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Digital Voice Recording: An Efficient Alternative for Data Collection

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Abstract—Study designs are usually constrained by logistical and budgetary considerations that can affect the depth and breadth of the research. Little attention has been paid to increasing the efficiency of data recording. Digital voice recording and translation may offer improved efficiency of field personnel. Using this technology, we increased our data collection by 55 percent. Digital voice recording was useful for the intense, repetitive, and structured data set we collected on black-backed woodpecker (*Picoides arcticus*) nest sites and perhaps for other studies.

Introduction

The time and resources committed to measuring and recording data are important considerations in the design of ecological studies. Because field sampling is often time and labor intensive, researchers designing field studies must sometimes make compromises between the desired sample size, breadth, and detail of the data to be collected and labor costs and efforts associated with the sampling approach. These compromises must be made within the context of temporal and logistical constraints.

Little effort has been devoted to increasing the efficiency of recording data, although data loggers that allow for electronic data recording have been available to field researchers for more than a decade. Many biologists record data on paper and subsequently enter it into a computer back at the lab. Recent advances in technology have made digital voice recording (DVR) systems and voice recognition software for recording field data available to biologists. The medical profession has been the primary user of these systems (Happe and others 2003). Using a DVR system, data is recorded with voice operated digital recorders that have hands-free microphone headsets. The data is then transcribed into suitable formats for analyses using voice recognition software. White and others (2002) used voice recognition to collect expanded data on cowbird (*Molothrus ater*) breeding behavior in a laboratory setting. We are unaware of other ecological studies that used or tested the applicability of digital voice recording to collect data, perhaps because of unfamiliarity with these systems.

Having the ability to speak into a microphone while taking measurements allows field crews to record data without laying aside their tools, thus, potentially improving the efficiency of their field sampling. In this paper, we present a case study evaluation of the utility and efficiency of recording data using DVR systems. Specifically, this case study reports on the improved efficiency of using a DVR system versus hand-held data loggers to record data during a 2-year study of nest site selection by black-backed woodpeckers (*Picoides arcticus*, BBWO).

Study Area and Methods

Field Sampling

Our study protocol included measuring all trees in 81, 12.5-m fixed-radius plots radiating from a plot centered on a black-backed woodpecker nest, and on random sites during 2004 and 2005. Specifically, we were characterizing forest vegetation to evaluate resource selection

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in mountain pine beetle (*Dendrochonotus ponderosae*, MPB) infestations. At each plot, we recorded site identification information, species, and condition of all stems 2.54 to 10 cm at diameter-breast height (dbh). For trees ≥10 cm dbh, we recorded species, dbh, and condition. In addition, we recorded status of the MPB infestation, age of snags killed by MPBs (Farris and others 2002), and number of egg niches from wood borers (Cerambycidae or Buprestidae) for ponderosa pine trees killed by MPBs.

Hand-Held Data Loggers

In 2004, we recorded data using hand-held data recorders (983 g, 11.4 x 24.8 x 5.1 cm) programmed for prompted data entry. Because data collection required tools for measurements and took place on steep terrain with extensive amounts of large woody debris, the most efficient use of personnel was usually two-person crews—an observer who verified the plot boundary using a 10-factor prism (Mannel and others 2006), collected the measurements, and called out the responses and a recorder who held the target object over the center of the plots and keyed values into the field data logger. These data were transferred as fixed-width ASCII text from field data loggers to PCs using HyperTerminal[1] (Hilegraeve, Inc. 1999, Monroe, MI; bundled with Windows®). We recorded data entry errors (we were aware of) on small field tablets and corrected them in a text editor.

Digital Voice Recording Systems

In 2005, we recorded data using a DVR system comprised of a voice operated digital recorder (Sony ICD-MS-515[1], Sony Corporation of America, Park Ridge, NJ) and a noise canceling, hands-free headset microphone equipped with a mute switch microphone cable (Andrea ANC-700[1], Andrea Electronics, Melville, NY). The digital recorder stopped recording after 4 seconds without an input signal. The DVR connected to a PC by a USB port and could be used like a flash memory device. We transferred digital voice data to a personal computer nightly and translated it to ASCII text using the voice recognition software Dragon Naturally Speaking (DNS) 7.3[1] (Nuance Communications, Inc. 2003, 1 Wayside Road, Burlington, MA). Digital voice files were saved as *.MSV files as data backup. Recording errors spoken into the recorder were obvious after translation to ASCII text. Errors were replayed for audio verification and then corrected. DNS develops a probabilistic voice model for individuals using both training data and corrected translation errors. Thus, repeated corrections of translation errors improved translation in subsequent sessions. ASCII text files were then edited to a suitable format for data analyses using text editor software.

Results and Discussion

In 2004, most field crews were comprised of two people. Occasionally, we had a one-person crew and on 2 days, we had a three-person field crew. Although exact crew size data are lacking, we conservatively estimated our field crews averaged 1.75 people. In 2004, we measured 36 sites (2,916 plots or 69,173 trees) and averaged 14.2 ± 0.6 ($\bar{x}$ ± SE) plots/person/day of field work. In 2005, we measured 60 sites (4,860 plots or 122,227 trees) and averaged 22.0 ± 0.8 plots/person/day of field work. Using a DVR system increased our efficiency by 55 percent in terms of plots measured/person/day. Additionally, in a study on the social interaction of cowbird, White and others (2002) improved the amount of data and breadth of the study. Generally, data from 8 hrs in the field resulted in 1 to 1½ hrs of recording time, and the translation and editing of voice data could be accomplished in <1 hr. We strongly recommend that voice translation and editing be completed each day.

While DNS has some reserved words for specific commands, it did not always recognize them when we said them. However, our data were highly structured, with each tree resulting in a separate data line. Consequently, translation errors of reserved words and other errors were easy to detect in the text files and could be corrected using the text editor. Some common translation errors were corrected using macros programmed into the text editing software or with the search and replace function.

Use of DVRs required that one person on the field crew be knowledgeable of the voice translation software. This required 1 to 2 days of preparation. Other members of the field crew could develop voice models in about 4 hrs. We also discovered that voice models could be copied and used by other technicians of the same sex and with similar accents after several iterations of interpretation and correction of a sample data set. Programming the field data loggers and training the crews required comparable effort.

Careful enunciation of words in the field improved the accuracy of the data translation. Although the microphones were noise canceling, more translation and post-processing was necessary for data recorded on

[1] Use of brand name does not constitute endorsement by the U.S. Forest Service to the exclusion of other products that are acceptable.

windy days. DNS translated English words better than scientific names, abbreviations, or codes. For some data, it was easier to change our input than to train the voice model. For example, "forb" was usually translated as four, so we substituted "herb," and with some training of the software, it translated well. Some numbers, such as 21, were translated as words (for example, twenty-one), while others were translated as word homophones (for example, 4 as four or for; and 2 as two or to). We found it difficult to train DNS to recognize these numbers. Unfortunately, attempts to train the software to recognize homophones do not substantially improve the translation error rates (Happe and others 2003). However, our data consisted of a limited range of responses, so translation errors were easily identified and corrected.

Management Implications

There are many potential applications to using DVRs to record data that could significantly change the future of data entry. The following are a few examples of the benefits we received by using DVR to record our research data.

- Recording research data using digital voice recording allowed for more efficient allocation of personnel resources than did recording data using hand-held data loggers.
- Technicians were unencumbered while taking measurements and data were recorded by simply speaking the values measured.
- Once translated into ASCII text files, data could easily be cleaned up and ready for analyses.
- In addition to this study, we used digital voice recording when measuring prairie vegetation, including herbaceous cover and shrub density measurements, and when characterizing drumming logs used by ruffed grouse (*Bonasa ubmellus*).
- Equipment and software for digital voice recording is inexpensive, and the initial cost of the system can be recovered by the time that is saved recording data.

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