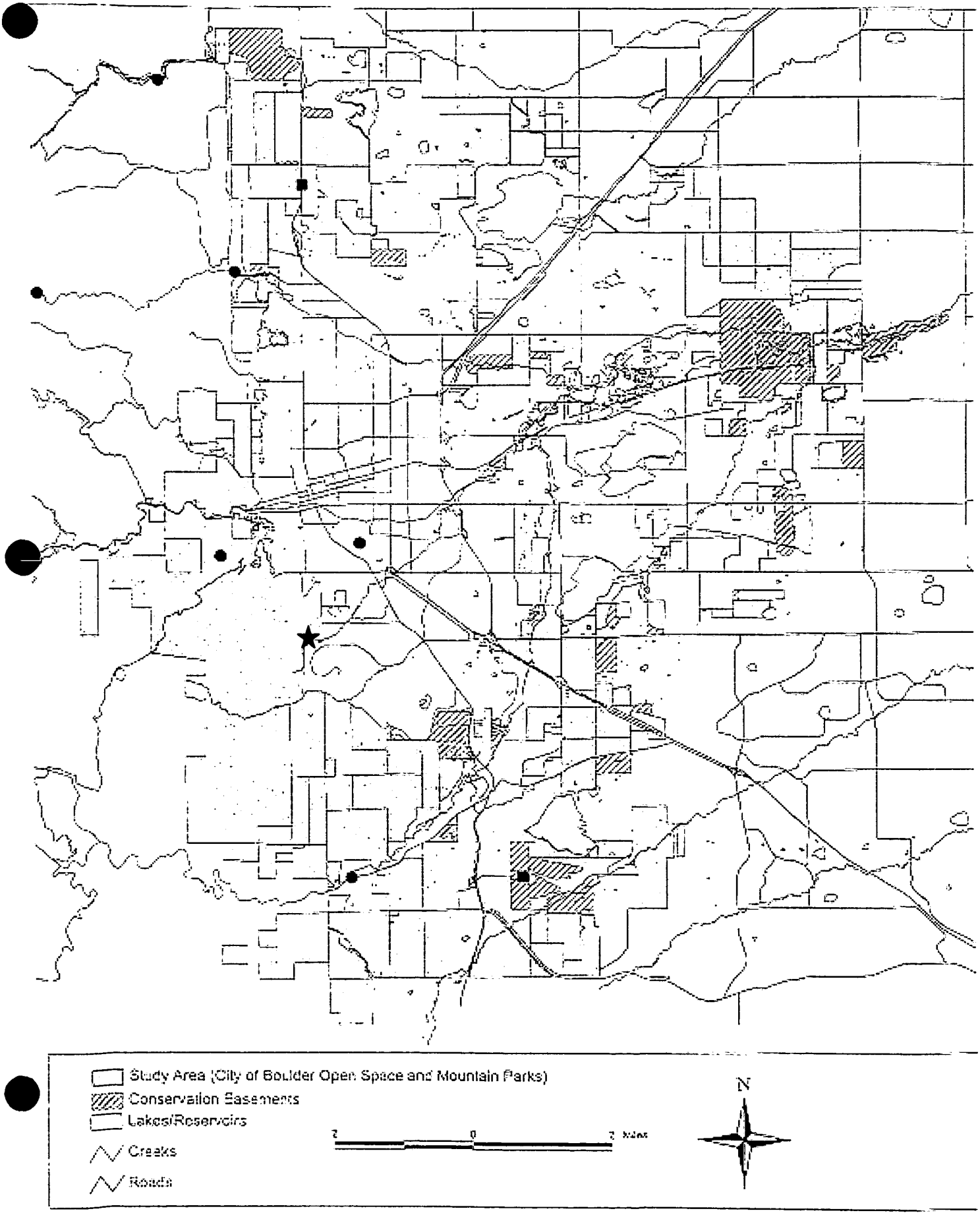
Coluber constrictor



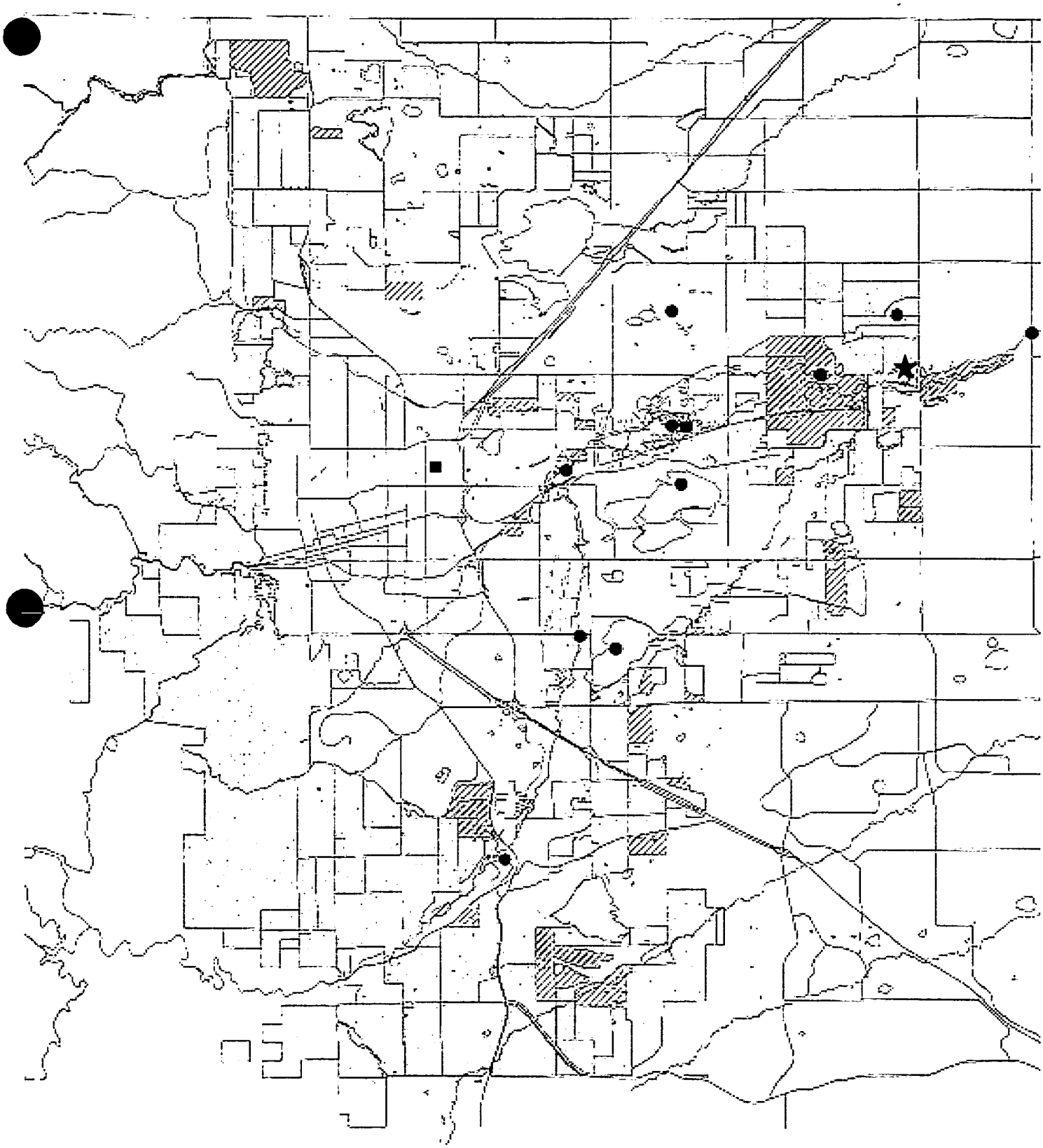
Crotalus viridis



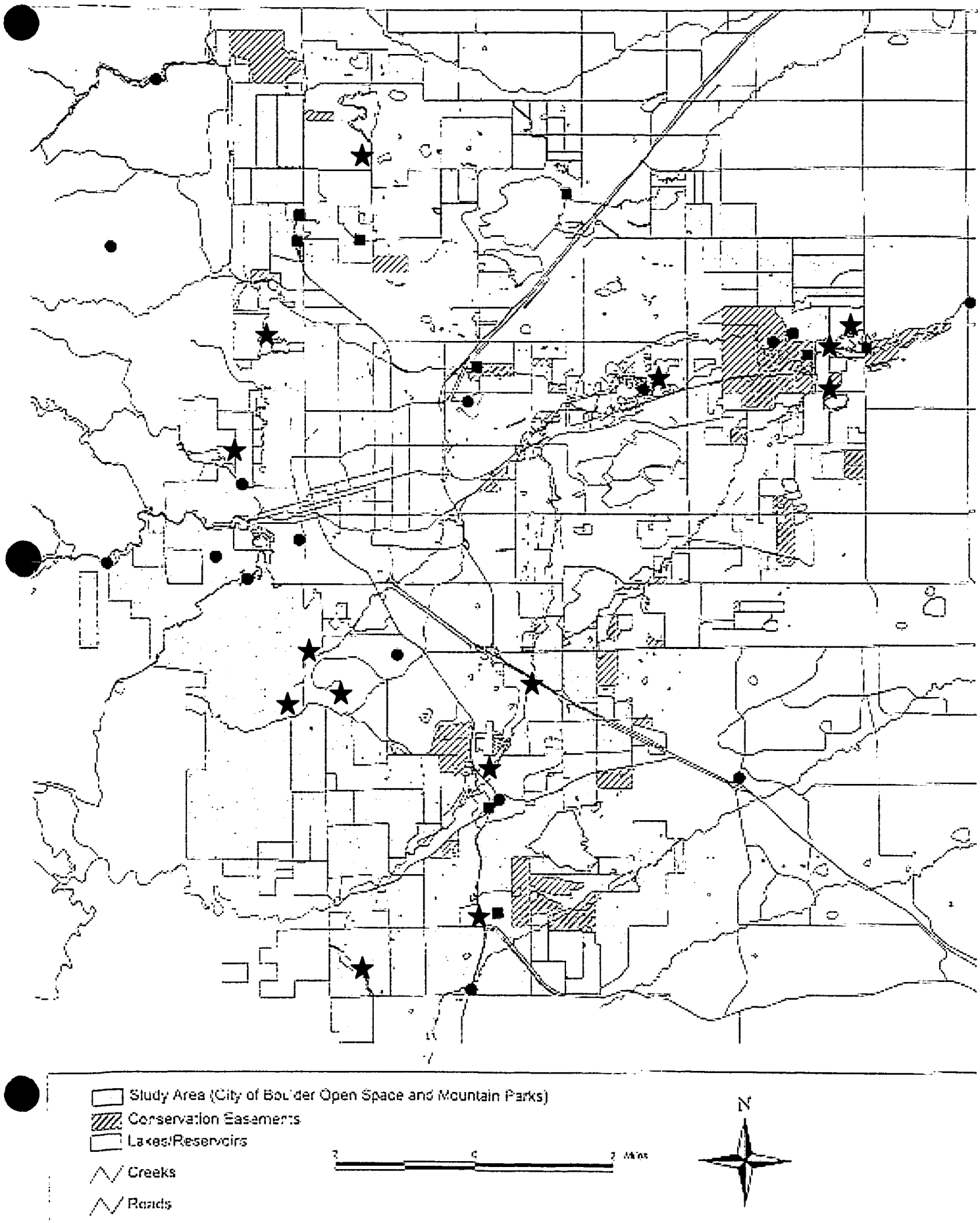
Lampropeltis triangulum



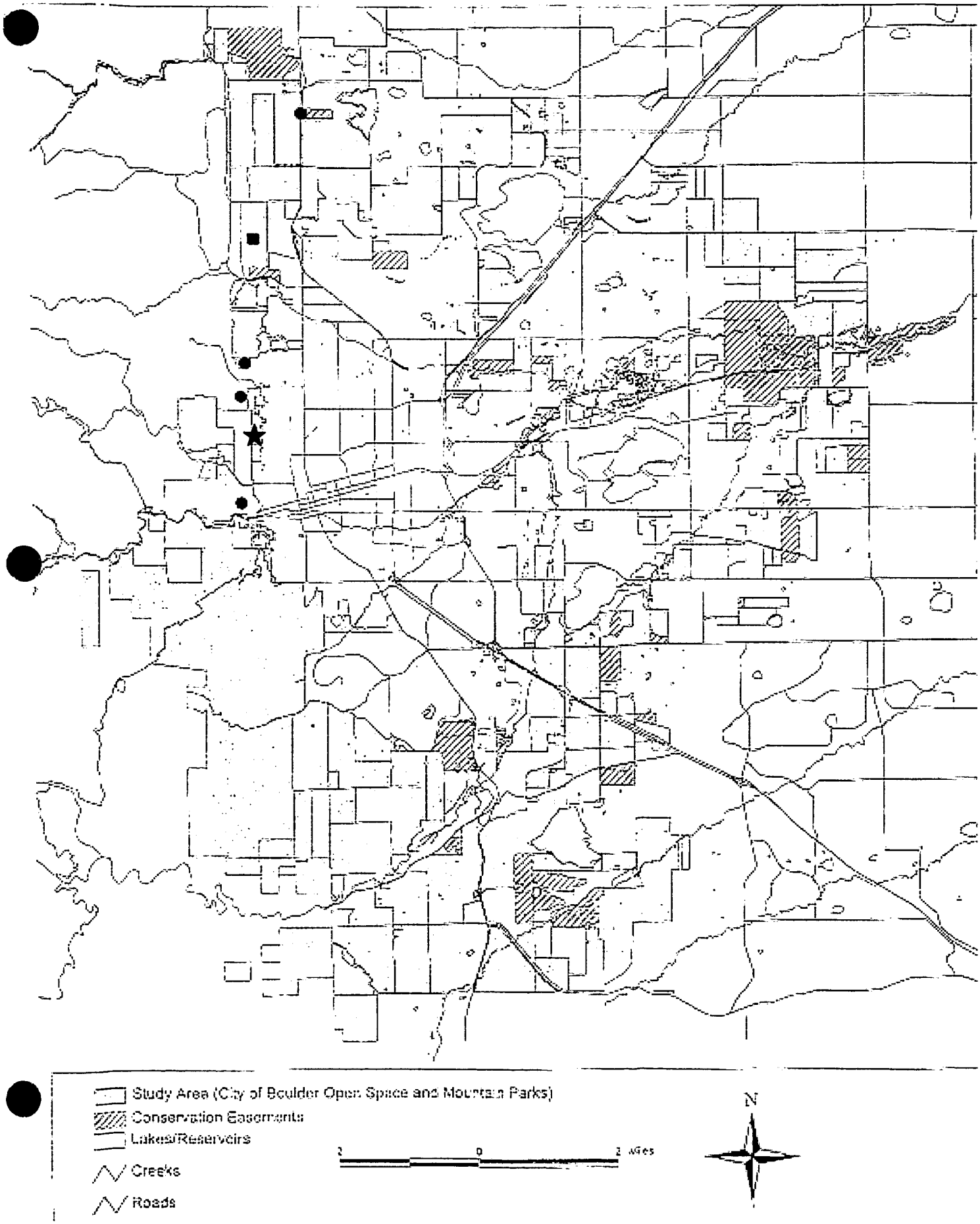
Nerodia sipedon



Pituophis catenifer



Tantilla nigriceps



Thamnophis radix