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Using an Internet Questionnaire to Characterize Bat Survey Efforts in the United States and Canada

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Abstract

Standardized survey methods are important for obtaining reliable information on wildlife populations. As a precursor to creating a regional bat-survey (Chiroptera) protocol, we distributed a questionnaire via e-mail to biologists responsible for conducting bat surveys in the United States and Canada. We received 415 responses from 45 states and 7 Canadian provinces or territories. Most of the responses were from western North America. Based on these responses, we characterized the biologists responsible for bat surveys, their objectives and methods, and the habitat types and spatial scales surveyed. Most respondents were government employees, had <5 years of experience working with bats, and had <20% of their professional responsibilities dedicated to bats. Surveys were most likely to occur in forests and at sites ≤1 km² in area. The 3 most important objectives identified by respondents for conducting bat surveys, in rank order, were to 1) create a list of species in an area, 2) monitor presence or abundance of a species at a structure, and 3) determine presence of a single species in an area. Experienced (>10 yr) surveyors tended to employ a wider variety of methods than those with less experience. We discuss how the results of this questionnaire will be used to draft a regional bat-survey protocol to better address the needs of its target audience. Using the Internet to survey the target audience proved to be a very useful step in the development of a standard bat-survey protocol. We believe similar methods should be considered for other taxa as a precursor to creation of standard survey methods. (WILDLIFE SOCIETY BULLETIN 34(4):1000–1008; 2006)

Key words

agency biologist, bat detectors, Chiroptera, experience-level, Internet, survey methods, survey protocol.

In 2002 a subcommittee of the Western Bat Working Group (<http://www.wbwg.org/>) was formed to pursue creation of a standardized protocol for bat surveys in forests of the western United States and Canada. The working group thought that standardized survey methods would help to meet local objectives as well as facilitate aggregation of survey results to address conservation concerns at larger spatial scales (Keeley et al. 2003, O'Shea and Bogan 2003). We believed that the value of such a protocol would be maximized if it was designed with the specific objectives of its users in mind and that a good way to obtain such information would be to poll the potential audience (White et al. 2005). In a sense, we wanted to do the market research necessary to ensure that the survey protocol developed would be adopted by large numbers of the biologists responsible for bat surveys.

Market research increasingly relies on the Internet to gather information (Kotler and Armstrong 2006), and we used it to conduct our assessment. We expected the increasing number of tasks involving the use of e-mail or the Internet to complete (e.g., communication with colleagues, conference registrations) meant that most wildlife biologists in the United States and Canada in 2003 had access to and frequently used e-mail. This characteristic of our target population suggested that an Internet approach would be superior to more expensive or time-consuming methods such as postal surveys or phone calls (Kotler and Armstrong 2006).

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Originally, our "target audience" was individuals with responsibility for bat surveys in forested communities of the western United States and Canada. However, we realized that most of our questions were broadly applicable to biologists throughout these countries and, thus, we expanded the survey to target all biologists with responsibility for conducting bat surveys. By doing so, we hoped the survey would identify the needs and level of detail required by those we expected to be the primary users of the protocol, while simultaneously gleaning important information from those with the most bat-survey experience.

In particular, we used a questionnaire to characterize bat surveys in the United States and Canada in terms of: 1) who conducts them, 2) where they are conducted, 3) why they are conducted, 4) the target species, and 5) the survey methods used. We expected responses might be influenced by 3 major factors: geography, experience, and occupation, and we tracked responses accordingly. Because of regional differences in species and their habitats, we expected survey objectives and methods would vary according to whether the respondent was from the East or the West. We also expected respondents' experience level to influence their survey objectives and the methods they used to conduct them. Finally, we reasoned that responses would vary according to a respondent's job description and motivation for the survey. For instance, survey objectives and methods used by a graduate student studying a species' roosting ecology may be much different from those of an agency biologist charged with determining whether a species of

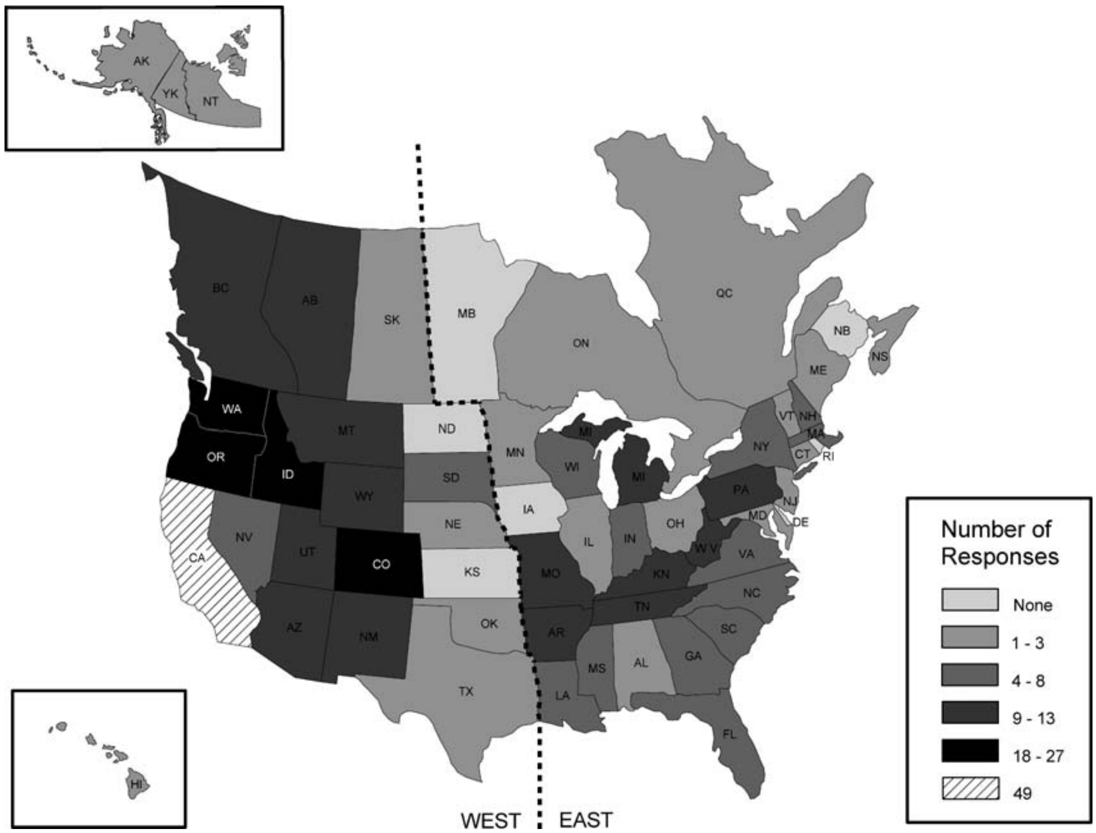

Figure 1. Map of United States and Canada with 2-letter state or provincial codes. Dashed line depicts division used to assign states and provinces to the East vs. the West. Shading indicates range in number of respondents from each state or province to an Internet questionnaire circulated to biologists in the United States and Canada during 19 Nov–22 Dec 2003.

concern occurs in an area where some forest management activity was planned. Accordingly, we examined whether responses from government agency employees differed from those in academia. We explain how this information will be used to inform the content, tone, and specific recommendations of a regional bat-survey protocol. Finally, we discuss the merits of surveying opinions of potential users prior to creating and disseminating a standardized survey protocol.

Methods

We designed a questionnaire to characterize bat surveys and surveyors across the United States and Canada (Weller 2003). The questionnaire had 11 questions followed by a list of alternative responses. We asked recipients to identify their state or province of residence and to choose a single response from a list of occupations, percentage of professional responsibilities involving bats, and experience conducting field surveys for bats. Next we asked them to rank, from a list, the top 3 habitat types where they conducted bat work, objectives of their bat surveys, and spatial scales of concern when assessing presence of one or more species in an area. For questions that required a rank, we instructed recipients that it was acceptable to report <3 ranks.

We asked recipients who conducted surveys to create a list of species in an area to specify the proportion of surveys in which they used various bat-survey techniques (e.g., mist nets, internal cave or mine surveys). We divided proportions into 6 categories: >90%, 60–90%, 30–60%, 10–30%, <10%, or never. We then asked recipients who conducted single-species surveys to repeat this exercise for up to 3 individual species. Finally, we asked recipients to identify the bat detection system(s) they used and to rank their top 3 objectives of acoustic surveys.

We designed the questionnaire as a form in Microsoft® Word (Microsoft, Redmond, Washington) for ease of use by recipients who used that computer program. The form allowed recipients to enter responses with a computer mouse-click in the appropriate space for some questions (e.g., occupation) and a mouse-click followed by a typed response for a minority of questions (e.g., ranks). We intended this format to minimize time required to complete the questionnaire and to facilitate compilation of results. A Corel® WordPerfect (Corel, Ottawa, Ontario, Canada) version of the questionnaire, which required a typed response (a single character in most cases) to each question, was also attached for recipients who did not have access to Microsoft Word.

We attached the questionnaire to an e-mail message that provided a brief explanation of the reason it was being circulated. The subject line of the message was "A 3 minute bat survey. Please forward widely!" We sent the e-mail to 392 individuals who were registered participants at the North American Symposium on Bat Research (NASBR) in 2002 and 2003. In addition, we sent it to the central e-mail

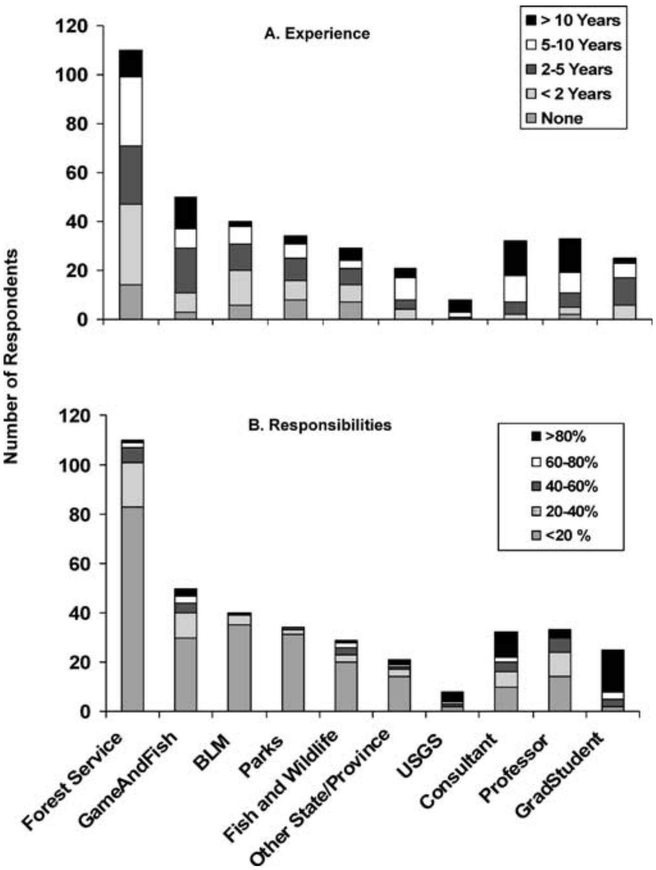

Figure 2. Number of respondents according to occupational category and within each category, from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003: (A) experience conducting bat surveys and (B) percentage of professional responsibilities involving bats.

contact for the Western Bat Working Group and the Southeastern Bat Diversity Network with a request to distribute to the membership of these groups. At the time the questionnaire was distributed, there was not a central contact point for the Northeastern Bat Working Group. However, as indicated by its subject line, the accompanying e-mail included a request to forward the questionnaire to others who conduct bat surveys but may not have otherwise received the questionnaire. We sent the e-mail and attached questionnaire on Wednesday, 19 November 2003. The response deadline specified on the questionnaire was 15 December 2003, but we accepted responses via return e-mail until 22 December 2003.

Compilation of results was straightforward for questions where a single response was provided, such as occupation or experience level. We categorized respondents as from the West if they identified themselves as being from one of the 24 states or provinces that compose the Western Bat Working Group; we categorized the remainder of respondents as from the East (Fig. 1). We categorized respondents as government agency employees (agency personnel for short) if their occupation fell into any of the following categories: United States or Canadian Forest Service (hereafter Forest Service); United States or Canadian Fish and Wildlife Service (Fish and Wildlife); state or provincial Game and Fish (Game and Fish); United States Bureau of Land Management (BLM); local, state, provincial, or national parks (Parks); other state or provincial biologists (other state or province); or United States Geological Survey (USGS). We categorized respondents who identified their occupation as graduate student or professor as academics.

For questions in which we asked respondents to rank up to 3 responses (e.g., objectives or habitat types), we created an importance index. For each response category, we multiplied the number of responses with the highest rank by 3, those ranked second by 2, and tallied those ranked third. We calculated percent importance of each category by dividing the summed total of the ranks within that category by the summed total for all categories. We condensed responses on survey methods to those who reported at least some use of a given method versus those who reported no use.

This was a descriptive study with the goal of elucidating some of the trends in bat surveys and bat surveyors at a single point in time. Our sampling scheme, which relied on voluntary response to an imperfectly circulated questionnaire, was inherently biased, thereby violating assumptions of most statistical methods. As a result we report descriptive rather than statistical differences among respondent groups.

Results

Who Conducts Bat Surveys?

We received 415 responses to the questionnaire: 200 within 2 days and 319 within the first week after distribution. It was not possible to determine an overall response rate because we do not know how many biologists ultimately received the questionnaire via forwarded e-mail. However, 88 (22.4%) participants of the 2002 and 2003 NASBR responded to the questionnaire. The majority (71%) of respondents were from government agencies with the greatest number of responses from Forest Service ($n = 110$ respondents), Game and Fish ($n = 50$), and BLM ($n = 40$). Most other groups had between 21 and 34 respondents (Fig. 2).

Experience level varied widely within each of the occupations (Fig. 2A). The occupations with the highest proportion of experienced (>10 yr) respondents were consultants (14 of 32 respondents), professors (14 of 33), and USGS (5 of 8). Thirty-six percent of government agency personnel reported >5 years experience conducting bat surveys, whereas 52% of academics had >5 years experience. Agency personnel accounted for 38 of the 41 respondents who reported no experience conducting bat surveys.

The largest proportion of respondents within most occupations reported that <20% of their professional responsibilities involved bats (Fig. 2B). Bats composed a small proportion of the responsibilities of government agency personnel, with 74% reporting that <20% and only 4% reporting >80% of their responsibilities involved bats. This contrasts with academics of whom 28% reported that <20% and 34% reported that >80% of their responsibilities involved bats. Over one-third of the 47 respondents who

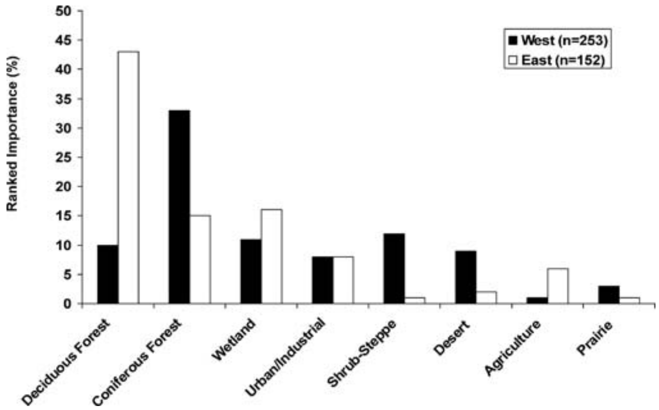

Figure 3. Ranked importance of habitat types where bat surveys are conducted by region, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Ranked importance is an index weighted according to respondents' assignment of a particular habitat type as one of their top 3 priorities for bat surveys.

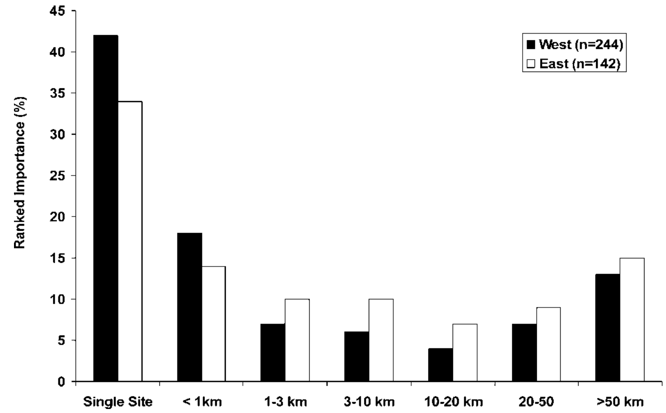

Figure 4. Ranked importance of spatial scale at which bat surveys are conducted by region, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Ranked importance is an index weighted according to respondents' assignment of a spatial scale as one of their top 3 priorities for bat surveys.

reported >80% of their responsibilities involved bats were graduate students.

Where Are Surveys Conducted?

We received responses from 45 states and 7 Canadian provinces (Fig. 1), 60% of which were from the West. We received no responses from Delaware, Iowa, Kansas, North Dakota, Rhode Island, Manitoba, or New Brunswick (Fig. 1). By far the largest number of responses was from California (Fig. 1).

Experience level was similar between respondents from the East and the West. The experience category with the largest proportion of respondents was 2–5 years in both the East (24%) and the West (27%). Among eastern respondents 22% had >10 years experience, whereas 17% of western respondents had >10 years experience. Agency personnel made up 62% of respondents in the East and 75% in the West, whereas academics accounted for 21% of respondents from the East and 10% in the West.

Which Habitat Types Are Surveyed?

Respondents from the East (58%) and West (43%) reported forests as the most important habitat type for bat surveys; however, the type of forest, coniferous or deciduous, was dependent on region (Fig. 3). Wetlands were an important habitat type to survey for both eastern (16%) and western (11%) respondents. Shrub-steppe (12%), desert (9%), and urban or industrial (8%) were important habitat types for western respondents, whereas urban or industrial (8%) and agriculture (6%) were important for eastern respondents. No other habitat type had a ranked importance >4%.

Respondents identified single sites, followed by areas <1 km^2, as the most important spatial scales for bat surveys (Fig. 4). Areas greater than 50 km^2 were the next most important spatial scale identified. The scale of interest to respondents from the West was heavily skewed toward single sites and the smallest areas but was more evenly distributed for respondents from the East.

Why Are Surveys Conducted?

When all responses were considered together, the stated objective of bat surveys, in decreasing order of importance, was to create a list of species in an area (35%), monitor presence or abundance of a species at a structure (27%), determine presence of a single species in an area (22%), or meet research needs (13%). Responses were remarkably similar among respondent groups, with the only major departure from these proportions coming from academics who reported meeting research needs as their most important objective (32.6%; Table 1). Regionally, eastern respondents reported a slightly greater importance for single-species surveys than structure surveys, whereas the reverse was true for western respondents (Table 1).

What Species Are Targeted?

Among respondents who reported on methods most frequently used to detect individual species, the 5 most frequently reported targets were *Myotis sodalis* (65.7%), *M. grisescens* (30.3%), *Corynorhinus rafinesquii* (18.2%), *M. leibii* (14.1%), and *C. townsendii* (12.1%) in the East, and *C. townsendii* (62.9%), *Antrozous pallidus* (15.9%), *Euderma maculatum* (15.9%), *Eptesicus fuscus* (7.6%), and *Lasiurus blossevillii* (6.8%) in the West.

How Are Surveys Conducted?

Mist nets were by far the most frequently reported survey method, with >67% of respondents in each respondent group reporting their use (Table 2). The proportion of respondents using acoustic and roost surveys was similar and relatively consistent (30–50%) among respondent groups (Table 2). Within respondent groups, a similar proportion of respondents reported use of the 3 modes of conducting acoustic surveys (e.g., 32.9%, 38.7%, and 37.3% for agency personnel) as well as external versus internal cave or mine surveys (e.g., 42.1% vs. 44.5%; Table 2). Respondents with >10 years experience reported more frequent use of each of the survey methods than less-experienced surveyors for multiple-species surveys (Table 2). The gap between

Table 1. Percent ranked importance for objectives of bat surveys in the United States and Canada, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Respondent groups are subcategorized by region, experience level, and occupation.

Respondent group	Objective: Determine presence of single species	Create a list of species	Monitor a structure	Meet research needs	Other
Region					
East (n = 156)	24.6	33.8	20.9	15.7	4.9
West (n = 259)	18.4	33.4	28.9	9.8	9.6
Experience					
<10 yr (n = 337)	21.2	34.0	25.6	10.5	8.6
>10 yr (n = 78)	18.6	31.6	27.2	17.5	5.1
Occupation					
Agency (n = 292)	22.3	34.0	28.9	6.8	7.9
Academic (n = 58)	12.8	29.1	16.9	32.6	8.6

experience categories was greatest for use of harp traps, other capture devices, and cave, mine, and bridge surveys. The greatest similarity between experience categories was in the use of acoustic survey methods. Western respondents reported less use of capture methods and more use of acoustic methods than eastern respondents. Academics reported greater use of mist net and other (non–harp trap) capture devices and passive acoustic surveys and less use of roost surveys (particularly cave and mine) than agency personnel (Table 2).

Approximately two-thirds of respondents with bat-survey experience reported use of the zero-crossings bat-detection system; this proportion was relatively similar among respondent groups (Table 3). Overall, 22% of respondents with bat-survey experience reported no use of bat detectors. Experienced surveyors reported the highest proportion of use for each of the bat-detection systems relative to all other respondent groups (Table 3). Use of time-expansion and heterodyne systems also was greater for western versus eastern and academic versus agency respondents (Table 3). The gap between proportions of respondents who used zero-crossing systems relative to other bat-detection systems was greatest for eastern respondents (Table 3).

The most important objectives of acoustic surveys among all respondents were to determine whether bats were present in an area (31%), to assist in creating a species list (23%), to assess bat activity levels (21%), and to assess presence of a single species (16%). The only notable departure from these proportions was for academics, who were much more likely than agency personnel to use acoustic surveys to assess activity levels and less likely to use detectors to identify individual species or help create a species list (Table 4).

Discussion

Number of Surveyors

The results from our questionnaire provide a description of bat surveys and surveyors in the United States and Canada in the early 21st century. Increased interest in bats over the past 2 decades has been documented (Fenton 1997) but, until now, the number and character of bat surveys arising as a result of this interest had not been described. The number of respondents who reported <5 years experience surveying for bats is an indication that the number of surveyors has indeed increased over this period.

We characterized respondents as "people responsible for bat surveys," rather than simply as "bat surveyors" because it was clear that some (n = 41) of them had planned or overseen surveys but had not conducted surveys in the field themselves. Our results do not allow direct calculation of the number of individuals responsible for bat surveys, but if we assume the response rate from NASBR participants (22.4%) holds for all respondents, then we estimate that 1,850

Table 2. Percent of respondents reporting use of bat-survey methods, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Respondent groups are subcategorized by occupation, region, and experience level.

Respondent group	Capture: Mist net	Capture: Harp trap	Capture: Other device	Acoustic: Passive	Acoustic: Active	Acoustic: Active + visual	Roost: External cave or mine	Roost: Internal cave or mine	Roost: Bridge	Roost: Other structure
Region										
East (n = 137)	81.8	48.2	11.7	35.0	38.0	26.3	40.9	47.4	35.8	17.5
West (n = 237)	74.3	35.4	9.3	40.9	47.7	48.5	47.7	46.0	45.6	21.5
Experience										
<10 yr (n = 296)	72.3	33.1	6.8	36.8	41.9	38.2	39.5	41.2	37.8	18.2
>10 yr (n = 78)	94.9	66.7	23.1	46.2	52.6	48.7	66.7	66.7	57.7	26.9
Occupation										
Agency (n = 292)	67.1	33.6	5.8	32.9	38.7	37.3	42.1	44.5	38.0	16.4
Academic (n = 58)	79.3	32.8	20.7	48.3	39.7	32.8	36.2	27.6	32.8	20.7

Table 3. Percent of respondents that reported use of common types of bat-detection systems, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Sample size is number of respondents in each subcategory that reported some experience conducting field surveys for bats.

	Detection system			
Respondent group	Zero-crossings	Time expansion	Heterodyne	None
Region				
East (n = 156)	62.8	9.5	8.8	28.5
West (n = 237)	67.9	22.4	15.2	18.6
Experience				
<10 yr (n = 296)	64.2	16.2	10.8	23.0
>10 yr (n = 78)	73.1	23.1	20.5	17.9
Occupation				
Agency (n = 254)	63.8	14.6	9.8	26.0
Academic (n = 56)	60.7	19.6	19.6	17.9

individuals may have responsibility for bat surveys in the United States and Canada. Individuals who received the questionnaire directly via e-mail (NASBR participants) might be expected to respond at a greater rate than those who received it via a forwarded e-mail. However, because the name of the sender (T. J. Weller) may not have been well known among NASBR participants, response rate from non-NASBR recipients may have been greater because the e-mail was received via a credible intermediary (e.g., state bat working group).

Characterizing the Typical Bat Surveyor

The questionnaire elucidated some noteworthy trends in both the types of biologists who conduct bat surveys and common objectives of their work. The large response to the questionnaire from agency personnel indicates a large proportion of bat surveys are carried out by government agencies. This likely represents a shift in bat surveyor demographics from previous times when most surveys were conducted by mammalogists affiliated with universities or museums. Surveys by agency biologists are vital components of local conservation efforts and make significant contributions to knowledge of distribution and habitat associations of bats (Bogan et al. 1996). However, many of these surveys are not conducted to meet research needs and, consequently, are unpublished. This may help explain the disparity, identified by Fenton (1997), of relative stasis in the number of scientific publications despite increased interest in bats.

Although most respondents had moderate (<5 yr) levels of experience, the largest number of respondents within each experience category (including >10 yr) reported that <20% of their responsibilities involve bats. In other words, few true bat specialists exist and it is possible that survey skills, particularly for those with the least experience, may be diluted by responsibilities for other tasks or taxa. This finding highlights the need for providing a protocol to biologists that would increase the accuracy and efficiency with which they conduct bat surveys.

Response to our questionnaire indicated that most surveys are conducted in forests. The co-importance of bats and forests has become increasingly evident during the last 2 decades (Barclay and Brigham 1996, Hayes 2003), and the bat literature of this period is dominated by papers describing various aspects of forest bat ecology. Thus, the importance assigned to surveys in forested habitat types was not simply a result of the number of Forest Service respondents, but, instead, reflects a real increase in attention to forest bats.

Biologists were interested in surveying for bats at single sites and small areas but also at larger spatial scales. This is an interesting paradox that may be explained by the fact that, while the longstanding practice of surveying for bats at caves or mines or buildings remains important, biologists exposed to modern conservation biology education have grown to understand that bat populations depend on larger landscapes and their compositions, and that these larger areas are important for bat conservation.

Creating a list of species in an area was a common objective of bat surveys regardless of respondent group. This highlights the continued lack of basic distributional information (Bogan et al. 1996) despite increased survey effort. Respondents assigned a lower importance to

Table 4. Ranked importance for objectives of surveys that used bat-detection systems, as determined from an Internet questionnaire circulated to biologists 19 Nov–22 Dec 2003. Respondent groups are subcategorized by occupation, region, and experience level.

	Objective					
Respondent group	Determine bat presence	Assess bat activity levels	Assist in creating species list	Detect single species	Describe echolocation	Confirm morphological identification
Region						
East (n = 103)	29.0	23.0	21.4	19.8	4.7	1.6
West (n = 207)	32.1	20.3	22.8	17.2	3.2	3.2
Experience						
<10 yr (n = 218)	32.1	20.3	22.8	17.2	3.2	3.2
>10 yr (n = 66)	28.0	25.4	25.7	13.4	4.0	2.6
Occupation						
Agency (n = 209)	32.3	18.1	23.9	18.6	2.7	3.1
Academic (n = 46)	31.9	31.5	18.3	9.2	6.0	2.0

detection of a single species (e.g., species of concern) but, in practice, this objective likely is pursued concurrent with efforts to create a species list.

Bat Detectors

We expected to find widespread use of zero-crossings bat-detector systems but were surprised that the proportion of respondents using them in passive mode was not higher relative to active methods. The ability to passively deploy bat detectors to collect data on bat activity is one of the primary advantages of this technique (Barclay 1999). On the other hand, active methods have been recommended as a means of enhancing call quality (O'Farrell et al. 1999, Johnson et al. 2002), which can improve the ability to identify free-flying bats especially when combined with visual observations (Ahlén and Baagøe 1999, Rydell et al. 2002). However, the training and experience required to identify bats using a combination of their calls and visual cues may exceed the skills of many surveyors, especially those with little experience or responsibility for bat concerns.

The objectives of acoustic surveys were largely similar between regions and experience levels but differed by occupation. We were surprised to find that a greater proportion of academics than agency biologists reported interest in assessing activity levels. Because assessment of activity generally is easier than species identification and can be accomplished using passively deployed detectors, we assumed this would be a frequent objective of agency biologists who generally have less time for bat work. Bat activity level also is frequently used to assess the impacts of habitat (e.g., forest) management (Hayes 2003), something that would ostensibly be of interest to agency, especially Forest Service, biologists. However, as agency missions largely are focused on inventory and management of species and their habitats, research into effects of management seems to have fallen largely to academics.

Agency personnel also reported greater use of acoustic methods than academics to meet species identification objectives. The ability to identify a species from its echolocation calls requires a good deal of experience and practice combined with a willingness to forgo species identification for a large proportion of calls (Hayes 2000, Fenton 2003). However, agency biologists reported less experience and a lower proportion of responsibilities dedicated to bats than academics, traits that may impede their ability to achieve their acoustic species-identification goals.

Regional Differences

Experience levels were similar between regions, but a higher proportion of western respondents were agency personnel and a lower proportion were academics, compared to eastern respondents. This likely is a result of greater amount of public land and land managers in the western compared to eastern United States. The greater focus of easterners on research needs is attributable to the higher proportion of academic respondents from the East versus the West, whereas their greater focus on single species is likely due to the importance of species on the United States Endangered Species List in the East and the amount of survey effort they stimulate.

The list of targets for single-species surveys was, not surprisingly, weighted heavily toward endangered species (*C. townsendii*, *M. grisescens*, *M. sodalis*) in the East. The 3 endangered species in the West (*Lasiurus cinereus semotus, Leptonycteris curasoae yerbabuenae*, *Leptonycteris nivalis*) have not inspired similar attention, likely due to their limited distribution (Hawaii and desert Southwest) and isolation from human population centers, relative to eastern species. The proportion of respondents who reported *C. townsendii* as target of single-species surveys was higher in the West, despite its endangered subspecies occurring in the East. This likely is a reflection of its broad distribution across the West, its status as a species of concern under most jurisdictions, and a lack of higher-priority species (e.g., endangered species) in the West.

A higher proportion of western than eastern respondents reported surveys focused on single sites, and monitoring the use of structures was a more frequent objective for western respondents. We attribute this to the greater number of mines on public lands of the West that require bat surveys prior to closure (Meier 2001).

Differences in Level of Experience

The major differences between experienced and less-experienced surveyors were in the methods they used. The proportion of experienced respondents using each method and type of bat detector was larger than for less-experienced respondents. Because objectives did not vary with experience, experienced surveyors probably employ a greater number of tools or select more appropriate tools to meet a given objective. Use of multiple tools (e.g., capture and acoustic) increases the number of species detected (Kuenzi and Morrison 1998, Murray et al. 1999, O'Farrell and Gannon 1999).

Occupational Differences

Academics reported greater experience conducting bat surveys than agency personnel. Although both groups were interested in creating lists of species in an area, agency personnel conducted more surveys to detect a single species or to monitor a structure. This may be the best evidence that a shift in objectives has accompanied increases in number of bat surveys in the recent past. Rather than surveys being conducted to understand bat communities or describe some aspect of a species' ecology, surveys are increasingly conducted to meet regulatory demands of detecting special-status species or managing roost sites.

Agency personnel are responsible for a large proportion of bat surveys, and the objectives of many of their surveys (monitoring bat populations at roosts and detecting rare species) are among the most difficult to achieve (O'Shea and Bogan 2003). That such tasks often may be undertaken by someone with $<$20% of responsibilities dedicated to bats underscores the magnitude of these challenges and their questionable probability of success. As the need for large-scale monitoring increasingly is recognized (Keeley et al. 2003, O'Shea and Bogan 2003), agency personnel, by virtue of sheer numbers, have the potential to contribute significantly to collection of data at the largest spatial scales. A standardized protocol will be of critical importance to these relatively inexperienced biologists who often have competing demands on their time.

Characterizing an Audience for a Protocol

A successful protocol is one that increases standardization and rigor of data collection and also responds directly to the needs of its target audience. The largest group of respondents was those with moderate levels of experience; we used this to define the experience level of the target audience for the proposed survey protocol. The questionnaire also helped refine our understanding of the common objectives of bat surveys. We anticipated that creating species lists and detecting presence of single species would be important objectives of bat surveys. However, the questionnaire clearly demonstrated that surveying structures was an important objective, particularly in the West. This insight prompted us to elevate the importance of structure surveys as we outlined a draft bat-survey protocol. One oversight in the questionnaire was our failure to inquire about to the importance of assessing the presence of bats, regardless of species, as a survey objective. This was the highest-ranking objective of acoustic surveys and we believe it is a frequent survey objective, particularly during structure surveys.

We also used the questionnaire to better understand the frequency with which various methods were employed in the field. Our intention was to determine which methods were universally employed compared to those used primarily by those with the most experience. The questionnaire showed that the number and breadth of field techniques used generally increased with experience level. In drafting a survey protocol, we cannot expect all users to have the skills of a bat specialist. Conversely, we are keenly aware that a written document is no substitute for field training for those with little to no experience conducting surveys. We plan to combine information gleaned from the questionnaire about the most commonly used field methods with the latest literature on their relative effectiveness to make recommendations as to the type and amount of effort required to meet various survey objectives.

Using the Internet to Circulate a Questionnaire

Questionnaires are an increasingly popular method of sampling opinion on ecological issues, but the Internet is an underutilized tool for doing so (White et al. 2005). One benefit of using the Internet is the large number of people who can be reached at no cost. We also found that it produced a large and rapid response. Although the 22.8% response rate from NASBR participants is considered low (White et al. 2005), we were pleasantly surprised by the number of responses and the rapidity with which we received them. We attribute part of our success to using closed-format questions (sensu White et al. 2005) and a form that allowed answers to be recorded with a mouse-click. These devices made it easier to complete the questionnaire and also increased the consistency and efficiency with which responses could be compiled. A World Wide Web–based questionnaire, where responses are automatically compiled into a database, would be even better and would eliminate time and potential errors associated with data entry and data storage.

We hope our results will be a useful resource as a current assessment of bat-survey characteristics as well as a baseline for future descriptions. Censusing the potential audience was invaluable in our efforts to draft a relevant and targeted survey protocol. Foremost, it confirmed that there was a relatively large group of biologists with moderate levels of experience who could benefit from structured guidance on how to survey bats in forests. It also allowed us the confidence to decide about specific content or points of emphasis in the protocol. For instance, the questionnaire clearly indicated that we should emphasize guidance on how to create a list of species in an area. Given the ease of circulating questionnaires using the Internet, their use should be considered prior to the development of research or management tools that can value from the broadest spectrum of biological opinion.

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