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POPULATION ESTIMATES OF RIVER OTTERS IN A LOUISIANA COASTAL MARSHLAND

MARK G. SHIRLEY,[1] Louisiana Department of Wildlife and Fisheries, Grand Chenier, LA 70643
ROBERT G. LINSCOMBE, Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560
NOEL W. KINLER, Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560
RONALD M. KNAUS, Nuclear Science Center, Louisiana State University, Baton Rouge, LA 70803
VERNON L. WRIGHT, Department of Experimental Statistics, Louisiana State University, Baton Rouge, LA 70803

Abstract: We estimated the population of river otters (*Lutra canadensis*) in a southwest Louisiana coastal marsh by labeling the feces of 7–9 otters with the radioisotope of zinc (^{65}Zn). Collection of 1,034 scats over 5 sampling periods yielded subsamples from which to estimate the population based on the ratio of marked to unmarked scats. We estimated there were 29.6 ± 3.43 (SE) otters in the study area. The corresponding density of otters was 1/86 ha of marsh.

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Louisiana leads the United States in the production of river otter pelts. From 1970 to 1982, a mean of 7,470 otters was harvested annually in Louisiana. Approximately 86% of the harvest was trapped in the coastal marshes (Linscombe and Kinler 1985).

Previous studies have not attempted to statistically estimate size of river otter populations. Live capture, mark and release, and recapture can be used to estimate wild populations and has been used successfully for many species (Davis and Winstead 1980:235). However, the recapture rate of otters would be too low for an adequate sample size.

Pelton and Marcum (1977) examined the potential of labeling black bear (*Ursus americanus*) scats to estimate bear populations. By determining the proportion of labeled scats to unlabeled scats, they generated a population size estimate. They determined that ^{65}Zn and the radioisotope of manganese (^{54}Mn) were suitable for labeling black bear feces. Davison (1980) used ^{65}Zn and ^{54}Mn to estimate coyote (*Canis*

[1] Present address: Louisiana Cooperative Extension Service, Abbeville, LA 70510.

latrans) populations in Utah and Conner (1980) used ^{65}Zn to estimate bobcat (*Felix rufus*) populations in Florida. Kruuk et al. (1980) used ^{65}Zn to estimate the size of a population of European badgers (*Meles meles*).

The objective of our study was to estimate the size of a population of otters in a coastal marsh habitat in southwestern Louisiana. We did this by marking a known number of otters with the radioactive isotope ^{65}Zn and subsequently determining the ratio of marked to unmarked scats.

STUDY AREA AND METHODS

River otters were trapped on Rockefeller Wildlife Refuge in coastal southwestern Louisiana. We trapped otters and collected scats near the Superior Canal in an area encompassing approximately 2,550 ha of impounded and semi-impounded marsh. The study area is predominantly a brackish marsh habitat with some intermediate marsh vegetation within the impoundments (Chabreck and Linscombe 1978). The study area is primarily managed for waterfowl and supports a large population of American alligators (*Alligator mississippiensis*).

We used number 11 leghold traps (Woodstream Corp., Lititz, Pa.) to trap river otters. The traps were modified as described by Shirley et al. (1983) to reduce the chance of injury to trapped animals. Ten otters were caught between December 1981 and February 1982. Intraperitoneal radio transmitters (Telonics Inc., Mesa, Ariz.) were implanted into these otters. While the animals were still anesthesized, they were injected intramuscularly with ^{65}Zn. We released the otters after they had recovered from the anesthesia, usually ≤ 24 hours after capture.

A common injection solution was prepared from a carrier-free solution of zinc chloride ($^{65}ZnCl_2$) in 0.5 M (molar) hydrogen chloride (HCl). It contained 55 microcuries of ^{65}Zn/mL (in 0.02 M HCl), an amount adequate to label otter feces for several months (Knaus et al. 1983). One-mL tuberculin plastic syringes were loaded with 1 mL of tracer solution and stored until needed. Fifty-five microcuries of ^{65}Zn were available in the solution on 1 January 1982. Otters injected before or after this date received slightly more or less radioisotope, respectively, due to radioactive decay.

Injections were placed deep in the muscles of the hips of the animals with a 2.5 cm long 26-gauge needle. The inoculum was injected slowly and the needle was partially withdrawn several times and reinserted at different angles into new tissue to allow greater distribution of the solution. Approximately 6% of the tracer solution remained in the syringe and needle after injection.

Scat collection began 5 weeks after the last otter was released to allow recuperation and resumption of normal activity. We used an airboat to search the marsh for resting sites and latrine sites throughout the study area. Scats were found along otter trails through the wiregrass (*Spartina patens*), along the edges of ponds, and at levee crossings. Otter scats were collected on 5 different occasions at 2-week intervals.

Individual fecal samples were placed directly into 15.2- × 1.2-cm metal-capped, plastic well tubes (Atomic Products Corp., New York, N.Y.). The age of the scats was estimated visually, and any scat >2 weeks old was not sampled. At some sites, piles of scats were encountered. Only the uppermost scat was sampled and the rest were discarded to avoid possible cross contamination. Known sites were cleared of all scat prior to the first collection and after each subsequent collection.

Fecal samples were analyzed for gamma radiation with an auto-gamma scintillation spectrometer (Packard Instruments, Downers Grove, Ill.) for 10 minutes each. At the wide-window, full-spectrum setting, counting efficiency for ^{65}Zn was 15.4%. Ten-minute background counts with empty counting vials for each of the 200 positions in the auto-gamma spectrometer were made frequently to assure that the instrument was not contaminated by the samples.

The number of marked scats was determined by plotting a histogram of the spectrometer readings. Scat samples that contained ^{65}Zn emitted radiation detectably greater than unmarked scats during the 5 collection periods.

A population estimate was calculated for each sampling period following Seber (1982:60): $N = [(n_1 + 1)(n_2 + 1)/(m_2 + 1)] - 1$, where N is the population estimate, n_1 is the number of marked otters, n_2 is the number of scats collected, and m_2 is the number of scats that contained ^{65}Zn.

Because all of the injected otters were followed by telemetry, the true number of marked animals could be determined for each sampling period. Otherwise the death of 1 of the injected otters and the subsequent dispersal of 2 injected otters could have inflated the population esti-

Table 1. Number of marked and unmarked scats collected during each sampling period to estimate the river otter population (*N*) on a 2,550 ha study area in Rockefeller Wildlife Refuge, Louisiana, 1982.

Sample no.	Collection date	No. marked otters[a]	No. scats	No. scats with ^{65}Zn[b]	*N*
1	8–11 Mar	9	226	51	42.6
2	24–25 Mar	8	170	68	22.3
3	7–8 Apr	7	179	49	28.8
4	21–22 Apr	7	179	53	26.7
5	5–6 May	7	280	80	27.7

[a] No. marked otters on the study area during each sampling period as determined by telemetry data.
[b] Radioisotope of zinc.

mates. Ingress and egress of non-labeled otters on the study area was unrestricted and could have contributed to the variance among the sample population estimates.

RESULTS

We collected 1,034 samples during the 8-week period. The population estimates for each sampling period ranged from 22.3 to 42.6 otters (Table 1). The mean population estimate for the 2,500-ha study area was 29.6 ± 3.43 (SE) otters (95% CI = 20.1–39.1). This mean population estimate indicates a density of 1 otter/86 ha of marsh.

DISCUSSION

Foy (1984) worked in a similar marsh in southeast Texas and estimated an otter density of 1/106 ha based on telemetry data. In the varied topography of westcentral Idaho, Melquist and Hornocker (1983) reported densities based on telemetry data and visual sitings of approximately 1 otter/3.9 km of waterway.

Linscombe and Kinler (1985) used reports from fur dealers and land company records to determine the distribution of fur harvested in Louisiana by marsh type and coastal region. The mean harvest rate of otters in the Chenier Plain Marsh Zone of southwest Louisiana between 1972 and 1983 was 1 otter/304 ha in brackish marsh and 1/509 ha in intermediate marsh. If we assume otter densities on our study area reflect population levels in similar habitat throughout the Chenier Plain, then the mean annual harvest rates in brackish and intermediate marshes were 17 and 28%, respectively, from 1972 to 1983.

Telemetry could have introduced bias in scat collection if prior knowledge of radio locations influenced which areas were searched for scats. Scats were collected by MGS and RGL on 8–11 March 1982; MGS spent the preceding 1–4 months following the injected otters daily. In an effort to avoid known locations of marked otters, a disproportionate number of unmarked feces may have unknowingly been sampled. This may explain the inflated estimate of sample 1 when compared with the rest. Collections 2 through 5 were made by RGL and NWK, who were familiar with the study area, but were not familiar with daily movement patterns and resting sites of marked otters.

The marked-feces technique works well to estimate otter populations in a marsh habitat. Capturing and handling otters only once is an advantage. Other mark–recapture methods involve capturing some marked animals a second time. Trapping otters is time consuming and the small number of recaptures would be statistically unacceptable. Otter scats are relatively easy to find during winter and early spring in intermediate and brackish marsh habitats. By collecting a large sample of otter scats, population estimates of river otters are precise. The suitability of the marked-feces technique in other habitats will depend on the ease with which otter scats can be located.

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DENTAL ERUPTION IN BOBCATS

DEBRA L. JACKSON, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762
ERNEST A. GLUESING,[1] Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762
HARRY A. JACOBSON, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762

Abstract: We documented tooth eruption in 9 hand-raised bobcat (*Felis rufus*) kittens. Tooth lengths were measured to the nearest mm. Deciduous dentition began to erupt at 11–14 days of age and was completed by 9 weeks of age. Permanent dentition began to erupt at 16–19 weeks of age and was completed by 34 weeks of age. The sequence and timing of deciduous and permanent dentition will aid in estimating parturition and copulation dates from bobcat kittens in the wild.

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Information on the dental eruption patterns of known-age bobcats has not been published. Data on sex ratios, age structures, and age-specific reproductive rates have been collected and analyzed by states to assess the status of resident bobcat populations (Gluesing 1982). These data have been compared to data collected and analyzed in a similar manner from prior studies (Gluesing et al. 1986). Therefore, researchers have compared 1 unknown to another when estimating age structure and periods of reproductive activity. Estimates of breeding and parturition dates of the bobcat have been based on dentition-eruption schedules and growth rates of the domestic cat. Crowe (1975) developed a dentition eruption schedule for bobcats using the tooth eruption schedule of the domestic cat presented by McClure et al. (1973:211). Crowe's (1975) schedule has been used to age wild bobcat kittens (Blankenship 1979). The purpose of our study was to determine eruption schedules for deciduous and permanent teeth from known-age bobcat kittens. An accurate knowledge of the tooth eruption schedules of bobcat kittens will aid in elucidating parturition and conception dates of wild bobcats.

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METHODS

Nine hand-raised bobcat kittens were maintained in a laboratory at Mississippi State University through 6 months of age and out-of-doors in chain link fence complexes, thereafter. Kittens were fed kitten milk replacer (KMR; Borden Inc., Hampshire, Ill.) diluted with sterile water until approximately 6 weeks of age. They were then gradually weaned to a diet of Zu-Preem (Hills Pet Products, Topeka, Kans.) and eventually Nebraska Brand (Central Nebr. Packing, Inc., North Platte, Nebr.) or Spectrum

[1] Deceased.