Estimating Muskrat Population Trends by House Counts
Author(s): Gilbert Proulx and Frederick F. Gilbert
Reviewed work(s):
Source: *The Journal of Wildlife Management*, Vol. 48, No. 3 (Jul., 1984), pp. 917-922
Published by: Allen Press
Stable URL: http://www.jstor.org/stable/3801438
Accessed: 14/12/2011 09:29

BROOKS, R. P., M. W. FLEMING, AND J. J. KENNELLY. 1980. Beaver colony response to fertility control: evaluating a concept. J. Wildl. Manage. 44: 568–575.

CAUGHLEY, G. 1967. Parameters for seasonally breeding populations. Ecology 48:834–839.

GROSS, J. E. 1969. Optimum yield in deer and elk populations. Trans. North Am. Wildl. and Nat. Resour. Conf. 34:372–386.

GUNSON, J. R. 1970. Dynamics of the beaver of Saskatchewan's northern forest. M.S. Thesis, Univ. Alberta, Edmonton. 122pp.

HENRY, D. B., AND T. A. BOOKHOUT. 1969. Productivity of beavers in northeastern Ohio. J. Wildl. Manage. 33:927–932.

HILL, E. P. 1982. Beaver (*Castor canadensis*). Pages 256–281 *in* J. A. Chapman and G. A. Feldhamer, eds. Wild mammals of North America. Biology, management, and economics. Johns Hopkins Univ. Press, Baltimore, Md.

KLEVEZAL', G. A., AND S. E. KLEINENBERG. 1967. Age determination of mammals by layered structure in teeth and bone. Transl. Ser. 1024 (1969). Fish. Res. Board Can., Arct. Biol. Stn., Ste. Anne de Bellevue, Que. 142pp.

LARSON, J. S., AND F. C. VAN NOSTRAND. 1968. An evaluation of beaver aging techniques. J. Wildl. Manage. 32:99–103.

LYONS, P. J. 1979. Productivity and population structure of western Massachusetts beavers. Trans. Northeast Sect., The Wildl. Soc., Fish and Wildl. Conf. 36:176–187.

MOLINI, J. J., R. A. LANCIA, J. BISHIR, AND H. E. HODGDON. 1980. A stochastic model of beaver population growth. Pages 1215–1245 *in* J. A. Chapman and D. Pursley, eds. Proc. Worldwide Furbearer Conf., Frostburg, Md.

NASH, J. B. 1951. An investigation of some problems of ecology of the beaver in northern Manitoba. M.S. Thesis, Univ. Manitoba, Winnipeg. 64pp.

PARSONS, G. R., AND M. K. BROWN. 1979. Yearling reproduction in beaver as related to population density in a portion of New York. Trans. Northeast Sect., The Wildl. Soc., Fish and Wildl. Conf. 36:188–191.

PAYNE, N. F. 1979. Relationship of pelt size, weight, and age for beaver. J. Wildl. Manage. 43:804–806.

———. 1980. Trapline management of Newfoundland beaver. Wildl. Soc. Bull. 8:110–117.

———. 1981. Accuracy of aerial censusing for beaver colonies in Newfoundland. J. Wildl. Manage. 45:1014–1016.

———. 1982. Colony size, age, and sex structure of Newfoundland beaver. J. Wildl. Manage. 46: 655–661.

———. 1984. Mortality rates of beaver in Newfoundland. J. Wildl. Manage. 48:117–126.

PEARSON, A. M. 1960. A study of the growth and reproduction of the beaver (*Castor canadensis* Kuhl) correlated with the quality and quantity of some habitat factors. M.S. Thesis, Univ. British Columbia, Vancouver. 103pp.

PROVOST, E. E. 1962. Morphological characteristics of the beaver ovary. J. Wildl. Manage. 26: 272–278.

RUTHERFORD, W. H. 1964. The beaver in Colorado. Its biology, ecology, management, and economics. Colo. Game, Fish and Parks Dep. Tech. Publ. 17. 49pp.

SEMYONOFF, B. T. 1951. The river beaver in Archangel Province. Transl. Russian Game Reps. (Can. Wildl. Serv., Ottawa, 1957. 109pp.) 1:5–45.

VAN NOSTRAND, F. C., AND A. B. STEPHENSON. 1964. Age determination for beavers by tooth development. J. Wildl. Manage. 28:430–434.

WILSON, E. O., AND W. H. BOSSERT. 1971. A primer of population biology. Sinauer Assoc., Inc., Stamford, Conn. 192pp.

Received 29 November 1982.
Accepted 2 November 1983.

ESTIMATING MUSKRAT POPULATION TRENDS BY HOUSE COUNTS

GILBERT PROULX, Department of Zoology, University of Guelph, Guelph, Ontario N1G 2W1, Canada; and FREDERICK F. GILBERT, Wildlife Biology, Washington State University, Pullman, WA 99164-4220.

Muskrat (*Ondatra zibethicus*) population trends must be known in order to establish proper levels of exploitation (Perry 1982). The primary methods used are aerial censuses in fall to count "active houses" (Dozier 1948) and surveys from snowmobiles (A. W. LaFrance, pers. commun.). Both methods require that observers distinguish houses from other muskrat installations and differentiate between unoccupied and occupied houses (Dozier 1948). Historically, the size of a house has been used to differentiate dwellings from

other structures. Dwellings were considered to be >40 cm high (Dozier 1948) and >60 cm high (A. W. LaFrance, pers. commun.). Some studies have shown that muskrats use burrows in summer and houses in fall (Dilworth 1966, MacArthur and Aleksiuk 1979, Phillips 1979). However, other studies have shown that muskrats also use houses in summer (Mizelle 1936, Wragg 1953, Olsen 1959). At Luther Marsh, Ontario, Proulx and Gilbert (1983) found that muskrats only used burrows as an alternative to houses in summer when heavy vegetation, such as cattail (*Typha* spp.), was absent and/or when water depths were <15 cm. Furthermore, houses built in summer may be abandoned if water levels decline (Coulter 1948, Danell 1977). Therefore, aerial surveys in fall and snowmobile surveys in winter may lead to overestimations of muskrat populations.

Dozier (1948:373) stated that "on any particular marsh, an increase or decrease in the number of houses signifies the relative change in the number of muskrats from year to year." This implies that the ratio of the index used to estimate the actual population is the same for all populations being compared (Davis and Winstead 1980). That the number of houses used by a family group remains constant from year to year has not been tested. Furthermore, the mean number of occupants per house has varied from 2.8 (Lay 1945), to 3.5 (Parker and Maxwell 1980), to 5.0 (Dozier 1948). The objectives of our study were to (1) test the reliability of fall and winter counts of muskrat houses to determine muskrat abundance in a marsh subjected to seasonal changes in water levels where muskrats use houses all year-round, and (2) determine when and how counts of muskrat houses should be conducted to provide wildlife managers with the most reliable population information.

STUDY AREA AND METHODS

The study was conducted at Luther Marsh, 65 km north of Guelph, Ont. The study area was an 11.2-ha bay, covered by dense stands of common cattail (*Typha latifolia*) and reed canarygrass (*Phalaris arundinacea*). The site, floristic composition, open water areas of the bay, and characteristics of muskrat populations have been described by Proulx and Gilbert (1983).

Livetrapping occurred from 25 May to 23 September 1979 and from 16 May to 25 September 1980. Two National traps (17.8 × 17.8 × 50.8 cm) (Tomahawk Livetrap Co., Tomahawk, Wis.), baited with carrots, were set at suitable trapping sites close to each active house. Use of houses by family groups during the livetrapping period was determined from captures and feces, feeding platforms, and trails (connected to the water pool of a dwelling). The average number of occupants per house prior to fall was estimated from capture data. The study area was free of any trapping pressure during fall 1979–spring 1980.

During the summers of 1979 and 1980, 115 and 143 muskrats, respectively, were captured in the study area. In 1979, six families had two litters each and four had one litter each. An average of 6.3 young/litter, combined with summer mortality rates of 33.6% for juveniles and 10% for adults, was used to estimate the 1979 fall population at 84 animals. In 1980, one family had three litters, seven had two litters each, and three had one litter each. The fall population was estimated at 104 animals.

RESULTS AND DISCUSSION

Data on 26 active and 22 inactive houses were recorded during June 1979 and 1980. The average water level at active houses

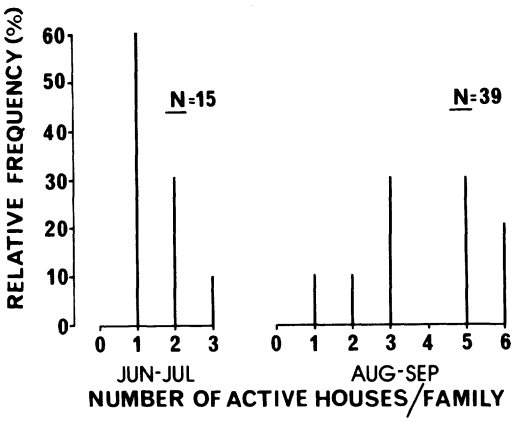

Fig. 1. Relative frequencies (%) of number of active houses per muskrat family at Luther Marsh in early and late summer 1979 (includes one burrow in Jun–Jul).

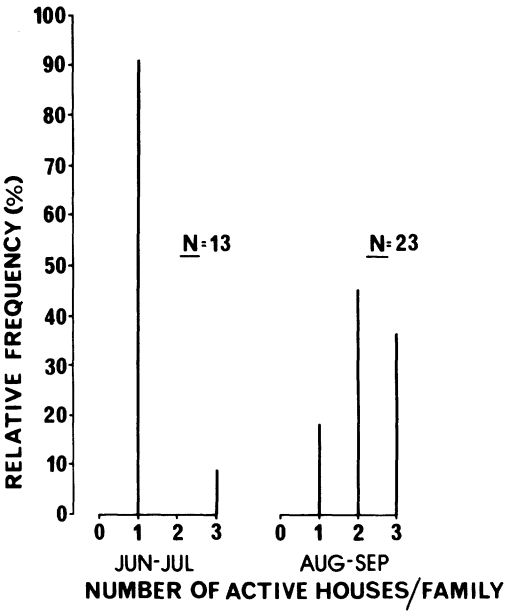

Fig. 2. Relative frequencies (%) of number of active houses per muskrat family at Luther Marsh in early and late summer 1980 (includes one burrow in each of Jun–Jul and Aug–Sep).

(54 ± 19 cm, $\bar{x}$ ± SE) did not differ from that at inactive houses (56 ± 16 cm; t = 0.348, $P > 0.05$). The average surface area covered by active houses (2.3 ± 1.0 m^2) did not differ from that of inactive houses (2.0 ± 1.2 m^2; $t = 0.807$, $P > 0.05$). However, the average height of a house above the water surface was greater (15 ± 5 cm; $t = 15.850$, $P < 0.005$) for active (52 ± 11 cm) than inactive houses. In June 1979, the water level was abnormally low. In June 1980, it was abnormally high and maximal (Proulx 1981). The minimum height above water at inhabited houses was determined from measurements during the time of maximum water level. At a confidence level of 95%, the minimum height above water for an active house at Luther Marsh was 30 cm. Therefore, in early summer, any house >30 cm above water was probably inhabited.

In 1979, 47 houses and one burrow were found during the last week of May but 5 houses were in a deteriorating state. Only 23 houses and one burrow actually were active in May. In June and July, trapping and field observations showed that 14 houses and one burrow were used by the members of 10 families, or 1.5 (±0.7, SE) dwellings/family in early summer (Fig. 1). Intensive building activity began in late July and abandonment and deterioration of several early summer houses also occurred. As a result, there were 55 emergent structures in August and September 1979. Trapping activities and field investigations indicated that only 39 of these were used by the members of the families or 3.9 (±1.7) active houses/family (Fig. 1). There were 2.15 muskrats/active house or 84 animals in fall 1979 (Proulx and Gilbert 1983). In August 1979, trapping was successful at 24 houses and 50 different animals were captured. At this time, there were 2.1 (±1.6) different animals/active house. If the muskrat population was equally distributed among the 39 active houses, there were 82 animals present. In September, trapping was successful at 17 houses with an average of 1.9 (±1.5) animals/active house. This average was not statistically different from that of August

Table 1. Population estimates of muskrats from house counts in fall and summer 1979–80 at Luther Marsh, Ontario.

	1979		1980	
	Summer	Fall	Summer	Fall
N houses				
Active	15	39	13	23
Inactive	27	16	6	2
Total	42	55	19	25
Population size				
2.8 muskrats/house (Lay 1945)				
Families				
Muskrats		154		70
5 muskrats/house (Dozier 1948)				
Families				
Muskrats		275		125
3.5 muskrats/house (Parker and Maxwell 1980)				
Families				
Muskrats		192		87
1.3 houses/family (Jul survey)				
Families	11		10	
Muskrats		112		102
Proulx and Gilbert (1983)				
Families	10		11	
Muskrats		84		104

($t = 0.472$, $P > 0.05$). For 39 houses, the September population was estimated at 74 animals.

In 1980, 24 houses were found during the last week of May but 5 were in an advanced state of deterioration. Only 12 houses and one burrow were used by the members of 11 families in June and July, i.e., 1.2 (±0.6) dwellings/family (Fig. 2). The average number of active houses per family in June–July 1979 was not different ($t = 1.057$, $P > 0.05$) from June–July 1980. However, there were fewer ($t = 2.943$, $P < 0.005$) houses per family in late summer 1980 than in 1979. In August and September 1980, there were 25 emergent structures and one burrow. Trapping data and field observations indicated that 22 houses (1 was shared by the members of two families) and one burrow were used by the members of 11 families, i.e., 2.2 (±0.7) dwellings/family (Fig. 2). Considering a fall population estimate of 104 animals, there were 4.5 animals/active dwelling. Trapping was successful at 14 houses in August, and there was an average of 3.8 (±4.3) different animals/active house (fall population estimate of 87 muskrats). In September, captures occurred at 21 houses; the average of 4.2 (±3.1) different animals/active house (fall population estimate of 97) did not differ ($t = 0.330$, $P > 0.05$) from the August value.

Aerial counts in fall would have overestimated the muskrat population by at least 70 animals in 1979 if all emergent structures were recorded as active houses (Table 1). In 1980, an underestimation between 32 and 15 animals would have been obtained with Lay's (1945) and Parker and Maxwell's (1980) conversion factors, and

an overestimation of 23 animals would have resulted from Dozier's (1948) conversion factor (Table 1).

House counts in summer are an alternative to fall surveys. The average number of June–July houses per family over the 2-year study was 1.3/family. The maximum summer juvenile populations were estimated at 139 animals in 1979 and 126 in 1980 (Proulx and Gilbert 1983). Based on the summer survival rates reported by Proulx and Gilbert (1983), the fall muskrat population would have been 112 (2.9 muskrats/house) in 1979 and 104 (4.5 muskrats/house) animals in 1980. Thus, the fall muskrat population would have been overestimated by 28 animals in 1979 and underestimated by 2 animals in 1980 (Proulx and Gilbert 1983, Table 1). This represents a considerable improvement over the estimates from aerial counts of houses in fall.

House counts in fall and winter might be reliable in areas where muskrats use mostly burrows in summer. These animals would build houses in the fall in areas with adequate water levels (Bellrose 1950) and these houses would remain active throughout the fall season unless drastic changes in environmental conditions occurred (Friend et al. 1964). At Luther Marsh, however, house counts in fall would not have been reliable in 1979 and 1980. Proulx and Gilbert (1983) have shown that muskrats at Luther Marsh depend upon an interspersion of open water and vegetation with neither covering <25% of home ranges. In late summer 1979, with low water levels, an expansion and/or relocation of home ranges involved more house building activity and more house abandonment to re-establish this balance of water and vegetation. At Luther Marsh, the number of fall houses did not signify a relative change in the number of muskrats from year to year. Instead it indicated how building activity varied with water level conditions and with the amount of accessible vegetation.

To estimate muskrat abundance, a perennially reliable index is needed. In this study, the number of houses per family in June–July was the only index that did not change significantly from 1 year to the next. In June–July, breeding pairs concentrate their activities around the dwelling containing the newborn of the first litter (Proulx and Gilbert 1983). However, in late summer, juveniles establish themselves by the parental house, and the number of new houses depends on the size of the litters and the harshness of the environmental conditions (LeBoulengé 1972, Proulx and Gilbert 1983).

In summer, muskrats do not use semipermanent retreats and push-ups, and it is possible to restrict the house count to true dwellings. Because abandonment of houses may occur from May to July, male bachelors may inhabit the breeding grounds in May and June (Proulx 1981), and new building activity may begin in late July. Thus, house counts in summer should be conducted during the first 2 weeks of July. Although Proulx et al. (unpubl. rep., Ont. Minist. Nat. Resour., 1983) reported that aerial surveys were not reliable for house counts in summer, surface surveys can provide good counts using transects in marsh areas and canoes along the shores. The surveyor should record all dwellings >30 cm above the water with fresh muskrat sign. Knowledge of the average productivity per female and the survival rate of the animals, when coupled with house counts in summer, would provide wildlife managers with more reliable fall population estimates. This census approach should be tested in other areas where muskrats inhabit houses all year and, if necessary, checked by live-trapping programs.

Acknowledgments.—We thank the Minist. of Nat. Resour. and Grand River Conserv. Authority for allowing us to study at Luther Marsh. We thank N. C. Wilson for assistance in data collection and T. D. Nudds, Dep. of Zool., Univ. of Guelph, for review of the original manuscript.

LITERATURE CITED

BELLROSE, F. C. 1950. The relationship of muskrat populations to various marsh and aquatic plants. J. Wildl. Manage. 14:299–315.

COULTER, M. W. 1948. A study of movements and habitat preferences of muskrats in Maine. M.S. Thesis, Univ. Maine, Orono. 114pp.

DANELL, K. 1977. Short-term plant successions following the colonization of a northern Swedish lake by the muskrat, *Ondatra zibethica*. J. Appl. Ecol. 14:933–947.

DAVIS, D. E., AND R. L. WINSTEAD. 1980. Estimating the numbers of wildlife populations. Pages 221–246 *in* S. D. Schemnitz, ed. Wildlife management techniques manual. 4th ed. The Wildl. Soc., Washington, D.C.

DILWORTH, T. G. 1966. Life history and ecology of the muskrat, *Ondatra zibethicus zibethicus*, under severe water level fluctuations. M.S. Thesis, Univ. New Brunswick, Fredericton. 125pp.

DOZIER, H. L. 1948. Estimating muskrat populations by house counts. Trans. North Am. Wildl. Conf. 13:372–392.

FRIEND, M., G. E. CUMMINGS, AND J. S. MORSE. 1964. Effects of changes in winter water levels on muskrat weights and harvest at the Montezuma National Wildlife Refuge. N.Y. Fish and Game J. 11:125–131.

LAY, D. W. 1945. The problem of undertrapping in muskrat management. Trans. North Am. Wildl. Conf. 10:75–78.

LEBOULENGÉ, E. 1972. Etat de nos connaissances sur l'écologie du rat musqué, *Ondatra zibethica* L. Terre Vie 1:3–37.

MACARTHUR, R. A., AND M. ALEKSIUK. 1979. Seasonal microenvironments of the muskrat (*Ondatra zibethicus*) in a northern marsh. J. Mammal. 60:146–154.

MIZELLE, J. D. 1936. Muskrat habitations of Marsh Island, Louisiana. Am. Midl. Nat. 17:661–663.

OLSEN, P. F. 1959. Muskrat breeding biology at Delta, Manitoba. J. Wildl. Manage. 23:40–53.

PARKER, G. R., AND J. W. MAXWELL. 1980. Characteristics of a population of muskrats (*Ondatra zibethicus zibethicus*) in New Brunswick. Can. Field-Nat. 94:1–8.

PERRY, H. R., JR. 1982. Muskrats (*Ondatra zibethicus* and *Neofiber alleni*). Pages 282–325 *in* J. A. Chapman and G. A. Feldhamer, eds. Wild mammals of North America. Johns Hopkins Univ. Press, Baltimore, Md.

PHILLIPS, D. W. 1979. Muskrat population dynamics on a controlled wetland in southern Saskatchewan. M.S. Thesis, Univ. Regina, Regina, Sask. 118pp.

PROULX, G. 1981. Relationship between muskrat populations, vegetation and water level fluctuations and management considerations at Luther Marsh, Ontario. Ph.D. Thesis, Univ. Guelph, Guelph, Ont. 239pp.

———, AND F. F. GILBERT. 1983. The ecology of the muskrat (*Ondatra zibethicus*) at Luther Marsh, Ontario. Can. Field-Nat. 97:377–390.

WRAGG, L. E. 1953. Notes on the life history of the muskrat in southern Ontario. Can. Field-Nat. 67:174–177.

Received 8 October 1982.
Accepted 24 August 1983.

FOODS OF ADULT MAINE COYOTES AND THEIR KNOWN-AGED PUPS

DANIEL J. HARRISON and JOYCE A. HARRISON, Maine Cooperative Wildlife Research Unit, 240 Nutting Hall, Orono, ME 04469.

Information about food habits of adult coyotes (*Canis latrans*) and their known-aged pups provides insight into foraging strategies of adult coyotes during pup-rearing. In this paper, we compare the food habits of pup and adult coyotes during several stages of pup development, and assess the reproductive status of adult coyotes preying on white-tailed deer (*Odocoileus virginianus*). This was part of a long-term study of furbearer ecology conducted by the Maine Cooperative Wildlife Research Unit, in cooperation with the Maine Department of Inland Fisheries and Wildlife (Fed. Aid in Wildl. Restoration Proj. W-69-R).