Mortality Estimates of Muskrat Litters in a Louisiana Coastal Marsh

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Abstract: Fetal counts of muskrats (*Ondatra zibethicus*) yielded an average of 2.97 ± 1.06 fetuses per litter (range: 1 to 5). Placental scars averaged 7.97 ± 4.34 per breeding female (range: 1 to 22) and indicated production of 2.7 litters per breeding female per year. Corpora lutea counts disclosed that litter sizes ranged from 1 to 7, averaged 3.54 ± 1.15, and differed significantly from fetal counts. Litter size as determined by lodge surveys ($\bar{x}$ = 2.18 ± 0.25) was less than that determined by fetal counts and represented post-partum mortality. Mortality estimates indicated a loss of 16.1% between ovulation and fetal counts; an 18.5% loss occurred between the time fetal counts were made and the time that muskrats reached the 1- to 5-day age class. Subsequent losses of 7.4%, 5.4%, 9.9%, and 9.4% occurred between 1–5, 6–10, 11–15, 16–20, and 21–24 day old age classes, respectively.

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The reproductive rate of muskrats may be determined by counts of corpora lutea, placental scars, and fetuses in adult females captured by trappers (Errington 1954, Donohoe 1966). However, information on post-partum litter size is lacking because of the difficulty of sampling this segment of the population. Post-partum litter mortality can greatly affect the accuracy of estimates of reproductive rates and

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must be known to accurately predict population growth from data gathered by examination of reproductive tracts.

While examining muskrat lodges to evaluate the effect of tidal flooding on muskrat reproduction, we determined the number of young per litter in the lodges (Kinler 1986). Trappers operated simultaneously in the same area during winter and provided carcasses of females. From reproductive tracts, we determined litter sizes at different stages of development and compared these with litter sizes in lodges.

Methods

The study was conducted on a 500-ha section of brackish marsh along the south-central Louisiana coast between Vermilion Bay and the Intracoastal Waterway. We obtained carcasses of female muskrats from trappers on and near the study area during 3 sampling periods in 1985: 1) 7–15 January, 2) 8–14 February, and 3) 27 February–8 March. Females were classified as adults if they contained fetuses, placental scars, or corpora lutea; otherwise, they were classified as immatures. Age ratios and pregnancy rates were compared among sampling periods using a chi-square test. Number of fetuses, corpora lutea, and placental scars per female were compared among sampling periods using a General Linear Model (SAS 1982). A paired *t*-test was used to test differences between corpora lutea and fetal counts of pregnant females. Age ratios, pregnancy rates, and litter sizes were compared to those reported by O'Neil (1949).

Age class distribution of young muskrats was determined by examining nest chambers, tunnels, and entrances of 50 active muskrat lodges each month during February, March, and April 1985 using methods described by Smith (1938), Errington (1939), and Sather (1958). Tail length, total length, and weight of each captured muskrat were determined. Growth curves presented by Errington (1939), Dorney and Rusch (1953), and Le Boulenge (1977) were used to estimate age of litters. Number of young per litter was compared among 5-day age groups using a General Linear Model (SAS 1982).

Results

Fetal Counts

We examined carcasses of 259 female muskrats and found fetuses, placental scars, or corpora lutea in 164 (63.3%) (Table 1). Age ratios did not differ among sampling periods ($\chi^2 = 5.39$, 2 df, $P > 0.05$). Ninety-five fetuses were visible in 32 females. Litter size ranged from 1 to 5 and did not differ among sampling periods ($F = 0.39$, 2,29 df, $P > 0.05$).

Placental scar counts

Placental scars in muskrats persist for nearly a year (Asdell 1964), and muskrats in Louisiana produce several litters per year (Arthur 1931, Svihla and Svihla

Table 1. Litter size estimates from adult female muskrats trapped on and near the study area, Iberia Parish, Louisiana, January–March, 1985.

Sampling period	Sampling date (1985)	N	Fetuses $\bar{x}^{a}$	Fetuses SD	Fetuses n	Placental scars $\bar{x}^{b}$	Placental scars SD	Placental scars n	Corpora lutea $\bar{x}^{c}$	Corpora lutea SD	Corpora lutea n
1	7–15 Jan	84	2.90	0.97	20	6.58	3.12	80	3.35	1.08	52
2	8–14 Feb	39	3.25	1.49	8	9.51	5.40	37	4.00	1.28	23
3	27 Feb–8 Mar	41	2.75	0.50	4	9.32	4.51	41	3.50	1.09	14
Total		164	2.97	1.06	32	7.97	4.34	158	3.54	1.15	89

[a] Not significantly different among sampling periods ($F = 0.39$; df = 2,29; $P > 0.05$).
[b] Not significantly different among sampling periods ($F = 2.64$; df = 2,86; $P > 0.05$).
[c] Significantly different among sampling periods ($F = 9.36$; df = 2,155; $P < 0.01$).

1931, O'Neil 1949). Thus, placental scars cannot be used as an estimate of litter size (Errington 1954, Donohoe 1966). However, the number of placental scars divided by the average litter size (from fetal counts) may be used to estimate the number of litters produced per year by a breeding female (Dilworth 1966).

Placental scars ranged from 1 to 22 per female, but did not differ among sampling periods (Table 1). Females produced an average of 2.7 litters per year (8.0 placental scars/3.0 fetuses per litter); maximum production was 7.4 litters (22 placental scars/3.0 per litter).

Corpora lutea counts

Number of corpora lutea per female ranged from 1 to 7, but did not differ among sampling periods (Table 1). Litter size estimates from counts of corpora lutea vs. fetuses differed for the same individual (t = 3.36, 31 df, $P < 0.01$). Pregnancy rate (percent of adults with corpora lutea) ranged from 61.9% during Period 1 to 34.1% during Period 3 (Table 2), but did not differ among sampling periods ($\chi^2 = 4.02$, 2 df, $P > 0.05$). The number of young per litter decreased 16.1% (31.5% of the total loss) between the time of ovulation and the time fetal counts were made (Table 3).

Lodge Surveys

We found 77 litters that ranged in age from 1 to 24 days. Younger litters were more common than older litters (Table 3), but the number of young per litter did not differ among age classes ($F = 1.12$; df = 2,72; $P > 0.05$). The number of young per litter averaged 2.18 ± 0.25 for all age classes and was considerably less ($F = 40.90$; df = 1,21; $P < 0.01$) than the litter size ($\bar{x} = 3.51$) from monthly lodge surveys during 1944–45 in Louisiana (O'Neil 1949). The number of young per litter as determined by fetal counts during January, February, and March (Table 1) was greater than ($t = 3.2885$, df = 63, $P < 0.01$) the number of young per litter as determined by lodge surveys the following month (Table 2). Also, the pregnancy rate of adult females differed ($\chi^2 = 155.0$, 2 df, $P < 0.01$) from the percentage of lodges with litters the following month.

Discussion

The proportion of muskrat lodges with litters should approximate the pregnancy rate of adult females during the previous month; however, considerable variation was noted among all sampling periods (Table 2). Possible explanations include 1) some of the pregnant females did not produce live litters, 2) all lodges sampled did not house an adult female, 3) post-partum litter mortality occurred before the lodge surveys, or 5) a combination of some or all of these factors. However, all explanations except No. 3 should have affected the results in all sampling periods in a similar manner. Kinler (1986) noted that variation in the number of days that muskrat lodges were flooded in the 24-day period prior to his examination of lodges accounted for 35.1% of the variation in lodges containing litters < 25 days old.

Table 2. Comparison of muskrat pregnancy rates and lodges with litters in Iberia Parish, Louisiana, January–May, 1985.

Date of female samples (1985)	Pregnancy rate (%)	Date of lodge survey (1985)	*N* young per litter	% lodges with litters
7–15 Jan	61.9	15 Feb	2.0	18.0
8–14 Feb	59.0	15 Mar	2.3	30.0
27 Feb–8 Mar	34.1	16 Apr	1.7	6.0

The number of young per litter in lodges also may be reduced by several of the previously discussed factors, but we believe that post-partum mortality caused by tidal flooding was primarily responsible. A loss of 18.5% (30.4% of the total loss) occurred from the time of fetal counts until muskrats reached the 1 to 5-day age class. Losses during this period represent prenatal mortality and initial mortality of individuals within lodges. Subsequent losses of between 5 and 24 days of age accounted for 38.1% of the total loss of young. Reeves and Williams (1956) found a loss of 11% during the first 2 weeks of life, and Dorney and Rusch (1953) reported a mortality rate of 41% between 6 and 24 days of age.

Management Implications

Data on the number of young per litter and pregnancy rate of muskrats gathered by examination of reproductive tracts did not provide an accurate estimate of reproductive success. Counts of corpora lutea and fetuses overestimated the number of young per litter in lodges by 18.1% to 51.1%. Also, the pregnancy rate of adult

Table 3. Number of muskrats per litter at different stages of development and rate of loss between ovulation and age 24 days.

Source of estimate	*N* of litters	$\bar{X}$ per litter	% loss between samples	% total loss
Corpora lutea counts	89	3.4		
			16.1	31.5
Fetal counts	32	2.97		
			18.5	30.4
Litter age (days)				
1–5	26	2.42		
			7.4	9.9
6–10	20	2.24		
			5.4	6.7
11–15	17	2.12		
			9.9	11.6
16–20	10	1.91		
			9.4	9.9
21–24	4	1.73		

females differed greatly from the percentage of lodges with young the following month. Post-partum litter mortality caused by excessive tidal flooding was thought to be largely responsible for loss of young.

Additional data are needed to relate number of young per litter and pregnancy rate based on examination of reproductive tracts to number of young per litter and frequency of litters in lodges and to evaluate the effect of environmental factors on loss of young in lodges. Models of population growth based on data from reproductive tracts may also require data on the rate and severity of tidal flooding to accurately predict post-partum mortality.

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