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QUANTIFYING THE BEHAVIOR OF FREE-LIVING ANIMALS: INTEGRATION OF BINOCULARS AND PALMTOP COMPUTER

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Abstract.—Quantification of the time animals spend at different activities or occupying specific sites is often a goal of behavioral ecologists. Here we report our use of a small palmtop computer, mounted on top of a pair of binoculars, such that the keyboard can be manipulated while the observer is viewing the subject. This system was designed around the Hewlett-Packard HP-95LX palmtop computer. Because of its small size, this MS DOS based computer can be mounted on virtually any medium to large binocular. Event-timing and data-processing programs written in BASIC for this system were used to quantify the time animals spend at specific activities. This system was easy to use and the keyboard can be accurately manipulated while viewing a subject through the binoculars or with the computer hanging against the operators chest by the binocular strap.

CUANTIFICANDO LA CONDUCTA DE ANIMALES DE VIDA LIBRE: LA INTEGRACIÓN DE LOS BINOCULARES CON LAS COMPUTADORAS

Sinopsis.—La cuantificación del tiempo que los animales invierten en diferentes conductas u ocupan un lugar en particular es a menudo una meta de los ecólogos de la conducta. Aquí informamos nuestro uso de una pequeña computadora de mano, colocada sobre unos binoculares de forma que el teclado puede manipularse mientras el observador mira el sujeto. Este sistema se diseñó utilizando un computador de mano Hewlett-Packard HP-95LX. Gracias a su pequeño tamaño, este computador basado en MS DOS puede colocarse en prácticamente cualquier binocular de tamaño entre mediano y grande. Para cuantificar el tiempo que los animales invierten en actividades particulares se usan programas de moni-

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toreo de tiempo de actividades y de procesamiento de datos escritos en BASIC para este sistema. Este sistema es fácil de usar y el teclado puede manipularse efectivamente mientras se observa un sujeto a través de la computadora o con la computadora colgando contra el pecho del operador por medio del cordel de los binoculares.

Behavioral ecologists and others often examine hypotheses or problems that require quantifying an animal's behavior in the field. This frequently involves recording the time that an animal devotes to particular activities or spends at specific microsites. Traditional methods of quantifying time budgets have relied on using a battery of stopwatches. The cumulative time that an animal is engaged in a specific behavior over some discrete interval of time is read from each stopwatch and is recorded on the data sheet (Walsberg 1975). More contemporary methods involve the use of small laptop computers with event-timing programs that simply require the observer to depress a specific key on the keyboard as any new activity or behavior starts (Powers and McKee 1994). These programs record the time from the point when a key is depressed at the start of an activity until the operator presses a different key signaling the start of some new activity or behavior. At the end of an observation period, a data-processing program allows the observer to total the time an animal was engaged in each activity during the timed interval. This system can be used to record many different activities or behaviors, only limited by the number of keys on the keyboard, for extended periods and allows the researcher to transfer the data directly into another computer where files can be summarized and manipulated. However, one drawback to this system is that it is potentially difficult to follow an animal in the field while observing its behavior and operating the computer simultaneously. In addition, behavioral observations of small animals such as birds, or observations made from a distance may also require the use of binoculars. The simultaneous use of both instruments may be impractical in many situations.

Here we report our use of a small palmtop computer, mounted on top of a pair of binoculars, such that the keyboard can be manipulated while the observer is viewing the subject (Fig. 1 and 2). We have used three of these systems successfully for several hundred hours in the field. This system is composed of five components: the palmtop computer, the RAM card, the event-timing and data-processing software, the mounting bracket system, and a pair of binoculars. The Hewlett-Packard HP-95LX palmtop computer, because of its small size and mass, is ideal for field use. The HP-95LX is a small (2.5-cm thick × 8.5-cm wide × 16-cm long; 300 g including two AA batteries) battery-powered MS DOS-based computer with 512 kb of RAM (newer models such as the HP-200LX have up to 2 Mb of RAM). The computer can run a variety of MS DOS programs and can be interfaced directly with other computers or peripheral devices through serial ports. Battery life is typically in excess of 2 wk during continuous daily field operation, and a small lithium cell supplies short-term backup power. The HP-95LX also has the capability of reading and writing to RAM cards which are inserted into a slot in the computer. These RAM cards are available in various memory sizes (128k to 2M) and can be used to

FIGURE 1. Palmtop computer on mounting bracket affixed to a pair of Leica 10 × 42 Ultra binoculars.

store programs and data as a backup or archive. Battery life of the RAM cards typically exceeds a year.

We use event-timing and data-processing programs written in BASIC and adapted for the HP-95LX computer. The BASIC program requires approximately 81 kb of memory and the event-timing and data-processing programs use 2.6 kb each. The event-timing program, as with earlier versions (Powers and McKee 1994), allows the user to assign timing functions to all keys except for "E" and "N" which are reserved for ending a timing sequence and entering a note, respectively. The event-timing program records the time that a key was depressed and the sequence of keys depressed and start times are thus recorded serially over the timing interval. The data-processing program totals the time a specific key was depressed during the timing interval for each key used during the timed interval. It also provides the percent of the total time for each key used and any notes entered during the timing sequence are also available.

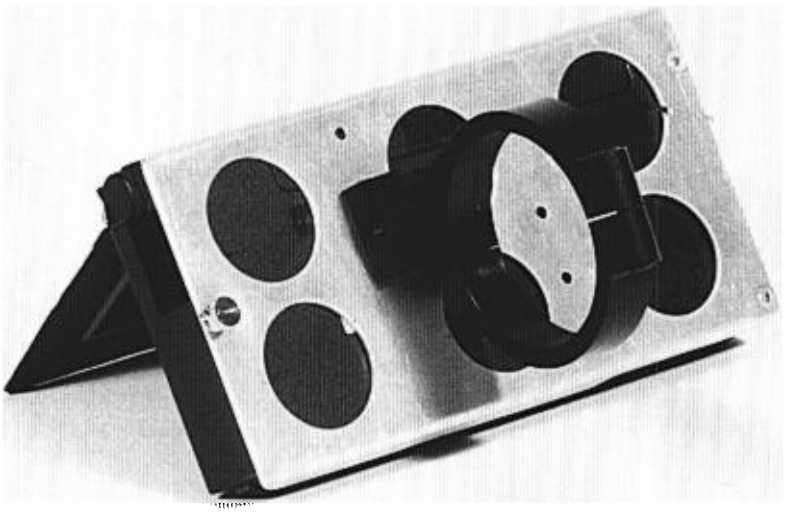

FIGURE 2. Computer bracket showing ring attachment for objective tube.

The mounting system can be fabricated to fit virtually any model of medium-to-large size binocular. The function of the bracket is to position to the computer so that its keyboard is accessible while holding the binocular with a natural hand position for viewing (Fig. 1 and 2). The bracket should also not interfere with operation of the computer or focusing of the binoculars. We used a machined nylon ring to clamp the computer bracket to the binocular. This ring is either clamped onto the objective lens tube or the binocular hinge assembly. Bolted to the ring is a nylon block that provides a pivot point and a mounting surface for the computer mounting plate. The computer mounting plate was fabricated from a 1.7-mm thick aluminum plate of slightly larger dimensions than the computer base. Two nylon clamps screwed into the mounting plate held the computer firmly against the mounting plate. Cutouts were machined in the clamps to allow access to the RAM card and AC power adapter socket. The clamps were also used to hold a sheet of 0.3-mm thick transparent polyacetate against the key board surface. The polyacetate sheet allowed actuation of the keys and provided a surface to mount 6

mm diameter self-adhesive clear silicone cabinet bumpers. Bumpers were affixed above keys assigned specific behaviors and thus the keys could be identified tactilely.

We found this system convenient to use, and the keyboard could be accurately manipulated while viewing a subject through the binoculars or with the computer hanging against the operators chest by the binocular strap. The system can also be designed for right- or left-handed operation. The Mechanical Instrument Shop at Arizona State University was able to fabricate the entire bracket at a cost of approximately US $90.00 and the computers are readily available (currently the HP-200 LX has a retail price of approximately US $900). We can provide a basic engineering drawing of the bracket assembly and a hardcopy of the event timing and data processing program to interested parties.

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