OBSERVER PERFORMANCE IN KNOWN AND BLIND RADIO-TELEMETRY ACCURACY TESTS

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Abstract: We investigated the error of our radio-telemetry system with and without the observers knowing an accuracy test was in progress. When observers were not aware of the test, precision and bias were reduced and angular error was greater. Radio-telemetry accuracy should be tested without the knowledge of radio-tracking personnel.

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Previous investigations of radio-telemetry system error have manipulated topography, distance, or equipment as observers estimated azimuths to surveyed locations (Cederlund et al. 1979, Springer 1979, Hupp and Ratti 1983, Lee et al. 1985). Application of error estimates to field data assumes that observer response in error tests is comparable to routine field operations. Studies in special education (Salvia and Meisel 1980) and wildlife biology (Balph and Balph 1983, Balph and Romesburg 1986) indicate that experimental results may be affected by observer expectations; however, these implications have not been considered in tests of radio-telemetry triangulation error. Such information is essential for a "thorough test of system accuracy" (Garrott et al. 1986:751).

During a coyote (*Canis latrans*) study in northern Utah, we investigated the error of our radio-telemetry system with and without the observers knowing an accuracy test was in progress. Our objective was to compare the error of our radio-telemetry system determined in a traditional accuracy test with error occurring under normal operating conditions.

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STUDY AREA AND METHODS

Sagebrush (*Artemesia tridentata*) and greasewood (*Sarcobatus vermiculatus*) communities comprised the dominant vegetation in the 400-km^2 study area in Curlew Valley, Utah. Topography, vegetation, and climate are described by Clark (1972) and Gross et al. (1974).

We used 2 radio-telemetry receiving stations permanently located on prominent hills 7.3 km apart. A 4-m rotatable mast at each station held a receiving antenna array consisting of 2 5-element Yagi antennas stacked horizontally and coupled out-of-phase with a hybrid junction. Azimuths were read to the nearest 0.5° from a compass rosette that rotated with the mast. Orientation of the compass rosette was checked every 15–60 minutes via a reference transmitter at known azimuths from the stations.

Observers recorded azimuths from each station to radio-collared coyotes between 1900 and 0700 hours during routine tracking operations. All 4 observers had prior experience with radio-telemetry equipment, and were instructed to be diligent. Because observers alternated between receiving stations and times of night, effects of interobserver bias were likely negligible in this study.

For the blind accuracy test, a transmitter was incorporated into the study without radio-tracking personnel knowing it was not on a coyote. During 2 nights of radiotracking this transmitter was moved among 17 permanent survey markers, so that observers at each station attempted azimuth readings at all 17 test sites. The need to covertly move this transmitter without the

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observers realizing the transmitter was not on a coyote precluded additional replications in the blind accuracy test.

After the blind accuracy test, but before radio-telemetry crews were informed of the blind test, 2 observers assisted in a known accuracy test. During this 1-night test, a transmitter was again placed at the permanently marked locations used in the blind accuracy test. The observers did not know the locations of the transmitter but knew the accuracy of the system was being tested. We surveyed azimuths from each receiving station to each test location with a transit.

For each transmitter location, we calculated an error (i.e., surveyed azimuth − telemetry azimuth) (Lee et al. 1985). The precision of radio-telemetry data sets is a function of variation and may be measured by the standard deviation of the errors (Lee et al. 1985). We tested for a difference in precision between the known and blind tests with an F-test for homogeneity of variances.

We estimated bias by averaging all errors. Bias does not, however, indicate the angular error between true azimuths and azimuths estimated by radio telemetry. Angular error was calculated as the mean of the absolute values of the errors (Heezen and Tester 1967). Differences in bias and angular error between the known and blind tests, and interactions between station and test, were determined with a 2-way factorial analysis of variance for unbalanced data. This also tested the least squares mean bias in the known and blind tests against zero.

RESULTS

Data analysis included only those test locations for which an azimuth was obtained in both tests. We obtained 16 test transmitter azimuths in blind and known tests from 1 station, and 10 from the other. Errors appear to be normally distributed, with 1 obvious outlier in each test (Fig. 1). Both outliers were excluded from calculations (Lee et al. 1985).

There was no station × test interaction for bias ($P = 0.6$) or angular error ($P = 0.2$). Bias was different from zero ($P = 0.008$) in the known accuracy test ($\bar{x} = 0.67$, $n = 25$). Bias in the blind test ($\bar{x} = -0.16$, $n = 25$) was less than the bias in the known test ($P = 0.04$) and was not different from zero ($P = 0.8$).

In this study, precision was greater ($P < 0.01$) during a known accuracy test ($n = 25$, SD = 0.86) than when observers were unaware they were being tested ($n = 25$, SD = 1.60). Similarly, the angular error during the known accuracy test ($\bar{x} = 0.9$, $n = 25$) was smaller ($P = 0.1$) than that during the blind accuracy test ($\bar{x} = 1.3$, $n = 25$).

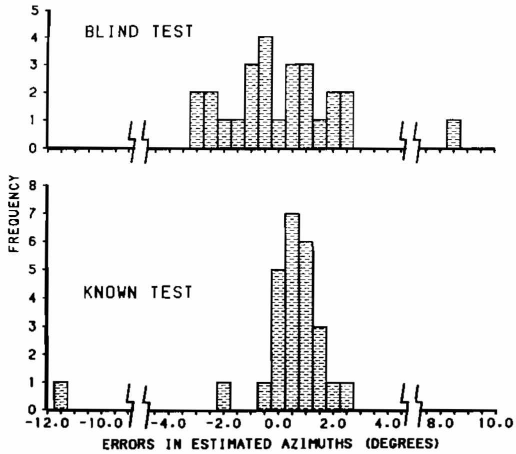

Fig. 1. Frequency histogram of errors in estimated azimuths to radio transmitters using identical locations for known and blind accuracy tests.

DISCUSSION

The accuracy components of interest in radiotelemetry generally include the precision and magnitude of angular errors. The increased precision and decreased angular error observed during the known accuracy test may result from "evaluation apprehension" (Rosenberg 1969: 281). It seems reasonable to expect observers to behave differently during routine field operations than during known accuracy tests, where the observer's diligence and accuracy are examined. Indeed, we noticed that during the known accuracy test, observers took longer to estimate azimuths to the test transmitter than the instrumented coyotes monitored in the same exercise. When questioned afterwards, observers acknowledged that they did concentrate more during the known test than during normal radiotracking procedures. As for the differences in bias, it is unclear why bias was greater during the known test, but such results further suggest a known accuracy test may not reflect error in regular radio-telemetry work.

Whatever the causes of differences in observer performance, we suggest that if observers know a test is in progress, error estimates will not reflect normal data collection operations.

This aspect of accuracy tests is especially relevant for radio-telemetry studies requiring highly reliable estimates of locations (Garrott et al. 1986, White and Garrott 1986) or animal movement and activity (Laundre et al. 1987). To be reliable, estimates of radio-telemetry system accuracy should be done covertly during data acquisition.

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