50–100 m ag to reduce disturbance of sheep, and >100 m ag to minimize disturbance. Data on habitat use or behavior patterns may be misleading if collected from flights at <100 m ag.

Acknowledgments.—We thank M. Chilelli, R. Ockenfels, R. Seegmiller, and S. Torres, University of Arizona, Tucson, for technical assistance. F. L. Miller provided many constructive suggestions on the manuscript. This study was funded by the U.S. Bureau of Reclamation and the Fish and Wildlife Service.

LITERATURE CITED

Chilelli, M. and P. R. Krausman. 1981. Group organization and activity patterns of desert bighorn sheep. Desert Bighorn Counc. Trans. 25:17–24.

Geist, V. 1971. Is big game harassment harmful? Oil Week 14:12–13.

Gilmer, D. S., L. M. Cowardin, R. L. Duval, L. M. Mechlin, C. W. Shaiffer, and V. B. Kuechle. 1981. Procedures for the use of aircraft in wildlife biotelemetry studies. U.S. Dep. Inter., Fish and Wildl. Serv. Resour. Publ. 140. Washington, D.C. 19pp.

MacArthur, R. A., R. H. Johnston, and V. Geist. 1979. Factors influencing heart rate in free-ranging bighorn sheep: a physiological approach to the study of wildlife harassment. Can. J. Zool. 57:2010–2021.

———, V. Geist, and R. H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. J. Wildl. Manage. 46:351–358.

Miller, F. L. and A. Gunn. 1979. Responses of Peary Caribou and muskoxen to helicopter harassment. Can. Wildl. Serv. Occas. Pap. No. 40. 90pp.

Received 24 August 1982.
Accepted 17 June 1983.

ESTIMATING RIVER OTTER POPULATIONS: THE FEASIBILITY OF ^{65}Zn TO LABEL FECES

R. M. KNAUS, ***Nuclear Science Center, Louisiana State University, Baton Rouge, LA 70803***

N. KINLER, ***Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560***

R. G. LINSCOMBE, ***Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560***

The harvest of river otter (*Lutra canadensis*) in Louisiana has increased dramatically in the last 30 years. The average annual production of otter pelts was approximately 4,760 animals from 1950 through 1970. From 1971 through the 1981–1982 trapping season, the average annual yield was 7,711 pelts, with a record 11,900 otters harvested during the 1976–1977 season (Ensminger and Linscombe 1980, Louisiana Department of Wildlife and Fisheries 1982).

Improved management of the river otter, an important natural fur resource for Louisiana, can now include new monitoring techniques involving radiotracer methodology to estimate population densities of these animals. Nellis et al. (1967), working with captive rabbits (*Sylvilagus* spp.), bobcats (*Felis rufus*), foxes (*Vulpes* spp.), and opossums (*Didelphis virginiana*), found that ^{65}Zn injected intramuscularly or intraperitoneally was detectable in feces 300–400 days post-injection. Equally important, these authors report that long-term weathering and water-leaching of the feces had no significant effect on the ability to detect the radioisotope. Pelton and Marcum (1977) and Kruuk et al. (1980), working with captive and wild European badgers (*Meles meles*) and black bears (*Ursus americanus*), respectively, have demonstrated the useful-

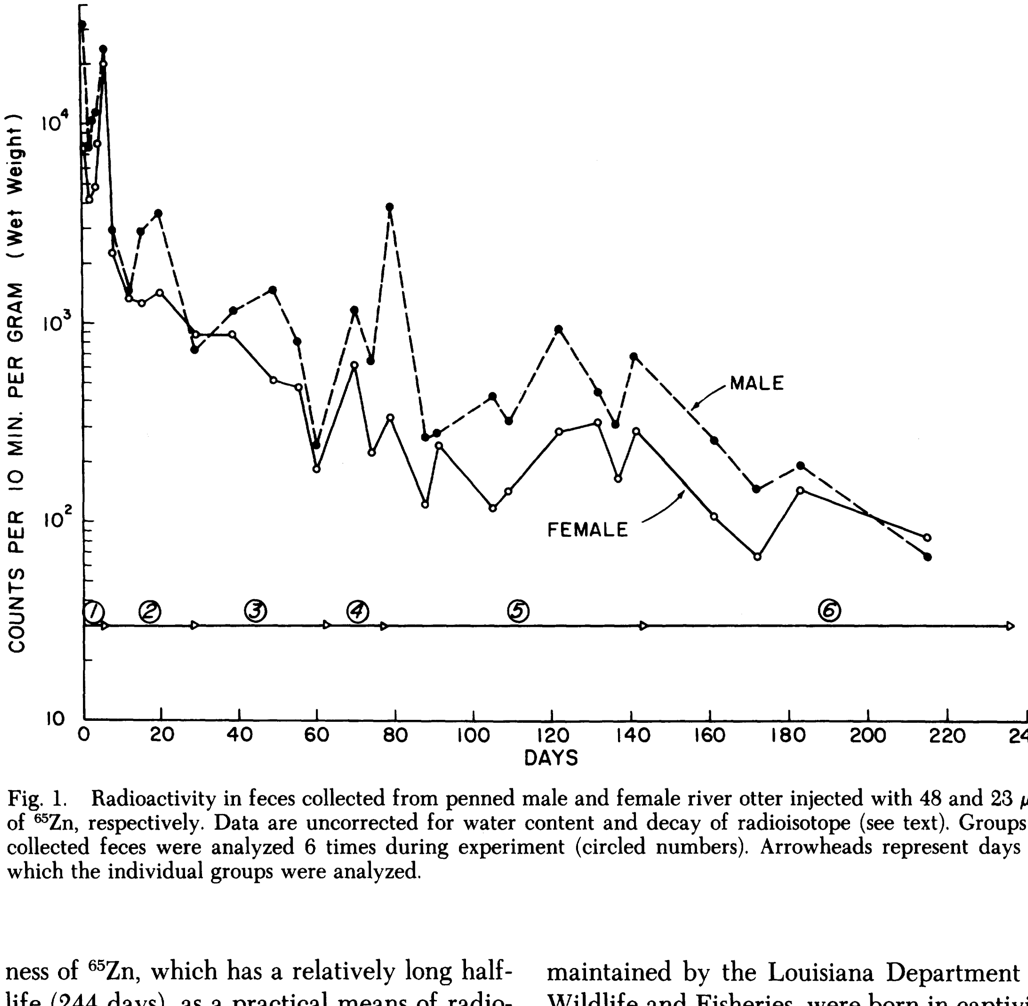

Fig. 1. Radioactivity in feces collected from penned male and female river otter injected with 48 and 23 μCi of ^{65}Zn, respectively. Data are uncorrected for water content and decay of radioisotope (see text). Groups of collected feces were analyzed 6 times during experiment (circled numbers). Arrowheads represent days on which the individual groups were analyzed.

ness of ^{65}Zn, which has a relatively long half-life (244 days), as a practical means of radioactively labeling feces in population studies. Although Davison (1980), working with ^{54}Mn and ^{65}Zn in coyote (*Canis latrans*) populations, reported poor population density estimates, he did not experience difficulty discerning whether or not feces were from tagged animals.

Prior to initiating a large-scale population density study of river otter in southern Louisiana (to be reported elsewhere), 1 male and 1 female captive otter were injected intramuscularly with ^{65}Zn to measure the fecal excretion of injected radiozinc by gamma-ray analysis over a period of 7 months. The otters, maintained by the Louisiana Department of Wildlife and Fisheries, were born in captivity from different parents and were 17 months old when this study began.

A 0.02M HCl solution containing 50 microcuries (μCi) of carrier-free ^{65}Zn/ml was prepared for injection. The male otter, weighing 6.8 kg, received 48 μCi of ^{65}Zn activity and the female otter, weighing 6.1 kg, received 23 μCi of activity, for a tracer dose of 7.1 μCi ^{65}Zn/kg body weight and 3.8 μCi/kg, respectively. (Approximately 2 μCi of ^{65}Zn remained in the syringes after the injections had been administered.) The male otter was given twice the activity of the female solely to determine the working range of ^{65}Zn activity needed in future experiments. The radiation doses absorbed by the otters during the 215 days of the experiment were calculated to be <13 rads for the male otter and <7 rads for the female. The dose calculations are conservative, meaning that every estimation and assumption was figured to yield a maximum dose to the animal. These dosage calculations would increase only 3% if calculated to the end of the lifespan of the animals.

The otters were kept in separate cages and feces were collected on a regular schedule. Fecal samples ranging from 2.1 to 12.3 g, wet weight, were analyzed for gross gamma-ray count with a Packard Autogamma Scintillation Spectrometer (15.4% efficiency for ^{65}Zn) for 10 min each. Samples were not dried because the objective of the experiment was to determine a quick and easy method of handling the samples and determine whether or not they were from a tagged animal.

Data were normalized to counts per 10 min per gram on a wet-weight basis vs. days after injection, and were corrected for background radiation only (Fig. 1). To represent an actual field experimental situation, the data were not converted to disintegrations per min (nor to μCi), and no attempt was made to correct for physical isotopic decay over the duration of the experiment. Also, it was found that drying or even weighing the fecal samples prior to the gamma-ray analysis was unnecessary and time consuming. For the researcher, in the final analysis it makes no difference how much ^{65}Zn activity exists per gram of feces, but rather how long the animal produces feces which have radioactivity clearly identifiable as to its source. A statistical analysis of the data between 28 and 215 days in Fig. 1 shows that the 95% confidence interval for being able to detect labeled feces from the male otter at 215 days is $32 \leq \hat{Y} \leq 420$ counts/min/gram of sample. At the same day for the female otter, the 95% confidence interval is $17.5 \leq \hat{Y} \leq 232$ counts/min/gram (Snedecor and Cochran, 1968:155). The data in Fig. 1 demonstrate that an otter given 23 μCi ^{65}Zn (3.8 μCi/kg) produced tagged feces which could be detected as easily as those from an animal given roughly double the tracer dose, and ^{65}Zn could be detected in fecal material from otters at levels significantly above natural background radiation for a period of at least 215 days.

Acknowledgment.—We appreciate the help of V. Wright and T. Hingtgen of the Department of Experimental Statistics at LSU in performing regression analyses and R. C. McIlhenny for technical assistance.

LITERATURE CITED

DAVISON, R. P. 1980. The effect of exploitation on some parameters of coyote populations. Ph.D. Diss. Utah State Univ., Logan. 153pp.

ENSMINGER, A. AND G. LINSCOMBE. 1980. The fur animals, the alligator, and the fur industry in Louisiana. Wildl. Educ. Bull. 109. 69pp.

KRUUK, H., M. GORMAN, AND T. PARRISH. 1980. The use of ^{65}Zn for estimating populations of carnivores. Oikos 34:306–308.

LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES. 1982. Comparative takes of fur animals in Louisiana. Louisiana Wildl. and Fish. Comm., Baton Rouge. 21pp. (Mimeo).

NELLIS, D. W., J. H. JENKINS, AND A. D. MARSHALL. 1967. Radioactive zinc as a feces tag in rabbits, foxes, and bobcats. Proc. Annu. Conf. Southeastern Assoc. Game and Fish Comm. 21:205–207.

PELTON, M. R. AND L. C. MARCUM. 1977. The potential use of radioisotopes for determining densities of black bears and other carnivores. Pages 221–236 *in* R. L. Phillips and C. Jonkel, eds. Predator Symp., held in conjunction with Am. Soc. of Mammal., Montana For. and Conserv. Exp. Sta., Univ. of Mont., Missoula.

SNEDECOR, G. W. AND W. G. COCHRAN. 1968. Statistical methods, Sixth ed. Iowa State Univ. Press, Ames. 593pp.

Received 19 January 1983.
Accepted 6 June 1983.