

THE OCCURRENCE AND ORIGIN OF SMALL MAMMALS ON THE ISLANDS AND PENINSULAS OF WESTERN LAKE ERIE¹

MICHAEL W. FALL², WILLIAM B. JACKSON, AND MICHAEL L. CARPENTER³

Department of Biology, Bowling Green State University, Bowling Green, Ohio

ABSTRACT

Collection of small mammals in the island and peninsula region of western Lake Erie from 1962 to 1967 has provided information on the present distribution of several species. The white-footed mouse (*Peromyscus leucopus noveboracensis*) was found in wooded areas throughout the region except on two of the smallest islands. Other native small mammals were trapped on Catawba and Marblehead Peninsulas but were not found on any of the islands. Various classical methods by which mice reach islands were considered in reference to the Lake Erie situation. None seemed appropriate for direct movements from mainland to island. Swimming, rafting, and movement across ice may be effective for the shorter inter-island and mainland-to-peninsula movements, but no adequate natural explanation for the longer movements can be offered. Human activity may aid in maintaining mouse populations on the smaller islands, but the limited diversity of island small-mammal fauna suggests a minor role for man in the importation of new animals.

ACKNOWLEDGEMENTS

For permission to visit individual areas, thanks are due the following persons: Mr. Walter S. Hayes (Mouse Island), Mr. G. W. Keny (Sugar Island), Mr. Robert C. Shull and Mr. Charles Busch (Rattlesnake Island), Mr. Estal C. Cloud and Mr. Keith Kimball of Meier's Wine Cellars (North Bass Island), and to Mr. Dale E. Whitesell of the Ohio Division of Wildlife (Green Island). Mr. Stanley E. Wulkowicz of South Bass kindly provided us with a boat during 1964. Three Bowling Green State University students, Larry Smith, John Rabbage, and Gail Peters, contributed additional observations and trapping data. This work has received partial support from the Scholarly Advancement Committee of Bowling Green State University and The Ohio Biological Survey. Part of the work was completed while in residence at the Franz Theodore Stone Laboratory.

THE OCCURRENCE AND ORIGIN OF SMALL MAMMALS ON THE ISLANDS AND PENINSULAS OF WESTERN LAKE ERIE

The islands and peninsulas of Lake Erie have held much interest for the biologist since the turn of the century when Moseley (1899, 1905) began his studies of the region. The ecology of the region and many of the biological studies of succeeding years have been summarized by Langlois (1954). The islands lie near the western end of Lake Erie, and the peninsulas project from the mainland of northern Ohio directly south of the islands (fig. 1). The region has extensive outcrops of Devonian and Silurian limestones and is strikingly different in physiography from the level, low-lying Lake Plains in adjacent northern Ohio. The shoreline consists of rocky headlands with interspersed pebble beaches. Quarrying, grape culture, and tourist services account for much of the land use in the region.

This paper reports data on small mammals (considered to mean myomorphs and insectivores) collected in the region from 1962 to 1967. Much of the field work for this study was completed during the summer of 1964 in conjunction with a study of morphological variation in the white-footed mouse *Peromyscus leucopus noveboracensis* (Fischer) on the islands (Fall, 1966). Although these data are by no means exhaustive and will undoubtedly be augmented as study of the Ohio

¹Manuscript received August 22, 1967.

²Present address: Department of Entomology, The Pennsylvania State University, University Park, Pennsylvania.

³Present Address: Department of Biology, Arizona State University, Tempe, Arizona.

fauna progresses, they are offered now with the hope of establishing a basis for further work on the mammalogy of the lake region. Because many of the sites were visited for only one trapping period, population fluctuations may influence the total small mammal picture. Thus a species at a low density at this time may not be encountered, but at a later date and during a time of higher density may be trapped readily. Further study will certainly improve our understanding of the problems suggested by this paper.

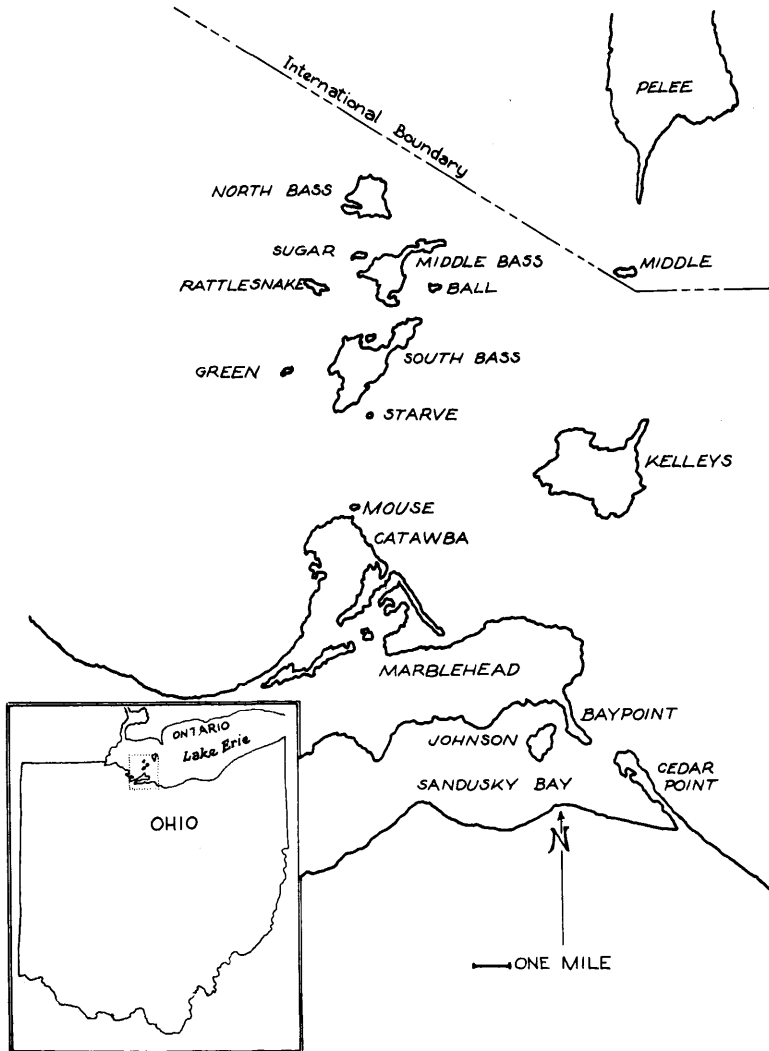


FIGURE 1. The Lake Erie island and peninsula region of Ohio.

Published material on the small mammals of the Lake Erie islands and peninsulas is scarce. Bole and Moulthrop (1942) reported collections from Bay Point in Ottawa County that included *Peromyscus leucopus noveboracensis*; the prairie deer mouse, *Peromyscus maniculatus bairdii* (Kenicott); the meadow vole, *Microtus*

pennsylvanicus pennsylvanicus (Ord); the house mouse, *Mus musculus musculus* Linnaeus; the short-tailed shrew, *Blarina brevicauda kirtlandi* Bole and Moulthrop; and the least shrew, *Cryptotis parva elasson* Bole and Moulthrop.

Banfield (1961) reported that extensive trapping in 1958 and 1960 on Pelee Island, the largest island in Lake Erie, produced only *P. l. noveboracensis*. He added that two specimens of *M. p. pennsylvanicus* had been discovered there in haycocks in 1947, and that *Mus musculus domesticus* Ruddy and the Norway rat, *Rattus norvegicus* (Berkenhout), also were known on the island. Jones (1912) notes that white-footed mice, squirrels, and rabbits were the only mammals seen by him on the islands.

METHODS

Specimens were collected using Museum Special snap traps in lines of 20 to 50 traps set at intervals of 50 feet. Peanut butter served as bait. Woods, scrub, and grassland habitats were trapped on each island whenever such tracts were available. These terms refer to: areas with canopy trees whose trunks average 4 inches in diameter; areas with sumac, blackberry, upright poison ivy, and red cedar occurring with various forbs; and fields dominated by grasses, respectively. Associated habitats, such as beaches, vineyards, buildings, and dumps also were trapped in some areas. In most cases, traplines were maintained for three successive nights.

Included in the trapping surveys of July and August, 1964, were South Bass Island, Middle Bass Island, North Bass Island, Kelleys Island, Sugar Island, Green Island, Rattlesnake Island, Mouse Island, and Catawba Peninsula. Mouse Island was also trapped in October, 1963; sites on Catawba have been trapped intermittently since 1962. Parts of Bay Point were trapped in September, 1965; a section of the Marblehead Peninsula was trapped in May, 1966. Additional trapping on Kelleys Island was done in May and August, 1967. The islands and peninsulas are shown in Figure 1.

RESULTS AND DISCUSSION

Table 1 shows area, species, and number of specimens obtained. Skins, skulls, and records for most specimens are deposited at the Bowling Green State University Biology Museum. Five of the six species obtained in the study were captured in low frequency in the island and peninsula region. *Rattus norvegicus* and *Mus musculus* expectedly were found primarily in areas of human activity: dwellings, dock areas, and dumps. Two young *R. norvegicus* were trapped on South Bass in a woods near the Lime Kiln Dock. On Catawba this species has been found using muskrat runs in marsh areas. A small number of *M. musculus* were trapped in grassland and scrub habitats on South Bass and in a scrub habitat on North Bass. Most scrub and grassland areas in the region, however, provided no small mammals during the time of these studies.

The identity of the subspecies of *Mus musculus* occurring in the Lake Erie region required clarification not within the scope of this paper. We note, however, that Bole and Moulthrop (1942) assign four house mice collected at Bay Point to *Mus musculus musculus* Linnaeus, while Banfield (1961) considers an individual collected on Pelee Island to be *Mus musculus domesticus* Ruddy. The classification by Schwarz and Schwarz (1943) would place the island house mice in the subspecies *domesticus*. Further examination of the island populations using larger numbers of specimens is necessary to determine whether any actual differences exist.

Microtus pennsylvanicus was not trapped on any of the islands during the collecting period (though three individuals were collected in supplementary trapping in 1967). Runways or grass cuttings which may often indicate its presence in an area were not observed. On Catawba, one individual was trapped

in October, 1965, in an old field at the perennial grass stage. Although *Microtus* had been observed here during the 1950's by Fall, considerable trapping in the same area since 1962 has not revealed its presence.

Likewise, *Blarina brevicauda* was uncommon through most of the region during our trapping. Two individuals were collected on Catawba—one in a marsh, the other in an old field. Thirteen were trapped at Bay Point along the borders

TABLE 1
Rodents and insectivores collected in the Lake Erie island and peninsula region of Ohio from 1962 to 1967

Area	Date	Trap-nights all locations	Number of locations	Number of Specimens*					
				P.l.	P.m.	R.n.	M.m.	M.p.	B.b.
South Bass Island	July-August 1964	455	7	63		7	4		
	June 1966	165	2	16					
Middle Bass Island	August 1964	141	4	34		1			
	June 1966	20	1	7					
North Bass Island	August 1964	135	2	19			8		
Green Island	July 1964	176	2						
Sugar Island	August 1964	120	3	1					
Rattlesnake Island	August 1964	224	3	6					
Gibraltar Island	August 1964	30	1						
Mouse Island	October 1963	86	1						
	August 1964	100	1						
Kelleys Island	August 1964	240	4	22		1 ⁺⁺			
	May, August 1967	1230	3	7				3	
Catawba Peninsula	Oct., Nov. 1962	270	5	20					
	Jan., April, Oct., 1963	90	2	3					
	Mar., Aug., Sept., Oct., Nov., 1964	197	6	7					
	October 1965	250	3	14			1		1 2
	May 1966	130	1	6					
Marblehead Peninsula	May 1966	70	1	1					
Bay Point	Sept. 1965	60	2	3	1				13

*Species indicated: P.l., *Peromyscus leucopus*; P.m., *Peromyscus maniculatus*; R.n., *Rattus norvegicus*; M.m., *Mus musculus*; M.p., *Microtus pennsylvanicus*; B.b., *Blarina brevicauda*.

⁺⁺Sight record.

between marshes and woods. No shrews were caught in the course of trapping similar habitats on the islands.

The occurrence of populations of *Peromyscus maniculatus* in the island-peninsula area is doubtful. One individual was trapped by us on Bay Point; likewise, one individual was recorded for the same area by Bole and Moulthrop (1942). Farther inland, however, in the area around Bowling Green, Ohio (about 50 miles southwest), this species is often abundant in old fields. Throughout the island and peninsula region, however, the species must be considered uncommon at the present time.

The fifth species captured, *Peromyscus leucopus*, was the most widespread, occurring on all areas trapped except Green and Mouse Islands. In this region of Ohio, *P. leucopus* occupies mainly wooded areas. Table 2 shows the distribution by habitat of *P. leucopus* captured on the larger islands during July and August, 1964. Most of the trapping in grassland and scrub habitats produced no mice. On Catawba Peninsula, annual trapping from 1962 through 1965 in a former alfalfa field, abandoned in the early 1950's, has never produced *P. leucopus*. However, the population in the adjacent sugar maple-hackberry (*Acer saccharum-Celtis occidentalis*) woods has been continuously high.

TABLE 2

Trap success, number of trap-nights, and number of white-footed mice (*P. leucopus*) captured in woods, scrub, and grassland habitats on four Lake Erie islands in July and August, 1964

	South Bass	Middle Bass	North Bass	Kelleys
Woods				
Trap success*	30	32	20	13
Number of trap-nights	201	107	90	120
Number of mice	60	34	18	16
Scrub				
Trap success	0	0	2	5
Number of trap-nights	114	28	45	60
Number of mice	0	0	1	3
Grassland				
Trap success	0	—	—	5
Number of trap-nights	45	—	—	60
Number of mice	0	—	—	3

*Trap Success = $\frac{\text{No. of mice}}{\text{No. of trap-nights}} \times 100$

A somewhat different habitat reaction by *P. leucopus* on the New Jersey Piedmont was described by Pearson (1959). Here, the species occupied both the early seral stages of oldfield succession and the climax oak forest. In Michigan the comparable oldfield niche was filled by *Peromyscus maniculatus bairdii* (Beckwith, 1954). But in both studies, *Peromyscus* occurred in the early seral stages, was replaced by *Microtus* as the vegetation became more dense, then gained importance again as the shrub-tree stage developed. On the Lake Erie islands, *P. leucopus* apparently has little competition from other mice. Nevertheless it makes little use of scrub or grassland habitats, leaving the niches of *P. maniculatus bairdii* and *Microtus pennsylvanicus* essentially unoccupied.

In the absence of competition, occupation of a wider range of habitats by resident island species has been noted in some studies. Dice (1925) and Manville

(1951), for example, have reported populations of *M. pennsylvanicus* in woodland habitats on Marion Island, Michigan, and on Little Rogg Island, Michigan, respectively. In our study, *P. leucopus* was found in scrub and grassland habitats on Kelleys Island and in scrub habitats, in association with *Mus musculus*, on North Bass Island. In both cases, trap success was low compared with that in nearby woodland (table 2); it is likely that these *Peromyscus* were transient animals. That the high-density populations of *P. leucopus* in woodlands do not extend into uncontested grass or scrub habitats may indicate a narrower habitat preference in these animals, compared with those studied by Pearson (1959) and Root and Pearson (1964) in New Jersey. We suggest that the apparent restriction of the island *P. leucopus* to the "preferred" forest habitats may indicate a relatively recent colonization of the island region. Longer association with an area where little competition is present may lead to utilization of a wider range of habitats.

ORIGIN OF THE LAKE ERIE ISLAND AND PENINSULA SMALL MAMMALS

Insular mammalian faunas may be established in a variety of ways. In addition to intermittent land connections, ice, water, or air may permit movements. Beer, Lukens, and Olson (1954) found fewer hibernating species of small mammals in the fauna of an island group in Minnesota than on the nearby mainland and concluded that winter movement across ice was the primary means by which animals reached the islands. Manville (1950) reached the same conclusion after finding hibernating species absent from the fauna of Drummond Island, Michigan. McCabe and Cowan (1945) found that dispersal of mice and other small vertebrates along the Canadian Pacific coast occurred when soil slides on mainland shores produced large consolidated rafts which drifted into contact with offshore islands. Beer, *et al.* (1954) suggested that this could happen on a smaller scale to animals foraging among beach drift. Ozoga and Phillips (1962), studying the mammals of Beaver Island in Lake Michigan, suggested that transportation by humans in freight, luggage, or forage might be important in moving small animals to the islands. Sheppe (1965) found swimming to be an effective means of dispersal over short distances by *Peromyscus leucopus*. Banfield (1961) concluded that *Microtus*, *Mus*, and *Rattus* were transported to Pelee Island in Lake Erie by man, while *Peromyscus* colonized the island by unknown natural means.

Although no studies of small-mammal dispersal have been made in this island and peninsula region, we believe a brief consideration of possible routes with regard to the ecology of the region is desirable. For purposes of discussion, we assume that man has had the same importance in distributing *Mus musculus* and *Rattus norvegicus* to the Lake Erie region that he has had in moving these animals throughout the world. It is dispersal (or lack of it) of native small mammals to this island region that requires explanation.

That small mammals are not found in a particular locale may be a function not only of geographic distribution, but also of population level or effort by the mammalogist. The meadow vole (*Microtus pennsylvanicus*) and the short-tailed shrew (*Blarina brevicauda*) were trapped on Catawba Peninsula only recently, after many unsuccessful trapping attempts during the past several years. More intensive collecting efforts may reveal new species on some of the islands we have studied, as indeed was the case with meadow voles on Kelleys Island in 1967. It may be noted, however, that accidental movements of animals over wide areas is much retarded at low population levels, because the probability of chance contact with various transport mechanisms is reduced and intraspecific strife and competition which may cause subordinate animals to modify their home ranges are lower.

The Pleistocene connection of the islands to Catawba Peninsula, considered by Moseley (1899) and Core (1948) to be a primary means by which the Lake Erie Islands acquired their flora, does not appear to have greatly influenced their

present small-mammal distribution. The swampland which formed as the recession of Pleistocene lakes progressed may have, in fact, served to retard the spread of small mammals into the area adjacent to the present lake, precluding dispersal across any then-exposed portion of the present lake bottom.

None of the classical methods of transport seems clearly applicable to the situation of the Lake Erie Islands. Sheppe (1965) found swimming important in distribution over short distances for *Peromyscus leucopus* in Ontario. Mice swam for as long as one-half hour without difficulty; however, the longest natural migration thought to have occurred by swimming was only 410 feet. Mice released at 1000 feet from shore in Sheppe's study appeared disoriented; only over short distances were courses toward shore chosen. In Lake Erie, it is unlikely that mice could swim directly from the mainland to the islands without help from currents. The general pattern of currents in western Lake Erie as shown by Hough (1958) would appear to hinder or prevent invasion of mice from the closest mainland shores.

Successful rafting as a chance occurrence might also be lessened by this general pattern of surface currents; however, the outward movement of waters during periods of southwest winds might bring some mainland debris to the islands. Ice rafts in the spring break-up of the ice pack could aid in small mammal dispersal, but direct movement to the islands across winter ice seems unlikely on Lake Erie in view of the long distances involved and the very rough ice that generally covers this section of the lake. (In preliminary experiments, white-footed mice released more than 80 meters from shore were disoriented and did not disperse across the ice.) One pregnant female, of course, could establish a new population, and introductions of individuals may have occurred many times. Movement between islands also may take place on occasion; inter-island distances are shorter and surface currents circulating through the island group (Hough, 1958) increase the probability of island-to-island contact. Rafting or movements across ice could be important in bringing small mammals across Sandusky Bay to the peninsulas.

The influence of humans in transporting mice to the islands and peninsulas cannot be overlooked. Tourists and freight come to the larger islands frequently, offering many opportunities for concealed animals to be transferred. These opportunities, however, would favor introduction of animals from various inland areas. Such a pattern would suggest a more diversified island fauna than has been observed. It is of note that, of the eight islands trapped, only two were without *Peromyscus leucopus*—the small, uninhabited islands, Mouse and Green. While this coincidence is certainly not explanatory, it suggests that humans may aid in maintaining mouse populations on the smaller islands by repeated introductions.

REFERENCES

- Banfield, A. W. F. 1961. Notes on the mammals of Pelee Island. Nat. Mus. Canada Bull. 183: 118-122.
- Beckwith, S. L. 1954. Ecological succession on abandoned farm land and its relationship to wildlife management. Ecol. Monog. 24: 349-376.
- Beer, J. R., P. Lukens, and D. Olson. 1954. Small mammal populations on the islands of Basswood Lake, Minnesota. Ecology 35: 437-445.
- Bole, B. P., and P. N. Moulthrop. 1942. The Ohio recent mammal collection in the Cleveland Museum of Natural History. Sci. Publ. Cleveland Mus. Natur. Hist. 5(6): 83-181.
- Core, E. L. 1948. The flora of the Erie Islands. Contrib. F. T. Stone Lab. Ohio State Univ. No. 9. 106 p.
- Dice, L. R. 1925. The mammals of Marion Island, Grand Traverse County, Michigan. Occas. Paper Mus. Zool. Univ. Michigan 160: 1-8.
- Fall, M. W. 1966. Variations in populations of the white-footed mouse (*Peromyscus leucopus noveboracensis*) on islands in Lake Erie. M. A. Thesis. Bowling Green State Univ., Bowling Green, Ohio. 48 p.
- Hough, J. L. 1958. Geology of the Great Lakes. Univ. of Illinois Press, Urbana. 282 p.
- Jones, L. 1912. A study of the avifauna of the Lake Erie Islands. Wilson Bull. 24: 95-108.
- Langlois, T. H. 1954. The western end of Lake Erie and its ecology. J. W. Edwards, Ann Arbor, Michigan. 479 p.

- Manville, R.** 1950. The mammals of Drummond Island, Michigan. *J. Mammal.* 31: 358-369.
———. 1951. A small island community in midsummer. *Ecology* 32: 608-617.
- McCabe, T. T., and I. M. Cowan.** 1945. *Peromyscus maniculatus macrorhinus* and the problem of insularity. *Trans. Royal Canadian Inst.* 25: 117-212.
- Moseley, E. L.** 1899. Sandusky Flora. *Ohio State Acad. Sci. Spec. Paper No. 1.* 167 p.
———. 1905. Formation of Sandusky Bay and Cedar Point. *Proc. Ohio Acad. Sci.* 13th Ann. Rpt. 4: 179-238.
- Ozoga, J. J., and C. J. Phillips.** 1964. Mammals of Beaver Island, Michigan. *Publ. Mus. Michigan State Univ.* 2: 307-347.
- Pearson, P. G.** 1959. Small mammals and old field succession on the Piedmont of New Jersey. *Ecology* 40: 249-255.
- Root, P. G. and P. G. Pearson.** 1964. Small mammals in the early stages of old field succession on the New Jersey Piedmont. *Bull. New Jersey Acad. Sci.* 9: 21-26.
- Schwarz, E., and H. K. Schwarz.** 1934. The wild and commensal stocks of the house mouse, *Mus musculus* Linnaeus. *J. Mammal.* 24: 59-72.
- Sheppe, W.** 1965. Dispersal by swimming in *Peromyscus leucopus*. *J. Mammal.* 46: 336-337.
-