Testing the Wildlink activity-detection system on wolves and white-tailed deer

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We tested the reliability and predictive capabilities of the activity meter in the new Wildlink Data Acquisition and Recapture System by comparing activity counts with concurrent observations of captive wolf (*Canis lupus*) and free-ranging white-tailed deer (*Odocoileus virginianus*) activity. The Wildlink system stores activity data in a computer within a radio collar with which a biologist can communicate. Three levels of activity could be detected. The Wildlink system provided greater activity discrimination and was more reliable, adaptable, and efficient and was easier to use than conventional telemetry activity systems. The Wildlink system could be highly useful for determining wildlife energy budgets.

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Nous avons vérifié la fiabilité et la valeur de prédiction de l'activomètre du nouveau système « Wildlink Data Acquisition and Recapture » en comparant les données obtenues selon ce système avec les résultats d'observations obtenues en même temps de l'activité de Loups gris (*Canis lupus*) en captivité et de Cerfs de Virginie (*Odocoileus virginianus*) en liberté. Le système Wildlink enregistre l'activité directement dans un ordinateur intégré à un collier émetteur avec lequel le biologiste peut communiquer. Trois niveaux d'activité ont été enregistrés. Le système Wildlink permet une discrimination plus grande de l'activité et s'est avéré plus fiable, plus adaptable, plus efficace et plus facile à utiliser que le système conventionnel de télémétrie. Le système Wildlink sera sans doute très utile dans la détermination des budgets énergétiques des animaux en nature.

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Introduction

Radiotelemetry, in addition to being valuable for determining animal movements and mortality, has been widely used to monitor animal behavior and activity. It is often the only means of obtaining such information. Although improvements and refinements have been made, the basic function of radiotelemetry has remained the same for 25 years. The reliability and usefulness of the two activity-measuring devices currently used on collars (variable-pulse and reset) are especially limited (Quigley et al. 1979; Gillingham and Bunnell 1985). To date, no telemetry system can reliably distinguish activity levels beyond resting versus active, and even this potential is limited (Beier and McCullough 1988). A system that can discriminate among more than two levels of activity would be highly useful for determining animal activity budgets and studying energetics.

A new type of telemetry system, the Wildlink Data Acquisition and Recapture System™ (Wildlink, Inc., 2924-98th Avenue N., Brooklyn Park, MN 55444), uses a computer in a 520-g waterproof radio collar to control several functions, one of which is to fire darts to recapture animals (Mech et al. 1990) and another to record degree of activity. The collar's computer monitors a mercury tilt switch once every 0.5 s for changes of state. The switch detects head-up, head-down movements of ≥10°, and activity counts are incremented by one on each detected change of state of the switch. The activity-storage capacity can be remotely set to record total counts for twenty-four 10- to 60-min periods, giving a total storage capacity of the most recent 4–24 h of activity.

A biologist-operated triggering transmitter provides two-way communication with the radio collar. The triggering transmitter, weighing 2 kg, uses an interactive menu that directs the operator to press numbered keys which send unique coded radio signals via a Yagi antenna to any number of collars. Stored activity data are accessed from the collar by sending a retrieve command via the triggering transmitter. Activity counts are then transmitted to any standard wildlife telemetry receiver. The receiver emits the activity counts in audible binary-coded decimal pulses.

The total number of activity counts since the collar was activated (cumulative counts) is also stored and can be accessed as often as every 64 s. A total count for any current period can be obtained by subtracting the cumulative count obtained at the beginning of the period from the count at the end.

We report on the field testing and potential applications of the activity-gathering capabilities of the Wildlink system.

Materials and methods

Thirteen adult female white-tailed deer were captured via rocket net and Clover trap from 1 February to 9 April 1989 in the Superior National Forest, Minnesota, fitted with Wildlink collars, and released. Commands were sent to the Wildlink collars on the deer to set the

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TABLE 1. Correspondence between Wildlink activity counts and observed captive wolf and wild deer behavior

Behavior	n	Activity count range	Mean ± SE
Wolf			
Resting–sleeping	38	0–7	1±2
Feeding–walking	22	17–82	44±23
Running	30	86–168	133±21
Deer			
Resting–sleeping	Not observed[a]		
Feeding–walking	19	10–36	24±7
Running	27	37–253	110±50

NOTE: For wolves, n is the number of 3-min activity counts; for deer, n is the number of 5-min activity counts.
[a]No such behavior was observed, but several hours of zero activity counts were recorded from both wild deer (probably indicating sleep or rest) and anesthetized deer.

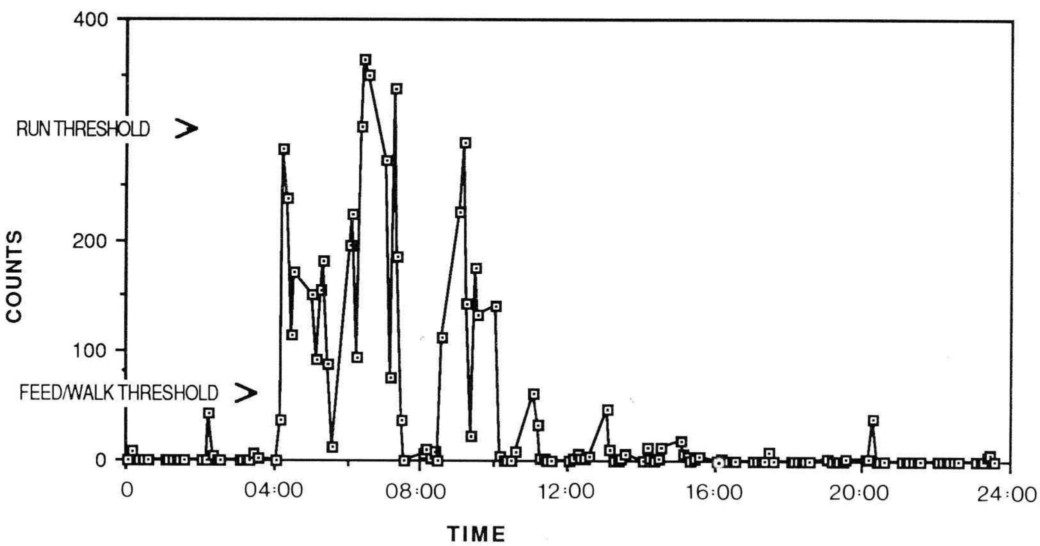

FIG. 1. Twenty-four hours of consecutive 10-min interval activity counts from wolf 139, 8 November 1989, in the Superior National Forest, Minnesota.

computer clocks and the activity-storage interval to 10, 20, or 60 min. Shorter interval counts of varying lengths were obtained via cumulative counts.

Initially, we programmed the collars to save counts at 60-min intervals and unloaded these counts every 24 h for each deer. Later, we remotely reprogrammed the collars to record at 10- and 20-min intervals and unloaded the counts every 4 and 8 h, respectively.

We measured the reliability of distinguishing among various activities via cumulative activity counts by observing captive wolves and free-ranging deer wearing Wildlink collars. Wolf behavior was observed in two 0.16-ha pens at Carlos Avery Wildlife Management Area, Forest Lake, Minnesota, while 1.1-min activity counts were recorded. Wolves were observed resting (sleeping or lying awake), feeding, walking, or running. Feeding involved the complex of behaviors related to eating, including walking and standing. Running was forced. Activity counts were also recorded from a wild wolf in the Superior National Forest, Minnesota. Activity counts were also taken before, during, and after we chased deer, while we observed deer feeding at bait stations, and before and after remote darting of the animals (Mech et al. 1990) in the Superior National Forest. Time and duration of each behavior for deer and wolves were recorded on a clock synchronized to that used to record activity counts.

Results

Activity counts were obtained from 13 free-ranging deer, 1 free-ranging wolf, and 12 captive wolves fitted with 25 different capture collars for varying periods from 1 February through 8 November 1989. Temperatures during this period ranged from −25 to +36°C. Activity data could be received ≤3 km away, line of sight, on the ground through heavy forest, and ≤26.5 km from the air at 1545 m elevation above ground.

We recorded two hundred and seventy 1.1-min samples of known behavior in the captive wolves and forty-six 5-min samples of known behavior in the deer (Table 1). Although 1-min activity counts from the captive wolves overlapped for various types of activity, by totaling them for consecutive 3-min periods of the same activity, we could classify them into three discrete ranges that corresponded to resting, feeding–walking, and running (Table 1). A daily activity pattern for a wild wolf included each of the three activity levels (Fig. 1).

Deer activity counts fell into three separate levels (Table 1). Although we never observed deer resting or sleeping, we recorded activity counts of zero for many hours each day. In addition, we invariably obtained activity counts of zero after drug induction in deer darted via the Wildlink collar. (Presumably this behavior is similar to sleeping or resting.)

Discussion

Gillingham and Bunnell (1985) found that slight head movements prevented conventional tip-switch collars from

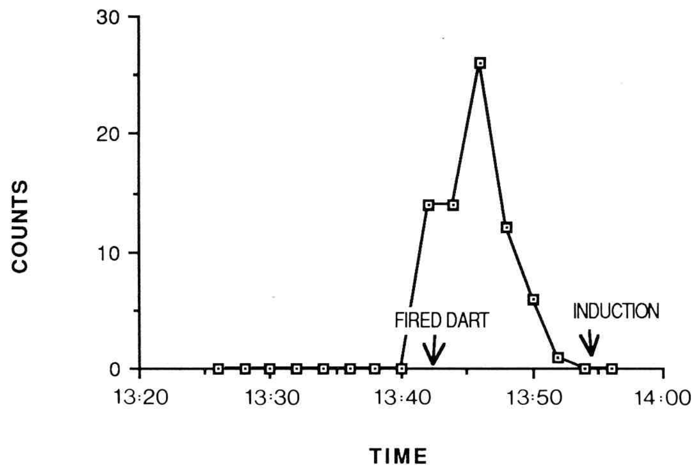

FIG. 2. Activity counts from capture – collar darting sequence of deer 6462, 19 April 1989, in the Superior National Forest, Minnesota.

transmitting an inactive pulse and therefore caused misclassifications of behaviors. Reset collars can only indicate activity or inactivity through a bimodal pulse rate, with slight movements and intense activity producing the same pulse rate (Gillingham and Bunnell 1985). Increased movement does not necessarily result in higher pulse rates with conventional variable-pulse collars (Gillingham and Bunnell 1985). The Wildlink system overcomes these problems by giving actual tilt counts, thereby potentially providing finer resolution and discrimination capabilities. Wildlink yields strictly quantitative data, with an increase in activity intensity producing an increase in counts. One other activity-sensing device can record and store actual tilt counts but is available only on Telonics satellite collars (Fancy et al. 1988). Furthermore, it can only discriminate between two levels of activity, and its data cannot be stored and retrieved upon command (Fancy et al. 1988).

Although Beier and McCullough (1988) distinguished between bedded and active behavior in deer, they had to use variability in signal amplitude as part of their test criteria, as is done with other, conventional systems. However, signal strength from an immobile transmitter may falsely appear variable (Gillingham and Bunnell 1985; Lindzey and Meslow 1977; Garshelis et al. 1982), causing misclassifications. Because Wildlink does not use signal strength as a criterion, this problem is avoided.

Erratic signals produced by tip-switch and variable-pulse collars make radio tracking more difficult (Quigley et al. 1979). Because Wildlink activity data are transmitted at the convenience of the biologist when not radio tracking, this is not a problem.

Extensive periods of listening or an external recorder are required to obtain sufficient data for determining activity levels by conventional telemetry. The former requires a large time expenditure and adequate real-time access to the animal's signal range. Wide-ranging animals may often be out of range of an external data recorder. Wildlink avoids these limitations by including the switch, processor, and recorder in the collar and continuously monitoring activity for limited periods.

Preliminary indications are that the Wildlink collar battery capacity remains adequate for 8–10 weeks. The animal must then be recaptured and the batteries changed. Although this process potentially makes it possible to collect activity data for the entire life of an individual, it also increases the cost of the system (new batteries and darts must be installed at each recapture) and increases the potential for premature transmitter failure if batteries are not changed in time. In addition, the effect of drugging an animal every 8–10 weeks on its behavior is presently unknown. We did find that deer captured by means of the Wildlink collar required less time to return to ''normal'' activity levels than those captured by conventional methods (K. E. Kunkel, L. D. Mech, and M. E. Nelson, unpublished data). This was possibly due to the reduced level of stress involved in Wildlink recapture (DelGiudice et al. 1990).

Because the Wildlink system provides greater flexibility, power, and reliability than conventional telemetry for studying activity, its potential field applications and value are high. It should help researchers analyze activity patterns in relation to sex, age, season, environmental factors, and disturbance more reliably than present systems. The activity system in the Wildlink collar also indicates if a recapture dart has fired (based on a sharp increase in activity after needle penetration) and when chemical induction commences (zero activity counts, Fig. 2).

To minimize overestimation of the time spent at a given behavior, Beier and McCullough (1988) recommended selecting the shortest sampling interval that successfully discriminates among behaviors (3 min for captive wolves in this study). With Wildlink, this interval can be changed remotely in the field as species or conditions warrant. However, to reduce the storage interval below 10 min, the manufacturer would have to reprogram the collars we tested.

Although observations of captive wolves clearly indicated that activity could be discriminated at three levels in this species, the field results on deer are less conclusive, so further testing is required while observing specific activities. (Calibration via blind testing should always be done on each species before interpreting the results from the field.) We were unable to observe deer at rest and thereby collect any known resting activity counts. Our feeding observations on deer were limited and included only feeding at bait stations. In addition, deer were rarely observed actually running while they were being chased (although they were definitely being pushed and were at a higher plateau of activity). This may explain the narrow margin between the upper end of the walking–feeding level (36 counts) and the lower end of the running level (37 counts). Additional testing will refine these cutoffs. Nevertheless, preliminary results from our field testing on deer yield three levels of discrimination and thus show great promise for determining energy budgets for free-ranging members of this species.

Developing an energy budget is often the ultimate objective of wildlife activity studies. Resting, feeding, and running correspond to three basic activity levels for determining energy expenditures. For white-tailed deer, Mautz and Fair (1980) were unable to distinguish significant differences in energy expenditures beyond three broad levels of activity: running–bounding, walking–standing, and lying. These three classifications include the fundamental behaviors that make up most activities. Whereas reliable discrimination, even between activity and inactivity, has rarely been achieved previously, we were able to successfully discriminate activity at the three levels.

Discriminating activity beyond these three levels to include specific behaviors (e.g., scent-marking, playing) that make up these activities is probably nonessential and unrealistic for most energy-budget purposes because these specific behaviors last for relatively short periods in free-ranging animals (Craighead et al. 1973, Jingfors 1982, Mech 1989). Conventional telemetry has fallen far short of its energy-budget objective, but the Wildlink system appears to reliably achieve it.

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