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Distribution of Small Mammals on the Apostle Islands

GAIL E. KANTAK*

ABSTRACT — Five weeks of small mammal trapping on the Apostle Islands in 1978 yielded few captures. The low capture rate was attributed to low invasion rates and high extinction rates. Distribution records of small mammal species on individual islands were compiled from studies conducted as early as 1917. The distribution of many small mammal species on these islands remains largely undocumented, and further study is desirable before the patterns are disrupted by human activity.

Since the publication of MacArthur and Wilson's equilibrium theory on island biogeography (1967) there has been a surge of interest in island ecology. Despite this interest, there remains much to be learned about the distribution of many animal species on island groups, especially the small mammals. Although scientific studies on mammals of the Apostle Islands date to 1917 (Jackson, 1961) information on the distribution of the small mammals on these islands is spotty. Objectives in this paper are to compile the available information on small mammal distribution on the Apostle Islands, to suggest how features of this island group may influence the distribution patterns, and to encourage researchers to take advantage of the opportunity these islands afford for investigation of biogeographic processes.

Characteristics of these Islands

The Apostle Islands are a group of 22 islands located off the tip of Bayfield Peninsula in Lake Superior (Figure 2). All of the islands except Madeline and some of the nearby Wisconsin mainland are presently included in the Apostle Island National Lakeshore.

The Apostle Islands range in size from about one to well over 5,000 ha. The minimum distance between any island and the mainland is about 2.5 km. The geology is uniform, with the islands composed of drift hills of red sandy clay and with the islands composed of drift hills of red sandy clay above red sandstone (Van Hise and Leith, 1911). The islands have varied their histories of logging, agriculture, mining, browsing, and fire. Most of the uplands are poorly drained, and the forests are dominated by yellow birch (*Betula lutea*) or arbor vitae (*Thuja occidentalis*) (Beals and Cottam 1960).

Trapping Methods and Results

Trapping for this project was done at five sites on four of the Apostle Islands and two sites on the adjacent mainland during the period 28 May - 5 July 1978. There were 54 trap stations with two traps per station arranged in a 9 by 6 grid with 15 m intervals. Sherman live traps were baited with a mixture of peanut butter and bird seed and provided with a tuft of fiberfill bedding material. Traps were placed under logs, at the base of trees, or at other suitable sites within one

meter of each actual grid point. Traps were checked once daily, soon after dawn. This trapping regime follows procedures recommended for small mammal studies (Davis, 1956).

Trapping results are given in Table 1. Trap success was extremely low; the meadow vole (*Microtus pennsylvanicus*) had the highest capture rate on the mainland, but this species was not captured at all on the islands, only on the mainland. Only the red-backed vole (*Clethrionomys gapperi*) was caught on the islands, and this at low frequency. The low capture rates suggest that some species were not very abundant that year, if even present at all, on the islands trapped. One might argue that the capture rate would be higher if trapping were conducted later into the summer and fall, when populations are generally higher (Delany, 1974). However, the mainland trapping was conducted first, from 28 May to 4 June, and the capture rate here was an order of magnitude greater than that on the islands, where the trapping was done later in the season. Also, Anderson et al (1979) conducted trapping throughout that same summer, but not on an island trapped in this study, and likewise got a capture rate (1.13%) which is low relative to that in comparable habitat on mainland. Clearly, the low trap success on the islands must be attributable to something more than simply time of year.

Distribution and Underlying Factors

Table 2 summarizes the available sources on the distribution of small mammal species on individual islands. Small mammals have not been systematically collected on the Apostle Islands save for intensive efforts on Bear, Oak, Outer, Raspberry, Rocky, Stockton, and York Islands (R. Brnader, personal communication). The 1977 Mammal Checklist for the Apostle Island National Lakeshore includes *Zapus hudsonius*, but does not indicate on which island(s) this species was found. Undoubtedly other unpublished records of small mammal captures exist, but until these become available, or new studies are done, the presence on the islands of some relatively common species remains unverified.

The almost ubiquitous presence of *Clethrionomys gapperi* on the islands is striking. The islands' moist, mixed forests with their numerous windfalls and moss-covered logs provide

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ideal habitat for this species. On the contrary, there is little field or grassy habitat for the meadow vole *Microtus pennsylvanicus*, although this species is known to move into woody habitat if the other species which normally occupy it are absent (Crowell and Pimm, 1976). That *Microtus* appears to be so widespread may be the result of biased sampling technique, if traps were preferentially placed near campsites or other areas of human habitation which tend to be in more grassy, open areas. In the woods proper it is unlikely that *Microtus* could coexist with the woodland specialist *Clethrionomys* (Clough, 1964; Morris, 1969; Morris and Grant, 1972).

That the shrews were found infrequently may also be due to less than ideal trapping techniques. Live traps and snap traps are much inferior to pitfall traps in taking these species (Brown, 1967; MacLeod and Lethiecq, 1963; Moore, 1949), but pitfall traps are seldom employed in small mammal studies unless the specific objective is to sample shrews. Thus the extensive use of live traps and snap traps has probably underestimated the shrew populations and distribution on the islands.

The paucity of records of the deermouse (*Peromyscus maniculatus*) on the islands is more difficult to explain. In writing of his 1919 field season on Outer Island, Jackson (1961) commented on the high density of the deermouse population there. In 1974, the deermouse was the most abundant mammal on Stockton Island (Stadnyk et al, 1974), but none were captured on 4 islands, and Anderson et al (1979) found them in low densities on Outer Island. Although *Peromyscus* populations do not normally fluctuate as widely or cycle as do other species of small mammals (Terman, 1966), in the Apostle Islands it appears the *Peromyscus* populations may

vary considerably from island to island and from year to year. This points out the need for more systematic sampling over a number of years to determine the mechanisms of any such cycling and to ascertain the true extent of this species' distribution.

According to biogeographical theory (MacArthur and Wilson, 1967), smaller islands have fewer species because smaller populations are more vulnerable to chance events and suffer higher extinction rates. So far the data from the Apostle Islands are too limited to test this hypothesis. The larger islands do tend to have more species recorded for them, but this may simply be due to the fact that the larger islands have been better studied. On islands off the coast of Maine, Crowell (1973) found *Peromyscus* only on the larger islands and suggested that this was because *Peromyscus* requires a larger home range than *Clethrionomys* or *Microtus*. More sampling is necessary to determine if this accounts for the limited distribution of *Peromyscus* on the Apostle Islands.

Although small mammals are likely distributed to a larger extent on the islands than Table 2 suggests, the prior studies do indicate that small mammals are neither as widespread nor as abundant as on comparable areas on the mainland. This may be attributable to low invasion rates coupled with high extinction rates on the islands. Small mammal populations in geographically limited areas may be extremely labile, as Daugherty et al (1978) documented for populations on islands of the Columbia River drainage of Montana. They attributed this liability to high extinction rates. The small size of many of the Apostle Islands and the severity of the winters there may lead to periodic extinction of local populations, with recolonization subject to aporadic invasions. The large distance to the mainland contributes to a low in-

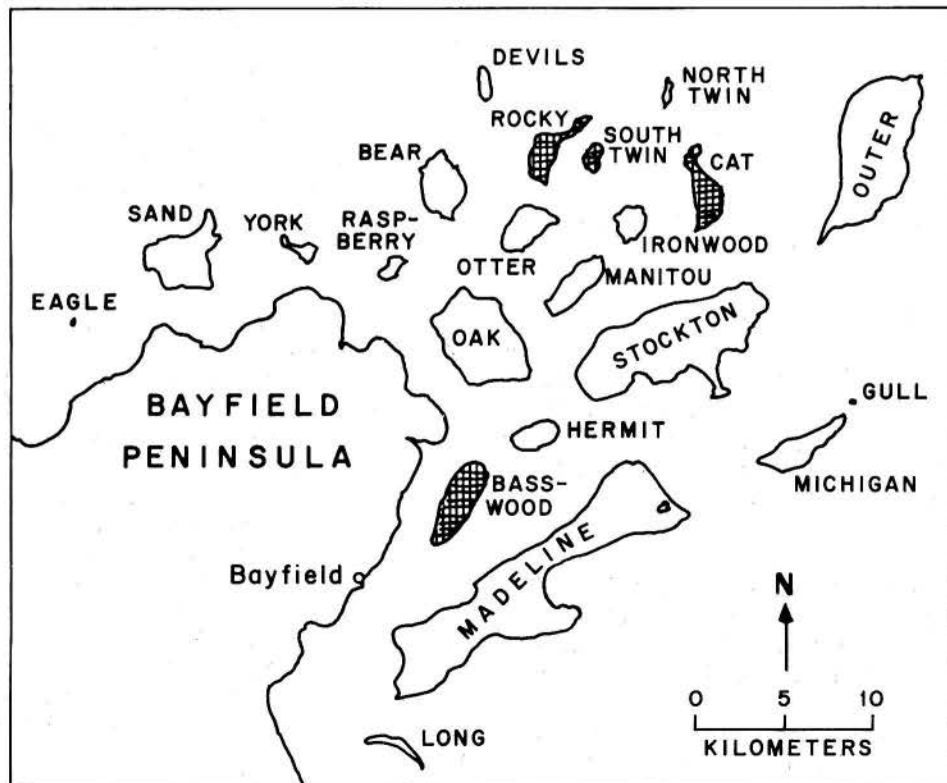


Figure 1. — MAP OF THE APOSTLE ISLANDS AND WISCONSIN'S BAYFIELD PENINSULA ON LAKE SUPERIOR. SHADED ISLANDS CONTAINED TRAP SITES FOR THIS STUDY.

TABLE 1. Results of trapping conducted on the Apostle Islands and vicinity, 1978.

SITE	TRAP NIGHTS	NUMBER OF CAPTURES	trap success; CAPTURES/100 TRAPNIGHTS
Mainland			
birch-maple forest	756	7 <i>Peromyscus maniculatus</i> <i>gracilis</i>	0.92%
old field	540	13 <i>Microtus P.</i> <i>pennsylvanicus</i>	2.40%
Basswood Island			
maple forest	540	0	0
Cat Island			
cedar-fir forest	540	2 <i>Clethrionomys g. gapperi</i>	0.37%
Rocky Island			
Cedar-birch-fir	540	0	0
South Twin Island			
cedar-birch-fir	540	1 <i>Clethrionomys g. gapperi</i>	0.18%
old field	540	0	

vasion rate. Jackson (1920) noted that the mammalian fauna of the Apostle Islands consisted primarily of species which were active during the winter months when ice provided access to the islands. Species which hibernated or were relatively inactive during winter were absent. Likewise, hibernating species were missing from an island in Lake Huron although they were present on the mainland one mile away (Manville, 1950). This accounts for the lack of some hibernating species on the Apostle Islands, but non-hibernators still have problems in getting to the islands. *Peromyscus* can travel short distances across ice (Beer et al., 1954, Christianson 1977) but the shortest distance between any of the Apostle Islands and the mainland is 2.5 km, so it is doubtful that small mammals could successfully make such a journey. A successful swim across the water in summer is even less likely. Sheppe (1965) reported that *P. leucopus* made crossings of 8-233m in the 21 -27 °C water of a lake in Ontario, but a swim of 2.5 km or more in the choppy 10 °C water of Lake Superior is probably not possible for a mouse, vole, or shrew. The most plausible natural means of invasion is transportation by driftwood or other rafts, but this is subject to chance rare events. Overall, one would expect the natural rate of invasion of small mammals to the Apostle Islands to be low.

This leaves the major means of transportation to man. Corbet (1961) attributed the irregular distribution of small

mammals in the British Isles to human transport. Foster (1965) thought that *Peromyscus* was carried by Indians to islands off the coast of British Columbia. In other islands of the Great Lakes, the introduction of half or more of the mammalian species is attributed to man (Hatt et al, 1948; Ozoga and Phillips, 1974). The Apostle Islands have had a long history of human use, beginning with native Indians who used the islands for hunting, and continuing with the arrival of white men, who at first used the islands for trapping and later developed shipping, fishing, mining, and logging industries in the area. In recent years there has been a tremendous upsurge in the recreational use of the islands. While in years past small mammals were probably transported in the fodder and grain carried by early settlers, the same journey may now be made via the yachts and other large passenger boats which regularly touch the shores of the Apostle Islands. The island with the greatest number of small mammals (Stockton), is also the island with the most regularly scheduled tourist boat stops at its dock. Because Stockton is also the largest island of the Apostle Island National Lakeshore, it is difficult to sort out the factors contributing to the number of mammals there, but this does point out the need for further study. There are many interesting questions relating to mammal distribution which ought to be addressed before the pattern and processes are greatly altered by further human activity.

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TABLE 2. Records of small mammals captured on the Apostle Islands. Numbers correspond to the following references: 1. Anderson et al, 1979, 2: Brander et al, 1978, 3: Brown, 1976, 4: Jackson, 1961, 5: Kantak, this study, 6: Meierotto, undated, 7:00 Patzoldt, 1978, 8: Schulz, 1976, 9: Stadnyk et al, 1974, 10: Wis. Cons. Dept. 1953-1964.

Island	<u>Sorex</u> <u>cinereus</u> <u>cinereus</u>	<u>Blarina</u> <u>brevicauda</u> <u>brevicauda</u>	<u>Peromyscus</u> <u>maniculatus</u> <u>gracilis</u>	<u>Clethrionomys</u> <u>gapperi</u> <u>gapperi</u>	<u>Microtus</u> <u>pennsylvanicus</u> <u>pennsylvanicus</u>
Basswood				2,6	2,6
Bear				6,8	8
Cat				5,6	
Devils				6	
Eagle				6	
Hermit				2,6	2,6
Ironwood				6	6
Madeline	4	4	4		4
Manitou				6	
Michigan				2,6	2,6
North Twin				6	
Oak	7	6,7	6,7	6,7	7
Otter				6	
Outer	1,4		1,4,6	1,4,6	1,4,6
Raspberry	3,6,7			6,7	7
Rocky	3,6,7			2,6,7	2,6,7
Sand	4		6	6	
South Twin				5,6	6
Stockton	4,6,9,10	6,9	6,9,10	4,6,9,10	4,6,9,10
York	3,7			6,7	3,7

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