

LOCATION AND DISTRIBUTION OF DIURNAL ROOSTS, ROOST SITE PARAMETERS, HOME RANGES, AND THE USE OF WATER RESOURCES BY BOULDER COUNTY BATS (2000)

Rick A. Adams¹ & Katherine M. Thibault²

¹Associate Professor, Department of Biological Sciences, University of Wisconsin-Whitewater, and President, The Colorado Bat Society, Boulder

²Ph.D. Student, Department of Biology, University of New Mexico, Albuquerque

SECTION I. ABSTRACT

Bats are known to be important components of ecosystems worldwide. In North America they act as natural insecticides and control insect populations which when unchecked may lead to massive destruction of forest stands and agricultural crops. Despite this, little is known about bat natural history and, most importantly, what components of their natural history are in jeopardy in any given region. The year 2000 project is designed to investigate parameters of roost site preferences among Boulder's bats and to compare these parameters with those of nonoccupied, but potentially appropriate, roost sites. In particular we seek to determine why bats in the area do not choose to use tree snags within which to form maternity and bachelor colonies, as many of them do in other parts of their Rocky Mountain range. We will gain tremendous insight into the habits of bats in their roost sites by monitoring temperature level within the roost sites and also by attaching temperature sensitive radio transmitters from which we can deduce activity level of bats while they roost during the day. We will also radio track individuals while foraging to determine preferred foraging habitats and home range estimates. In addition, we will continue our investigations into waterhole preferences among bat species. An unexpected discovery in 1999, has led us to believe that female and juvenile bats of all species seek out waterholes with highest calcium levels. We seek to further investigate

this compelling find, with the hopes that the City of Boulder will provide funds for the testing of samples taken from waterholes in the area.

SECTION 2. INTRODUCTION

Objectives for 2000.-- The main objectives of the proposed project are to 1) add to the current locality data base ($n = 16$, Adams and Thibault, 1999) for maternity and bachelor diurnal roost sites of Boulder bats using radio telemetry, especially for two species (the fringed myotis, *Myotis thysanodes*, and Townsend's big-eared bat, *Corynorhinus townsendii*) listed as sensitive and in need of immediate conservation efforts by the Western Bat Working Group (WBWG). In particular, to locate the maternity site of a colony of *C. townsendii* captured, but not radio tagged, last year in the area of Dowdy Draw open space SE of Eldorado Mountain, 2) measure roost temperatures in relation to ambient temperatures, with the use of temperature-sensitive data loggers, throughout the summer for both known roost sites and for sites not occupied by bats, including apparently suitable tree snags, to determine roost site parameters, 3) measure the body temperatures of bats while roosting, with the use of temperature-sensitive transmitters, to determine activity levels of individuals while in the day roost, 4) continue to document colony sizes by conducting visual counts during evening outflights from previously discovered, and newly discovered, roost sites, 5) map out roost sites and document distances between them and waterhole sites of capture, 6) continue to document home-ranges and preferred foraging habitats per species by conducting nighttime tracking of radio-tagged individuals, 7) evaluate bat species richness, diversity, and evenness at previously uncensused waterhole sites, and 8) conduct water testing at waterhole sites to

determine characteristics of waterholes attractive to bats.

Hypotheses.-- **H₁**: Roosting colonies of Boulder County bats will be located in sites other than (REMOVE those documented in) rock crevices; **H₀**: Roosting colonies of bats will not be located at sites other than rock crevices. **H₂**: Temperature parameters within roost sites will differ among species and between occupied roost sites and potential but unoccupied roost sites. **H₀**: Temperature parameters of roost sites among species or between occupied and unoccupied roost sites will not differ significantly. **H₃**: Reproductive females will exhibit higher levels of activity while roosting than males and nonreproductive females; **H₀**: Levels of activity will not differ significantly among reproductive females, nonreproductive females, and males. **H₄**: All roosts will be located in close proximity to a source of water, with smaller body sized species demonstrating a stronger tendency due to their higher levels of water stress. **H₀**: Roost site locations are not constrained by distance to waterholes for any species, regardless of body size. **H₅**: Bats will have home ranges encompassing < 2 km in radius from their diurnal roost site; **H₀**: Bats will have home ranges encompassing > 2 km in radius from their diurnal roost site. **H₆**: There is a significant positive correlation between water temperature, pH, and mineral content relative to species diversity and evenness as well as the distribution of species by age and sex at waterholes. **H₀**: There is not a significant positive correlation between these variables and species diversity and evenness at waterholes. **H₇**: Significant differences occur among bat species in preferred foraging habitats. **H₀**: No significant differences occur among bat species in preference for foraging habitats.

Resource Management Needs, Anticipated Value, & Relevance to Ongoing

Studies.—This project accords with several facets of the natural resource management needs of the City of Boulder Open Space program. Firstly, the results of this project's investigation of waterhole parameters preferred by bats will contribute to the knowledge base for the effective management of water availability, an essential resource for wildlife in Boulder parks and open space area. In addition, our project is directly related to the management of forests, since bat populations in the area may be constrained by the lack of appropriate tree snags and older trees that provide cavity and crevice roost sites in other parts of these species' ranges (Vonhoff and Barclay, 1996). The lack of females and apparently maternity roosts for some species living in Boulder open space, may be resultant of the lack of such roosts. Furthermore, since roost sites are of potentially paramount in importance to bats and human disturbance at these sites are known to be devastating to local populations, knowledge of localities of these sites for the establishment of effective protective measures is necessary if bat diversity and abundance are to be maintained in the region as human population increases resulting in greater impacts to the area. Since bats apparently prefer rock-crevice roost sites, many colonies may be in danger from direct human disturbance in the form of rock climbing activities, which are becoming increasingly popular. The effects of human-caused disturbance became abundantly clear last summer when a nursery colony of fringed myotis (*Myotis thysanodes*) was disturbed by a rock climber who removed a data logger from the site after placement about a month earlier by Ranger Burton Stoner. We believe this human disturbance caused a premature breakup of this maternity colony because the bats were

present after the logger was placed at the site and the colony was gone from the site before it was recorded to have left in 1998. Such disturbance at this site is particularly troubling because the fringed myotis is categorized by the Western Bat Working group as a species in immediate danger and in need of immediate protective measures. We feel it is time that protection of bat maternity roosts subject to potential human disturbances be brought into line with concerns and protective measures used to secure nesting sites of other rock-roosting species such as the Peregrine and Prairie falcons. The anticipated value of the year 2000 effort will be the documentation and mapping of more roost sites, especially for two species of concern, *Myotis thysanodes* and *Corynorhinus townsendii*. Finally, documenting home ranges and preferred foraging habitats for the area's bat species is important in constructing a conservation management plan for the area.

The discovery in 1999 that the pattern of visitation to waterholes in the area by females and their young is highly correlated with calcium content of the water (see attached tables) is a highly significant find, not only for bats, but potentially for other animals as well. In addition, water tests have shown that Gregory Canyon creek is being polluted with high amounts of chlorine and manganese that apparently negatively affects its use by bat in the area. These data compel further research into the question of the importance of certain types of waterholes to the long term survival and conservation of bats in the area. In other words, not all waterholes are equal in value for reproductive females (Adams and Thibault, 1999), that require calcium to replace what is leached from bone during lactation, (Barclay, 1996; Studier et al., 1991), and for young that require calcium for skeletal growth. Calcium is thought to be the major limiting nutrient to bats,

perhaps constraining litter size, and recent studies have shown that tropical fruit-eating bats also ingest leaves high in calcium (Kunz, 1999). A rigorous study that determines if waterholes are important calcium sources to bats in the area would contribute significantly to the field of bat biology. In addition, relative mineral and nutrient concentrations of the waterholes in Boulder parks and open spaces is likely important for other wildlife species as well. Since such concentrations are known to change temporally and spatially, further analyses are required to fully understand these patterns.

Understanding roost site preferences and abiotic factors preferred by bat species in the area is critical to any management plan. We have yet to determine why Boulder bats are not using tree roost sites in the area. This is highly anomalous and suggests that roosts could be limiting or that rock crevices provide superior microclimates for bats. The latter, however, remains to be documented, and many studies throughout the northern Rockies have shown that the species present in Boulder use a variety of roosts, including tree snags. Placing temperature- and humidity-sensitive data loggers into known roost sites can give insight into roost parameters for these species, and by placing this equipment in tree snags and unoccupied crevices, we can determine what is lacking at these other sites. With such information, we will be able to more accurately, and perhaps be able to eventually predict, the relative availability of roost sites in a given area.

Educational Value.--Over the past four years the City of Boulder bat project has received exposure via the Daily Camera newspaper, which published a front page article on their Environmental Page, complete with color photographs of bats captured during the census in 1995 and more recently in the Daily Camera Friday Section cover article (22 October

1999). Our work has also been featured in the *University of Colorado Alumnus* that featured a full page article on the Principal Investigator (PI) and the City of Boulder Project. In addition, the P.I.'s work in Boulder has been published recently in an article on bats in the *Wisconsin State Journal*, the most widely read newspaper in the state. In addition, the Colorado Bat Society has published yearly articles in *The Chiropteran*, the Society's Newsletter, to educate our members about what CBS and the City of Boulder are doing for bat conservation and public education in the Front Range. Kate and I have also participated in the field education programs for the public, teaching them about bat ecology and conservation efforts in the City of Boulder open space. Furthermore, the P.I. has given public educational slide-talks about bats, and the efforts towards bat conservation that the City of Boulder Open Space and Boulder Mountain Parks have undertaken. Because of these efforts the public has become much more aware of the plight of bats, their importance in ecosystems, and how the City of Boulder Open Space department is an important contributor towards bat conservation.

In relation to past and ongoing research projects in the City of Boulder Mountain Parks and Open Space, studies of bat populations are highly important as indicators of general forest health, community ecology and ecosystem stability. Understanding critical roosting habitats, foraging habitats, and waterhole requirements for bats is, therefore, instrumental in building a management plan for the Front Range Corridor for the 21st century.

Literature Review

- Adams, R. A. 1988. Trends in the reproductive biology of some bats in Colorado. *Bat Research News*, 39:21-25.
- Adams, R. A. 1990. Biogeography of bats in Colorado: ecological implications of species tolerances. *Bat Research News*, 31:17-21.
- Adams, R. A. 1992. Developmental ecomorphology of the little brown bat, *Myotis lucifugus*. PhD Dissertation, University of Colorado-Boulder. 275 pp.
- Adams, R. A. 1995. Boulder County bats: a one year census. *City of Boulder Open Space Technical Report, Boulder*.
- Adams, R. A. 1996a. Size specific resource use between juvenile little brown bats, *Myotis lucifugus* (Chiroptera: Vespertilionidae): Is there an ontogenetic niche? *Canadian Journal of Zoology*, 74:1204-1210.
- Adams, R. A. 1996b. Patterns of water resource use and continued census of bats in Boulder County. *City of Boulder Open Space Technical Report*, 34 pp.
- Adams, R. A. 1997. Onset of volancy and foraging patterns of juvenile little brown bats, *Myotis lucifugus*. *Journal of Mammalogy*, 78:239-246.
- Adams, R. A. and K. M. Thibault. 1998. Survey of Boulder County bats: A study of roost site distribution and community ecology *City of Boulder Tech. Report*, 46 pp..
- Adams, R. A. and K. M. Thibault. 1999. Survey of Boulder County bats: A study of roost site distribution and community ecology *City of Boulder Tech. Report*, 59 pp.
- Adams, R. A. and K. M. Thibault. *In Press*. Records of the Brazilian free-tailed bat *Tadarida brasiliensis*, in Colorado. *The Southwest Naturalist*.

- Armstrong, D. M. 1972. Distribution of mammals in Colorado. *Mus. of Nat. Hist., Univ. Kansas*, 3:1-415.
- Armstrong, D. M., R. A. Adams, and J. Freeman. 1994. *Distribution and ecology of bats of Colorado*. Univ. Colorado Nat. Hist. Inventory., 15:1-83.
- Armstrong, D. M., R. A. Adams, K. Navo, J. Freeman, and S. Bissell. 1995. *Bats of Colorado: Shadows in the night*. Colo. Div. Wildlife Publ., Denver.
- Barclay, R. M. R. 1995. Does energy or calcium availability constrain reproduction in bats? In *Ecology, Evolution and Behaviour of Bats*, eds. P.A. Racey and S.M. Swift, pp 245-258. Oxford: Clarendon Press
- Brigham, R.M. 1991. Flexibility in foraging and roosting behaviour by big brown bats (*Eptesicis fuscus*). *Can. J. Zool.*, 69:117-121.
- Brigham, R.M., and M.B. Fenton. 1986. The influence of roost closure on the roosting and foraging behaviour of *E. fuscus*. *Can. J. Zool.*, 64:1128-1133.
- Burnett, C.D., and P.V. August. 1981. Time and energy budgets for day roosting in a maternity colony of *M. lucifugus*. *J. Mamm.*, 62:758-766.
- Cambell, L.A., J.G. Hallett, and M.A. O'Connell. 1996. Conservation of bats in managed forests: use of roosts by *L. noctivagans*. *J. Mamm.*, 77:976-984.
- Findley, J. S. 1993. *Bats: a community perspective*. Cambridge Univ. Press, 167 pp.
- Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. *Mammals of Colorado*. Denver Mus. Nat. Hist., Denver, and Univ. Colorado Press, Niwot.
- Hall, J. 1995. Results of the Colorado Bat Society's Bat Trend Survey. *The Chiropteran*, 4:3.

- Hamilton, I.A., and R.M.R. Barclay. 1994. Patterns of daily torpor and day roost selection by male and female *E. fuscus*. *Can. J. Zool.*, 72:744-749.
- Harvey, M.J., J. S. Altenbach, and T.L. Best. 1999. Bats of the United States. Published by the Arkansas Game and Fish Commission in cooperation with the U. S. Fish and Wildlife Service.
- Krutsch, P.H. 1961. A Summer colony of male little brown bats. *J. Mamm.*, 42:529-530.
- Kunz, T.H. 1982. *Ecology of bats*. Plenum Press, New York.
- Kunz, T. H. 1988. *Ecological and behavioral methods in the study of bats*. Smithsonian Press, Washington.
- Kurta, A., K. J. Williams, and R. Mies, 1996. Ecological, behavioural, and thermal observations of a peripheral population of Indiana bats (*Myotis sodalis*) in *Bats and Forests* (R.M.R. Barclay and R.M. Brigham, eds.). Research Branch Ministry of Forests, Victoria, British Columbia, Canada.
- McNab, B. K. 1982. Evolutionary alternatives in the physiological ecology of bats. Pp 151-200 in *Ecology of bats* (T. H. Kunz, ed.) Plenum Press, New York.
- Norberg, U. M. 1995. Wing form and flight mode in bats. Pp. 43-56 in *Recent advances in the study of bats* (M. B. Fenton, P. Racey, and J. M. V. Rayner, eds.). Cambridge University Press, Cambridge.
- O'Farrell, M.J., and E.H. Studier. 1973. Reproduction, growth, and development in *Myotis thysanodes* and *M. lucifugus*. *Ecology*, 54:18-30.
- O'Farrell, M.J., and E.H. Studier. 1975. Population structure and emergence patterns in *Myotis thysanodes* and *M. lucifugus* in Northeastern New Mexico. *Amer. Midl.*

Nat., 93: 368-376.

Ormsbee, P. C. 1996. Characteristics, use and distribution of day roosts selected by female *Myotis volans* (long-legged myotis) in forested habitat of the central Oregon Cascades. Pp.124-131 in *Bats and Forests Symposium*, (R. M. R. Barclay and R. M. Brigham, eds.) Ministry of Forestry Program, British Columbia.

Ormsbee, P.C., and W.C. McComb. 1998. Selection of day roosts by female long-eared myotis in the central Oregon Cascade Range. *J. Wildlife. Management*, 62:596-603.

Perkins, J. M. 1996. Does competition for roosts influence bat distribution in managed forests? Pp. 164-174 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds). Ministry of Forestry Program, British Columbia.

Rabe, M.J., T.E. Morrell, H. Green, J.C. Devos, JR., and C.R. Miller. 1998. Characteristics of ponderosa pine snag roosts used by reproductive bats in northern Arizona. *J. Wildlife Management*, 62:612-621.

Studier, E. H., D. P. Viele, and S. H. Sevick. 1991. Nutritional implications for nitrogen and mineral budgets from analysis of guano of the big brown bat *Eptesicus fuscus* (Chiroptera: Vespertilionidae). *Comparative Biochemistry and Physiology*, 100A: 1035-1039.

Thibault, K. M., and R. A. Adams. 1996. Patterns of water usage by a Coloradan bat assemblage. *Bat Research News*, 37:153.

Thibault, K. M. and R. A. Adams. 1998. Use of rock crevices as day roosts by the bat of Boulder. *Bat Research News*, In Press.

- Tuttle, M. D. 1988. *America's neighborhood bats*. Univ. Texas Press, Austin.
- Vonhoff, M.J., and R.M.R. Barclay. 1996. Roost site selection and roosting ecology of forest dwelling bats in southern British Columbia.. *Can. J. Zool.*, 74:1797-1805.
- Vonhof, M. J., and R. M. R. Barclay. 1997. Use of tree stumps by the western long-eared bat. *J. Wildlife Management*, 61:675-684.
- Webb, P. I. 1995. The comparative ecophysiology of water balance in microchiropteran bats. Pp. 203-218 in *Ecology, Evolution and Behaviour of Bats*, P. A. Racey and S. M. Swift, eds. Oxford Press, Oxford.
- Wilkinson, G. S., and J. W. Bradbury. 1988. Pp 105-124 in *Ecological and behavioral methods in the study of bats* (T. H. Kunz, ed). Smithsonian Press, Washington D.C.
- Williams, L.M., and M.C. Brittingham. 1997. Selection of maternity roosts by big brown bats. *J. Wildlife Management*, 61:359-368.
- Winchell, J.M., and T.H. Kunz.1993. Sampling protocols for estimating time budgets of roosting bats. *Can. J. Zool.*, 71:2244-2249.

SECTION 3: METHODS

Survey Methods.--Bats will be captured using Japanese mist nets that typically are stretched over a pond or other water source. Nets will be erected approximated 20-30 minutes before dark. Number of nets erected per site will vary depending upon P.I.'s strategy. Captured individuals will be distinguished to species, weighed, sexed, and checked for reproductive condition. To allow for analysis of movement patterns, all

captured individuals will be marked with a plastic, split-ring, numbered forearm band for identification in the case of recapture (Adams, 1992; Kunz, 1988). Some captured individuals of each species at different sites will be outfitted with LB-2 temperature-sensitive radio transmitters produced by Holohil Systems, Ltd. These transmitters are the smallest and lightest (0.47 grams) currently available commercially. Each transmitter, having a life-span of 10-14 days, will be attached to the fur using surgical glue. A Wildlife Materials (Carbondale, IL) 48-Channel Receiver outfitted with a Yagi antenna will be used to track radio-tagged individuals to their roost sites and, by using triangulation techniques with two receivers, we will follow tagged individuals nightly to document movement and foraging patterns.

Temperature-sensitive and humidity-sensitive data loggers (Onset Computer Corp.) will be placed in occupied and unoccupied, but potential, roost sites to compare and contrast these parameters. These data will allow US to better understand how particular species of bats choose roost sites. In addition, temperature-sensitive transmitters will give us data on the body temperatures of bats in their roost sites, because the pulse rate of the transmitter changes predictably as the body temperature of the bat increases or decreases. These units will also allow us to monitor behavior such relative amounts of time spent in torpor while roosting and how activity differs between males and females of a species in the roost sites.

Water samples will be collected from the surface of the water at all of our waterholes. In order to determine relative mineral and nutrient content of our six sites of highest bat activity, we will collect two samples, each 250 ml, of water from each site.

One sample from each site will be immediately acidified to a pH level below 2 with nitric acid, while the other sample from each site will be immediately treated with phenylmercuric acetate (PMA). Samples will be transported to a chemical laboratory (yet to be determined). The samples treated with nitric acid will be utilized to determine the concentrations of minerals, Na, K, Ca, Mg, and Fe, with the atomic absorption spectrophotometric method. The samples treated with PMA will be analyzed for concentrations of the nutrients, Cl, PO₄, SO₄, and NO₃, using ion chromatography. All concentrations will be measured to the nearest hundredth.

Statistical Analyses.—Water hole visitation data will be analyzed for species richness, diversity, and evenness across water holes and within water holes throughout the season using rarefaction analysis (Ludwig and Reynolds, 1988). Spearman Rank Correlation analysis will be used to discern relationships between physical parameters of waterholes (i.e. water temperature/water pH) and measures of species diversity and evenness. Chi Square analysis for general (*GO*) and specific overlap (*SO*) will be used to test for significant differences in habitat utilization among bat species (Ludwig and Reynolds, 1988). Student T-test and ANOVA will be used to compare temperature and humidity differences between occupied and unoccupied roosts as well as comparing male and female activity levels in the roost..

Project Schedule.—Data will gathered from 25 May to 25 August 2000. Data collection will involve nighttime mist netting at each of the waterholes on a rotational basis of no less than 10 days to avoid disturbance at the sites. Daytime search for previously unnetted (new) sites will occur. Daytime reconnaissance of roost site locations based

upon nighttime tagging of individuals will also be performed. Evening counts of individuals leaving roosts will allow for colony size estimations. Radio-tracking will take place at night, and placing of data recorders at roost sites will take place during the day. Because field work on bats is driven primarily by weather conditions, it is impossible to determine a day-specific trapping schedule. However, we head into the field on virtually all weather-permitting nights and days.

Project Requirements.—Colorado Division of Wildlife Research/Collection and City of Boulder Open Space Research Permits. Overnight Parking Permits for City of Boulder Trailhead parking lots. We will need to coordinate with Mountain Parks Ranger Burton Stoner who has graciously volunteered to help in the placing of data loggers in roosts requiring technical climbing experience.

Potential Impacts.—Whenever manipulations of animal populations are considered, so must be the risk of impacting those populations due to investigative techniques. The use of radio telemetry and light tags have been used by bat biologists for more than 20 years to study foraging behavior in bats. It is also the method of choice for locating maternity and hibernation sites because it is the safest, most effective, and least disruptive way to gather such data (Buchler, 1976; Kunz, 1988; Wilkinson and Bradbury, 1988). The skin-bond (Smith & Nephew Inc., Largo, FL) used to attach radio transmitters disintegrates within two weeks of application. In addition, because bats groom themselves and each other when roosting, they usually inadvertently remove devices from themselves and colony members. Since the primary effort in this project is to locate roost sites, a transmitter removed and dropped in the roost is a welcomed event. There is no

anticipated long-term impact to marked individuals during the study, and the knowledge gained will go a long way in helping to maintain healthy bat populations for the future in Boulder County. Plastic split-ring forearm bands have been used on bats for the last 10 years and have proven to be a safe method for marking with little or no impact to individuals if they are applied correctly (Kunz, 1988). We have used this method over the past four years on the Boulder bat populations ($n = 1272$) without incident.

The impact on roost sites in terms of data logger placement will be minimized by placing the loggers before bats arrive in large numbers at the known roost sites and with as little disturbance as possible into newly found roost sites. When possible, data loggers will be placed in occupied sites after the bats have left to forage for the evening.

SECTION 5: QUALIFICATIONS OF RESEARCHERS

Please see attached CV's

SECTION 4. BUDGET**Materials**

10 LB-2 temperature-sensitive transmitters (Holohil Inc.)(\$200.00ea.).....\$2000.00

6 Onset Temperature/Humidity Data Loggers (\$90.00 ea. x 4).....\$ 540.00

Miscellaneous (batteries, couplers, headlamp bulbs, etc.).....\$ 100.00

Principal Investigator Cost

PI.....\$4,000.00

Graduate Student (Co-PI).....\$3,000.00

TOTAL **\$9,640.00**

Water Sample Analysis: *If the City of Boulder Open Space and Boulder Mountain Parks Department is interested in funding water sample analyses, we would be willing to collect the samples and preserve them with the proper chemicals in the field at no extra charge. Estimates we have obtained from private firms were \$175.00 per sample, with two samples required per site.*

Table 1. Amounts measured in milligrams per liter of nine elements present at six waterholes in City of Boulder Open Space and Mountain Parks. nd < 0.03, ndd < 0.045.

Site	Cl	NO ₃	PO ₄	SO ₄	Na	K	Ca	Mg	Fe
Gregory Canyon	9.85	0.03	ndd	10.4	8.19	0.31	19.4	8.2	0.09
Stockton Cabin	0.46	1.3	0.045	8.65	2.73	0.18	6.2	1.52	0.2
North Shanahan	1.23	0.06	ndd	8.1	3.88	1.12	10.8	5.1	4.19
South Shanahan	1.17	nd	ndd	3.66	4.15	0.4	3.8	2.1	0.81
Bear Creek	1.17	0.07	ndd	5.31	4.88	0.24	11.6	4.6	0.04
Abbey	1.1	nd	ndd	4.13	4.73	0.78	7.4	3.9	2.95

Table 2. R^2 values from model II multiple regression analysis with probability values and Spearman Rank Correlation (r values in parentheses) analyses of mineral content of water taken from five waterholes in Boulder County versus number females, males and juveniles captured at each site ($n = 1127$). The only significant values are for high calcium content of water relative to high numbers of females and juveniles present. The relationship between high calcium content and males was not significant. The values for females and juveniles are highly significant, suggesting that these groups may be utilizing these sites as a calcium resource. * = significant correlation.

ELEMENT	FEMALES $n = 346$	MALES $n = 699$	JUVENILES $n = 80$
Calcium	0.946 (0.973)* $p = 0.005$	0.483 (0.694) $p = 0.192$	0.895 (0.946)* $p = 0.015$
Chlorine	0.027 (0.165) $p = 0.790$	0.266 (-0.516) $p = 0.373$	0.004 (-0.066) $p = 0.915$
Nitrogen (NO ₃)	0.000 (-0.012) $p = 0.985$	0.385 (0.621) $p = 0.263$	0.040 (0.200) $p = 0.746$
Phosphate (PO ₄)	0.002 (-0.051) $p = 0.935$	0.347 (0.589) $p = 0.296$	0.026 (0.161) $p = 0.796$
Sulfate	0.056 (-0.236) $p = 0.701$	0.219 (0.468) $p = 0.426$	0.000 (0.009) $p = 0.988$
Sodium	0.003 (-0.053) $p = 0.933$	0.217 (-0.466) $p = 0.428$	0.021 (-0.145) $p = 0.815$
Potassium	0.023 (0.153) $p = 0.0805$	0.126 (-0.355) $p = 0.557$	0.001 (0.025) $p = 0.968$
Magnesium	0.330 (0.574) $p = 0.311$	0.002 (0.042) $p = 0.947$	0.245 (0.495) $p = 0.397$
Iron	0.008 (0.093) $p = 0.882$	0.124 (-0.353) $p = 0.560$	0.000 (-0.007) $p = 0.991$

CURRICULUM VITAE

NAME: Rick A. Adams

ADDRESS: 549 W. Walton St.
Whitewater, WI 53190
E-MAIL: adamsr@uwwvax.uww.edu
TELEPHONE: (414) 473-2397

Department of Biological Sciences
University of Wisconsin
Whitewater, WI 53190-1790
(414) 472-1092

DEGREES

- Ph.D. 1992 Department of Environmental, Population, and Organismic Biology,
University of Colorado, Boulder.
M.A. 1989 Department of EPO Biology, University of Colorado, Boulder
B.A. 1985 Department of EPO Biology, University of Colorado, Boulder

PROFESSIONAL EXPERIENCE

Teaching

Associate Professor, Department of Biological Sciences, University of Wisconsin, Whitewater. *General Zoology, Biological Foundations, Comparative Vertebrate Anatomy, Vertebrate Field Biology, Mammalogy*, 1993-Present, Tenured 1999.

Visiting Professor, University of Colorado Mountain Research Center. *Living on the Edge: Biodiversity of Rocky Mountain Mammals*. Summer 1996.

Visiting Professor, Department of Biological Sciences, California State University, Stanislaus. *Mammalogy, Environmental Biology*, 1993.

Instructor, Cloud Ridge Naturalists. *Pinon Juniper Woodlands: A Workshop in Forest Ecology*. 1994.

Instructor, Cloud Ridge Naturalists. *The Natural History of Bats at Colorado National Monument*, 1993.

Instructor, Institute of Arctic and Alpine Research and the University of Colorado Mountain Research Station. *Animal Ecology*, 1992-1994.

Instructor, Aspen Center for Environmental Studies. *Montane and Alpine Mammal Ecology*, 1988 - 1989.

Instructor, Keystone Science School. *Mammalian Ecology*, 1989.

Graduate Teaching Assistant. *Mammalogy, Human Anatomy, Biology for nonMajors, General Biology*, 1985-1992.

Instructor, Science from CU, Outreach Program, 1988-1991.

Mentoring/Advising

- Summer 1998. Independent Study Project: Distribution of fruit bats on Montserrat.
Student: Samuel Daane
- Fall 1997. Independent Research Project: Comparative roosting ecology between eastern gray and eastern fox squirrels. *Student:* Jacob Schleuter.
- Fall 1996. Honors Mentor. Honors Project: Speciation as a consequence of genetic drift. *Student:* International Exchange Student (Tanzania): Joana Nqwilizi
- Fall 1996. Independent Research Project: Pedagogy in Biology. *Student:* Amy Kylmanen.
- Fall 1996. Undergraduate Teaching in Biology, Laboratory Assist. for General Zoology. *Student:* Amy Kylmanen
- Summer 1996. Project: Water use patterns of a Coloradan bat assemblage.
Research Assistant: Katherine Thibault, Boston College
- Fall 1995 and Spring 1996. Independent Research Project: Comparative skeletogenesis of Old and New World bats. *Student:* Aaron Briggs
- Spring 1995. Independent Research Project: Nest site selection by Gray (*Sciurus carolinensis*) and Fox squirrels (*Sciurus niger*) living in sympatric populations. *Student:* Shelly Hammer
- Fall 1994 and Spring 1995. Independent Research Project: Development of the handwing in *Myotis lucifugus*. *Student:* Meg Sorensen.
- Fall 1994. Independent Research Project: Development of the hind foot and calcar in *Myotis lucifugus*. *Student:* Kay Olsen.
- Spring 1994. Independent Research Project: Use of human trails by Cottontail Rabbits. *Student:* Shala Werner.
- Spring 1994. Independent Research Project: Development of the hind limb in *Myotis lucifugus*. *Student:* Beth McDonough.
- 1993-Present. Student Advising: Incoming Freshmen and 30 Continuing Majors

Research and Consulting

- Co-Principal Investigator:** Comparisons of biodiversity of bats on Montserrat & Antigua, BWI: the effects of the Soufrier Hills Volcano. 1998-Present.
- Principal Investigator:** Water use patterns and continued census of Boulder County bats. Summers 1995-Present.
- President of Organizing Committee:** Four Corners Regional Bat Conference, Durango, Colorado. January 1996. 2 days/153 attendees.
- Principal Investigator.** Distribution and ecology of bats of Boulder County. City of Boulder Open Space, Boulder County Open Space, Boulder Mountain Parks, Boulder, CO. 1995.
- Research Associate:** A Survey of Preble's Jumping Mouse, National Institute of Standards and Technology Site, Boulder, CO. The S. M. Stoller Corporation, Boulder, CO. 1994.

Research Associate. Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO. 1994-Present.

Founder and President. The Colorado Bat Society: a nonprofit corporation dedicated to fostering educational information and the conservation of bat species in Colorado, 1990-Present.

Principal Investigator. Bat/Inactive Mine Project, Colorado Division of Wildlife, 1992.

Research Associate. University of Colorado Museum, 1992-Present.

Consultant. Bat Relocation Project, Fort Laramie National Historical Site, 1992-1994.

Principal Investigator. Bat species distribution and abundance at Colorado National Monument, 1989-1994.

Principal Investigator. Status of Brazilian Free-tailed bats in the San Luis Valley of Colorado, 1988.

Consultant and Trapper. David Attenborough's Living Planet Series, 1987.

Graduate Curatorial Assistant. Mammal Section, University of Colorado Museum, 1987-1992.

Graduate Research Assistant. Small Mammal Project, Institute of Arctic and Alpine Research, University of Colorado, Boulder, 1985-1988.

Graduate Research Assistant. Mammal Survey of Rocky Mountain National Park, 1987.

Graduate Research Assistant. Vertebrate Survey of Devil's Tower National Monument, Wyoming, 1986.

ARTICLES PUBLISHED

Adams, R.A. *In Press.* Wing ontogeny, shifting niche dimensions, and adaptive landscapes. *In* Ontogeny, Functional Ecology and Evolution of Bats (Adams and Pedersen, eds.). Cambridge University Press.

Adams, R.A., and S.C. Pedersen. *In Press.* Integrating ontogeny into ecological and evolutionary investigations. *In* Ontogeny, Functional Ecology and Evolution of Bats (Adams and Pedersen, eds.) Cambridge University Press.

Adams, R.A. and K.M. Thibault. *In Press.* Ontogeny and evolution of the bat hindlimb and the calcar: assessing phylogenetic trends. *In* Ontogeny, Functional Ecology and Evolution of Bats (Adams and Pedersen, eds.) Cambridge University Press.

Adams, R.A. and K.M. Thibault. *In Press.* New record of the Brazilian free-tailed bat, *Tadarida brasiliensis* (Chiroptera: Molossidae) in Colorado. *The Southwestern Naturalist*.

Adams, R.A. and K.M. Thibault. *In Press.* Growth, development, and histology of the calcar in the little brown bat, *Myotis lucifugus*. *Acta Chiropterologica*.

Adams, R. A. 1998. Evolutionary implications of developmental and functional integration in bat wings. *Journal of Zoology, London*, 246:165-174.

Adams, R. A. 1997. Onset of juvenile volancy and foraging patterns of little brown bats, *Myotis lucifugus*. *Journal of Mammalogy*, 78:239-246.

- Adams, R. A. 1996. Size-specific resource partitioning among juvenile little brown bats (*Myotis lucifugus*): Is there an ontogenetic shift? *Canadian Journal of Zoology*, 74:1204-1210.
- Armstrong, D. M., R. A. Adams, K. Navo, J. Freeman, and S. J. Bissell. 1995. Bats of Colorado: shadows in the night. Colorado Division of Wildlife Publication, Denver, 30 pp. (*not peer-reviewed*)
- Armstrong, D. M., R. A. Adams, and J. Freeman. 1994. Distribution and ecology of bats of Colorado. Natural History Inventory, University of Colorado Museum, Boulder, 15:1-83.
- Adams, R. A., and S. C. Pedersen. 1994. Wings on their fingers: despite 50 million years of evolution, bats don't become expert fliers overnight. *Natural History*, 103:48-55.
- Adams, R. A. 1993. Consumption of water boatmen (Hemiptera: Corixidae) by little brown bats, *Myotis lucifugus*. *Bat Research News*, 34:66-67.
- Adams, R. A. 1992. Comparative growth and development of the forearm between the little brown bat (*Myotis lucifugus*) and the Norway rat (*Rattus norvegicus*). *Journal of Morphology*, 214:251-260.
- Adams, R. A. 1992. Stages of development and sequence of bone formation in the little brown bat, *Myotis lucifugus*. *Journal of Mammalogy*, 73:160-167.
- Adams, R. A. 1990. Biogeography of bats in Colorado: ecological implication of species tolerances. *Bat Research News*, 31:17-21.
- Adams, R. A. 1988. Trends in the reproductive biology of some bats in Colorado. *Bat Research News*, 29:21-25.
- Adams, R. A., B. J. Lengas, and M. Bekoff. 1987. Variations in the avoidance responses of black-tailed prairie dogs (*Cynomys ludovicianus*). *Journal of Mammalogy*, 68:696-689.
- Adams, R. A. 1982. The endothermic properties of Dinosaurs. *Journal of the Northern Ohio Association of Herpetologists*, 8:2-13.

PROCEEDINGS (* = undergraduate student)

- Sorensen, M.*, and R. A. Adams. 1996. Comparative development of the forelimb between the little brown bat (*Myotis lucifugus*) and the Norway rat (*Rattus norvegicus*). Proceedings of the 10th Natl. Conference on Undergraduate Research, Ashville.

ARTICLES IN PREPARATION (* = undergraduate student)

- Adams, R. A. and K. M. Thibault. In Prep. Abiotic preferences among bats of drinking holes in a Coloradan bat assemblage. *Journal of Zoology*, London.

BOOKS IN PREPARATION

- Adams, R. A., and S. C. Pedersen, eds. *Expected 1999. Ontogeny, Functional Ecology, and Evolution of Bats*. Cambridge University Press, Cambridge.
- Adams, R. A. *Natural History and Conservation of Rocky Mountain Bats Ranging from Mexico to Canada*.

ABSTRACTS (* = undergraduate student)

- Adams, R.A. and K.M. Thibault. 1998. Timing of visitation at waterholes of a Coloradan bat assemblage: Is there pattern? 28th North American Symposium on Bat Research, Hot Springs.
- Pedersen, S.C. and R.A. Adams. A comparison of 20 years of data with historical accidents in the Belham River Valley of Montserrat, BWI. 28th North American Symposium on Bat Research, Hot Springs.
- Thibault, K.M. and R.A. Adams. 1998. 1998. Roosting behavior of bats in the Front Range of Colorado. 28th North American symposium on Bat Research, Hot Springs.
- Adams, R.A. 1997. Growth of the wing in *Myotis lucifugus*: the dynamics of size over shape. 27th North American Symposium on Bat Research, Tucson.
- Adams, R.A., and S.C. Pedersen. 1997. The functional matrix and evolutionary innovations in bats. Society for the Study of Evolution Meetings, Boulder.
- Adams, R. A., and A. Briggs*. 1996. Development and growth of the calcar in the little brown bat, *Myotis lucifugus*. *Bat Research News*, 37:20. Presented Paper. North American Symposium on Bat Research (NASBR), Bloomington.
- Thibault, K. M. *, and R. A. Adams. 1996. Timing of visitation to ponds by a Coloradan bat assemblage. *Bat Research News*. Poster. NASBR, Bloomington.
- Sorensen, M. *, and R. A. Adams. 1996. Comparative development of the forelimb between the little brown bat (*Myotis lucifugus*) and the Norway rat (*Rattus norvegicus*). Proceedings of the 10th NCUR, Ashville.
- Adams, R. A. 1996. Troubles in Camelot?: Boulder County bats show skewed sex ratios. Four Corners Regional Conference, Durango. Presented Paper.
- Adams, R. A., and S. C. Pedersen. 1995. Cruising for a bruising: volant juveniles face a steep learning curve. *Bat Research News*, 36:42. International Bat Research Conference, Boston.
- Adams, R. A. 1994. . Compensatory growth of the wing in *Myotis lucifugus*. *Bat Research News*. Poster. NASBR, Ixtapa, Mexico.
- Adams, R. A. 1992. Density dependent effects and the ontogenetic niche in *Myotis lucifugus*. *Bat Research News*, 33:38. Presented Paper, (NASBR). Lincoln,
- Adams, R. A. 1992. Developmental ecomorphology of the little brown bat (*Myotis lucifugus*). Presented Paper, American Society of Mammal., Salt Lake City
- Adams, R. A. 1991. Growth of the wing and developmental convergence in niche space in the little brown bat (*Myotis lucifugus*). *Bat Research News*, 32:63. Presented Paper, NASBR. Quebec, Canada.
- Adams, R. A. 1990. Resource partitioning between juvenile and adult *Myotis*

- lucifugus* in a mosaic habitat setting. BRNews, 31:69. Paper, NASBR.
- Adams, R. A., and S. C. Pedersen. 1990. Comparative development of the forelimbs of three bats: *Myotis lucifugus*, *Eptesicus fuscus*, and *Artibeus jamaicensis*. American Zoologist, 29:181. Poster, American Society of Zoologists Meetings (ASZ), Boston.
- Adams, R. A. 1989. Growth and development of flight morphology in the little brown bat, *Myotis lucifugus*. BRN, 30:59. Pres. Paper, NASBR, Knoxville
- Adams, R. A. 1987. Aspects of forelimb development in bats of the family Vespertilionidae. Bat Research News, 28:31. Presented Paper, NASBR.
- Adams, R. A., B. J. Lengas, and M. Bekoff. 1985. Variations in the threshold response in black-tailed prairie dogs (*Cynomys ludovicianus*). American Zoologist, 24:120. Presented Paper, ASZ Meetings, Denver.
- Adams, R. A., and J. Freeman. 1984. Synopsis of reproductive information on the bats of Colorado. Journal of the Colorado/Wyoming Academy of Science, 16:31. Presented Paper, Gunnison, CO.

TECHNICAL REPORTS

- Adams, R.A. 1998. Survey of Boulder County Bats: A study in Roost Site Distribution and Community Ecology. City of Boulder Open Space Department, Boulder. 41 pp
- Adams, R. A. 1997. Survey of Boulder County Bats: A Study in Biodiversity and Community Ecology. City of Boulder Open Space Department, Boulder. 42 pp.
- Adams, R. A. 1996. Patterns of water use by Boulder Bats, 33 pp. City of Boulder Open Space Department, Boulder.
- Adams, R. A. 1995. Boulder County bats: a one-year census, 15 pp. City of Boulder Open Space Department, Boulder.
- Adams, R. A. 1994. Report: 1994. Continued census of the bat fauna at Colorado National Monument, 5 pp.
- Adams, R. A., and J. Freeman. 1993. Status of Townsend's big-eared bats at historic cave sites in Colorado. Colorado Division of Wildlife. 20 pp.
- Freeman, J., and R. A. Adams. 1992. Bat species occurrence, abundance, and distribution in inactive mines in Colorado. Colorado Division of Wildlife. 20 pp.
- Adams, R. A. 1990. Bat species abundance and distribution in Colorado National Monument. National Park Service, Supplements 1992 and 1993, 19 pp.
- Adams, R. A. 1989. Population status of Brazilian free-tailed bats at the Orient Mine. Colorado Division of Wildlife. 15 pp.
- Armstrong, D. M., and R. A. Adams. 1988. The vertebrates at Fort Laramie National Historical Site: an historical and ecological perspective. 73 pp.

INVITED TALKS

- 1997. Wing ontogeny, foraging ecology and population dynamics of little brown bats, *Myotis lucifugus*. Dept. Biol. Colloq., Carleton College, Northfield.
- 1997. How to teach students about flight development and the echolocation ability of bats. Denver Regional Teachers Conf., Denver Mus.of Natural History.
- 1996. How to teach student about bats. Denver Regional Teachers Conference, DMNH.
- 1996. Wonderful World of Bats: Audubon Society, Williams Bay, WI
- 1995. Embryos, wings, and evolution. Dept. Bio. Sci. Colloq. UWW.
- 1995. Development and ecology of bats. Denver Museum of Natural History.
- 1994. The ontogenetic niche in the little brown bat, *Myotis lucifugus*. Department of Biology Colloquium Series, University of Windsor, Windsor, Ontario.
- 1994. "Bats I've known and loved." UWW Colloquium Series.
- 1994. Bats: Myths and Realities. UWW Biology Days for High School Teachers
- 1994. The Natural History of Bats. Front Range Chapter of the Audubon Society.

REVIEWS (1997-1998)

- Five Articles Reviewed for *Journal of Mammalogy*
- One Article Reviewed for *Behavioral Ecology*
- Two Articles Reviewed for *Great Basin Naturalist*
- One Article Reviewed for *Condor*

RECOGNITION AWARDS

- 1996 Nominated for University Excellence in Research Award
- 1996 Chosen for Inclusion in Who's Who Among American Teachers
- 1995 Excellence in Teaching Award, University of Wisconsin Whitewater
- 1995 Chosen for Inclusion in Marquis Who's Who in the World, 12th Edition
- 1994 Chosen for Inclusion in Marquis Who's Who in the West, 25th Edition
- 1993 Chosen for Inclusion in Marquis Who's Who in the West, 24th Edition
- 1990 Student Honor. Award: Best Student Paper, NA Symp.on Bat Research
- 1987 Nominated Member of Sigma Xi Scientific Society

SERVICE

- 1998 UWW-University Graduate Council Committee
- 1998 College of Letters and Sciences Honors Committee
- 1998 College of Letters and Sciences Salary Committee
- 1998 College of Letters and Sciences Audit & Review Committee
- 1997 UWW-University Graduate Council Committee
- 1997 College of Letters and Sciences Award for Excel. in Res.Committee
- 1997 University Audit and Review Committee
- 1997 Dept. Bio. Sci.-Merit Review Committee

- 1997 Dept. Bio. Sci.-Merit Form Revision Committee
- 1997 Scout Night: Biology Education for Boy Scouts-Upham Hall
- 1996 College of Letters and Sciences Award for Excel. in Res. Committee
- 1996 College of Letters and Sciences Audit and Review Committee
- 1996 Biological Sciences Search and Screen Committee
- 1996 Judge: Oral Presentations for Wisconsin Colleges Undergraduate
Research Day
- 1996 Scout Night: Biology Education for Boy Scouts (Lakeview Elementary
School)
- 1995 College of Letters and Science Award for Excel. in Res. Committee
- 1995 Wisconsin Bat Advisory Committee, Dept. Nat. Res.
- 1994 Chair, Search and Screen Committee. Vertebrate Evolutionary Ecologist
- 1993-97 Biological Sciences Curriculum Committee, UWW
- 1993 College of Letters and Science Curriculum Committee, UWW
- 1993 Biological Sciences Search and Screen Committee, UWW

RESEARCH GRANT AWARDS

- 1999 Location and distribution of diurnal roosts and the use of water resources
by Boulder County bats. City of Boulder (\$9389.00)
- 1998 Loss of biodiversity of bats on the Caribbean island of Montserrat.
UWW-Research Grant (\$3000.00)
- 1998 Continued research on bat roost locations. City of Boulder Grant
(\$7585.00)
- 1997 Location of bat roost sites using radio telemetry. City of Boulder Open
Space Competitive Grant Program (\$6600.00)
- 1996 Location and distribution of Boulder County bats. City of Boulder Open
Space Competitive Grant Program (\$3300.00)
- 1995 University of Wisconsin-Whitewater Research Grant (\$4900.00)
- 1994 University of Wisconsin-Whitewater, Research Grant (\$4000.00)
- 1994 Sponsor: University of Wisconsin Undergraduate Research Grants (2)
(\$500.00 each)
- 1991 Research Fellowship, Department of EPO Biology, University of Colorado,
Boulder (\$1000.00)
Dean Small Grant Award (\$250.00), William H. Burt Award (\$1000.00)
- 1990 William H. Burt Award (\$1200.00)
- 1988 William H. Burt Award (\$1600.00)
- 1987 Grant-in-Aid of Research, Sigma Xi (\$800.00)
Kathy Lichty Memorial Fund (\$600.00)
Colorado Mountain Foundation (\$500.00)
- 1986 Lichty/Alexander Memorial (\$800.00)
Colorado Mountain Foundation (\$ 700.00)
- 1985 Grant-in-Aid of Research, Sigma Xi (\$800.00)

GRANTS PENDING

- 1999(Fall) *National Geographic Society* (\$23,000.00). Adams, R.A. & S.C. Pedersen.
Preliminary Proposal: Recovery of Montserrat: Importance of Fruit Bats in
Primary and Secondary Succession on a Volcanically Inundated Island.
- 1998(Fall) *NSF-REU*. (\$207,000.00) Adams, R.A. & S. Ghosh, UWW; Adewusi, K. &
J. Hoerter, Ferris State University. Collaborative REU-Research Link Consortium.
- 1998(Fall) *NSF-CCLI*. (approx. \$100,000.00) Adams, R.A, S. Ghosh, & J. McKinnon.
Integrative Freshman Biology: A Modular Approach (Due Date, Nov. 15)
- 1998(due Dec. 15) *NSF Grant Resubmission*. (\$193,000.00). Adams, R.A.
Investigations into community dynamics and temporal patterns of waterhole
visitation by a Coloradan bat assemblage.

PROFESSIONAL MEMBERSHIPS

Sigma Xi Scientific Foundation
American Society of Mammalogists
American Society of Naturalists
Society for the Study of Mammalian Evolution
Colorado/Wyoming Academy of Science

REFERENCES

- Dr. David M. Armstrong**, Professor, Department of Environmental, Population, and
Organismic Biology, UC-Boulder, 303-492-7965, david.armstrong@colorado.edu
- Dr. Alexander Cruz**, Professor, EPO Biology, University of Colorado, Boulder,
303-492-8189. alexander.cruz@colorado.edu
- Dr. Sibdas Ghosh**, Assistant Professor, Department of Biological Sciences, University of
Wisconsin-Whitewater, 53190. ghoshs@uwwvax.uww.edu
- Dr. Richard Jones**, Professor, EPO Biology, University of Colorado, Boulder,
303-492-8189. richard.e.jones@colorado.edu
- Dr. Carron Meaney**, Research Associate, Denver Museum of Natural History and
University of Colorado Museum. meaney@stripe.colorado.edu
- Dr. Dennis Van Gerven**, Professor, Department of Anthropology, University of
Colorado, Boulder, 303-492-8107. dennis.vangerven@colorado.edu
- Dr. Steven Bissell**, Colorado Division of Wildlife, Denver, 303-297-1192.
- Dr. Michael Bogan**, National Biological Survey, Department of Biology, University of
New Mexico, Albuquerque, NM 87131. 505-766-3903.

CURRICULUM VITAE

Katherine M. Thibault
Department of Biology
University of New Mexico
Albuquerque, NM 87131
(505) 277-0870
katet@unm.edu

EDUCATION

B.S. Biology. 1997. Boston College, Chestnut Hill, MA

Biology Courses: Molecular Cell Biology and Genetics, Ecology, Animal Behaviour, Comparative Animal Physiology, Methods in Field Research, Coastal Field Ecology, Environmental Biology, Vertebrate Zoology, Undergraduate Research

Overall GPA: 3.71

Biology GPA: 3.79

Honors: *Magna cum laude*; Phi Beta Kappa

RESEARCH

Research Assistant. 1996-1999. Distribution and ecology of bats of Boulder County. City of Boulder Open Space, Boulder, Colorado. Rick A. Adams, P.I.

Research Assistant. 1998. Development of the calcar in the little brown bat, *Myotis lucifugus*. Rick A. Adams, P.I.

Research Assistant. 1998. Roosting ecology, social structure, and home ranges of the New Zealand long-tailed and short-tailed bats in the Eglinton Valley, Fiordland National Park, New Zealand. Department of Conservation, Christchurch, NZ.

Research Assistant. 1997. Parental care in microhylid frogs in the Crater Mountain Wildlife Management Area, Wara Sera Research Station, Papua New Guinea. David P. Bickford, P.I.

Research Assistant. 1996. Preliminary analysis of social behavior in a captive herd of white-tailed deer, *Odocoileus virginianus*. Boston College.

PROFESSIONAL EXPERIENCE

Curatorial Assistant. Department of Mammalogy, The Museum of Comparative Zoology, Harvard University, Cambridge, MA. 1996-1997.

MEETINGS ATTENDED

1996 Animal Behavior Society, Flagstaff, AZ

1996 North American Symposium on Bat Research, Bloomington, IL

1998 North American Symposium on Bat Research, Hot Springs, AR

1999 North American Symposium on Bat Research, Madison, WI

PUBLISHED ABSTRACTS

- Adams, R. A., K. M. Thibault, and B. Petru. *In press*. Are all watering holes created equal? *Bat Research News*.
- Thibault, K. M., and R. A. Adams. 1998. Use of rock crevices as day roosts by the bats of Boulder, Colorado. *Bat Research News*.
- Adams, R. A., and K. M. Thibault. 1998. Timing of visitations to waterholes by a Coloradan bat assemblage: Is there pattern? *Bat Research News*.
- Thibault, K. M., and R. A. Adams. 1996. Timing of visitations to ponds by a Coloradan bat assemblage. *Bat Research News*.

PUBLICATIONS

- Adams, R. A., and K. M. Thibault. *In press*. The development of the calcar in the little brown bat, *Myotis lucifugus*. *Acta Chiropterologica*.
- Adams, R. A., and K. M. Thibault. *In press*. Ontogeny and evolution of the Chiropteran hindlimb: assessing phylogenetic trends. *In* *Ontogeny, Functional Ecology, and Evolution of bats* (R. A. Adams and S. C. Pedersen, eds.). Cambridge: Cambridge University Press.
- Adams, R. A., and K. M. Thibault. *In press*. New record of the Brazilian free-tailed bat, *Tadarida brasiliensis*, (Chiroptera: Molossidae) in Colorado. *Southwestern Naturalist*.

SOCIETY MEMBERSHIPS

- Animal Behavior Society--1996-1998
 American Society of Mammalogists--1997, 1999
 Southwestern Association of Naturalists--1999

REFERENCES

- Rick A. Adams, Ph.D. Dept. of Biological Sciences, University of Wisconsin-Whitewater. Whitewater, WI 53190. *Email*: adamsr@uwwvax.uww.edu
- Peter J. Auger, Ph.D. Biology Dept., Boston College, Chestnut Hill, MA 02167.
- David P. Bickford. Research & Conservation Foundation of PNG, PO Box 1261, Goroka, EHP, PNG. *Email*: rcf@dg.com.pg
- Judy Chupasko, M.S. Museum of Comparative Zoology, Harvard University, Cambridge, MA. *Email*: chupasko@mcz.harvard.edu
- Eric G. Strauss, Ph.D. Biology Dept., Boston College, Chestnut Hill, MA 02167. *Email*: eric.strauss@bc.edu
-