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in Maine**



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## NUMBER OF CORPORA LUTEA AS RELATED TO AGE AND DISTRIBUTION OF RIVER OTTER IN MAINE

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Reproductive biology of river otters (*Lutra canadensis*) has been well-documented (Hamilton and Eadie, 1964; Harris, 1968; Liers, 1951; Tabor, 1974; Wilson, 1959; Wright, 1963). Low rates of intrauterine mortality have allowed reliable estimates of young produced from counts of corpora lutea for otters (Hamilton and Eadie, 1965; Tabor and Wight, 1977), as well as for many other mammals (Kirkpatrick, 1980).

Female river otters often first breed at two years of age (Hamilton and Eadie, 1964; Liers, 1951), but may conceive as early as 15 mo (Liers, 1958). Tabor and Wight (1977) noted that an increase in mean number of corpora lutea with age class was not significant for river otters in Oregon. Increasing fecundity with age, however, is typical of other large mustelids (Messick and Hornocker, 1981; Rausch and Person, 1972; Shea et al., 1985).

Lauhachinda (1978) noted that number of corpora lutea from river otters in Alabama varied slightly from other areas of North America, and Hamilton and Eadie (1964) studied reproduction of river otters in New York. Data on fecundity of river otters from the ecologically diverse regions of Maine, however, are lacking. This study examined number and frequency of occurrence of corpora lutea for river otters in Maine in relation to age class and capture location.

We divided Maine into three ecologically diverse regions (Fig. 1). Region 1 includes northern and western Maine; it is characterized in the northeast by forested areas and agricultural lands with loamy soils, and in the northwest by stony, sandy loams. The transitional zone between northern spruce (*Picea* sp.)-fir (*Abies balsamea*) forests and southern white pine (*Pinus strobus*)-hardwood forests is located in the western portion. This area is the most mountainous of the regions, and contains the headwaters of many streams. Region 1 averages 0.61 km of linear flowing water (streams, brooks, or rivers) per km<sup>2</sup>; 5.0% of the total area is lakes and ponds.

Region 2 includes central Maine and is characterized by a moderate climate and rolling hills with sandy loam soils. This area supports productive agricultural lands and woodlands. Flowing water averages 0.66 km/km<sup>2</sup>, and lakes and ponds compose 5.3% of the total area.

Region 3 includes all of coastal Maine and supports semi-urban, agricultural, and wooded areas. Topography is comparatively level. Flowing water averages 0.59 km/km<sup>2</sup>, and lakes and ponds account for 4.6% of the total area.

Reproductive tracts with both ovaries present were removed from carcasses of 114 female river otters trapped from 20 October 1982-28 February 1983, and 20 October 1983-4 December 1983; location of capture was known for all but 5 individuals. Age was determined by personnel of the Maine Department of Inland Fisheries and Wildlife using radiographic analysis of tooth width ratios to identify juveniles (Kuehn and Berg, 1981), and tooth cementum annuli (Fancy, 1980) for older otters. Reproductive tracts were stored in AFA (85 parts 85% ethyl alcohol, 10 parts formalin, 5 parts glacial acetic acid). Ovaries were hand-sectioned in 1 mm divisions as described by Kirkpatrick (1980) and examined with a 25× dissection microscope. Corpora lutea were distinguished from corpora albacantia by size and color (Hamilton and Eadie, 1964; Kirkpatrick, 1980). No significant ( $P > 0.30$ ) difference occurred in mean number of corpora lutea between study years, thus data were pooled for analyses.

A Z-test (Remington and Schork, 1970) was used to examine regional differences in the proportion of adult ( $\geq 1$  year) otters with corpora lutea. The Spearman rank correlation (Siegel, 1956) was used to evaluate the relationship between corpora lutea number and age class. The *t*-test (Remington and Schork, 1970) was used to examine differences in mean number of corpora lutea among age classes, and the Friedman two-way analysis of variance (Siegel, 1956) was used to test for differences in age classes among regions of the state.

Of 114 pairs of ovaries examined, 22 were from Region 1, 47 from Region 2, 40 from Region 3, and 5

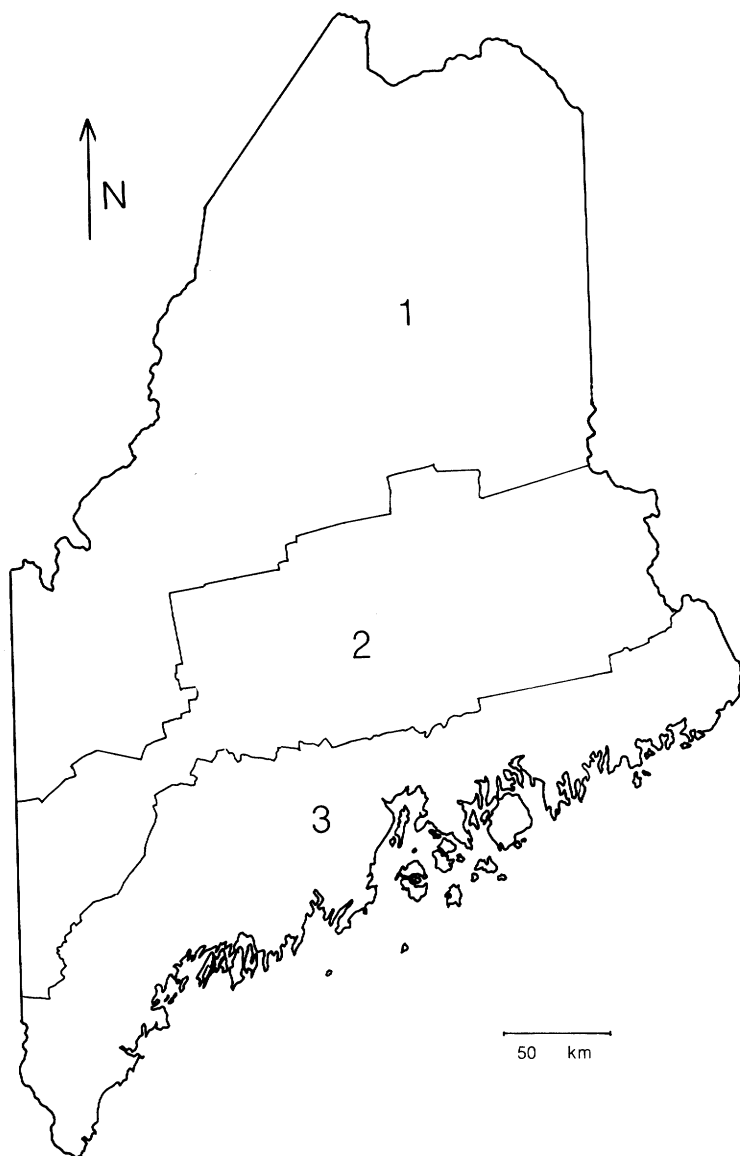


FIG. 1.—Regions of Maine from which 114 female river otter were trapped, 1982–1983. 1 = Northern Region, 2 = Central Region, 3 = Coastal Region; see text for further descriptions of regions.

from unknown locations. Sixty-six percent of 63 adult (1–12 yrs) otter ovaries contained corpora lutea: 33% of 15 1-year-olds, 56% of 16 2-year-olds, 70% of 10 3-year-olds, 100% of 7 4-year-olds, and 93% of 15  $\geq 5$ -year-olds possessed corpora lutea. The Z-test showed no significant differences ( $P > 0.10$ ) in the proportion of adult otter reproductive tracts with corpora lutea between pairings of the three regions of Maine. The Friedman two-way analysis of variance indicated that no significant difference in number of corpora lutea occurred among regions of the state for all adult otters examined ( $P > 0.12$ ).

Mean number of corpora lutea in adults was 1.49 ( $SD = 1.42$ , range = 0–6) (Table 1). Number of corpora lutea increased significantly with increasing age class ( $r_s = 0.826$ ,  $P < 0.001$ , 112 *d.f.*).

A pregnancy rate of 50% among mature otters in the southeastern U.S. led Lauhachinda (1978) to surmise that females breed in alternate years. Tabor and Wight (1977), however, reported that 98% of 43 mature (2–11 years of age) female otters from Oregon were pregnant. In Maine, 77% of 48 otters 2 years of age or older possessed corpora lutea, suggesting most adult females reproduced on a yearly basis. Although otters

TABLE 1.—Number of corpora lutea from age classes of river otter captured in Maine, 1982–1983.

Age class (yrs)	$\bar{x}$	SD	Range	n
0	0.00	0.00	0	51
1	0.53	0.91	0–3	15
2	0.87	0.96	0–3	16
3	1.60	1.42	0–4	10
4	2.29	1.25	1–5	7
5–12	2.67	1.40	0–6	15
0–12	0.82	1.29	0–6	114

occasionally breed as yearlings (Liers, 1958), a comparatively large proportion (33% of 15) of yearling otters we examined possessed corpora lutea; judging from the season of trapping, these females probably were 1.5 years of age.

Mean number of corpora lutea was 2.40 for mature ( $\geq 2$  years) otters in New York (Hamilton and Eadie, 1964), 3.02 for otters in Oregon (Tabor and Wight, 1977), and 2.90 for otters in Alabama and Georgia (Lauhachinda, 1978). Mean number of corpora lutea from otters ( $\geq 2$  years of age) we examined was 1.8. Regional comparisons of corpora lutea number, however, may be problematical without data on the age structure of the females because number of corpora lutea is positively correlated with age class.

River otters are economically important furbearers with populations that probably are stable or expanding in states where they are harvested (Toweill and Tabor, 1982). Local overharvests, however, may have occurred in Maine (Endangered Species Scientific Authority, 1978). Our data demonstrate that neither mean number of corpora lutea nor the proportion of females with these ovarian structures varied significantly across the state, suggesting a stable reproductive rate for otters throughout Maine. If a heavy local harvest produced a density-dependent increase in reproduction characteristic for many larger mammals, it was not detected in our samples.

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## NAVIGATION BY ADULT BLACK BEARS

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Translocated large mammals have returned home from up to the following distances: white-tailed deer (*Odocoileus virginianus*), 560 km (Hahn, 1945); polar bear (*Ursus maritimus*), 480 km (Stirling et al., 1977); timber wolf (*Canis lupus*), 282 km (Henshaw and Stephenson, 1974); grizzly bear (*Ursus arctos*), 258 km (Miller and Ballard, 1982); black bear (*Ursus americanus*), 229 km (Harger, 1970); house cat, 217 km (Carthy, 1956); red fox (*Vulpes vulpes*), 56 km (Phillips and Mech, 1970); and mule deer (*Odocoileus hemionus*), 50 km (Eberhardt and Pickens, 1979). However, questions remain as to whether homing by large mammals is achieved by chance, expanding search patterns, familiarity with large areas, or some means of navigation (Beeman and Pelton, 1976). Data used to assess which of these mechanisms is used for homing should be collected in a variety of regions to minimize the influence of any local features that might hinder or aid homing. Such data are available for black bears. Researchers have translocated black bears in various regions of North America and have studied nontranslocated bears sufficiently to determine a distance beyond which nearly all bears should be unfamiliar.

Translocation data sets were included for analysis if they conformed to the following criteria. (1) Marked black bears were transported >64 km, which is the distance beyond which most bears should be unfamiliar (see below). (2) Distance and direction of movements after release were described for individuals. (3) Sufficient age data were included to exclude bears younger than 2 years. Cubs and yearlings have previously been shown to return home less frequently than older bears (Alt et al., 1977; Harger, 1970; Massopust and Anderson, 1984). (4) The bears were not released in national parks. Hunting was the primary means of recovery and is prohibited in national parks.

Eight data sets were used in which 77 black bears were translocated an average of 106 km (median 88 km, range 64 to 271 km) in seven states or provinces (Table 1). The bears in those studies were drugged for ear-tagging or radio-collaring, and they typically remained unconscious or semiconscious in metal box-traps during immediate transit by road. Sex ratios (male : female) varied from 20:0 in New Hampshire (Orff, 1982) to 2:6 in Wisconsin (Massopust and Anderson, 1984). Overall, sex ratio was approximately 52:25 (three data sets gave sex ratios as percent males rather than giving sex of individuals). Kill locations provided most of the movement data, but a few end points were determined by telemetry or recapture. Direction of movement was calculated as the bearing of the final location from the release point relative to home (Fig. 1). Bears were considered to have returned home if they were found within 8 to 20 km of the original capture site, depending upon the distance criterion for homing used by researchers in the individual studies; home ranges differed with sex and region. Data for all 77 bears were pooled to test the null hypothesis that bear movements were not oriented toward home. Distance and direction of travel from release points to recovery sites (or to final telemetry locations) were used to test that hypothesis (Batschelet, 1981).

The 77 bears showed a highly significant ( $P < 0.0001$ ; Rayleigh test, Batschelet, 1981) preference for the home direction (Fig. 1), and 34 of them reached home before they were shot, recaptured, or their radio-collars expired (Table 1). The 43 that did not return should include those with poorest homing ability, those deflected by physiographic barriers, and any not inclined to return because they were not residents of the capture area. Nevertheless, homeward orientation among those 43 was also significant ( $P < 0.002$ ) (Fig. 1),