TECHNICAL NOTES:

SAMPLING RATE FOR MEASUREMENT OF PIGLET THERMOREGULATORY BEHAVIOR

H. Zhou, H. Xin, D. S. Bundy

ABSTRACT. *Diurnal piglet behavior of heat lamp usage was recorded by photographic time lapse technique at 15 min intervals for 24 h and expressed as the percentage of litter mates using the heat lamp. The 15 min behavioral data was then divided into subsets with a sampling interval of 30, 45, 60, 75, 90, or 120 min; and data series comprised of the averages of 15 min data corresponding to each of the augmented sampling intervals. Correlation analyses between the subsets and the average data series indicated that a sampling interval of up to 60 min results in reliable measurement of the dynamic heat lamp usage of the piglets.*
Keywords. *Discrete sampling, Photographic recording, Heat lamps, Animal behavior.*

Discrete sampling of animal behaviors over an extended period can significantly reduce the labor force and resource needs for data analysis as compared to continuous measurement. However, discrete measurements must be performed with proper sampling rates or intervals to avoid pattern distortion or aliasing. For a complete review of behavioral sampling methods, the reader may refer to Altmann (1973) and Lehner (1992). The critical sampling intervals for animal behavior measurement have been shown to range from 15 s to 120 min, depending on the nature of the behavior (Harker et al., 1954; Lofgreen et al.; 1957; Hull et al., 1960; Heitman et al., 1962; Hultgren and Hazen, 1971; Riskowski et al., 1990; Korthals et al., 1995). One important factor that influences the design and management of swine farrowing facilities is the dynamic behavioral responses of piglets to localized supplemental heating sources. The review of literature did not reveal information on sampling interval requirement for measuring such behavior. The objective of this work was to examine the effects of sampling interval on the measurement of circadian behaviors of heat lamp usage for neonatal piglets.

MATERIALS AND METHODS

Three experimental farrowing rooms (14 crates each) on a 1,100-sow commercial farm were equipped, respectively, with 250 W, 175 W, and 125 W heat lamps. The heat lamps were located in the back of the crates during farrowing and moved to the front of the crates within two days after farrowing. The heat lamps were suspended 40 to 60 cm from the floor (depending on the piglets age), which provided heating to a 50 cm × 50 cm creep area. There were 10 to 11 piglets in a litter.

Heat lamp use behavior of the piglets was defined as lying in the heated creep area. It was recorded with time lapse photographic cameras (Canon model T70 with command back) that were mounted 1.5 m above the creep area. The cameras were programmed to take pictures at 15 min intervals for 24 h at one week of age and again at two weeks of age. The selection of 15 min sampling interval was based on the literature report that major behaviors of farm animals could be observed at intervals up to 30 min with reasonable accuracy (Hull et al., 1960; Heitman et al., 1962). No auxiliary light was used for the cameras because illumination by the heat lamps was sufficient.

The discrete photographs of the piglet position were manually examined to determine the number, expressed as a percentage of litter mates, using the heat lamp. The same position was assumed to continue until the next sampling time (Hull et al., 1960). The 15 min main dataset containing 96 observations was then divided into subsets with sampling intervals of 30, 45, 60, 75, 90, and 120 min, respectively. For each of the subsets, their corresponding 15 min averages were calculated to form a new data series, i.e., average data series. The correlation coefficient between the subsets and their concomitant average data series, r, was computed (Runyon and Hater, 1984) and test of significance was performed (Arnold-Meeks and McGlone, 1986). Specifically,

$$r = \sqrt{1 - \frac{\sum_{i=1}^{n} (y_i - [Y]_i)^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2}} \qquad (1)$$

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where

- y = discrete observation of the subset using augmented sampling interval
- [Y] = expected value of y, computed as average of 15 min data over the augmented sampling interval
- $\bar{y}$ = arithmetic mean of y
- n = number of observations

Results and Discussion

Figure 1 presents an example of the diurnal piglets behavior of heat lamp use obtained by discrete samples of 60 min intervals versus averages of 15 min interval data over the same period. Table 1 lists the correlation coefficients between the discrete measurements and the average measurements for the selected sampling intervals.

Correlation coefficients for sampling intervals of up to 60 min were all significantly greater than their critical values ($P < 0.01$) regardless of lamp size or piglet age, suggesting that measurement accuracy of the diurnal piglet behavior was not affected by sampling intervals of 15 to 60 min. This result paralleled the report by Heitman et al. (1962) on observations of swine behaviors of lying in the shade, eating, and wallowing as influenced by sampling interval. They further indicated that even 120 min interval also yielded reasonable accuracy. However, the study reported here with piglets showed that as the sampling interval exceeded 60 min, the correlation coefficients became unstable and tended to be affected by the type of heat lamps involved. For example, r was less than the critical values for 75 min ($r_{0.05}$ = 0.456 and $r_{0.01}$ = 0.575) and 90 min ($r_{0.05}$ = 0.497 and $r_{0.01}$ = 0.623) intervals during the first week exposure to 175 W. Moreover, the correlation coefficients tended to be lower for two-week-old piglets than for one-week-old piglets. This outcome was presumably attributed to the decreased thermal needs and therefore less use of the heat lamp by the older piglets as observed by Xin et al. (1995).

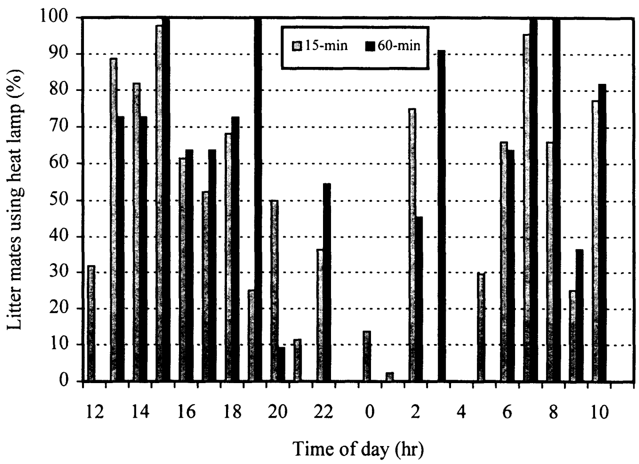

Figure 1–Diurnal heat lamp usage of one-week-old piglets with a 250 W heat lamp by 60 min discrete observations compared to averages of 15 min discrete observations over the same 60 min period (room temperature = 20~21°C; relative humidity = 40~45%).

Table 1. Correlation coefficients between discrete observations at various intervals and the corresponding 15-min averages of piglet heat lamp usage

Sample	One Week of Age			Two Weeks of Age					
Interval	Heat Lamp Size			Heat Lamp Size					
Min	250W	175W	125W	250W	175W	125W	n	$r_{0.05}$	$r_{0.01}$
30	0.8721	0.8319	0.8691	0.8806	0.8388	0.8641	48	0.280	0.370
45	0.8997	0.8451	0.8175	0.7261	0.7188	0.7504	32	0.349	0.449
60	0.6554	0.7185	0.6494	0.6667	0.7091	0.6667	24	0.404	0.515
75	0.6296	0.7729	0.7814	0.4591	0.4287	0.6456	19	0.456	0.575
90	0.7688	0.1667	0.6693	0.7027	0.6839	0.4394	16	0.497	0.623
120	0.3879	0.7538	0.5507	0.2032	0.7587	0.1157	12	0.576	0.708

n = number of observations.
$r_{0.05}$ = critical correlation coefficient at the significance level of 5%.
$r_{0.01}$ = critical correlation coefficient at the significance level of 1%.

Conclusions

Discrete sampling intervals of up to 60 min may be used to measure diurnal behavior of heat lamp usage by neonatal pigs with reasonable accuracy.

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