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A PORTABLE COMPUTER-COMPATIBLE SYSTEM FOR COLLECTING BIRD COUNT DATA

MARTIN G. RAPHAEL
USDA Forest Service
Rocky Mountain Forest and Range Experiment Station
222 South 22nd Street
Laramie, Wyoming 82070 USA

Abstract.—A portable, battery-operated system for recording bird count data is described. All components are commercially available and include a hand-held terminal for recording observations in the field, a battery-operated microcomputer and disk drive for storing daily observations onto a diskette, and a second disk drive and software for data editing and analysis in the laboratory. The system was used by five observers to collect about 20,000 observations during 2160 10-min counts using the variable circular plot technique. It proved to be highly reliable and efficient.

SISTEMA PORTÁTIL DE COMPUTADORA PARA TOMAR DATOS EN EL CAMPO

Resumen.—En este trabajo se describe un sistema portátil de computadoras que operan con baterias y es útil para hacer conteos de aves. El equipo consiste de un terminal manual, una microcomputadora, un manejador de discos (disk drive) para almacenar los datos y un segundo equipo similar, para analizar en el laboratorio los datos obtenidos en el campo. El sistema fue utilizado por tres observadores que tomaron 20,000 observationes durante 2160 conteos de 10 minutos.

Portable data collectors (data loggers) have been used to acquire data on biotelemetry (White and Garrott 1984), animal behavior (Hensler et al. 1986), animal activity patterns (Cooper and Charles-Dominique 1985), and vegetation characteristics (MacCracken et al. 1984). Foresters also use them for timber cruising, lumber inventory, and log scaling (Cooney 1985). I describe a portable data collector for recording bird census data. This method could help researchers and managers monitor populations and conduct long-term resource inventories.

In this study, birds were counted using the variable-circular plot technique (Reynolds et al. 1980). During June and July of 1986 and 1987, an observer visited 15 stations spaced 200 m apart each morning, and recorded the distance from the station to each bird seen or heard during 10-min intervals. Birds (but not distances) also were recorded while traveling toward a station, during a 1-min waiting period before the formal 10-min count, and traveling from a station after the count.

All observations were recorded using MSI/85[1] portable data collectors (MSI Data Corporation, Costa Mesa, California). MSI/85 weighs 0.5 kg, measures 15 × 9 × 4 cm, and is easily carried in one hand. Data are entered manually through a 33-key alphanumeric keyboard. The MSI/85 is fully programmable using MSI's AUTOGEN software, which

[1] *Use of trade or company names is for the benefit of the reader and does not imply endorsement or preferential treatment by the U.S. Department of Agriculture.*

is available on a plug-in chip. This software is used to create prompts for data entry and other features, such as automatic entry of date and time. The software also allows for some data checking, such as acceptable range and field length. The MSI/85 has a liquid crystal display of up to 16 characters (5 × 7 dot matrix) and is powered by four AA batteries. Maximum memory allows for storage of 32,768 alphanumeric characters (32K).

FIELD OPERATION

Each of three observers carried an MSI/85 in the field. Data entry followed the flow chart in Figure 1. To conserve memory, the data-entry program was designed to minimize repetitive information. For example, the observer's name and current date were recorded only at the start of a day, and a station identification number was recorded only for the first bird observation at that station.

At the end of each day, the observers returned to the field camp (which had no electric power), transferred all stored data onto a 3.5-in diskette, and produced a hard copy of the day's results using a portable printer. The MSI/85 is equipped with an (optional) RS-232C interface and built-in communications software. Appropriate communications parameters, such as data transmission rate, can be programmed and stored in memory. Thereafter, all stored data were transmitted by simply selecting the name of the file containing the data and issuing a few simple commands via the keyboard.

Data were temporarily transferred to a Radio Shack TRS-80 Model 100 battery-operated microcomputer (Tandy Corp., Fort Worth, Texas) equipped with a battery-operated 3.5-in disk drive (Tandy Corp.) and a battery-operated printer (TRP-100, Tandy Corp., Fig. 2). An optional read-only memory chip, Ultimate ROM II (Traveling Software, Inc., Seattle, Washington) and disk operating software (TS-DOS, Traveling Software) facilitated transferring each data file from the Model 100 to a floppy diskette. Before erasing the file from the Model 100's memory, the entire file was printed. This printed copy served as a backup for manual re-entry of data should any be accidentally lost (which never occurred).

Each file consisted of one observer's records for one day. An observer visited 15 stations per day, and usually recorded 5–20 birds per station. A typical file was about 200 lines long, and required about 4.5K of memory in the MSI/85, Model 100, and floppy diskette. Maximum memory would allow recording about 1500 observations per recorder per day. Each diskette holds about 100K, and thus could store about 20 census-days of data. In practice, data from the three observers were accumulated for one work-week (5 d) on one diskette (15 separate files).

At the end of the week, the diskette was brought back to the lab for analysis. A second Tandy portable disk drive was connected to a personal computer via LAPDOS hardware and software (Traveling Software). This system allowed the user to access the files on the 3.5-in diskette and

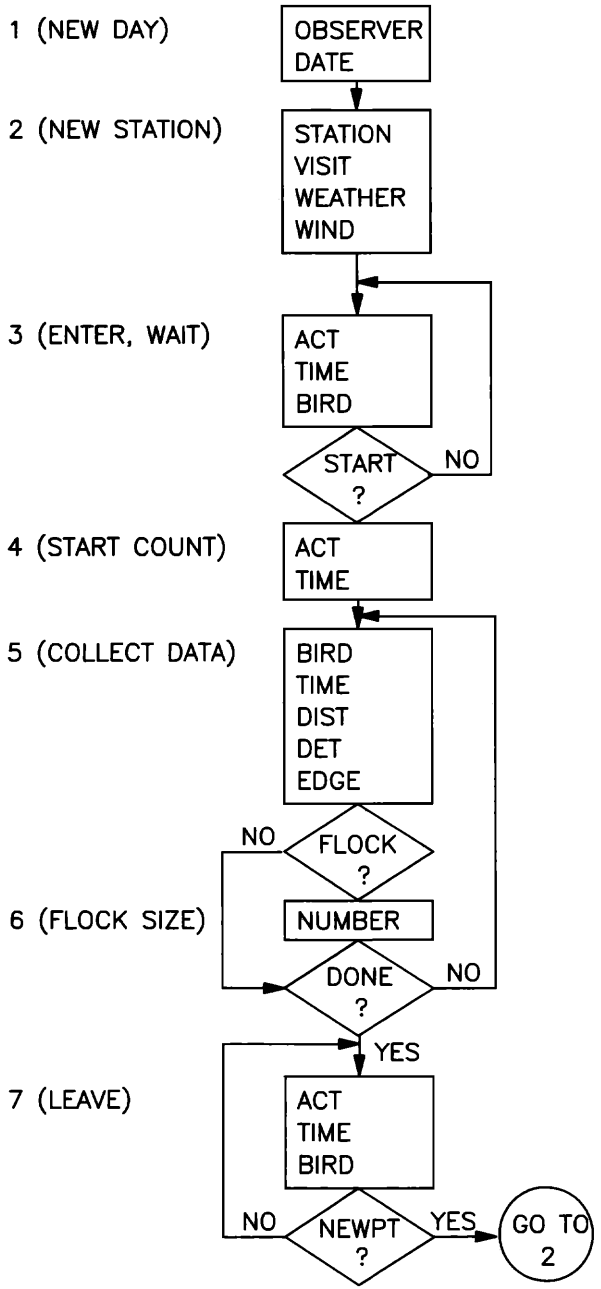

FIGURE 1. Flow chart for bird-census data entry using a portable, battery-operated data logger. Users entered data in response to prompts (right column) appearing in display.

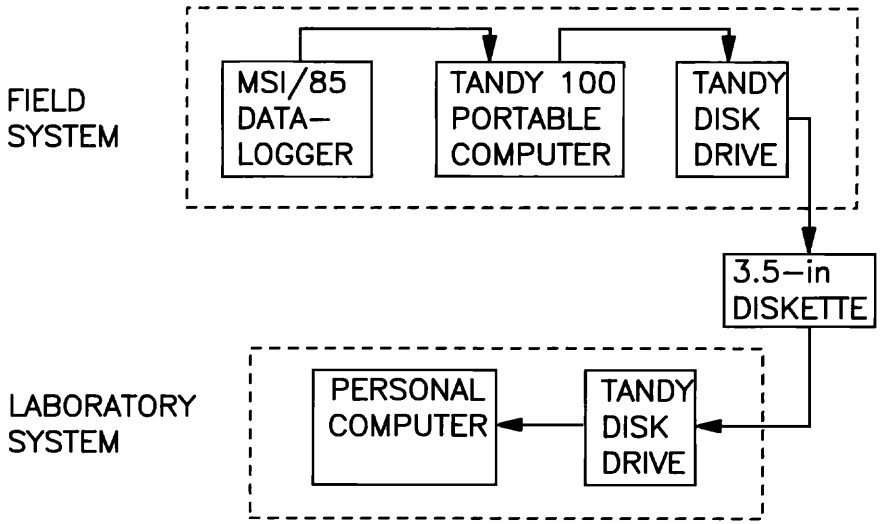

FIGURE 2. Diagram of major components of a battery-operated data entry system for the field and an ac-powered data storage and analysis system for the laboratory.

copy them to memory or one of the disk drives on the personal computer for subsequent analyses. A special FORTRAN program (available from the author) was written to convert the abbreviated data collector file to a more manageable file that associated the observer's initials, date, station number, etc., with each observation. From that point on, results were quickly edited and summarized using packaged word-processing and statistical software on the personal computer.

COSTS

Total cost of each MSI/85 as equipped for this study (optional real-time clock, leather case, 32K memory) is $1253.75. In addition, the AUTOGEN software license fee is $552.50 (this covered software for all machines), the RS-232C interface is $127.50, and miscellaneous cables total $85.00 (all prices in 1984 United States dollars). The price of the MSI/85 varies greatly depending on memory configuration; the 8K version, for example, costs about $850. Other components of the system cost as follows: Model 100, $399.20; portable disk drive, $159.96; portable printer $233.96; Ultimate ROM II, $195.46; LAPDOS $69.95, TS-DOS, $69.95 (total = $1128.48).

DISCUSSION

The primary concerns in setting up this system were data integrity, speed, and ease-of-use. The system functioned well on all factors. First, the MSI/85 memory is kept active by a NICAD battery that is continuously charged by the removable AA batteries. The device signals the

user when batteries are low, allowing at least 24 h to replace batteries without losing memory contents. Second, this system provides multiple back-up capabilities via the memory of the MSI, the stored file on diskette, and the printed copy. Even if the data had accidentally been erased from memory and disk, the printed version would have allowed re-entry of information. This was never necessary, however, through two full field seasons involving 2160 10-min counts totalling over 20,000 observations. Entering data was simple, because the observer responded to prompts that appeared in the display. Entering data for each observation took slightly longer than it would have taken using traditional paper-and-pencil method, but not so long that observers could not keep up with new observations during the 10-min count. Data entry could be made faster, however, by replacing four-letter bird name codes with two-letter codes, or by using a barcode reader to scan appropriate codes from a master sheet. Observers found it somewhat difficult to find the appropriate letters on the MSI's keyboard. Transferring data to the Model 100 and to the disk drive took about 5 min; printing the file took up to 15 min. Complete summaries of the week's results were possible within 30 min after a diskette was received at the lab.

The biggest advantage of this system was the elimination of keypunching from hand written data sheets and the errors and time-delays that keypunching introduces. Observers were able to field-edit their entries using the built-in editor on the MSI/85 and again using the text editor included on the Model 100. Thereafter, no further edits were necessary; the data were translated accurately from one system to the next. In addition, observers were provided with weekly reports on total observations, mean distances to each bird species, and other relevant summaries.

Many improvements are possible that could save time and costs. The MSI/85 was chosen because of its small size and large memory. But a Model 100 (since replaced by a newer version, Model 102), also can be used in the field, as demonstrated by Hensler et al. (1986). This computer is bulkier, weighing 1.4 kg and measuring 30 × 22 × 5 cm. However, its keyboard is laid out like a standard typewriter, which permits more natural key entry. It can easily be programmed to prompt the user, similar to the MSI/85. Upon returning from the field, the observer would simply plug in the disk drive and printer and store the day's data. A further enhancement, designed to speed data entry, would involve using a barcode reader (which both the MSI/85 and Model 102 are equipped to run) to scan the appropriate code from a master sheet that the observer would carry. Such a system would speed data entry considerably, especially when more than about 20 birds are encountered during a 10-min period.

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