

## Geography Student Knowledge of Bats and Austin Bat Colonies

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Bats provide many ecological and economic benefits to humans, yet bats are often perceived in a negative way. Central Texas is the seasonal home of several large, locally well-known colonies of Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) including Bracken Cave and Congress Avenue Bridge. The Texas State University-San Marcos campus is centrally located between these two colonies, and hosts several small Mexican free-tailed bat colonies as well. Though bats are fairly common in the area, misinformation about bats persists. This research examines the level of basic knowledge and the nature of misinformation among geography undergraduate students at Texas State University-San Marcos, through the use of a close-ended survey. Wildlife knowledge and attitudes play an important role in garnering support for conservation and management of these populations. Understanding the nature of misinformation about bats will help focus future educational efforts. *Key Words: central Texas, Mexican free-tailed bats, wildlife perception, urban wildlife.*

### Introduction

For centuries, bats have captivated the human imagination, inciting both fear and wonder. Because bats are often portrayed as macabre creatures in folklore, literature, and film, they have developed a dark reputation. In both North American and European folklore, for instance, beliefs that bats are returning souls of the dead, minions of the devil, or vampires are quite common (McCracken 1993a; 1993b). Bram Stoker's (1897) book, *Dracula*, and horror films including *The Devil Bat* (1940), *Scars of Dracula* (1970), *Dracula* (1931 and 1992), and *Bats* (1999), as well as the mainstream film series *Batman* (*Batman* 1989, *Batman Forever* 1995, and *Batman Begins* 2005) in which an ordinary man chooses the persona of a bat to "strike fear into the hearts of men who do wrong," have only served to solidify this association between bats and the macabre in the public consciousness. Some bat behaviors, such as being active at night and a propensity to roost in dark and often forbidding places, serve in part as the genesis for this dark reputation. Additionally, bats are often associated with the rabies virus, a fatal disease transferred through the bite of infected animals (Rupprecht et al. 1995).

Species conservation, particularly within an urban setting, depends on public support. Bats' dark reputation may negatively impact their conservation by limiting advocacy and adversely affecting voting outcomes on initiatives to preserve vital habitats or the creation of alternative habitats. Less well known are the many ecological and economic benefits of bats. Bats are highly beneficial as seed dispersers, pollinators, and insect predators (Kunz and Fenton 2003). The notorious vampire bat is even a potential source of medication used to avert strokes (Graham 2003; Locke 2003). Additionally, bat guano is a superior natural fertilizer. In fact, before modern chemical fertilizers were available, guano was so prized by American farmers that the Federal government offered free land as an incentive to those who discovered and made it available for sale (Keleher 1996).

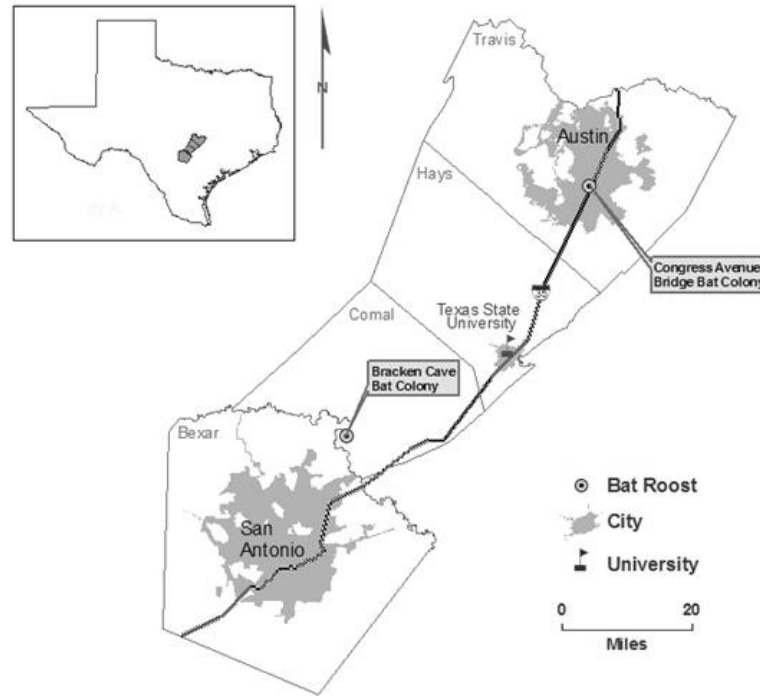
Many bat species take advantage of habitat resources associated with urbanization, thus, of particular concern is how people's lack of, or inaccurate, knowledge and fear intersect in cities where bats are common. Central Texas is home to both a rapidly growing urban population and some of the largest Mexican free-tail bat colonies in the world. Austin's Congress Avenue Bridge Colony and Bracken Cave, just north of San Antonio, are the most well-known bat roosts in the area. Texas State University in San Marcos has buildings and parking structures that often serve as diurnal roost sites as well, and is centrally located between these two sites (Figure 1.)

The location of the University, combined with its readily available educated audience, presents an opportunity to assess the level of basic knowledge and the nature of misinformation among geography undergraduate students at Texas State University-San Marcos. Of particular interest is the source from which students garnered their information about bats, be it films, conservation organizations, literature, or other sources, and which misconceptions about bat behavior are most persistent.

Public knowledge and perception of wildlife species ultimately plays a role in the way these populations are managed, and the allocation of research dollars, most especially in urban and recreational areas where the public may interact with wildlife. Understanding the source of people's fears and negative attitudes is one way conservationists can counteract misinformation and educate the public about the benefits of bats. Species education can also avert the potential for public health risk.

### **Study Area**

Each spring, millions of Mexican free-tailed bats migrate to central Texas for the birthing of their young. In fact, the limestone caves of the Hill Country are some of the largest Mexican free-tailed bat maternity roosts in the world (Davis et al. 1962). Bracken Cave, with a seasonal Mexican free-tailed bat



**Figure 1.** Central Location of Texas State University.

population estimated at around 20 million individuals, is not only the largest bat colony in the region, but also holds the Guinness Book of World Records title for the world's largest congregation of mammals (Guinness World Records 2006). This site, located just north of San Antonio, near Garden Ridge, is owned and operated by Bat Conservation International (BCI) in Austin and offers tours exclusively to BCI members. As a result, the educational outreach potential of this site is limited.

In the last twenty years, urban growth in central Texas, particularly the construction of new bridges and expansion of existing bridges and overpasses, has provided new roost habitats for bats (Keeley and Tuttle 1996). This phenomenon was first noted in 1983, when reconstruction of Austin's Congress Avenue Bridge resulted in the presence of a small colony of bats inhabiting the bridge (Murphy 1990). Mexican free-tailed bats comprise the largest portion of bat species at the bridge, though cave myotis (*Myotis velifer*) are also known to roost in association with Mexican free-tailed bats (Schmidly 2004). Today, Austin's Congress Avenue Bridge is often marketed as the world's largest urban bat colony (Bat Conservation International).

No formal tours of the colonies in Austin currently exist; however, during the spring and summer, the nightly emergence of bats from the city's Congress Avenue Bridge is a popular attraction for tourists and local residents (Figure 2). The *Austin American Statesman* allows the public to view the nightly bat emergence from its property along the south bank of the Colorado River on a grassy knoll facing the bridge. Additionally, visitors to the site may gather along the top of the bridge or choose to view the emergence from the public walking trail, hotels, and restaurants along the north bank of the river (Figure 3). BCI volunteers are often present at the *American Statesman* site during the summer to greet visitors and hand out copies of their informational brochure, *The Free-tail Flyer*. For visitors to the north bank, BCI sponsors a large informational sign along the public walking trail not far from the bridge.

The spectacular bat emergence from the Congress Avenue Bridge not only generates approximately 8 million dollars in annual revenue for the city of Austin from tourism, bat predation of agricultural pests also saves regional farmers thousands of dollars in pesticide use (Adams et al. 2006; Cutler et al. 2006). Yet, in spite of the benefits provided by Austin's bat colonies, misperceptions persist. Understanding the nature of misinformation about bats will help focus future educational efforts in the region and minimize the risk of negative bat/human interactions.

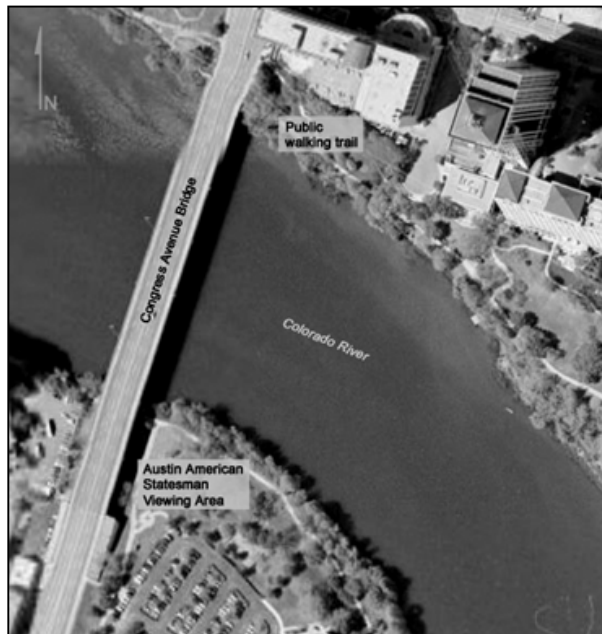
### **Wildlife Knowledge and Attitudes**

Studies of human attitudes toward wildlife have investigated a range of topics including management, conservation, biodiversity, and pests/hazards, though we are not aware of any previous studies which specifically address bats. Research on knowledge and/or attitudes toward various species exist especially with regard to species viewed as nuisances or hazards, such as bears and wolves. Recent studies of this nature include Gore et al. 2007, who studied risk perceptions associated with human-black bear conflict and Williams et al. 2002, who assessed attitudes toward wolf reintroduction. Here, we examine bats in this same fashion exploring the link between the level of general bat knowledge and attitudes toward this species.

Over the last fifty years, the migration of human populations from rural to urban areas, combined with higher income and better education has precipitated a shift in wildlife perceptions away from wildlife solely as an economic good to include an appreciation for wildlife's ecological and aesthetic values (Butler et al. 2003; Manfredo et al. 2003). The history and evolution of people's attitudes toward individual wildlife species may vary; however, research suggests that the outcome of these beliefs follows a predictable pattern in terms of species conservation and/or management. Simply, people protect, and even nurture, species perceived as providing either aesthetic and/or economic value.



**Figure 2.** Bats from the Congress Avenue Bridge flying along the Colorado River corridor.



**Figure 3.** Congress Avenue Bridge and bat viewing areas. Images generated from Google Earth.

This is especially true of urban populations, which typically have more sympathetic attitudes toward wildlife, but are often less knowledgeable about wildlife than their rural counterparts (Haldidian 1991; McKinney 2002). In contrast, bats and species such as rats or wolves, which have been historically viewed as “intrinsically unworthy” of care or concern, are often hunted and killed (Kellert et al. 1996).

Several studies have more broadly assessed the wildlife and/or environmental attitudes of children and/or students (Kellert and Westervelt 1983; Caro et al. 1994; Bjerke et al. 1998; Rauwald and Moore 2002). During the first comprehensive series of studies regarding American wildlife attitudes, Kellert (1980) developed a typology of nine attitudes, which has since been used extensively in a host of other sociological-environmental research. Kellert’s typology, which included classes such as “utilitarian” and “moralistic,” was designed to measure not only people’s attitudes toward wildlife, but also to examine people’s beliefs about human-nature relationships by using animals as a vehicle for expression of underlying values (Rauwald and Moore 2002). Of particular interest is the Rauwald and Moore (2002) study of university students from the Dominican Republic, Trinidad and the United States which linked positive environmental attitudes. Using the Kellert Typology in combination with Dunlap and Van Liere’s New Environmental Paradigm (NEP) Scale, Rauwald and Moore (2002) concluded both scales were effective in predicting policy support in the U.S.

While urban populations may be less knowledgeable about species and their ecology, the sheer ratio of urban versus rural populations gives urbanites considerable voting power over wildlife policy and decision-making (Haldidian 1991; McKinney 2002). As a result, the nature of urbanites’ knowledge and information (or misinformation) about wildlife species potentially plays an important role in determining wildlife attitudes.

## Method and Results

The survey consisted of 29 close-ended questions subdivided into four subsections: information about respondent, general knowledge of bats, information and misinformation about bats, and knowledge of Austin bat colonies (Figures 4-8). For the majority of questions, respondents were asked to select from among five possible categorical responses. In the third section on information and misconceptions about bats, subjects were required to choose either true, false, or I don’t know. Survey participants were asked to complete the final section regarding Austin’s bat colonies only if they were aware of a significant bat colony living in downtown Austin.

Survey data were collected from undergraduate geography students at Texas State University in the fall of 2005. Over a two week period in October, eight undergraduate geography courses were visited and interested students

were invited to participate in this research. The two-page survey required an average of ten minutes to complete. A total of 268 completed questionnaires for analysis were received.

The sample population was consistent with the overall student population at the University. The number of males was ten percent greater in the sample population, whereas the University population was composed of ten percent more females. Age data for the University's student population were not available. However, typical of college students, the majority of survey respondents (216 of 268) were between 18 and 24 years of age.

A majority of respondents (89%) indicated that they were not members of any type of environmental organization or interest group. It follows that no survey participants selected a conservation group as the source of their information about bats. Most students surveyed garnered their bat information from movies (37%) and newspapers, magazines, or books (35%). Whereas respondents did not identify conservation groups as a source of information, 24% reported obtaining information from visiting a cave or caverns which often work in tandem with conservation organizations and biologists.

General knowledge of bats was fairly high (Table 1). Most subjects (85%) correctly identified bats as mammals. Respondents were able to identify the most common bat food sources, but few students (11%) recognized the full range of bat diets. Similarly, knowledge about bat habitats was also high for specific responses, though only 47% could identify the full range of bat habitats. More specific biological knowledge, such as number of offspring, was not well known. On the other hand, an overwhelming 94% of respondents were aware that bats are nocturnal. Likewise, the percentage of participants who were aware that some bat species migrate (67%) and some hibernate (57%) was also high.

The abilities of students to recognize bat facts from fiction varied, depending on the statement presented (Table 2). The myth that bats try to get in your hair was readily recognized as false by 68% of those surveyed. In contrast, 60% of subjects believed the myth that bats are blind to be true. At least half of all respondents were aware of the ecological benefits of bat predation as a control of mosquitoes and agricultural insects, and the use of guano as a fertilizer. Lesser known facts included rabies risk from bats compared to dogs and that bats are a potential source of human medications.

Survey participants were almost equally divided between those that have lived in central Texas for ten or less years (49%) and greater than ten years (51%) (Table 3). Of respondents that have lived in the area for less than ten years, 20% reported residency of one year or less. Surprisingly, there was no correlation between either the number of students who reported they were aware of Austin's bat colonies, or the percentage who had viewed a bat flight, and length of residency in the area.

**Table 1.** General Information Questions: Frequency of Response.

Question	Percentage Frequency of Response				
Bats are	mammals	reptiles	birds	other	don't know
	85%	2%	3%	0%	10%
Bats eat	insects	frogs or lizards	fruit	blood	don't know
	88%	24%	72%	38%	4%
Bats are known to live in	trees, woods	man-made structures	caves or caverns	other	don't know
	53%	80%	94%	5%	0%
Bats have ___ pups	1-2	3-4	5-6	7+	don't know
	14%	16%	11%	6%	52%
Bats are active	morning	afternoon	all day	at night	don't know
	1%	0%	2%	94%	3%
Do any bats hibernate?	yes	no			
	57%	43%			
Do any bats migrate?	yes	no			
	67%	33%			



**Table 2.** Information and Misconceptions

Question/Statement	True	False	Don't Know
Bats try to get in your hair.	9%	68%	23%
"Blind as a bat" is	60%	35%	5%
You are more likely to contract rabies from bat than dog.	35%	45%	20%
Installing bat house helps control mosquitoes.	55%	12%	33%
Bat poop (guano) can be used to enrich soil.	87%	1%	12%
Bats are resource for human medications.	39%	9%	52%
Bat predation of insects saves farmers money they would otherwise spend on pesticides.	64%	7%	29%

**Table 3.** Time of residency and awareness of Austin's bat colonies.

Are you aware of any significant colonies of bats living in downtown Austin?	Years in Area	
	$\leq 10$	$> 10$
Aware	63%	68%
Watched bat flight in Austin	52%	55%
Unaware	37%	32%

**Table 4.** Knowledge of Congress Avenue Bridge Bat Colony

Topic	% Correct Responses	Don't know
Species	55%	38%
Number of Species	16%	56%
Diet	75%	19%
Gender	9%	67%
Seasonal presence	41%	25%
Tourism revenue	5%	60%

The final portion of the questionnaire, which addressed questions specific to the Congress Avenue Bridge bat colony was completed by 67% of the original sample population (Table 4). Though just over 55% of respondents were aware that Mexican Free-tailed bats are the primary species occupying the Congress Avenue Bridge, many (56%) were not aware of how many total bat species inhabit the bridge. Diet knowledge of the Congress Avenue bat colony was high; as 75% of respondents correctly identified insects as the primary food source for this colony. This finding is consistent with the results from the general knowledge portion of the survey, in which a slightly larger percentage (88%) were aware that insects comprised a portion of bat diets. Though the Congress Avenue Bridge is ecologically significant as a Mexican Free-tailed bat maternity colony, many students did not know the colony is predominantly composed of female bats. Similarly, few students (41%) were knowledgeable about the seasonal presence of the colony, a discovery which is somewhat inconsistent with information from the general knowledge section of the survey in which 67% of respondents indicated they were aware that bats migrate. Finally, only 5% of students had a sense of the annual tourism revenue generated as a result of Congress Avenue Bat Bridge tourism.

## Discussion and Conclusion

The survey revealed that general knowledge about the biology and ecology of bats was fairly high among Texas State University-San Marcos geography students. Similarly, students were also familiar with some general facts regarding the beneficial ecological and economic benefits of bats and bat guano. Whereas general knowledge about bats was high, specific knowledge about Austin's Congress Avenue Bridge bat colony was lacking. This finding is somewhat surprising given that a minimum of 60% of those surveyed were aware of Austin's colonies and that just over 50% of those who knew of Austin's colonies had actually been to see a bat flight.

Knowledge and attitudes of local residents towards urban wildlife play an important role in the conservation and management of those populations (Caro et al. 1994; McKinney 2002). Texas State is a commuter school, so many students are residents of Austin. As such, understanding their general knowledge about bats, and more importantly their perceptions of the Congress Avenue Bat Bridge, suggests that opportunities exist to improve specific knowledge about the Congress Avenue Bridge colony. This opportunity is underscored by the fact that 24% of respondents obtained information from visits to caves and/or caverns. Research indicates that communicating the particular benefits of urban wildlife populations and the relevance of these benefits to people's lives, is an essential aspect of building support for conservation in general (Miller and Hobbs 2002). Therefore the lack of knowledge about the unique benefits of the Congress Avenue Bat Bridge, particularly with regard to tourist revenue, suggests that future public education efforts should focus more specifically on linking bats to benefits for local communities and residents.

This study serves a good beginning to understanding people's knowledge of central Texas bats in an effort to improve public education and promote bat conservation. However, this study specially addressed a college-educated population, whereas to best serve conservation efforts, future research should include a more diverse survey population. By expanding the survey population to include participants from a wider educational and ethnic background, the effect of cultural attitudes and fears about bats on conservation education may be explored. Another avenue of future investigation may include a comparison between the findings of this study and a survey of visitors to the Bridge to assess the success of educational outreach at the site.

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