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Vertebrate animal populations of the McCormick Forest

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VERTEBRATE ANIMAL POPULATIONS OF THE MC CORMICK FOREST

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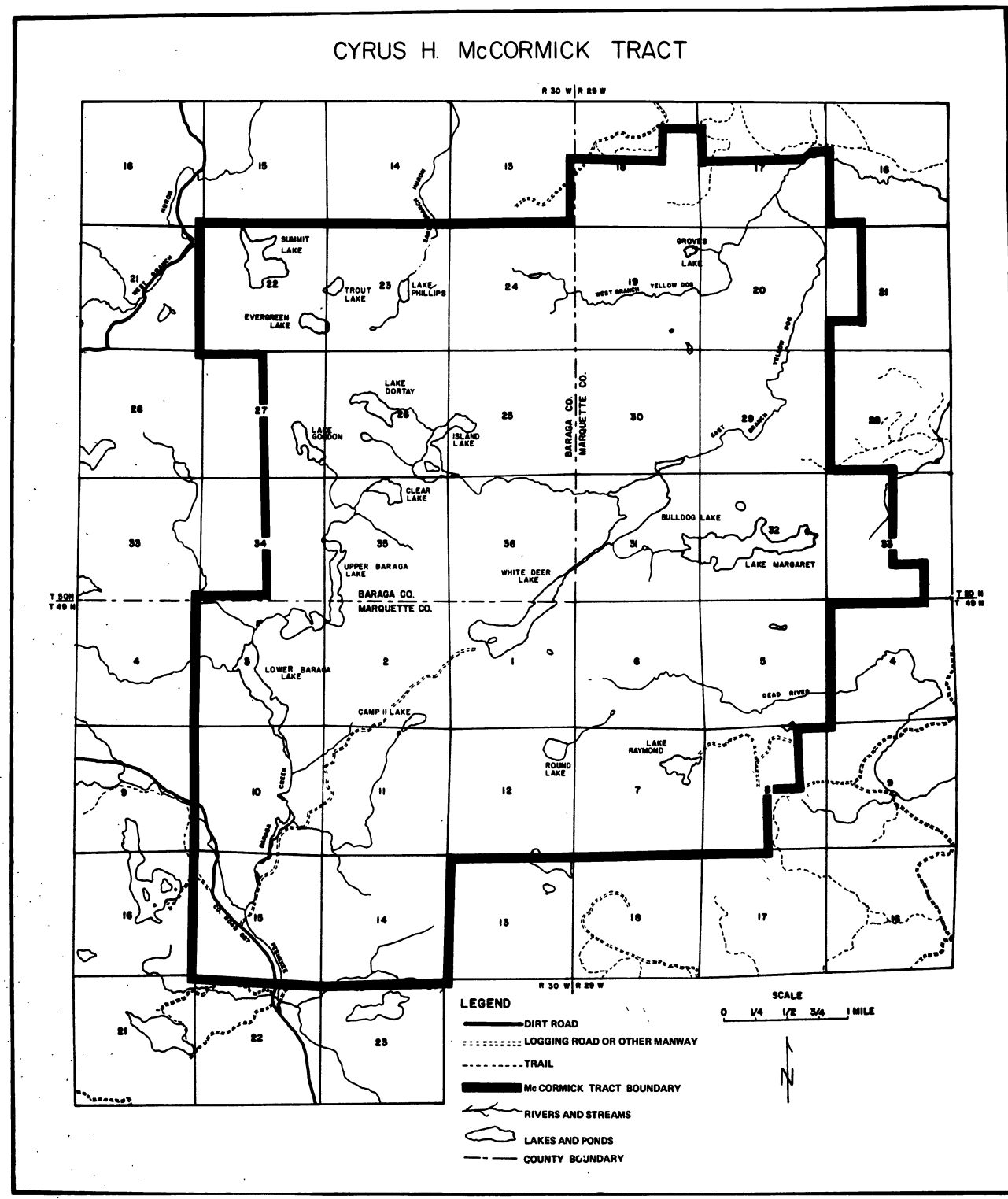

Fig. 1.--*Map of the Cyrus H. McCormick Experimental Forest.*

BIRDS AND MAMMALS

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ABSTRACT.--Birds and mammals were inventoried on a 17,124-acre forested tract recently acquired by the USDA Forest Service in the Upper Peninsula of Michigan. An annotated list was made of the 109 species of birds and 33 species of mammals observed. Population densities were estimated for loons (*Gavia immer*), ruffed grouse (*Bonasa umbellus*), beavers (*Castor canadensis*), and small mammals in various forest habitats. Comparisons with the findings of other workers and a discussion of birds and mammals found elsewhere in Upper Peninsula but not in the McCormick Forest are also included.

In recent years there has been increasing awareness of the interdependence of all the various elements of the biosphere. The impact of man's activities has been global, and in many cases overwhelming. Yet there remain scattered enclaves in which the influence of man and his machinery has been minimal.

In the forested parts of the eastern United States these enclaves are rare and valuable. Their value lies in their capacity to provide us not only with inspiration but also with information as to how plant and animal communities function in the absence of extensive human intervention. They may serve as controls in the huge experiment of manipulation that man is carrying out on the Earth and its atmosphere. The McCormick Forest is one of these enclaves, one which may serve us best as a natural laboratory--a standard by which changes in the world around it can be compared.

A first step in understanding the functioning of a community is an inventory of its participants. This paper is a report on such an inventory in the McCormick Forest, carried out in 1972 and 1973. The objectives of the inventory were to gather information on the birds and mammals present on the McCormick Forest, determine their approximate densities, and find out what habitats they occupy.

The McCormick Forest is a 17,124-acre tract located in northwestern Marquette and eastern Baraga Counties in the Upper Peninsula of Michigan. It was donated in 1968 to the USDA Forest Service by the late Gordon McCormick whose family had purchased the tract piecemeal from about 1900 to 1936. Liitle disturbance has occurred since 1936. The McCormick Forest includes 28 lakes and numerous small streams. The topography is rugged with rock outcrops that rise to an elevation of 1,900 feet. A variety of vegetation types occur, ranging from sphagnum bogs to mature upland hardwoods dominated by sugar maple (*Acer saccharum*). Between these extremes are spruce (*Picea mariana*) and cedar (*Thuja occidentalis*) swamps, white birch (*Betula papyrifera*) - aspen (*Populus tremuloides*) stands, and a burned-over area consisting of sparse spruce trees (*Picea glauca* and *P. mariana*) and blueberries (*Vaccinium* spp.). The mature hardwoods also contain some large white pines (*Pinus strobus*), yellow birch (*Betula alleghaniensis*), hemlock (*Tsuga canadensis*), and some balsam fir (*Abies balsamea*). Metzger (1973) described the vegetation of the 3,675-acre natural area in the northeast corner of the forest.

METHODS

Field work began in June 1972 and continued through April 1974. Observations of birds and mammals made in previous years were obtained by consulting persons familiar with the area and records of the Michigan Department of Natural Resources. Because there are probably over 200 species of birds and 45 species of mammals in the

McCormick Forest, it would be difficult and time consuming to obtain quantitative data on the densities of all of them. It was thus desirable to use extensive methods for most species and intensive methods for species that are of particular interest or that lend themselves well to quantitative sampling.

Extensive Methods

Extensive methods were designed to obtain a broad coverage of the tract to learn what birds and mammals were present, without regard for estimating population densities. These methods consisted of observing animals while traveling by automobile, foot, canoe, and airplane.

About 1.5 miles of County Road 607 cuts across the southwest corner of the tract and a dirt road runs from there 3.4 miles into the abandoned McCormick lodge on White Deer Lake (fig. 1). During travel on these roads records were kept of all birds and mammals seen from the car. A total of 214 miles were traveled by auto in the tract in 1972 and 284 miles in 1973. County Road 607 was plowed in winter but the road to the lodge was not.

In addition to animals seen within the McCormick Forest, records were also kept of all birds and mammals seen on County Road 607 while traveling by car the 8.8 miles between the Forest boundary and U.S. Highway 41.

We traveled by canoe during both day and night and kept records of the animals seen. In the daytime we paddled about 42 miles in 21 hours on the following lakes: Bulldog, Lower Baraga, Margaret, Summit, Upper Baraga, and White Deer. We canoed at night with the aid of a hand-held spotlight attached to a 12-volt car battery. The bowman handled the light, searching the shoreline for animals, while the sternman paddled quietly. About 20 miles of shoreline were traveled by canoe at night in 17 hours. All mammals and birds seen or heard and identified were noted. The lakes covered by night were the Baraga Lakes, Bulldog, and White Deer.

About 148 miles were walked on bare ground in the tract from April to October, and 70 miles were snowshoed or skied from November to March.

Two flights were made over the tract to count beaver dams in November 1972, and to locate deer or deer trails in March 1973. Active beaver colonies were also noted from ground observation of dams, fresh cuttings, and the animals themselves.

Chance sightings of birds and mammals were recorded and sightings by other competent observers were also used.

Intensive Methods

Attempts were made to obtain quantitative information on populations of small mammals in five habitat types (table 1). The usual scheme was to set a 7 by 4 grid of live traps[1] spaced 50 feet (15.2 m) apart for 4 nights. All live mice and chipmunks caught were ear tagged and released. Immediately after this 4 night period, pitfalls were dug in the center of each 50-foot square enclosed by the trap locations, resulting in a 6 by 3 grid of pitfalls. A metal can 10 inches in diameter and 12.5 inches deep was sunk into each pitfall. Chipmunks could escape by jumping out of the cans but it is unlikely that any mice or shrews did. The objective of the pitfalls was two-fold. First they are effective in capturing shrews (Buckner 1955, Coulombe and Banta 1964), and second they provide a way of capturing small rodents that eliminates the bias in mark-recapture data caused by avoidance or attraction of baited traps (Kott 1965).

In 1973 considerable effort was spent in determining loon populations and their reproductive efforts and success. Each lake was visited several times and intensively searched for nests if loons were found. The hatching and rearing success of loons was followed through the month of July.

Ruffed grouse populations were estimated by recording sighting distances and perpendicular distance of each bird from the line of walk, according to the formulas of Kelker (1945) and King (Leopold 1933), recently

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[1] *Some were specially designed and provided by Richard Buech, USDA Forest Service, Rhinelander, Wisconsin, and some were Havahart No. 0. Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

Table 1.--*Small mammal trapping dates and locations*

Dates	Trap nights	Type of trap[1]	Type of habitat	Location
July 7 to 17, 1972	198	P	Bog	NW¼ of NW¼ Sec. 11. T49N R30W
July 17 to 21, 1972	112	L	Hardwood-pine	SW¼ of SE¼ Sec. 2. T49N R30W
July 21 to 25, 1972	72	P	Hardwood-pine	do.
July 24 to 29, 1972	140	L	Spruce barrens	NE¼ of NW¼ Sec. 15. T49N R30W
July 29 to Aug. 2, 1972	90	P	Spruce barrens	do.
July 31 to Aug. 4, 1972	140	L	Spruce swamp	SW¼ of NW¼ Sec. 15. T49N R30W
Aug. 4 to 11, 1972	144	P	Spruce swamp	do.
Aug. 7 to 11, 1972	112	L	White birch-aspen	E½ of NE¼ Sec. 15. T49N R30W
May 21 to 25, 1973	90	P	Spruce barrens	NE¼ of NW¼ Sec. 15. T49N R30W
May 21 to 25, 1973	90	P	Spruce swamp	do.
May 28 to June 3, 1973	90	P	Hardwood-pine	SW¼ of SE¼ Sec. 2. T49N R30W
May 28 to June 3, 1973	90	P	Bog	SE¼ of SE¼ Sec. 2. T49N R30W
July 9 to 19, 1973	198	P	Hardwood-pine	NE¼ of NE¼ Sec. 20. T50N R29W

[1] P = pitfall; L = live-trap.

shown to be two of the most reliable estimating methods (Robinette *et al.* 1974). The formulas are:

Kelker: $N = N^1 A/2 L D$, and
King: $N = n A/2 L R$.

Where: N = estimated animal population; n = number of animals seen; n^1 = number of animals seen within 2D; D = width of a strip within which all animals are believed to be seen (25 feet for ruffed grouse); A = area sampled; L = length of census lines; and R = mean sighting distance.

RESULTS

Birds

Bird species seen in the McCormick Forest numbered 109 (table 2). Most of the species seen along County Road 607 within 9 miles of the McCormick Forest, probably also occur within the Forest. These include the goshawk, Cooper's hawk, brown thrasher (observed in the tract by Hermann), the red crossbill and the starling. A goshawk nest was found between Bulldog and Margaret Lakes in 1969.[2] Two starlings were seen about 9 miles south of the McCormick Forest. They are also found near Ives Lake 10 miles north. Because of the nearly unbroken forest habitat on the McCormick Forest, however, the starling probably does not occur there. Spruce grouse were reported from a conifer area 8 miles west of the McCormick Forest and they are common on the Yellow Dog Plains, 3 miles north, but none was found in the McCormick Forest during the present study.

[2] *Reported by Duane Campbell, Fisheries Biologist, Ottawa National Forest.*

Table 2.--*Birds seen in the McCormick Forest*

Species	Present study	Hermann[1]	Status[2] and comments
Common loon[3] (*Gavia immer*)	X	X	Abundant
Pied-billed grebe (*Podilymbus podiceps*)	X	--	Uncommon
Great blue heron (*Ardea herodias*)	X	X	Common
American bittern (*Botaurus lentiginosus*)	X	X	Uncommon
Canada goose (*Branta canadensis*)	X	--	Migrants only passing over
Mallard[3] (*Anas platyrhynchos*)	X	--	Common-nesting
Black duck[3] (*Anas rubripes*)	X	--	Common-nesting
Wood duck (*Aix sponsa*)	X	--	Common-nesting
Ring-necked duck (*Aythya collaris*)	X	--	Uncommon-nesting
Common goldeneye (*Bucephala clangula*)	X	--	Migrants only - feeding in lakes
Bufflehead (*Bucephala albeola*)	X	--	Migrants only - feeding in lakes
Hooded merganser (*Lophodytes cucullatus*)	X	--	Common-nesting
Common merganser (*Mergus merganser*)	X	--	Abundant-nesting
Red-breasted merganser (*Mergus serrator*)	--	X	Rare
Goshawk[3,4] (*Accipiter gentilis*)	--	--	Rare
Sharp-shinned hawk (*Accipiter striatus*)	X	X	Uncommon
Cooper's hawk (*Accipiter cooperii*)	--	--	Rare
Red-tailed hawk (*Buteo jamaicensis*)	X	--	Common-nesting
Red-shouldered hawk (*Buteo lineatus*)	--	X	Rare
Broad-winged hawk (*Buteo platypterus*)	X	--	Common-nesting
Marsh hawk (*Circus cyaneus*)	X	--	Uncommon
Osprey[3] (*Pandion haliaetus*)	X	X	Uncommon
Sparrow hawk (*Falco sparverius*)	X	X	Uncommon
Ruffed grouse[3] (*Bonasa umbellus*)	X	X	Common-nesting
Sandhill crane (*Grus canadenis*)	X	--	Rare-one seen flying over
American coot (*Fulica americana*)	--	X	Rare
American woodcock[3] (*Philohela minor*)	X	--	Common-nesting

(Table 2 cont. on next page)

(Table 2 cont.)

Species	Present Study	Hermann[1]	Status[2] and comments
Common snipe (*Capella gallinago*)	X	--	Rare
Spotted sandpiper (*Actitis macularia*)	X	X	Common-nesting
Solitary sandpiper (*Tringa solitaria*)	X	--	Rare-one seen on Groves Lake, Aug. 2, 1972
Herring gull (*Larus argentatus*)	X	X	Common
Black-billed cuckoo (*Coccyzus erythropthalmus*)	--	X	Rare
Great-horned owl (*Bubo virginianus*)	--	X	Rare
Barred owl (*Strix varia*)	X	--	Common
Whip-poor-will (*Caprimulgus vociferus*)	X	--	Uncommon
Nighthawk (*Chordeiles minor*)	X	X	Common
Chimney swift (*Chaetura pelagica*)	X	X	Common
Ruby-throated hummingbird (*Archilochus colubris*)	X	X	Uncommon
Belted Kingfisher (*Megaceryle alcyon*)	X	X	Common
Common flicker (*Colaptes auratus*)	X	X	Common
Pileated woodpecker (*Dryocupus pileatus*)	X	X	Uncommon
Yellow-bellied sapsucker (*Sphyrapicus varius*)	X	X	Common-nesting
Hairy woodpecker[3] (*Dendrocopos villosus*)	X	X	Common
Downy woodpecker (*Dendrocopos pubescens*)	X	X	Common
Black-backed woodpecker (*Picoides arcticus*)	X	--	Uncommon
Eastern kingbird (*Tyrannus tyrannus*)	X	X	Common-nesting
Alder flycatcher (*Empidonax alnorum*)	X	X	Common
Eastern phoebe (*Sayornis phoebe*)	X	X	Common-nesting
Least flycatcher (*Empidonax minimus*)	X	X	Common
Eastern wood pewee (*Contopus virens*)	X	X	Common
Olive-sided flycatcher (*Nuttallornis borealis*)	X	--	Uncommon
Tree swallow (*Iridoprocne bicolor*)	X	X	Common
Barn swallow (*Hirundo rustica*)	X	X	Common-nesting
Purple martin (*Progne subis*)	X	X	Rare
Gray jay[3] (*Perisoreus canadenis*)	X	--	Uncommon

(Table 2 cont. on next page)

(Table 2 cont.)

Species	Present study	Hermann[1]	Status[2] and comments
Blue jay[3] (*Cyanocitta cristata*)	X	X	Common
Common raven[3] (*Corvus corax*)	X	X	Common
Common crow[3] (*Corvus brachyrhynchos*)	X	X	Uncommon
Black-capped chickadee[3] (*Parus atricapillus*)	X	X	Common
Boreal chickadee[3] (*Parus hudsonicus*)	X	--	Uncommon
Red-breasted nuthatch (*Sitta canadensis*)	X	X	Common
Brown creeper (*Certhia familiaris*)	X	X	Uncommon
Winter wren (*Troglodytes troglodytes*)	X	X	Common
Catbird (*Dumetella carolinesis*)	--	X	Rare
Brown thrasher[3,4] (*Toxostoma rufum*)	--	X	Uncommon
Robin (*Turdus migratorius*)	X	X	Abundant-nesting
Hermit thrush (*Catharus guttatus*)	X	X	Common
Swainson's thrush (*C. ustulatus*)	X	X	Common-nesting
Veery (*C. fuscescens*)	X	X	Common-nesting
Golden-crowned kinglet (*Regulus satrapa*)	X	X	Common
Ruby-crowned kinglet (*Regulus calendula*)	X	X	Uncommon
Cedar waxwing (*Bombycilla cedrorum*)	X	X	Common
Starling[3,4] (*Sturnus vulgaris*)	--	--	Absent on Forest
Solitary vireo (*Vireo solitarius*)	X	X	Common
Red-eyed vireo (*Vireo olivaceus*)	X	X	Common
Black and white warbler (*Mniotilta varia*)	X	--	Uncommon
Tennessee warbler (*Vermivora peregrina*)	--	X	Uncommon
Nashville warbler (*Vermivora ruficapilla*)	X	X	Common
Northern parula (*Parula americana*)	X	X	Common
Yellow warbler (*Dendroica petechia*)	X	X	Uncommon
Magnolia warbler (*Dendroica magnolia*)	X	X	Common
Black-throated blue warbler (*Dendroica caerulescens*)	X	X	Uncommon
Yellow-rumped warbler (*Dendroica coronata*)	X	X	Common

(Table 2 cont. on next page)

(Table 2 cont.)

Species	Present study	Hermann[1]	Status[2] and comments
Black-throated green warbler (*Dendroica virens*)	X	X	Common
Blackburnian warbler (*Dendroica fusca*)	X	X	Common
Chestnut-sided warbler (*Dendroica pensylvanica*)	X	X	Common
Oven-bird (*Seiurus aurocapillus*)	X	X	Abundant
Northern waterthrush (*Seirus noveboracensis*)	--	X	Uncommon
Mourning warbler (*Oporornis philadelphia*)	X	X	Common
Yellowthroat (*Geothlypis trichas*)	X	X	Uncommon
American redstart (*Setophaga ruticilla*)	--	X	Uncommon
Red-winged blackbird (*Agelaius phoeniceus*)	X	X	Common
Common grackle (*Quiscalus quiscalus*)	X	X	Common
Brown-headed cowbird (*Molothrus ater*)	--	X	Uncommon
Scarlet tanager (*Piranga olivacea*)	X	X	Uncommon
Rose-breasted grosbeak (*Pheucticus ludovicianus*)	X	X	Common
Evening grosbeak (*Hesperiphona vespertina*)	X	X	Common
Purple finch (*Carpodacus purpureus*)	X	X	Uncommon
Pine grosbeak (*Pinicola enucleator*)	X	--	Uncommon
Pine siskin (*Spinus pinus*)	--	X	Uncommon
American goldfinch (*Spinus tristis*)	X	X	Uncommon
Red crossbill (*Loxia curvirostra*)	--	--	Uncommon
Vesper sparrow (*Pocecetes gramineus*)	X	--	Rare
Slate-colored junco (*Junco hyemalis*)	X	X	Common
Chipping sparrow (*Spizella passerina*)	X	X	Abundant
White-throated sparrow (*Zonotrichia albicollis*)	X	X	Abundant-nesting
Swamp sparrow (*Melospiza georgiana*)	--	X	Uncommon
Song sparrow (*Melospiza melodia*)	X	X	Common-nesting
Snow bunting (*Plectrophenax nivalis*)	X	--	Uncommon migrant in fall

[1] From list of F. J. Hermann, June 18-21, 1971.

[2] *Abundant*--very likely to be seen in large numbers in its habitat at the proper season; *common*--may be seen most of the time in the proper habitat in the proper season; *uncommon*--may be seen quite regularly in small numbers in the proper habitat and season; and *rare*--may be seen only on a small percent of trips and habitat is restricted. (Robbins et al. 1966)

[3] Discussed in text.

[4] Species seen only on County Road 607 leading to McCormick Forest.

Undoubtedly many species of birds that occur in the McCormick Forest went unobserved. Concerted effort by large numbers of people, especially during migration seasons, would probably reveal perhaps 50 additional species. Rice[3] has recently compiled a list of 225 species of birds sighted since 1900 at the Huron Mountain Club 8 to 12 miles north of the McCormick Forest. Rice suggests that it is possible for a single observer at the Huron Mountain Club to record 120 to 150 species in a summer season. By comparison, our list of 109 for 2 seasons on the McCormick Forest appears scanty. Because the Huron Mountain Club area borders on Lake Superior, however, and contains an abandoned dairy pasture, more bird habitats and species occur there than on the relatively uniformly forested and landlocked McCormick Forest.

In 1973 intensive efforts were made to census populations of the common loon and their reproductive success. Four nests were found; one each on Summit, Upper Baraga, Bulldog, and Raymond Lakes. Adult loons were also seen on Lake Margaret and Island Lake but they apparently did not nest. The nest on Upper Baraga Lake, which contained one egg, was incubated faithfully but did not hatch. The other three nests each contained two eggs and all of them hatched. All six young were still alive in mid-August. Thus a population of 11 to 12 adult loons produced 6 offspring on the McCormick Forest in 1973. The previous year an estimated 13 adults produced 4 young. During the 2 years the adult:young ratio was about 25:10 or 2.5:1. This compares favorably with a ratio of 4:1 reported by Olson and Marshall (1952) from northern Minnesota and 7.1:1 in British Columbia (Olson and Marshall 1952). The breeding range of the loon in Michigan has been rapidly restricted in recent years because of development of lakeshores and increased disruption of nesting areas by people engaged in recreation. It would appear that the isolated and undisturbed character of the McCormick Forest contributes substantially to the breeding success of its loon population.

Upper Michigan lies in a transitional area between the range of the black duck to the east and the mallard to the west (Johnston 1970). Seven sightings of mallards with two broods were made and five sightings of black ducks with two broods were made in the McCormick Forest, adding support to Johnston's (1970) contention that mallards slightly outnumber black ducks in Marquette County.

No osprey was seen in 1972, but in 1973 several sightings of a lone bird were made at Bulldog Lake and one sighting was made at Summit Lake. Hermann reported seeing an osprey in 1971.

In the summer of 1972, seven adult ruffed grouse were seen[4] in 35.5 miles of walking for an average of one adult grouse seen per 5.1 miles. In summer of 1973, 16 adult grouse were seen in 104 miles of walking for an average of 1 per 6.5 miles. In the winter of 1972-73, 11 grouse were seen in 70 miles of walking, or 1 per 6.4 miles. In 1972, 5 of the 7 adult ruffed grouse seen had broods, while in 1973 only 6 of the 16 adults had broods. Population density in 1972 as estimated by the King method (Robinette *et al.* 1974) was 17.3 adults per square mile while in 1973 it was 15.0 per square mile. Estimates made by the Kelker method were 30.2 and 18.1 birds per square mile for 1972 and 1973, respectively. These densities compare with 17 to 31 per square mile in the Adirondack Mountains of New York (Bump *et al.* 1947), 5 to 54 per square mile in Lower Michigan (Palmer and Bennett 1963), and 27 to 40 per square mile in Alberta (Rusch and Keith 1971), to pick a few examples. Thus, ruffed grouse populations are comparable to those in other areas.

On the evening of May 31, 1973, nine singing male woodcock were counted on a 1.8-mile route extending from the spruce barrens along the Peshekee River down County Road 607 and up the McCormick Road along Baraga Creek. About nine woodcock were seen performing in mid-May on the spruce barrens.[5]

In summer, six hairy and five downy woodpeckers were sighted, indicating a nearly even ratio of the two species. In winter, however, the downy was more prevalent, with 18 downy to only 7 hairy woodpeckers seen.

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[3] *R. A. Rice. Unpublished revised checklist, Huron Mountain Birds. 22 p. Huron Mountain Club, Big Bay, Mich. 1974.*

[4] *In this case and others similar throughout the paper, some animals may have been "seen" or "sighted" more than once.*

[5] *Reported by James Haveman.*

Of the 2 jays recorded, sightings of the blue jay outnumbered those of its northern relative, the gray jay, by 16 to 6 in the summer. In winter, however, we saw three gray jays but no blue jays. Although the blue jay is found in Marquette County commonly in winter, it apparently associates closely with man during that season.

Black-capped chickadees outnumbered boreal chickadees in summer with 9 sightings to 3 and in winter by 26 to 2.

Ravens were far more commonly seen than crows, with 6 summer and 17 winter sightings of ravens to only 3 summer sightings of crows.

Eleven species of birds were seen in the winter. Species and numbers seen were: black-capped chickadee (26), downy woodpecker (18), raven (17), ruffed grouse (11), hairy woodpecker (7), pileated woodpecker (3), gray jay (3), boreal chickadee (2), black-backed woodpecker (1), red-breasted nuthatch (1), and brown creeper (1). A goshawk and a blue jay were seen on County Road 607 in winter several miles south of the McCormick Forest.

Mammals

Insectivora

Masked shrew (Sorex cinereus).--The masked shrew was found in all habitat types in densities of up to 11 per acre[6] (table 3). Ozoga and Verme (1968) found this species to be the most common small mammal in conifer swamps in the east-central Upper Peninsula (UP). Manville (1949) found masked shrew densities of 0.2 per acre in hemlock habitat and 4.2 per acre in a cedar swamp in the Huron Mountain area. Laundre (1974) in the same area found densities of 8.1 per acre in maples and 4.6 per acre in open meadows. It appears that shrew densities in the McCormick Forest were quite high in 1972.

Arctic shrew (Sorex arcticus).--Eight arctic shrews were captured, four each in the hardwood-pine and bog areas. Ozoga and Verme (1968) also caught this species in conifer swamps in the east-central UP. Neither Laundre (1974) nor Manville (1949) caught arctic shrews in their studies of mammals in the Huron Mountain area.

Water Shrew (Sorex palustris).--One water shrew was collected in a pitfall set for amphibians near Camp 11 Lake in July 1972. Another was seen on July 1, 1972, on the Yellow Dog River. This species is apparently not common anywhere (Burt 1948). Manville (1942) captured two water shrews in the Huron Mountain area, but Laundre (1974) caught none in that area. Ozoga and Verme (1968) likewise reported no captures of this species in their work in conifer swamps in Alger and Schoolcraft Counties.

Pigmy shrew (Microsorex hoyi).--Eleven pigmy shrews were captured during the study with population densities of up to only 3 per acre in the bog. None were caught in hardwood-pine habitat. Manville (1949) caught three pigmy shrews in the Huron Mountains but Laundre (1974) caught none. Ozoga and Verme (1968) captured none in the east-central UP. It appears that populations of pigmy shrews were unusually high on the McCormick

[6] *Haveman (1973) gives details of shrew distribution, food habits, and population in the McCormick Forest.*

Table 3.--*Shrew population densities on the McCormick Forest*
(In number per acre[1])

Habitat	*Year*	*Sorex cinereus*	*Sorex arcticus*	*Microsorex hoyi*	*Blarina brevicauda*
Bog	1972	6	4	2	5
Bog	1973	5	0	3	3
Spruce swamp	1972	11	0	2	7
Spruce barrens	1972	4	0	1	1
Hardwood-pine	1972	9	4	0	19
Hardwood-pine	1973	4	0	0	7

[1]Determined by trapping a 1-acre plot for 5 days. Only areas trapped one time are included because the high rate of removal probably influences subsequent estimates.

Forest as Burt (1948) noted only four records from the UP.

Short-tailed shrew (Blarina brevicauda).--The short-tailed shrew was the most frequently captured shrew, with 48 being taken, and at least 1 from each habitat sampled. In 1972, 1 hardwood-pine plot had a density of at least 19 per acre. Manville (1949) found densities of up to 12 per acre in the Huron Mountain area, and Laundre (1974) found densities of up to 8 per acre. Highest densities were in the hardwood-pine area on the McCormick Forest, but other authors (Manville 1949, Ozoga and Verme 1968, Nofz 1972) report high densities from wetter areas. Apparently this abundant shrew has rather cosmopolitan habitat preferences.

Chiroptera

Little brown bat (myotis lucifugus).--The little brown bat was the only species of bat identified on the Forest. A colony of about 200 occupied the buildings near White Deer Lake. The colony was examined several times but no other species was found. The little brown bat is undoubtedly the most common bat in northern Michigan. Bats were not common on lakes other than White Deer and Bulldog.

Carnivora

Black bear (Euarctos = Ursus americanus).--Tracks, droppings, and diggings of bears were found throughout the Forest. Two bears were seen in 1973, a yearling near Baraga Lakes and a large adult in the southwest corner of the Forest. The black bear is probably as abundant on the Forest as elsewhere in the UP. Because of the low level of human usage, however, the bears in the McCormick Forest are not prone to scavenging from human food supplies or refuse, and remain quite secretive.

Raccoon (Procyon lotor).--The raccoon has become common in the northern Upper Peninsula only in the past 25 years (DeVos 1964, Laundre 1974). Tracks were found along Lower Baraga Lake and along the east branch of the Yellow Dog River. A lactating female was observed closely with a spotlight from a canoe on Lower Baraga Lake on June 25, 1973. Raccoons seem to maintain low numbers in the McCormick Forest.

Weasels (Mustela erminea *and* M. frenata).--The ermine (short-tailed weasel) and long-tailed weasel are combined in this discussion because of the difficulty of distinguishing their tracks. Only one weasel, an ermine, was seen during the study. Tracks of 20 weasels were encountered during the winter indicating that they are widespread in the Forest but not abundant. Laundre (1974) collected a short-tailed weasel and the skull of a long-tailed weasel in the Huron Mountains in 1973. Manville (1942) collected six short-tailed and four long-tailed weasels in the Huron Mountain area.

Fisher (Martes pennanti).--The fisher was a former resident of Upper Michigan but was apparently trapped to extinction by the 1930's (Brander and Books 1973, Irvine *et al.* 1964, Manville 1942). Between 1961 and 1963, 61 fishers from Ontario were released in Iron County, about 90 miles southwest of the McCormick Forest. Continued collection of specimens indicates that the fisher has become re-established in Michigan (Brander and Books 1973). In the McCormick Forest five fisher tracks were found in the winter of 1972-73. Their location and travel routes indicated that there were probably no more than two present. Laundre (1974) found two sets of fisher tracks in the Huron Mountains in 1973-74. It appears that the fisher is present in low densities on the McCormick Forest.

Mink (Mustela vison).--Mink are common in the McCormick Forest although they are not frequently seen. On October 25, 1969, I saw one on the Peshekee River beneath the McCormick Road bridge. Seven mink tracks were found on March 20, 1973, and tracks were seen in the summer along the Peshekee River and Lower Baraga Lake. Laundre (1974) and Manville (1942) also found mink to be common in the Huron Mountains.

Otter (Lutra canadensis).--One otter was seen on a bog pond south of Lake Dortay. Scats were found at Lower Baraga and Island Lakes. In the winter eight otter tracks were found in various locations throughout the Forest. Similar low density but probably typical otter populations appear to exist in the Huron Mountains area (Laundre 1974).

Red fox (Vulpes fulva).--One fox was seen on the Forest and another about a mile south of it. Only four fox tracks were found during the winter. Manville (1942) reported foxes to be numerous in the Huron Mountain area, with 23 killed in 1932 and 1933. Laundre (1974) also regarded them as common there. The red fox appears to be uncommon on the McCormick Forest.

Coyote (Canis latrans).--One coyote was seen about 2 miles west of the Forest and one was heard howling in the southwest corner of the Forest. A few scats and tracks were found in the summer; 22 tracks were found during the winter. The coyote is uncommon, probably because it prefers open or semi-open country to heavily wooded terrain. Manville (1942) reported that the coyote was common in the Huron Mountain area but Laundre (1974) suggests it is uncommon there recently.

Wolf (Canis lupus).--It is estimated that only 6 to 10 native wolves remain in the Upper Peninsula after populations declined sharply in the late 1950's (Hendrickson *et al.* 1975). Four radio-tagged wolves were released in the Huron Mountains in March 1974 but none of these entered the McCormick Forest. In May 1972, tracks of a wolf were seen[7] in the southwest part of the Forest. One was reported near Wolf Lake, about 5 miles southwest of the Forest in November of 1973. It can be concluded that the wolf is all but absent from the study area.

Bobcat (Lynx rufus).--Thirteen bobcat tracks were found during the winter and 3 in the summer. Laundre (1974) reported seeing a bobcat in the Huron Mountains and a few tracks. Manville (1942) reported the bobcat to be present but not abundant there. In the McCormick Forest bobcats seem to be somewhat more abundant than in the Huron Mountains, possibly because the snowshoe hare, its principal prey, is also more abundant.

Rodentia

Woodchuck (Marmota monax).--Nine sightings of woodchucks were made in the McCormick Forest. One was on the spruce barrens, another on the road, and the rest near the buildings at White Deer Lake; two sightings were in 1972, and seven in 1973. On County Road 607, south of the Forest, 4 sightings of woodchucks were made in 1972 and 19 in 1973. It is likely that the population increased in 1973. In the Huron Mountains both Manville (1942) and Laundre (1974) considered the woodchuck common. In the more continuous cover of the McCormick Forest it seems to be uncommon.

Least chipmunk (Eutamias minimus) *and Eastern chipmunk* (Tamias striatus).--Both species of chipmunks are abundant in the Forest. Because of their abundance and conspicuous diurnal behavior, all sightings of chipmunks were not recorded. They were present in all habitats except the bog and there seemed to be little distinction between habitats of the two species.

More least chipmunks (33) than eastern chipmunks (29) were sighted on the Forest. On County Road 607, 46 sightings of least chipmunks were made to 31 of the eastern.

Laundre (1974) reported a decline in least chipmunks in the Huron Mountains between 1972 and 1973. No such decline appeared in the McCormick Forest with 16 recorded sightings in 1972 to 17 in 1973. (Sightings were recorded while we were walking but only on certain days.) Along County Road 607 in 1972, however, 27 sightings were made in 1972 to 19 in 1973, despite the fact that about 20 percent more miles were driven in 1973. Differences in population levels between the 2 years were not statistically significant.

Red squirrel (Tamiasciurus hudsonicus).--The red squirrel is common in the McCormick Forest; 29 were sighted during the study. During winter, 143 red squirrel tracks were found in 56 miles of hiking. Laundre (1974) recorded a sharp decline of this species in the Huron Mountain area between 1972 and 1973. No decrease in red squirrel numbers could be noted in the McCormick Forest with 11 sightings in 1972 and 18 in 1973. On County Road 607, however, eight squirrels were seen in 1972 and four in 1973. Laundre (1974) estimated a population of about 11 per acre in the Huron Mountains in summer of 1972 based on a call census. Although no quantitative data on density were gathered on the Forest, I estimate that there was less than one red squirrel per acre.

Northern flying squirrel (Glaucomys sabrinus).--Assessing the population of flying squirrels is difficult because of their secretive, nocturnal habits. During night lighting we saw one along the shore of White Deer Lake and one was heard along Bulldog Lake. Tracks of four flying squirrels were found in the snow at various locations, and it is possible that some tracks identified as red squirrel tracks could have been those of flying squirrels. Manville (1942) saw nine flying squirrels in 29 weeks in the Huron Mountain Club

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[7] *By Donald Lappala, USDA Forest Service, Iron River.*

between 1939 and 1942. Laundre (1974) saw only two in about 16 weeks in 1972 and 1973, about the same frequency as our two observations. The flying squirrel appears to be uncommon in the McCormick Forest.

Beaver (Castor canadensis).--The beaver is very common on the McCormick Forest. Night lighting produced 15 sightings, and 12 other beavers were seen in the daytime. Active colonies were present on practically every waterway and lake. At least 17 colonies with 9 known active lodges were present in 1973. Using Bradt's (1938) estimate of 2.4 beavers per colony with no lodge and 4.0 per colony with a lodge, at least 55 beavers were present. Using Manville's (1942) estimate of 5.1 beaver per colony a total of 87 beavers is obtained. Assuming that we may not have found several colonies, an estimate of a summer population of 70 to 100 beavers (2.6 to 3.8 per square mile) is probably realistic. This compares with 1.8 beavers per square mile in 1973 (Laundre 1974) and 4.7 per square mile in the early 1940's (Manville 1942) in the Huron Mountain area. Beaver trapping is permitted on the Forest but only one trapper was known to have trapped there. He caught an adult beaver in March 1972 on an un-named stream in Section 11.

Deer mouse (Peromyscus maniculatus).--Deer mice were abundant on the McCormick Forest; densities ranged up to 43 per acre in mature upland forest (table 4). Manville (1949) found somewhat lower densities than this in the Huron Mountain area but Laundre (1974) found about 36 mice per acre in the mature maple forest there. By adjusting Manville's calculations to assume a somewhat smaller area of trap influence, Laundre concluded that Manville's deer mouse population densities were actually similar to his. Terman (1968) in reviewing literature, notes that populations greater than 11 per acre may be exceptionally high. It appears that deer mouse populations in the proper habitat in northern Michigan are very high relative to those in other areas.

Southern bog lemming (Synaptomys cooperi).--We caught only three bog lemmings, one each in the bog, spruce-blueberry barrens, and the hardwood-pine forest. Both Manville (1942) and Laundre (1974) reported this species to be rare in the Huron Mountain area and that evaluation seems to apply in the McCormick Forest.

Boreal redback vole (Clethrionomys gapperi).--The redback vole is probably the second most common but the most widespread mouse in the McCormick Forest (table 4). It was found in all habitats sampled except the bog. Densities of six to eight voles per acre were estimated in the white birch-aspen and mature hardwood-white pine areas, consistent with densities in other areas (Laundre 1974, Jackson 1961, Manville 1949). Manville (1949) also found this species over a wide range of habitats in the Huron Mountains.

Meadow vole (Microtus pennsylvanicus).--Meadow voles were captured only in the bog

Table 4.--*Estimated population densities of small rodents on the McCormick Forest*
(In animals per acre)

Habitat	Deer Mouse	Red-backed vole	Meadow mouse	Bog lemming
Hardwood-white pine, 1972[1]	43[2]	8	0	2
Hardwood-white pine, 1973	19	6	0	0
White birch-aspen, 1972	5	6	0	0
Spruce-blueberry barrens, 1972	2	2	0	2
Spruce swamp, 1972	0	2	0	0
Bog, 1972	0	0	8	2

[1]Estimates in this plot are based on a Lincoln Index (Giles 1969) of animals originally captured in live-traps and subsequently recaptured in pitfalls.

[2]Standard estimate against which catch per trap-night in live-traps or pitfalls in other habitats were compared.

habitat where six specimens were taken. This species prefers dense grassy cover (Jackson 1961) and sometimes reaches densities of up to 2,000 per acre (Aumann 1965). In the McCormick Forest populations are apparently scattered and not very dense where they do occur in grassy bogs and beaver meadows. Manville (1949) captured several meadow voles in bog and meadow habitats in the Huron Mountains but Laundre (1974) caught only one. Nofz (1972) likewise found low populations in the Keweenaw Peninsula, although it was present in a variety of habitats, and Ozoga and Verme (1968) found small numbers of meadow voles in conifer swamps in Alger and Schoolcraft Counties. Investigators in Upper Michigan have not reported more than 10 voles per acre; thus it appears that meadow voles do not reach high densities in this area.

Muskrat (Ondatra zibethica).--Probably all the lakes and streams in the McCormick Forest support muskrats. Nowhere are they abundant, however, probably because there are no extensive marshes or shallows with rich emergent vegetation that muskrats thrive on. Tracks, droppings, or muskrats themselves were seen on Bulldog, White Deer, Round, Margaret, Groves, Island, and Baraga Lakes. Laundre (1974) and Manville (1942) both concluded that the muskrat is common in the Huron Mountains but not abundant. The same can be said for the McCormick Forest.

Meadow jumping mouse (Zapus hudsonius) *and woodland jumping mouse* (Napeozapus insignis).--Five meadow jumping mice were found during the study. Two were trapped in pitfalls in the hardwood-white pine area, one was trapped in live-traps in the birch-aspen area, and two juveniles were caught by hand near Lower Baraga Lake. A jumping mouse of undetermined species was seen near Groves Lake, and a woodland jumping mouse, identifiable by its white-tipped tail, was seen near Summit Lake. Densities of both species are probably less than one mouse per acre. Manville (1949) and Laundre (1974) also found low densities of jumping mice in the Huron Mountain area and Ozoga and Verme (1968) found very low populations of both species in swamps in east-central Upper Michigan. Nofz (1972) found similar low densities of woodland jumping mice in the Keweenaw Peninsula but somewhat higher densities of meadow jumping mice. Although he gave no estimate of population density, Nofz' catch per unit effort and relative density (15 percent of the small mammals captured in swamp habitats) indicate populations several times denser than those in northern Marquette County and east-central Upper Michigan. Such differences, however, could be accounted for by annual variations in numbers.

Porcupine (Erethizon dorsatum).--Casual observations indicate that porcupines in northwestern Marquette County have declined in the past 20 years and are no longer common. In the McCormick Forest only three porcupines were seen in the 2 years of this study. Although hemlock groves were searched carefully in the winter, no signs of porcupine could be found, and not a single track was seen in 69 miles of walking. Manville (1942) saw 20 porcupines in 31 days afield in summer of 1942 in the Huron Mountains, and in 1939, 36 porcupines were killed along Cedar Creek near the Huron Mountains. Laundre (1974) found porcupine populations to be sparse in the Huron Mountains. Whether or not the decline in porcupines is related to the re-establishment of the fisher, which preys upon them, can only be speculated.

Lagomorpha

Snowshoe hare (Lepus americanus).--Snowshoe hares were abundant on the McCormick Forest. Fifteen animals were seen, and their tracks could be found in winter in nearly all areas where coniferous trees were growing. A winter track count kept during 51 miles of walking in a typical assortment of habitats yielded an index of 1.0 snowshoe hare tracks per-10-miles per-hour-since-snowfall. On January 30, 1973, a walk of 5.5 miles in good snowshoe hare habitat along the south border of the Forest crossed 308 hare tracks laid down in the previous 48 hours for an index of 11.3 tracks per-10-miles per-hour-since-snowfall. On May 17, 1973, an observer[8] saw five hares together within 20 feet of him near the bridge on the McCormick Road. Snowshoe hares are considerably more abundant on the McCormick Forest than in the Huron Mountains (Laundre 1974). Hares are subject to great fluctuations in populations (Keith 1963). To what extent their density in the McCormick Forest is temporary cannot be determined without long-term observations.

Artiodactyla

White-tailed deer (Odocoileus virginianus).--Deer are common in the McCormick Forest from May through November. They apparently winter near

[8] *James Haveman.*

Lake Superior 8 to 18 miles to the north, possibly in the Huron Mountain area (Westover 1971). During the winter of 1972-73 the last deer track on the McCormick Forest was found on January 23 and the first returning tracks were seen on April 24. On that date tracks of about 30 deer were seen along Baraga Lakes trail and crossing the McCormick Road. About 95 percent of these were headed south, probably migrating from winter yards in the north.

We saw 44 deer during 72 trips to the study area, an average of 0.61 deer per trip. These 44 deer were in 31 groups of 1 to 4 animals, so the probability of seeing a deer on a trip to the study area was 0.43. On County Road 607 between highway U.S. 41 and the McCormick Forest, nine deer were seen.

In the 1972 deer-hunting season an 8-point buck was shot on opening day in the southwest part of the Forest and several bucks were reportedly taken along the northern boundary (Robinson 1973). Ryel *et al.* (1972) estimated, on the basis of pellet counts, an average of about six deer per square mile in the Lake Superior Watershed in 1972. Laundre (1974) made extensive pellet counts in the Huron Mountains in the spring of 1974 and estimated a deer population there of 74 deer per square mile in the winter yard. Because of relatively mild winters since 1969, the deer population appears to be increasing somewhat.

Man (Homo sapiens).--Although evidence of man's former presence in the McCormick Forest is abundant in the form of old roads, dams, and cut stumps, people were encountered less frequently than deer and beaver. Since 1970 it has been illegal to drive any wheeled vehicle past the gate off County Road 607, and overnight camping has been prohibited. In 28 trips in 1972, 9 automobiles other than our own were seen parked at the gate and in 1973 only 4 were seen there in 44 trips. A total of 15 visitors, excluding research and management personnel, were encountered during the 2 summers. Only three instances of illegal overnight camping were found. On November 15, 1972, the opening of deer-hunting season, six people legally camped at the gate. Human use may be more frequent in winter. On the weekend of February 24, 1973, an observer reported that 24 people in small groups had snowshoed and skied to and from the lodge at White Deer Lake.

On summer nights all sounds of human origin other than our own were noted. In 21 hours of listening and canoeing only three airplanes and two trucks could be heard for an average of less than one machine sound per 4 hours. On July 28, 1972, and January 3, 1973, when the air was somewhat stagnant, the odor of iron ore pelletizing was noted. The source was probably the operations at Humboldt or Republic 12 to 18 miles to the southeast.

Other Mammals Possibly Present

Some species of mammals besides those discussed may be present on the McCormick Forest because they are present in the Upper Peninsula, but for various reasons were not seen or identified on the study area.

Opossum (Didelphis marsupialis).--This mammal is extending its range northward. Only two reports are known from the UP, one from Iron County, 60 miles southwest of the McCormick Forest, and one from Gogebic County, 100 miles southwest (Ozoga and Gaertner 1963). The oppossum is probably not present on the McCormick Forest.

Star-nosed mole (Condylura cristata).--This mole is found in the Huron Mountain Club (six specimens, Laundre 1974); 9 miles northeast of McCormick Forest, and is probably present in the McCormick Forest.

Keen bat (Myotis keenii).--Specimens of this uncommon bat have been collected from Baraga and Marquette Counties according to University of Michigan Museum of Zoology Records and in the Keweenaw Peninsula (Stones and Fritz 1969). It is probably present on the McCormick Forest.

Silver-haired bat (Lasionycteris noctivagans).--Manville (1942) reported seeing a silver-haired bat in the Huron Mountain Club although Laundre (1974) found none in that area. Stones and Holyoak (1970) collected one in 1970 in northern Houghton County. It may be present but rare in the McCormick Forest.

Big-brown bat (Eptesicus fuscus).--This bat was seen by Manville (1942) but not by Laundre (1974) in the Huron Mountain Club. Stones and Fritz (1969) found this species in mines in the Keweenaw Peninsula. It is probably present in the McCormick Forest.

Red bat (Lasiurus borealis).--It is likely that this species is present on the

McCormick Forest although neither Manville (1942) nor Laundre (1974) found it on the Huron Mountain Club. The University of Michigan Museum has specimens from Chippewa and Gogebic Counties. Nichols and Stones (1971) reported it on Isle Royale.

Hoary bat (Lasiurus cinereus).--Neither Manville (1942) nor Laundre (1974) found this bat in the Huron Mountain area. Specimens in the University of Michigan Museum include one from Gogebic County (1920) and two from Keweenaw County (1948). Its status in the McCormick Forest is unknown.

Marten (Martes americana).--The marten was extinct from about 1920 until 99 were released in 1969 and 1970 about 60 miles southeast of McCormick Forest. Laundre (1974) saw one on Huron Mountain Club in July 1973 10 miles north of McCormick Forest, but no other nearby reports of specimens have been made.

Striped skunk (Mephitis mephitis).--This animal is common near civilized and agricultural areas of the UP. There may be only an occasional individual in the McCormick Forest.

Badger (Taxidea taxus).--The badger is rare in most of the UP. Manville (1942) reported signs of one in Huron Mountains and Long (1972) examined a specimen collected near Sands in central Marquette County. It is probably not present in the McCormick Forest.

Gray fox (Urocyon cinereoargenteus).--Laundre (1974) reported seeing a gray fox in the Huron Mountain Club and several specimens have been taken from Central UP (Ozoga and Verme 1966). An occasional individual may be present.

Lynx (Lynx canadensis).--Harger (1965) reports possible resurgence of this species in the UP with 12 specimens taken in 1962. A lynx was killed near Negaunee in June 1972, 30 miles east of the McCormick Forest. Occasional individuals may be present.

Domestic cat (Felis domesticus).--Laundre (1974) reported seeing a feral house cat in the Huron Mountain area and an emaciated cat was found on the Yellow Dog Plains, 3 miles north of the McCormick Forest in fall of 1972.[9] It is not likely that the domestic cat could survive in the McCormick Forest.

Thirteen-lined ground squirrel (Spermophilus tridecem-lineatus).--One was captured by us by hand 8 miles south of the McCormick Forest in July 1972. Has also been reported from Big Bay and the Huron Mountain area (Phillips and Robinson 1969, Laundre 1974). Because of lack of grassland habitat it is probably absent from the McCormick Forest.

Gray squirrel (Sciurus carolinensis).--The reason for the absence of this species in the McCormick Forest is a mystery. None were seen and no nests, gnawings, or tracks were found despite careful search and the presence of several large mature oak stands and good acorn crops. I have seen gray squirrels near Big Bay, and on the Yellow Dog Plains, 5 miles northeast of the McCormick Forest (October 1973) along U.S. 41, 7 miles south of the McCormick Forest, and near Skanee, 12 miles northwest of the McCormick Forest. Nofz (1972) reported them from Keweenaw County. Because the gray squirrel has been slowly spreading its range northward, it is possible that all gaps in its range have not been filled in yet and the McCormick Forest may be one such gap.

Southern flying squirrel (Glaucomys volans).--Two specimens were recently captured by James Haveman in central Marquette County, the farthest north this species has been reported.[10] It is not likely that it has reached the McCormick Forest.

Norway rat (Rattus norvegicus).--Manville (1942) reported the rat at the Huron Mountain Club prior to 1906 and Laundre (1974) mentioned possible rats there in the late 1960's, but none in the early 1970's. Nofz (1972) reported this species in wild lands in the Keweenaw Peninsula. It can be found in cities in the UP. It is unlikely, however, that rats occur on the McCormick Forest.

House mouse (Mus musculus).--Manville (1942) captured four house mice in the Huron Mountain area but Laundre (1974) found no evidence of them there in the early 1970's. It is probably absent on the McCormick Forest.

Cottontail rabbit (Sylvilagus floridanus).--In northern Upper Michigan the cottontail is associated only with civilization. Isolated populations exist in the cities with practically no rabbits found in wooded areas between.

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[9] *By Fred Rydholm, 1973.*

[10] *J. Haveman and W. L. Robinson. Occurrence of the southern flying squirrel in Upper Michigan. Jack Pine Warbler. (In press.)*

No evidence of cottontails was found in the McCormick Forest and it is unlikely that they are present there. Manville (1942) reported them in the Huron Mountain Club but Laundre (1974) reported only possible recent sightings and believes the cottontail to be absent from that area as well.

Moose (Alces alces).--No sign of moose was found during this study. This animal formerly ranged throughout the UP. It is still present in low numbers. In the winter of 1968-69 tracks and droppings of a moose were found on the Yellow Dog Plains about 3 miles northeast of the McCormick Forest. In May 1972 a 3-year-old bull was found dead 8 miles west of the McCormick Forest and autopsied by Department of Natural Resources biologists. In July 1973 a cow was seen by a DNR employee near Craig Lake about 7 miles west of the study area. It is likely that an occasional moose wanders through the McCormick Forest.

It is likely that the present populations of birds and mammals of the McCormick Forest are similar to those found throughout most of the 1,000-square-mile area that lies north of U.S. Highway 41 between Marquette and L'Anse. Future changes may occur, however, as the human population expands, and invasion of wild areas by people increases. Natural succession may also play a role in changing the biological communities present. Future studies may reveal the nature and extent of these changes.

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AMPHIBIANS AND REPTILES

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ABSTRACT.--During the spring and summer of 1972 and 1973, a herpetological survey was conducted in the Cyrus H. McCormick Experimental Forest in Marquette and Baraga Counties, Michigan. Eleven amphibian and 5 reptile species were found. The 16 species represent 62 percent of the known herptofauna of the area. During the summer of 1973 population estimates were made on common amphibians that inhabited a bog, stream, woods, and marsh-pond habitat. The estimates were converted to biomass per hectare. About twice as much amphibian biomass was found in the bog (43,257 grams) as in the pond (26,323 grams) and three and a half times as much in the bog as in the stream (12,164 grams). The hardwoods were the least productive accounting for 730 grams per hectare.

Amphibians and reptiles are among the least known, the least studied, and the least abundant vertebrate fauna of the Upper Peninsula of Michigan. Since the early surveys of Ruthven *et al.* (1928), fewer than six published articles have dealt exclusively with Upper Peninsula herptofauna. Only two references (Manville 1948, Johnson[1]), include locality records in the vicinity of the McCormick Forest in western Marquette and eastern Baraga Counties. These authors list 16 species of amphibians and 10 species of reptiles for the central Upper Peninsula in which the McCormick Forest is located. Range maps by Conant (1958) indicate that about half of these species extend no further north than Lake Superior, just 15 miles from the McCormick Forest.

During 1972-73, a herpetological survey was undertaken as part of a general inventory of vertebrate fauna of the McCormick Forest (Werner 1973, Robinson 1973). Because the forest had not been previously surveyed, new locality records were established for all species found and information was collected on the distribution and abundance of each species. In 1973, the studies were expanded to estimate population densities and standing crop figures for the common amphibian species.

MATERIALS AND METHODS

During the spring and summer of 1972 and 1973, my student assistants and I surveyed the Forest (described by Robinson, Part I, this report) on foot or by canoe. Amphibians and reptiles were captured by various techniques including open pitfalls, minnow traps, seines dip nets, and hand.

From early May through June of 1973, four areas were selected for intensive study based on the presence of known populations. The four areas are as follows. (1.) The bog site (NW¼ of NW¼, Sec 11, T49N, R30W; fig. 1) consisted of 0.18 hectare of northern bog. About two-thirds of the area was covered by 15 to 30 cm of standing water; the remaining area was matted with *Sphagnum* moss, pitcher plants (*Sarracenia purpurea*), sweet gale (*Myrica gale*), leatherleaf (*Chamaedaphne calyculata*), cranberry (*Vaccinium* sp.), and other bog plants. The site was bounded on the east by a high rock ledge and on two sides by stands of tamarack (*Larix laricina*), tag alder (*Alnus rugosa*), and leatherleaf. The northern end was open to a larger bog area.

(2.) The pond site (SE¼ of NE¼, Sec 10, T49N, R30W; fig. 1) consisted of 0.21 hectare of pond-marsh habitat in which various

[1] *Wendel John Wagner Johnson. A Zoogeographical analysis of the herptofauna in northern Michigan and adjacent Isle Royale. 90 p. Unpublished M.S. Thesis, Mich. State Univ. 1965.*

unidentified grasses and sedges predominated although a few bog plants such as leatherleaf and sweet gale were also present. At the beginning of the study period, about half of the area was under 8 to 46 cm of water which receded to cover less than one-eighth of the area at the end of the period. The site was bounded on all four sides by steep rock cliffs or forested hills, except where a stream entered and departed through narrow gaps in the rock.

(3.) The stream site (SE¼ of NW¼, Sec 10, T49N, R30W; fig. 1) consisted of 95 m of stream, which varied from 0.61 to 1.83 m in width and from 5 to 46 cm in depth. Gravel and scattered boulders lined the streambed except for back eddies of loose silt. The water was generally fast moving, dropping about 6 m in the 95 m of stream. The grid site extended into the forest 3 m on each side, thus, the stream grid encompassed 0.11 hectares.

(4.) The woods site incorporated three separate plots in mixed hardwoods. The dominant canopy trees in one plot (NW¼ of NW¼, Sec 11, T49N, R30W; fig. 1) were white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*). In the second and third plots (SE¼ of NE¼, Sec 30, T50N, R29W) sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) predominated.

The bog, pond, and stream sites were gridded into 10-by 10-ft (3.03-by 3.03-m) plots using 12-gauge wire and small colored plastic markers. The grids were sampled a minimum of six times at about 3-day intervals (2 to 4 days). During each sampling period, two groups of students of three to four individuals each, spent about 3 hours carefully searching the entire grid in an orderly sequence. All animals captured (either by hand or nets) were toe-clipped, measured (body length, head width), sexed (when possible), and released. About 75 percent of the sampling was done at night using headlamps. Populations were estimated by the Schumacher method (DeLury 1958) or as otherwise indicated.

The only amphibian found with regularity in the hardwood areas was the red-backed salamander (*Plethodon cinereus*). Because mark and recapture techniques are not successful with this amphibian, two alternative methods of sampling were used and the results averaged. In the first method (Heatwole 1962) a total of 30 square-meter plots was layed out at 10-meter intervals on a fixed grid and analyzed layer by layer down to and including the A_2 soil horizon. The second method, referred to as the suitable habitat method, was based on the assumption that the majority of individuals in any one area are found in or under decaying logs. The assumption was based on extensive field work in the area and supported by Heatwole for northern hardwood regions.

In the suitable habitat method, 1 square meter of log (diameter x appropriate length) from each of 10 randomly selected logs in the grid was examined carefully piece by piece and a frequency index established based on the average number of salamanders per volume of log. The volume of the log rather than its area was chosen for final analysis because it was more indicative of the amount of habitat examined. To calculate volume, the diameter and length measurements of the square meter were considered as delineating a cylinder whose volume was determined by the formula $\pi r^2 h$, where r is the radius and h the length. Following establishment of a frequency index, a straight line of 91 m (300 feet) was then laid out by compass through the grid and the number and volume of suitable logs 1 m on each side of the line was recorded. From the total area canvassed and the frequency index, the total number of salamanders per hectare was estimated.

Biomass figures were derived by constructing a weight-length curve for each species from measurements made in the field on 10 to 50 live individuals. The values were converted to log values and plotted on graph paper, yielding approximate straight lines, whose equations were determined by the method of least squares (table 1). The equations were used to convert all individual measurements to biomass.

RESULTS

Survey

The species encountered, their density index, general habitat types, and locality records are summarized in table 2. Two snakes (ring-necked (*Diadophis punctatus*), and red-bellied (*Storeria occipitomaculata*)), and one salamander, the four-toed salamander (*Hemidactylium scutatum*), were found only once and are considered rare.

Table 1.--*Regression equations of body weight (y) on body length (x) for amphibian species found in the McCormick Forest.*

Species	N	Equation
R. catesbiana	13	log Ye = -4.149 + 2.89 logx
R. clamitans	58	log Ye = -4.147 + 2.88 logx
R. septentrionalis	36	log Ye = -5.339 + 3.20 logx
R. pipiens	34	log Ye = -4.150 + 2.84 logx
R. sylvatica	27	log Ye = -4.637 + 2.52 logx
H. crucifer	26	log Ye = -4.485 + 2.41 logx
B. americanus	35	log Ye = -5.854 + 3.07 logx
P. cinereus	44	log Ye = -4.201 + 2.58 logx

Table 2.--*Summary of amphibian and reptile survey of the McCormick Forest, 1972-73.*

Species	Frequency index[1]	Habitat	Number of section where found[2]
Caudata			
Plethodon cinereus (Red-backed salamander)	Common	Wooded uplands	1, 2, 3, 10, 19, 22, 23, 30, 32
Hemidactylium scutatum (Four-toed salamander)	Rare	Bog	15
Ambystoma laterale (Blue-spotted salamander)	Few	Ponds, bog, marsh	2, 3, 11, 22, 32
Notophthalmus viridescens (Central newt)	Few	Lakes	3, 11, 31, 35
Anura			
Bufo americanus (American toad)	Common	Wooded uplands, lakes, marshes, ponds, bogs streams	1, 2, 3, 7, 10, 11, 12, 22, 23, 26, 34
Rana clamitans (Green frog)	Common	Lakes, ponds, marsh, bogs, streams	1, 2, 3, 7, 10, 11, 12, 22, 23, 27, 32, 34, 35, 36
Rana pipiens (Leopard frog)	Common	Lakes, marsh, ponds, bogs	1, 2, 3, 7, 10, 11, 12, 19, 22, 26, 27, 35
Rana catesbiana (Bullfrog)	Frequent	Lakes, bogs, marsh	1, 3, 10, 11, 35
Rana sylvatica (Wood frog)	Frequent	Wooded uplands, streams, ponds, bogs, marsh	2, 3, 10, 11, 19, 23, 23, 30, 32, 35
Rana septentrionalis (Mink frog)	Frequent	Lakes, bog marsh, pond	1, 10, 11, 35
Hyla crucifer (Spring peeper)	Frequent	Lakes, bog, marsh, pond, stream, wooded uplands	3, 10, 11, 32, 34, 35
Chelonia			
Chrysemys picta (Painted turtle)	Few	Ponds, lakes	1
Chelydra serpentina (Snapping turtle)	Few	Lakes, ponds, marshes	1, 3, 26
Serpentes			
Thamnophis sirtalis (Eastern garter snake)	Frequent	Lakes, ponds, marshes	1, 3, 10, 15
Storeria occipitomaculata (Red-bellied snake)	Rare	Wooded uplands	15
Diadophis punctatus (Ring-necked snake)	Rare	Wooded uplands	10

[1]Rare--seen less than 25 percent of the time (less than one sighting for every four trips); few--seen at least 25 percent of the time; frequent--seen at least 50 percent of the time; common--seen 100 percent of the time.

[2]See location of sections on figure 1. Underlined numbers indicate that the specimens were collected there. Nonunderlined numbers indicate that the animal was sighted only.

Most of the frog species were commonly found during the spring-early summer breeding season but tended to become scarce as the season progressed. The exceptions were the leopard frog (*Rana pipiens*), green frog (*Rana clamitans*), and American toad (*Bufo americanus*), which were common throughout most of the summer.

Among Urodeles, the red-backed salamander (*Plethodon cinereus*) and the blue-spotted salamander (*Ambystoma laterale*) were found in forested areas, the former commonly, the latter uncommonly near ponds, bogs, or lakes. Central newts (*Notophthalmus viridescens*) were found together throughout the summer in localities such as Baraga Lake, Bulldog Lake, Clear Lake, and Two-Hole Bog.

Only a few painted turtles (*Chrysemys picta*) and snappers (*Chelydra serpentina*) were found. Female painted turtles were found laying eggs near the shore of White Deer Lake in June of 1972 and 1973.

The garter snake (*Thamnophis sirtalis*) was common in most aquatic habitats especially during the spring-early summer when its amphibian prey was abundant.

Five additional species, the spotted salamander (*Ambystoma maculatum*), the gray treefrog (*Hyla versicolor*), the pickerel frog (*Rana paulustris*), the Blandings turtle (*Emydoidea blandingi*), and the fox or pine snake (*Elaphe vulpina*), probably inhabit the Forest based on locality records by Manville (1948) and Johnson[1], but were not found. The gray treefrog was collected 2½ miles south of the Forest on June 20, 1974, and the Blanding's turtle has been seen in the past, several miles north of the Forest[2].

Population Studies

The total number of marked and recaptured animals in all samplings is summarized in table 3. With the exception of the American toad and the spring peeper, the third or fourth sampling usually resulted in recapture success of 50 percent or better allowing for reasonable estimates and confidence limits (table 4).

Population estimates of the spring peeper and the American toad were complicated by the fact that the sampling period spanned the end of the breeding period of both species in the bog, hence emigrating animals were counted. The sampling also spanned the metamorphosing period of toads in the pond causing new additions to the pond population to be counted. A significant emigration and immigration rate or both violated the assumption of a constant population level during sampling, which is necessary for multiple mark-recapture methods, including the Schumacher. Thus the population estimates for both species are subject to error.

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[2] *By Fred Rydholm, a native of the area.*

Table 3.--*Mark-recapture data on seven amphibian species found in the McCormick Forest*

Date (all during 1973)	Bog				Pond					Stream		
	R. catesbiana	*R. clamitans*	*B. americanus*	*H. crucifer*	*R. pipiens*	*R. septentrionalis*	*R. clamitans*	*B. americanus*	*H. crucifer*	*R. sylvatica*	*R. clamitans*	*B. americanus*
May 27	--	0/13[1]	0/17	0/29	--	--	--	--	--	--	--	--
May 28	--	--	--	--	0/9	0/18	0/38	0/1	0/28	--	--	--
May 29	--	--	--	--	--	--	--	--	--	0/4	0/5	0/3
May 30	0/4	5/20	10/60	7/43	--	--	--	--	--	--	--	--
May 31	--	--	--	--	0/5	2/5	13/24	0/6	1/30	--	--	--
June 1	--	--	--	--	--	--	--	--	--	5/10	1/2	0/10
June 3	4/5	9/27	3/8	13/43	2/6	4/8	16/21	1/34	1/14	--	--	--
June 4	--	--	--	--	--	--	--	--	--	1/3	0/3	1/11
June 6	3/3	21/44	4/4	1/2	--	--	--	--	--	4/5	1/3	2/29
June 7	--	--	--	--	5/10	5/11	22/30	5/65	4/7	--	--	--
June 8	--	--	--	--	--	--	--	--	--	4/5	2/2	8/25
June 9	2/7	21/42	--	--	--	--	--	--	--	--	--	--
June 11	--	--	--	--	9/11	3/3	18/22	19/44	1/4	1/4	1/3	7/12
June 12	4/4	15/20	--	--	--	--	--	--	--	--	--	--
June 13	--	--	--	--	--	--	--	--	--	5/10	1/3	10/13
June 14	--	--	--	--	3/3	4/5	16/21	20/73	2/10	--	--	--
June 16	4/4	--	--	--	--	--	--	--	--	2/3	7/9	9/10
June 18	--	--	--	--	--	--	--	--	--	5/6	2/4	4/5

[1] First number indicates the number marked in the sample, the second number sample size.

Table 4.--*Estimated population of amphibians in four habitats*
(In number per hectare)

Species	Bog	Pond	Stream	Woods
R. catesbiana	51 (34-89)[1]	--	--	--
R. clamitans	657 (516-898)	358 (316-411)	197 (144-251)	--
R. septentrionalis	39	206 (158-282)	--	--
R. pipiens	78	148 (114-200)	--	--
R. sylvatica	--	38	206 (152-314)	--
H. crucifer	1157 (943-1,494)	1,478	27	--
B. americanus	629	1,751	968 (780-1,282)	--
P. cinereus	--	--		838

[1]Figures in parenthesis are 95 percent confidence limits (0.05).

In the bog, the leopard frog (*R. pipiens*) and the mink frog (*R. septentrionalis*) were found only occasionally within the grid. Population estimates of these two species based on mark-recapture were not possible because of the small number captured; instead the population was estimated to be the total number found during all samplings. The same situation prevailed with respect to the woodfrog (*R. sylvatica*) in the pond.

Bog

Between May 27 and June 3, 1973, the bog habitat was dominated by three species; the spring peeper, (1,157 individuals per hectare), the American toad (629 individuals per hectare) and the green frog, (657 individuals per hectare) (table 4). After June, the former two species disappeared from the grid and bullfrogs increased in number.

A total of 10 bullfrogs (*R. catesbiana*) were marked of which eight were recaptured. Bullfrogs constituted 16 percent of the total amphibian biomass (table 5), although their number was only 2 percent of the total--a reflection of their larger size and weight.

The green frog (*R. clamitans*) far outnumbered other *Rana* spp., not only in the bog, but in most other areas. A total of 90 individuals were marked, of which 26 were captured once, 16 captured twice, and 3 captured 3 or more times, yielding a population estimate of 657 per hectare. The biomass contribution of the green frog was 18,938 grams per hectare, 44 percent of the total.

Table 5.--*Amphibian biomass from four habitats*
(In grams per hectare)

Species	Bog	Pond	Stream	Woods
R. catesbiana	6,956 (16)[1]	--	--	--
R. clamitans	18,938 (44)	7,797 (29)	3,312 (27)	--
R. septentrionalis	504 (1)	2,045 (8)	--	--
R. pipiens	772 (2)	1,860 (7)	--	--
R. sylvatica	--	229 (1)	1,570 (13)	--
H. crucifer	2,125 (5)	2,315 (9)	15 (1)	--
B. americanus	13,962 (32)	12,076 (46)	7,267 (60)	--
P. cinereus	--	--	--	730 (100)
Total	43,257	26,323	12,164	730

[1]Figures in parenthesis are percent of total biomass.

A total of 14 leopard frogs and 7 mink frogs were captured in the bog grid; together they made up 3 percent of the total biomass.

Pond

The pond habitat differed from the bog in the absence of the bullfrog and the increase in mink and leopard frogs. A total of 25 leopard frogs were marked, 13 of which were later recaptured. Of the more secretive mink frogs, 32 were marked, of which 10 were recaptured. The biomass contribution of both species was nearly identical (7 and 8 percent), although their population densities were different; 206 per hectare and 148 per hectare for the mink and leopard frogs, respectively. Dole (1965) found 311 leopard frogs per hectare in a comparative study in Michigan's Lower Peninsula.

The two most common amphibians of the pond were the spring peeper and the American toad. Unlike those in the bog, however, toad populations in the pond consisted primarily of young juveniles and recent hatchlings. In fact, only 25 percent (19 of 77) of the individuals in the pond were adults, whereas in the bog all of the population were adults (50 mm or greater snout-vent length). The difference in age also reflects on the biomass, i.e., the population density in the pond was almost three times that of the bog, but the biomass was actually less. The fact that the spring peeper had the second highest population estimate in the pond (1,478 per hectare), yet contributed only 9 percent of the total biomass, is because of its small size.

The predominant ranid in the pond was again the green frog; 66 were marked and 40 were recaptured, yielding 358 individuals per hectare. Martof (1956) in a study of green frog populations near Ann Arbor, Michigan, reported 229 individuals per hectare during a comparable sampling period. Eight wood frogs were captured at the west end of the pond near the stream and are thought to have been the remnants of a breeding congregation. They contributed 1 percent of the total biomass (229 grams per hectare).

Stream

In the stream habitat, green and wood frogs were about equal in number (200 individuals per hectare). However, the biomass contribution of the green frog was more than twice that of the wood frog (29 percent and 12 percent, respectively). The green frog population along the stream was much smaller than the 467 per hectare stream population studied by Martof in the Ann Arbor region. At no time were other ranid species encountered along the stream, although a few spring peepers were captured on two occasions.

The toad population along the stream was about half adults and half juveniles. The population estimate of 968 individuals per hectare far outnumbered that of other amphibians.

Woods

In the hardwood forests, the red-backed salamander (*Plethodon cinereus*) was the only amphibian found in measurable quantities although a few adult and juvenile toads as well as one blue-spotted salamander (*Ambystoma laterale*) were found in site No. 1. The two different methods of estimating *P. cinereus* population produced similar results. In site No. 1, the quadrat method yielded 665 individuals per hectare, the suitable habitat method, 549 per hectare; in site No. 2, the estimates were 333 and 355 individuals per hectare; and in site No. 3, which was notably more populated, the quadrat method yielded 1,334 individuals per hectare, and the suitable habitat method 1,792 individuals per hectare. The data averaged 838 individuals per hectare for all areas and all methods and amounted to 730 grams of biomass per hectare. The range of population estimates for the red-backed salamander (333 to 1792 individuals per hectare) compares with 90 to 1000 individuals per hectare found by Heatwole (1962) in several wooded habitats in lower Michigan. Both of these studies indicate that population densities of the red-backed salamander are quite variable from locality to locality.

DISCUSSION

The Schumacher method assumes that the population level remains constant throughout the sampling period, i.e., that dilution and mortality are negligible. In this study, even though the sampling period was short (2½ weeks), it is unreasonable to assume that there wasn't some dilution, mortality, or both. The question is whether it was significant enough to invalidate the results.

Two statistical tests were made to help assess the constancy of the population level. Leslie Method C (1952) indicated no significant dilution (table 6). Mortality coefficients (DeLury 1958) were calculated (assuming no dilution) even though a constant interval between sampling periods was not

Table 6.--*Chi-square test for dilution*[1] *in five ranid populations in three habitats*

Species	Value	Bog	Pond	Stream
R. catesbiana	x^2	10.27(10)[3]	--	--
	μ[2]	-0.152	--	--
R. clamitans	x^2	14.17(10)	14.07(10)	17.53(28)
	μ	-0.178	-0.234	-0.017
R. septentrionalis	x^2	--	4.08(10)	--
	μ		0.424	
R. pipiens	x^2	--	8.12(10)	--
	μ		0.386	
R. sylvatica	x^2	--	--	33.61(28)
	μ			-0.141

[1] Leslie (1952).
[2] Mortality coefficient (DeLury 1958).
[3] Figures in parenthesis are degrees of freedom.

strictly adherred to. (The interval between samplings ranged from 2 to 4 days (table 2) averaging about 3 days.) The coefficients were either negative or unreasonably large (table 6) indicating that mortality was probably not a factor in explaining the present results. These tests were not made on the toad and spring peeper populations because, as previously pointed out, substantial immigration and emigration was known to have occurred.

Several apparent differences between populations were evident: both the American toad and spring peeper bred earlier in the pond than in the bog. This is possibly due to the 2 to 3° C lower water temperature recorded during each sampling period in the bog. A second difference between bog and pond populations of the American toad was that after breeding no adult toads could be found in the bog, but some adults were always present in the pond. The pond area, however, tended to dry up as the sampling period ended, creating more terrestrial conditions, perhaps encouraging adults to remain in the area. It did not appear that any toads of the stream population were breeding. No eggs, tadpoles, or adults in amplexus were found. Most likely, toads found along the stream had either bred earlier in nearby ponds or did not breed at all.

The population data correlated with those of the general survey of the Forest, in which numerous bogs, marshes, streams, and lakeshore habitats were sampled. The green frog was the most common ranid found and the mink frog was the least common. The bullfrog displayed the most restricted distribution, inhabiting pockets around some, but not all, of the major lakes or open bog areas. In three other areas where bullfrog breeding choruses were recorded in 1973 (Lower Baraga, White Deer, Bulldog Lakes), the largest number of individuals counted, based on calls, was six.

The only discrepancy between the general survey of the Forest and the individual habitat studies was that the former revealed greater numbers of leopard and mink frogs, and lesser numbers of bullfrogs in the bogs. However, in the habitat study the bog grid was located in only one part of a larger bog area, where both leopard and mink frogs were more abundant.

In comparing all four habitats, amphibian biomass or standing crop was greatest in the bog. On a hectare basis about twice as much amphibian biomass was found in the bog (43,257 grams) as in the pond (26,323) and three and a half times as much in the bog as in the stream (12,164 grams). The hardwoods were the least productive in amphibian biomass, accounting for only 730 grams per hectare. However, the fact that large percents of American toad and spring peeper populations migrate to the woods means that this habitat is important in analyzing energetics, especially because toads were so numerous.

In terms of both biomass and numbers, the American toad ranked at the top in all environments except the bog, where it ranked second only to the green frog; however, such a ranking applies only to the period of time in which the toad is present in these environments. A factor in the movement of energy and nutrients from the low-lying pond areas to higher elevations in the hardwoods is the ability and tendency of populations to move out of breeding areas.

Some sampling was done along the shores of Lower Baraga Lake. In general, the lakeshore populations varied little either in species or approximate numbers from the three aquatic habitats examined above. The type of vegetation that bordered the lake and the period of time sampled were the two most important factors that influenced sampling results along the lake.

The survey revealed the presence of 69 percent (11 of 16) of the amphibian species and 50 percent (5 of 10) of the reptile species known to occur in the central Upper Peninsula. The total of 16 species represents 62 percent of the herptofauna of Michigan's Upper Peninsula.

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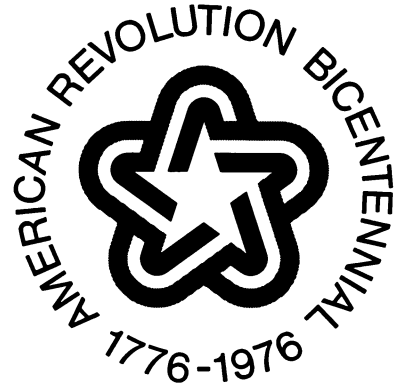
AMERICAN REVOLUTION BICENTENNIAL
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