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MAMMALS OF THE GRAND CALUMET RIVER REGION

John O. Whitaker, Jr.: Department of Life Sciences, Indiana State University, Terre Haute, Indiana 47809

ABSTRACT. At least 37 of the 57 species of mammals occurring in Indiana are found in the Calumet region. These include species as follows: the opossum, 3 shrews, 1 mole, 4 bats, 1 rabbit, 7 squirrels, the beaver, 10 mice, 9 carnivores and the white-tailed deer.

Keywords: Mammals, Indiana, Calumet, distribution

The objectives of this paper are to describe the pre-settlement and present-day mammal communities of the Grand Calumet River basin and to discuss how dredging operations may affect these communities. A further objective is to present some restoration options that might be implemented during the dredging operations to enhance the mammal populations of the area.

PRE-SETTLEMENT/EARLY SETTLEMENT MAMMAL COMMUNITY

Pre-settlement records of mammals of northwest Indiana are scant and consist mainly of diary records of explorers such as Marquette and LaSalle, and of trading-post fur records. Records from the 1600s mentioned the Virginia opossum (*Didelphis virginiana*), the American beaver (*Castor canadensis*) and the bison (*Bos bison*). "Panther" (mountain lion or possibly bobcats) were reported in the 1830s. White-tailed deer were plentiful until the 1870s, but they and beavers were extirpated from the state by the turn of the century (Mumford & Whitaker 1982). Deer reintroductions began in the 1930s. There were an estimated 900 deer in Indiana by 1943, 5000 by 1951; and there were probably deer in every county by 1966. Both deer and beaver were still scarce in the 1960s but have become abundant in the last two decades in northwest Indiana and elsewhere. Wolves (possibly coyotes) were reported as late as 1914 (Lyon 1923), and black bears (*Ursus americana*) were present until about 1870.

A total of about 10 species of large mammals that were here prior to European settlement are no longer present (Table 1). Large mammals are generally most subject to extirpation when humans populate the land because they are more feared (bear, wolf, mountain lion) than smaller animals, or they are hunted and trapped (deer, elk, bison, fisher, beaver) more than smaller mammals. Also, they usually need larger tracts of undisturbed habitat. Smaller mammals live alongside humans more easily because they are not hunted and they can use smaller patches of habitat. The extirpated species are discussed below.

EXTIRPATED SPECIES

American porcupine (*Erethizon dorsatum*).—The American porcupine was clearly present in pre-settlement times; skeletal remains were found by Rand & Rand (1951). The last known specimen was from 1918.

Gray wolf (*Canis lupus*).—There are several reports of timber wolves from Indiana, but there is some question as to whether they were wolves or coyotes. The last report of a timber wolf in the state was in 1908 (Mumford & Whitaker 1982).

Black bear (*Ursus americanus*).—There are records of black bears in the area in the pre-settlement records, and Rand & Rand (1951) found skeletal remains of black bear. The last report of a bear living in Indiana was in 1850. The last time a bear was seen in the Calumet region was in 1871, but that individual was apparently a stray driven south from Michigan by a great fire (Brennan 1923).

Fisher (*Martes pennanti*).—Rand & Rand (1951) found fisher remains in the region, indicating that they were clearly present. The last report of a fisher in Indiana was in 1859 (Mumford & Whitaker 1982).

River otter (*Lutra canadensis*).—The last record of the river otter in northwest Indiana

Table 1.—Mammals taken by Mierzwa et al. (1991) in traps in the Grand Calumet River Basin. Area 1 = Dupont; 2 = Clark and Pine; 3 = Ivanhoe; 4 = Big Marsh/Indiana Ridge; 5 = Burnham Prairie/Powderhorn Prairie, 6 = Egger's Woods. A trap-night is one trap set for one night.

	Gray area			Lake Calumet area			
	1	2	3	4	5	6	Total
Trap-nights	1388	1444	1426	1310	1352	1265	8185
Virginia opossum	0	0	0	0	0	1	1
Masked shrew	0	0	0	4	20	11	35
Short-tailed shrew	4	1	0	0	4	0	9
Gray squirrel	7	0	2	0	2	12	23
Franklin's ground squirrel	1	0	0	1	0	0	2
White-footed mouse	12	35	4	2	6	8	67
Prairie deermouse	6	1	0	23	0	0	30
Meadow vole	1	3	0	8	13	0	25
House mouse	0	0	0	1	0	0	1
Norway rat	0	0	0	1	0	0	1
Totals	31	40	6	40	45	32	

is from 1900. Otters were reintroduced into Indiana at several localities between 1995 and 1999; they could be reintroduced or make their own way into the Calumet region.

Mountain lion (*Felis concolor*).—Panthers were reported in the 1660s, and the last mountain lion recorded from Indiana was seen in 1830. There is some question as to whether it was identified correctly.

Canada lynx (*Felis lynx*).—The last Canada lynx in the region was reportedly killed by Hunter Green in 1873 at Tremont, although the identification of this species in Indiana has been questioned. The last record in the state is from 1880.

Bobcat (*Felis rufus*).—The bobcat is rare in Indiana, but there have been 42 confirmed reports in the state since 1970. It is possible that this species still occurs at the Indiana Dunes National Lakeshore (INDU), but the last record there was in 1888.

Bison (*Bison bison*).—The bison was present in northwest Indiana until well into the 19th century. The last record was in 1850.

American elk (*Cervus canadensis*).—Rand & Rand (1951) found skeletal material of elk at INDU.

All but two of the species of mammals now present were probably present in pre-settlement times. The exceptions are the old world rats and mice: the housemouse, *Mus musculus*, and the Norway rat, *Rattus norvegicus*. They are exotics that arrived in North America on ships with the early settlers. Another species possibly present now that was absent in pre-settlement times is the western harvest mouse, *Reithrodontomys megalotis*. It moved across Illinois between 1953–1969 and into Newton County, Indiana around 1969, where it was first found at Willow Slough Fish and Wildlife Area (Whitaker & Sly 1970). By 1974 (Ford 1977), this species occurred in at least seven counties, but it had not crossed the Kankakee River. If it is not already in the vicinity of the Grand Calumet River, the harvest mouse will likely make its way across the Kankakee to the Grand Calumet area relatively soon.

MAMMALS CURRENTLY PRESENT OR LIKELY TO BE PRESENT

Much information is available on mammals of Indiana (Mumford & Whitaker 1982), Illinois (Hoffmeister 1989) and INDU (Whitaker et al. 1994); but little is available specifically on mammals of the Grand Calumet River basin. Three papers present data from areas actually within the Grand Calumet River basin: Whitman et al. 1990), Mierzwa et al. (1991), and Whitaker et al. (1994).

Whitman et al. (1990) found 16 species of mammals at Miller Woods: opossum, short-tailed shrew, masked shrew, eastern mole, cottontail, white-footed mouse, prairie deer mouse, meadow vole, muskrat, fox squirrel, gray squirrel, thirteen-lined ground squirrel, red squirrel, raccoon, long-tailed weasel and white-tailed deer.

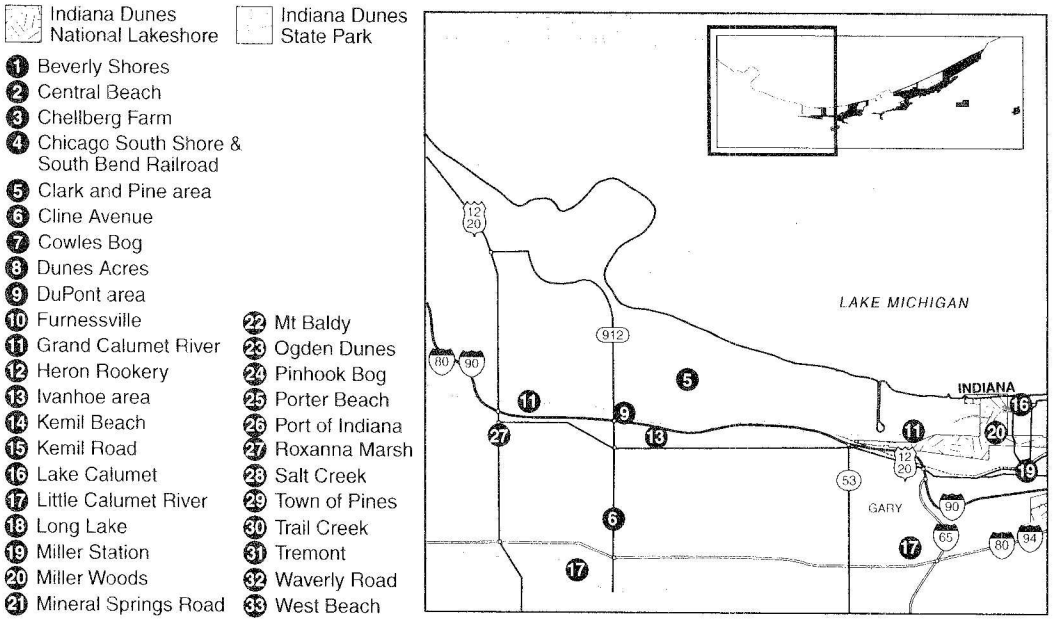

Figure 1.—The Grand Calumet River area that parallels the shore of Lake Michigan. Sites mentioned in the text are indicated by the numbers.

Mierzwa et al. (1991) studied mammals at 15 sites in five different study areas in northeastern Illinois and northwest Indiana as possible sites at which to establish an airport. Two of the areas were in the Grand Calumet River area: one in Gary, the other near Lake Calumet. However, they reported only 10 species of mammals in these two areas (Table 1): Virginia opossum, masked and short-tailed shrews, gray and Franklin's ground squirrels, deer and white-footed mice, meadow vole, house mouse and Norway rat.

Whitaker et al. (1994) included information on Miller Woods, but otherwise they did not study areas within the Grand Calumet River basin; however, the habitats, and therefore the mammals, of the Grand Calumet River basin are similar to those of INDU. Therefore, information from that work and from other papers on the Indiana Dunes was used extensively in this work.

The first significant publication on the mammals of the Indiana Dunes was by Lyon (1923). Lyon reported 22 species: opossum, short-tailed shrew, eastern mole, eastern red bat, eastern cottontail, eastern chipmunk, woodchuck, thirteen-lined ground squirrel, fox squirrel, red squirrel, prairie deer mouse, white-footed mouse, prairie vole, woodland vole, muskrat, Norway rat, house mouse, red fox, raccoon, long-tailed weasel, mink and striped skunk. He did not personally observe specimens of eastern mole, muskrat, Norway rat, raccoon (a few were taken for fur each year) or long-tailed weasel. He apparently felt these records were reliable. That he personally saw no raccoons would indicate that this species must have been uncommon at that time. He reported that white-tailed deer, although extirpated for many years, had been fairly numerous around 1875. Lyon reported that the white-footed mouse was the most abundant mammal at INDU, and it was especially abundant in wooded dunes, swamps and marshes. From foredunes he reported prairie deer mice and a few house mice. From interdunal meadows, he reported white-footed mouse, prairie deer mouse, prairie vole, pine vole and short-tailed shrew. Lyon did not take the masked shrew, the meadow vole or the meadow jumping mouse. In addition to the 22 species that he observed, Lyon (1923) listed nine species as "almost certain to be found": little brown myotis, northern myotis (Keen's myotis until recently), big brown bat, silver-haired bat, hoary bat, meadow vole, meadow jumping mouse, southern flying squirrel and gray squirrel. He listed six species as probably oc-

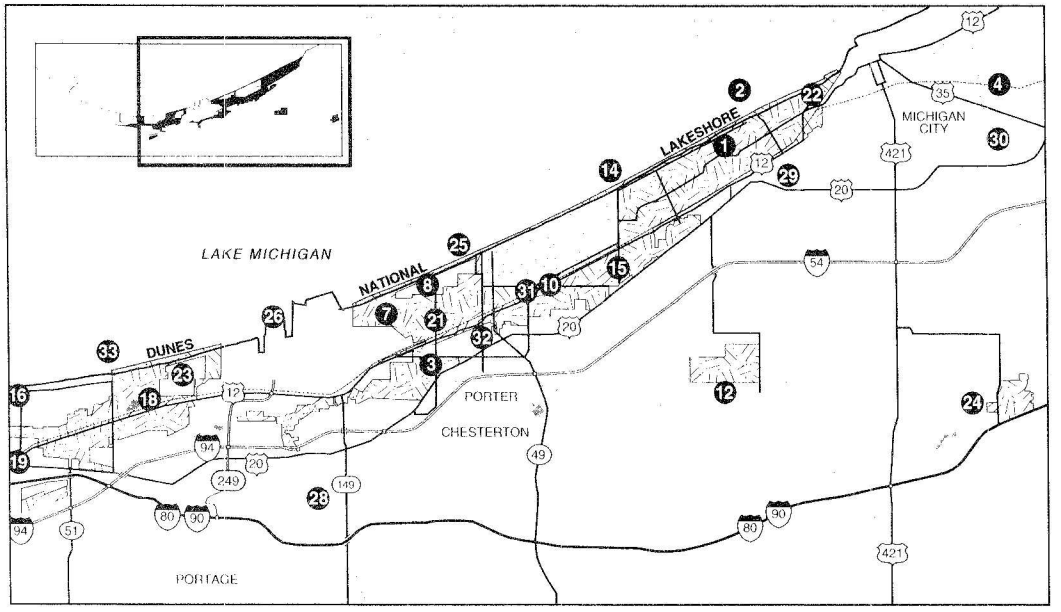

Figure 1. Continued.

curring: star-nosed mole, least shrew, masked shrew, southern bog lemming, American badger and coyote. Lyon listed 11 species as "not now extant but whose remains may possibly be found," as "extinct," or as "probably extinct,": timber wolf (*Canis lupus*), fisher (*Martes pennanti*), black bear (*Ursus americanus*), river otter (*Lutra canadensis*), mountain lion (*Felis concolor*), Canada lynx (*Felis lynx*), bobcat (*Felis rufus*), porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), bison (*Bison bison*), and elk (*Cervus canadensis*). We have listed evidenced extirpated species of the Grand Calumet basin except for the snowshoe hare, for which presence we find no evidence.

Brennan (1923) relates early reports of bison, black bear, mountain lion, Canada lynx, bobcat, white-tailed deer (the last one shot was in the early 1870s), elk, coyotes (Brennan cited many reports of timber wolves, and stated that there were a few left between Dunes Park and Michigan City until 1919. It is suspected by Whitaker et al. (1994) that all or many of these were actually coyotes.), porcupine, river otter, and beaver. Brennan reported several mammals as still present as of 1923: opossum, red fox (near the Furnessville Blowout), gray fox, raccoon, mink (in streams and marshes), eastern skunk, muskrat (thousands in the marshes), cottontail (common), eastern mole (exceedingly common as indicated by burrows), woodchuck (thousands present), red squirrel, gray squirrel, badger, and fox squirrel.

Lyon (1936) reported the least shrew, masked shrew, silver-haired bat, Franklin's ground squirrel, meadow vole, meadow jumping mouse and badger from the Lakeshore. Rand & Rand (1951) reported skeletal remains of 32 species of mammals in blowouts in Indiana Dunes State Park, including 26 species still present: opossum, masked shrew, northern short-tailed shrew, eastern mole, silver-haired bat, big brown bat, eastern red bat, eastern cottontail rabbit, eastern chipmunk, woodchuck, thirteen-lined ground squirrel, Franklin's ground squirrel, fox squirrel, red squirrel, southern flying squirrel, white-footed and prairie deer mouse, meadow vole, muskrat, southern bog lemming, Norway rat, house mouse, raccoon, least weasel, long-tailed weasel, mink and striped skunk. They also reported six extirpated species: black bear, fisher, beaver, porcupine, elk and white-tailed deer. New species recorded by Rand & Rand were big brown bat, southern flying squirrel, southern bog lemming and least weasel, so the new total species number from the area was 34.

A Texas Instruments team studied the Cowles Bog area from 1975 to 1980, and they

collected or observed 25 species of mammals. Some of their more interesting records include the little brown bat, woodland vole, and least weasel. Surprisingly, they failed to capture any prairie deer mice, meadow voles, or prairie voles. Species reported for the first time from the area by Texas Instruments were the little brown bat and the white-tailed deer, making a total of 36 species known from the area.

Krekeler (1981) stated that the gray squirrel had been extirpated at one time but is now common in certain areas. He also indicated that the beaver had been extirpated but reintroduced, and it had caused high water problems at Dune Acres. His was the first definite recent record of the beaver at the Lakeshore. Krekeler states that skunks forage on the beach and that tracks of the white-tailed deer are now regularly seen at the Lakeshore. These additional species bring the total number of species recorded at the Lakeshore to 37.

Whitaker et al. (1994) reported opossum, two species of shrews (masked and northern short-tailed), eastern mole, three bats (red, silver-haired and big brown), eastern cottontail, seven squirrels (chipmunk, woodchuck, thirteen-lined ground squirrel, and fox, gray, red and southern flying squirrels), beaver, eight mice and rats (white-footed mouse and prairie deer mouse, Norway rat, house mouse, prairie, woodland and meadow voles and meadow jumping mouse), ten species of carnivores (coyote, red and gray foxes, raccoon, long-tailed and least weasels, mink, American badger, striped skunk and feral cat) and white-tailed deer. Gray fox brought to 38 the number of species known to the Lakeshore.

The diverse habitats of the Lakeshore thus create a home for approximately 38 of the 57 species of mammals presently known to occur in Indiana. Franklin's ground squirrel was probably present at the Lakeshore through the 1940s, but then it apparently disappeared. However, it was recorded in the Grand Calumet River basin by Mierzwa et al. (1991). Feral dogs and cats are present, and they may partially fill the predator niche. Signs of bobcat (state endangered) have been reported in the Heron Rookery area of the Lakeshore, but their presence has not been verified.

Species of mammals suspected to currently reside in the Grand Calumet River basin are discussed below and are indicated in Table 2.

DIDELPHIDAE
(opossums)

Virginia opossum, *Didelphis virginiana* Kerr.—The opossum is common in the Lakeshore area, and likewise it is surely common throughout the Grand Calumet River region. It was found in 10 of the 24 habitats sampled at INDU, and 93 were recorded as roadkills (Whitaker et al. 1994). Texas Instruments, Inc. found this species in all six of the terrestrial habitats they sampled, and Whitman et al. (1990) commonly found it at Miller Woods. Mierzwa et. al. (1991) recorded one in Egger's Woods near Wolf Lake.

INSECTIVORA
(shrews and moles)

The Insectivora consists of the moles and shrews, six species of which conceivably could occur in the Grand Calumet River area: four species of shrews and two of moles. The presence of only three species of shrews (masked, short-tailed and least) and one mole (eastern) have been confirmed there.

Northern short-tailed shrew, *Blarina brevicauda.*—The short-tailed shrew is one of the most common mammals in northwest Indiana, and it is common in the Grand Calumet River basin (Mumford & Whitaker 1982; Krekeler 1981; Texas Instruments 1975–80; Whitman et al. 1990; Whitaker et al. 1994). Whitaker et al. (1994) took short-tailed shrews in 17 of the 24 habitats studied. They were most abundant in upland terrestrial shrubland, wet prairie, old field, ephemeral lowland forest and mixed deciduous savanna. Mierzwa et al. (1991) trapped nine short-tailed shrews: four at the DuPont area, four at the Burnham Prairie/Powderhorn Prairie area, and one at the Clark and Pine area.

Least shrew, *Cryptotis parva* (Say).—The least shrew is a small, brownish short-tailed shrew, much smaller than *Blarina*. Its total length is only about 63–88 mm; its tail is only 11–20 mm. It usually is found in fairly dry open fields. It occurs throughout Indiana, but it is not taken often. There are few records in the northern part of the state. Lyon trapped a least shrew in "subdunal woods" on 31 October 1924. It was apparently from Tremont, as Sanborn (1925) reported that Lyon took one there in the fall of 1924. The specimen was deposited in the U.S. National Museum (#240630). Whitaker et al. (1994) did not take

it at INDU, but it most likely lives sparingly in dry fields in the Calumet River area.

Masked shrew, *Sorex cinereus* Kerr.—The masked shrew is common in several habitats at INDU and in the Grand Calumet River area, especially in wet areas. Mierzwa et al. (1991) captured 35 individuals in their Lake Calumet study area: four in the Big Marsh/Indiana Ridge area, 20 in the Burnham Prairie/Powderhorn Prairie area, and 11 at Egger's Woods. Mumford & Whitaker (1982) found masked shrews in several habitats east of the Bailey Generating Station, and 124 of 178 mammals (69.7%) taken at Cowles and Pinhook Bogs and at Trail Creek Fen were masked shrews. Whitman et al. (1990) reported masked shrews from Miller Woods. Whitaker et al. (1994) took only 35 during their study of mammals at INDU. This included individuals from eight habitats, although they were most abundant in wet prairie (1.83 per 100 trap-nights) and marsh (1.17 per 100 trap-nights). Shrew populations were apparently low at the time of this study. The masked shrew lives in areas where the soil retains moisture sufficient to maintain burrows 100% saturated. Because of this moisture requirement, the species often lives in dense vegetation or in mossy areas.

Pygmy shrew, *Sorex (Microsorex) hoyi* Baird.—The pygmy shrew has long been presumed rare, but pitfall trapping has shown otherwise. The pygmy shrew could inhabit the Calumet River basin, but it has not been found at INDU or elsewhere in northern Indiana. It does not occur in the southern portion of the lower peninsula of Michigan either (Baker 1983). There are records from Wisconsin, including one at the extreme southeast corner, or less than 80 miles (128 km) from the Grand Calumet River area. Also, one was taken in mid-winter in a garage 50 miles (80 km) from the Grand Calumet. No pygmy shrews were taken in extensive trapping at Bailly, Cowles, or Pinhook Bogs (Mumford & Whitaker 1982); and none were taken in other areas at INDU (Whitaker et al. 1994). Thus, this shrew's occurrence in the Grand Calumet River area is unlikely. However, the unicuspid teeth of all long-tailed shrews (*Sorex*) from that area should be carefully examined. (*Sorex cinereus* has four "large" unicuspids and one small unicuspid, all easily visible from the side. *Sorex hoyi* has the third and fifth extremely reduced, thus only three unicuspids are readily visible from the side).

TALPIDAE
(moles)

Eastern mole, *Scalopus aquaticus* (Linnaeus).—The eastern mole is common at INDU (Krekeler 1981; Whitman et al. 1990; Whitaker et al. 1994) and in the Grand Calumet River region. Whitaker et al. (1994) found burrows of the eastern mole in 10 of 24 habitats examined at INDU. This species was most abundant in pine plantations, oak savanna, excavated sand, and mixed deciduous forest. The author saw a number of its burrows in the sand on 20 July 1996 at the DuPont and Clark and Pine areas in the Grand Calumet River basin. The eastern mole is common in many of the drier habitats at the Lakeshore.

Star-nosed mole, *Condylura cristata* (Linnaeus).—The star-nosed mole lives in muckland habitats. This habitat makes its burrows quite evident; burrows of eastern moles are usually in drier areas. The star-nosed mole has been documented only in the northeast portion of the state, and its range has apparently contracted in the 20th century. This species has never been taken at INDU. However, on 28 October 1982, Whitaker trapped one at Trail Creek Fen, a site east of INDU. This record suggests its presence at INDU. Muckland habitats suitable for star-nose moles are abundant in the Grand Calumet River basin, and it may occur there.

CHIROPTERA
(bats)

Twelve species of bats are found (or were found—two are probably extirpated) in Indiana, all in the family Vespertilionidae. All are nocturnal and have well-developed echolocation abilities, and all feed almost exclusively on flying insects. Little information is available on bats of INDU or northwest Indiana. There are records at INDU for only three species: big brown bat, red bat and silver-haired bat. There is an early record of the evening bat, but no recent records. There is an unverified record of the little brown myotis, but this species surely exists there. The northern myotis and hoary bat are undoubtedly present, and it is likely that the Indiana myotis is also there. Rand & Rand (1951) reported silver-haired, red and big brown bats. Information

on bats of northwest Indiana is provided below. Most of these species should occur in the area of the Grand Calumet River, at least where there is adequate woodland.

Big brown bat, *Eptesicus fuscus* (Beauvois).—Whitaker et al. (1994) found one big brown bat in a large building north of Route 12 and west of Mineral Springs Road, and a post-lactation colony is located behind the barn doors at Chellberg Farm. A total of 113 bats emerged from behind this door on 27 August 1988. Several maternity colonies were found by Whitaker et al. (1994): 1) about 100 individuals in a brick house 0.2 miles east of 33E on U.S. Route 20; 2) about 20 individuals at the Lutheran Church at the south end of Mineral Springs Road (just north of I-94); 3) about 80 individuals on 9 September 1988 at the Portage Park barn, southwest of I-94 and State Road 249; 4) 43 individuals in the soffit of an old but well-preserved brick house near U.S. Route 49 north of Route 6. There are undoubtedly many maternity colonies of big brown bats in buildings in the Grand Calumet basin. This is the only species likely to winter (hibernate) at INDU, since it is the only species in Indiana that hibernates in buildings.

Red bat, *Lasiurus borealis* (Muller).—Lyon (1923) observed a female red bat roosting in blackberry bushes in the Lakeshore region. Whitaker (Mumford & Whitaker 1982) shot a female red bat at daybreak on 26 August 1963 as it was flying over the beach in what is now the Lakeshore. Whitaker et al. (1994) recorded several red bats: 1) a young female collected in July of 1987 at the West Beach bathhouse; 2) an individual observed flying at Indiana Dunes State Park on 27 August 1988; and 3) two individuals netted (1♂, 1♀) over Dunes Creek, Indiana Dunes State Park, on 23 September 1988. The red bat is solitary and hangs in trees during the daytime. It is one of the most common bats in wooded areas of northwest Indiana, and it should inhabit areas of the Grand Calumet River basin where enough trees are present.

Little brown myotis, *Myotis lucifugus* (LeConte).—Neither Lyon (1936) nor Mumford & Whitaker (1982) recorded the little brown myotis in Lake, Porter or LaPorte Counties. The only specific record of this species at INDU is that of Texas Instruments (1975–80), but this record needs verification. The author has often seen small bats flying about over openings in Indiana Dunes State Park and vicinity which could be this species or the northern myotis, *Myotis septentrionalis*. The little brown myotis migrates to the karst regions of southern Indiana where it hibernates in caves.

Silver-haired bat, *Lasionycteris noctivagans* (LeConte).—Hahn (1909) reported this species from Michigan City, LaPorte County. Mumford & Whitaker (1982) reported three individuals taken at the Indiana Dunes State Park: a female on 24 September 1928 by W.A. Weber, and two individuals on 3 May 1936 by J. Schmidt. Whitaker et al. (1994) netted one individual on 9 September 1988, about one mile northeast of the visitor center at INDU.

The silver-haired bat is a migratory solitary bat. It spends the summer and has its young north of Indiana and then migrates south. A few individuals hibernate in caves or mines in southern Indiana, but most winter in southern states. This species is fairly common in Indiana during migration from about 18 April to 28 May and from about 29 August to 6 November, when it should be relatively common at the Lakeshore (Mumford & Whitaker 1982).

Evening bat, *Nycticeius humeralis* (Rafinesque).—Russell E. Mumford shot an evening bat two miles (3 km) northwest of Porter (Porter County) on 5 August 1958. Populations of this species have decreased greatly in Indiana in recent years, and we doubt that it is currently present in northwest Indiana. The single record could have been a stray.

BAT SPECIES PROBABLY PRESENT

Northern myotis, *Myotis septentrionalis* (Merriam).—This species has often been referred to as Keen's bat, *Myotis keenii septentrionalis*. However, populations in eastern regions of the United States are currently recognized as a separate species from populations in the western U.S. (Van Zyll de Jong 1979). The eastern species is known as the northern myotis, *Myotis septentrionalis*. There are no records of this species for any of the Lakeshore counties (Mumford & Whitaker 1982). Because wooded habitat is abundant and it is a northern species, the author suspects its presence. It forms small summer colonies under the bark of trees or in buildings, and it then migrates to caves and mines where it hibernates individually rather than in

groups. Kurta (1982) found it was relatively uncommon in southern Michigan, and Long (1974) reported it as less common than the little brown myotis in the Lake Michigan drainage.

Hoary bat, *Lasiurus cinereus* (Palisot de Beauvois).—Like the red and silver-haired bats, this is a solitary, migratory species that roosts in trees. It is the largest and one of the most colorful bats of Indiana. It occurs throughout the state, but it is not common anywhere. It probably lives in the Grand Calumet River basin in areas with adequate trees.

Indiana myotis, *Myotis sodalis* (Miller & Allen).—The Indiana myotis is listed as endangered. There are no records for the northwestern 15 or so counties of the state (Mumford & Whitaker 1982); however, Kurta (1982) recorded this species, and Kurta et al. (1993) later recorded a maternity colony of this species from southern Michigan. The Indiana myotis is probably present in northwest Indiana in areas forested with large trees, including the Grand Calumet River area. It forms small summer colonies under the bark of dead trees, often along watercourses. It hibernates in large numbers in a very few caves, some of which are found in southern Indiana.

LAGOMORPHA
(rabbits and hares)

Eastern cottontail, *Sylvilagus floridanus* (Allen).—The eastern cottontail is the only lagomorph in northwest Indiana. Lyon (1923), Krekeler (1981), Texas Instruments, and Whitaker et al. (1994) all listed it as common in the area of INDU. It was observed occasionally in Miller Woods by Whitman et al. (1990). Fecal pellets and tracks are commonly seen throughout INDU, and 65 cottontails were recorded as roadkills (Whitaker et al. 1994). This species was often seen by Mierzwa et al. (1991) at Clark and Pine, Lakeshore Railroad Prairie, and DuPont and Burnham Prairie. Cottontails are fairly common in the Grand Calumet River basin.

RODENTIA
(rodents)

Rodents constitute the largest group of mammals in northwest Indiana (and in the world) in number of species and individuals. The total number of rodent species includes seven species in the squirrel family; the beaver; two sigmodontine rodents (= old Cricetinae), both of which are in the genus *Peromyscus*; four or five species of arvicoline rodents (= old Microtinae; muskrat, three voles and probably the bog lemming); two Old World rodents (Murinae), the Norway rat and the house mouse; and the meadow jumping mouse (Zapodinae, Dipodidae).

SCIURIDAE
(squirrels)

There are seven species of squirrels in northwest Indiana, including the state-endangered Franklin's ground squirrel. Squirrels are some of the most conspicuous mammals, partly because most are diurnal. The largest member of the squirrel family is the woodchuck. Also, there are many fox and red squirrels at INDU. Besides being diurnal, these two are common and quite noisy. The gray squirrel and chipmunk are obvious where common. The flying squirrel may often be common, but it is seldom observed because it is nocturnal. The thirteen-lined ground squirrel has a spotty distribution, but it is found at several INDU localities (Whitaker et al. 1994). Gray and Franklin's ground squirrels have been documented within the Grand Calumet River basin (Mierzwa et al. 1991). The various squirrels are discussed below.

Eastern chipmunk, *Tamias striatus* (Linnaeus).—The chipmunk is common in many of the wooded habitats of northwest Indiana, although it is sporadic in occurrence. Lyon (1923) stated that "chipmunks do not appear to be very common in the dunes." Krekeler (1981) listed it as abundant in open woods, thickets and suburbs. Texas Instruments (1975–80) recorded numerous captures of chipmunks in several habitats. Whitman et. al. (1990) did not mention them in their Miller Woods report. Whitaker et. al. (1994) captured 24 chipmunks in nine habitats at INDU, and sign or sight observations were made in 11 plots in seven habitats. Seventeen roadkills were seen, and numerous individuals were seen elsewhere at INDU. The chipmunk should be fairly common in the Grand Calumet River basin, but Mierzwa et al. (1991) did not report it.

Woodchuck, *Marmota monax* (Linnaeus).—Lyon (1923) & Whitaker et al. (1994) commonly found woodchucks in several habitats at INDU. Whitman et al. (1990) does not

mention them from Miller Woods, but Mierzwa noted them from DuPont and Burnham Prairie.

Thirteen-lined ground squirrel, *Spermophilus tridecemlineatus* (Mitchell).—Lyon (1923) found this species "not uncommon along the Chicago, Lake Shore and South Bend Railway just south of the dunes," and reported one "just north of Oak Hill Station and a few feet above the subdunal swamp." Krekeler (1981) listed it as "common" at INDU and indicated its habitat as "pastures, road borders, dunes, weedy or cultivated fields." Texas Instruments (1975–80) reported three individuals: two from Cowles Bog and one from the transmission corridor. Whitman et al. (1990) saw this species along the railroad bed "at the north end of the study area." Whitaker et al. (1994) found a roadkill individual on Wagner Road north of Route 20, and two additional roadkills south of Route 20. Fifteen individuals were trapped in nine plots in four habitats: four in dry prairie, four in terrestrial shrubland, three in oak savanna, and four in coniferous savanna. Ten of the 15 were at West Beach. Mierzwa et al. (1991) saw this species only at Wolf Lake where it was common in Illinois on grassy roadsides. The species should be present in dry open areas with little ground cover near the Grand Calumet River.

Franklin's ground squirrel, *Spermophilus franklinii* (Sabine).—Neither Lyon (1923), nor Krekeler (1981), nor Texas Instruments (1975–80), nor Whitaker et al. (1994) reported Franklin's ground squirrels from INDU. Three Franklin's ground squirrels were taken by Alex Bognar, from "Miller" in Lake County, Indiana in 1947. The specimens are in the Field Museum (CNHM #'s 73872, 73873 and 73874). We assume these were near Miller Station, which is about half a mile south of Miller Woods. In 1986–87, Scott Johnson and other Indiana DNR personnel used two sets of 10 live traps to examine the area along the railroad at Miller Station for Franklin's ground squirrels. This locale is close to where Bognar collected this species, but no Franklin's ground squirrels were seen or taken there.

Mierzwa et al. (1991) trapped two Franklin's ground squirrels on low dunes between swales: one at the Dupont area and one at the Big Marsh/Indian Ridge area. Also, they commonly found it at Powderhorn Lake, and it was present at Burnham Prairie and near Lake Calumet. These records are exceedingly interesting since this species is listed as endangered in Indiana. Most of the currently known populations are along railroads, although a few are along roadsides.

Gray squirrel, *Sciurus carolinensis* (Gmelin).—Lyon (1923) did not report this species from the Lakeshore area; however, Krekeler (1981) recorded it as common in woods and suburbs, and Texas Instruments (1975–80) reported 23 from three habitats at the Lakeshore. Whitaker et al. (1994) recorded it in upland oak forest and in oak savanna and also several roadkilled individuals. Also, several were seen in black oak forest at Miller Woods, and one was observed in black oak forest at Dune Acres. Whitman et al. (1990) observed gray squirrels at Miller Woods.

Mierzwa et al. (1991) recorded 23 gray squirrels in the Grand Calumet River area: seven in the DuPont area, two in the Ivanhoe area, two in the Burnham Prairie/Powderhorn Prairie area, and 12 at Egger's Woods. This species is relatively uncommon at INDU, but it is more common in the Grand Calumet River basin.

Fox squirrel, *Sciurus niger* Linnaeus.—Lyon (1923), Krekeler (1981), Texas Instruments (1975–80) and Whitaker et al. (1994) all reported this species as common at INDU; and it is common in proper habitat in all of northwest Indiana. This species was not reported by Mierzwa et al. (1991) in their study plots, but it should be fairly common in the Grand Calumet River basin.

Red squirrel, *Tamiasciurus hudsonicus* (Erxleben).—Lyon (1923), Krekeler (1981) Texas Instruments (1975–80) and Whitaker et al. (1994) reported the red squirrel as fairly common in the wooded portions of INDU. Whitman et al. (1990) took it in traps along pond edges in Miller Woods. Mierzwa et al. (1991) found no red squirrels in the vicinity of the Grand Calumet River, and it is likely this species is rare or absent because of the lack of forest, particularly conifers.

Southern flying squirrel, *Glaucomys volans* (Linnaeus).—Lyon (1923) did not see flying squirrels but listed them as almost certainly present at INDU. Texas Instruments (1975–80) collected three from black oak/swamp forest at INDU; and Whitaker et al.

(1994) trapped two flying squirrels: one in black oak forest and one in black oak savanna. Scrubby black oak is a good habitat for flying squirrels because old woodpecker holes and other openings can be used as nest sites or refuges for this species. Flying squirrels were not reported by Mierzwa et al. (1991), and they are probably not common in the Grand Calumet area because of the lack of suitable forest. Flying squirrels feed heavily on nuts and seeds but will readily eat insect material or even young birds and their eggs.

Beaver, *Castor canadensis* Kuhl.—Beavers had nearly disappeared from Indiana by 1840 (Lyon 1936). They were reintroduced into Jasper-Pulaski and Kankakee Fish and Wildlife Areas in 1935 from Wisconsin and Michigan, and later introductions were made into other areas. Brooks (1959) knew of 326 colonies in 43 counties of Indiana. The majority were in portions of northwest Indiana, including Lake County. There is a 1968 photograph of a beaver lodge at Cowles Bog (Lindsey et al. 1969). Krekeler (1981) listed the beaver as uncommon at INDU but said that it had caused high water problems on the road leading into Dune Acres (at Cowles marsh). There is currently a beaver colony on the Salt Creek watershed, and signs of beaver were seen by Whitaker et al. (1994) on the lower portions of the Little Calumet River. There was a colony on the Little Calumet north of Chesterton, but all of those beavers have been trapped. Mierzwa et al. (1991) did not mention beaver in their studies of the Grand Calumet River area. The beaver should be a prominent species in wooded portions of a clean Grand Calumet River.

MURIDAE
(mice and rats)

Most mice and rats are currently placed in the family Muridae, which contains three subfamilies: the Sigmodontinae (previously the Cricetinae), the Arvicolinae (previously the Microtinae) and the Murinae. The Murinae are the Old World rats and mice, *Mus* and *Rattus*.

Sigmodontinae

The Sigmodontinae are native rats and mice and constitute one of the largest groups of mammals in North America, both in number of species and individuals. However, there are only two (or possibly three) species in this group in the Grand Calumet River basin, although one of them, *Peromyscus leucopus*, is the most abundant mammal there.

Western harvest mouse, *Reithrodontomys megalotis* (Baird).—The western harvest mouse was first taken in Indiana in 1969 at Willow Slough State Fish and Wildlife area in Newton County (Whitaker & Sly 1970). By 1975 it had extended its range to include at least seven counties of northwest Indiana (Ford 1975), but it had not crossed north of the Kankakee River into Lake and Porter Counties. By 1994 (Whitaker unpubl. data), it had extended its range south into Vigo County. By 1995 it had crossed the Wabash River into Clay County, and by 1997 it had crossed the Kankakee. Now that barrier has been crossed, harvest mice should become part of the fauna of northwest Indiana.

Deer mouse, *Peromyscus maniculatus* (Wagner).—The deer mouse occupies a variety of habitats ranging from woods to dry open areas. Its prime habitat in Indiana is in cultivated fields where it lives even when the fields are bare (Whitaker 1967). However, only the prairie deer mouse, *P. m. bairdii* is present in Indiana. It lives in dry open areas. It is never found in woods, although it can be abundant in savanna with open sand. Unlike all of the other species of small mammals in Indiana, its habitat is inversely related to plant cover; and it can live in areas with little or even no herbaceous vegetation, such as recently plowed or harvested fields or open sandy areas. Its prime habitat in Indiana is in cultivated fields (Whitaker 1967; Mumford & Whitaker 1982). Its tracks are often obvious in loose sand on dunes, or in light snow in plowed fields, where it emerges from one burrow and enters another. It probably inhabited areas of open sand such as on dunes in presettlement times.

Hahn (1909) recorded this species from only five counties and did not think it was common in Indiana. Evermann & Butler (1894) stated that it was abundant on the dunes along Lake Michigan. Lyon (1923) found numerous footprints of this species in the loose sand on the dunes but took few specimens. Krekeler (1981) recorded it as abundant in foredunes, grasslands, thickets and old fields. Whitman et al. (1990) found it from Miller Woods. Whitaker et al. (1994) recorded *Peromyscus maniculatus* from 10 habitats, but

it was most common in dry prairie and on INDU right-of-ways. Mierzwa et al. (1991) recorded 30 individuals in open sand on Clark and Pine Complex, and stated that they were "so common at Lakeshore Railroad Prairie that we were able to find them under boards and debris without even trapping for them."

White-footed mouse, *Peromyscus leucopus* (LeConte).—*Peromyscus leucopus* is the most abundant small mammal at INDU (Lyon 1923; Texas Instruments 1975–80; Krekeler 1981; Whitman et al. 1990). Whitaker et al. (1994) took a total of 445 individuals in 22 of 24 habitats they studied and in 98 of the 168 (58.3%) plots in which they trapped. The only habitats from which the white-footed mouse was not taken were barren grounds and excavated areas, both habitats lacking plant cover. The highest numbers were taken in ephemeral lowland forest, oak upland forest, mixed deciduous savanna, mixed deciduous upland forest, coniferous savanna, and pine plantations. It is probably also the most abundant species in the area of the Grand Calumet River, as Mierzwa et al. (1991) took 67 individuals of this species and found it in every one of their study sites (Table 1).

Arvicolinae (microtines or voles)

All five species of microtines present in Indiana are probably present both at the Lakeshore and in the area of the Grand Calumet River.

Meadow vole, *Microtus pennsylvanicus* (Ord).—The meadow vole is found throughout northern Indiana where it is usually the most abundant small mammal of moist grassy meadows and wet prairies. In dry fields with sparse vegetation, it tends to be replaced by the prairie vole, *M. ochrogaster*. Lyon (1923) took prairie voles and pine voles at INDU, but inexplicably, he did not take meadow voles. Krekeler (1981) and Texas Instruments (1975–80) indicated it as abundant. Whitman et al. (1990) trapped them in low-lying areas around one pond at Miller Woods. Whitaker et al. (1994) trapped 171 individuals in 28 plots in 13 habitats. These animals were most abundant in old field and upland terrestrial shrubland. Thirty-four were taken in one plot in this latter habitat. The cover here was heavy and mainly forbs, but it included dogwood, poison ivy, roses, some young pines and few grasses. The soil was quite moist. Mierzwa et al. (1991) captured 25 meadow voles in five of their six study areas near the Grand Calumet River, but they found them most abundant at the Big Marsh/Indian Ridge site.

Prairie vole, *Microtus ochrogaster* (Wagner).—Lyon (1923) took seven prairie voles. Krekeler (1981) listed this species as uncommon in relatively dry fields with cover of grasses or weeds. Whitaker et al. (1994) took 17 individuals in eight plots in five habitats. The species was most abundant in old fields. Mierzwa et al. (1991) did not capture any prairie voles, but additional trapping in the drier grasslands of the Grand Calumet River will undoubtedly yield prairie voles. This species lives in drier and sparser vegetated areas than the meadow vole, and it is much less abundant to the north.

Woodland vole/Pine vole, *Microtus pinetorum* (Le Conte).—Lyon (1923) found many subterranean burrows probably used by this species but trapped only two woodland voles in the Indiana Dunes area. Krekeler (1981) listed it as uncommon and Texas Instruments (1975–80) caught two individuals in black oak/swamp forest. Whitaker et al. (1994) did not take any individuals in their study plots, but they did take four in pitfall traps set for this species in black oak woods. Mierzwa et al. (1991) did not take any woodland voles in studies using surface trapping methods. The woodland vole lives in underground burrows, and thus it is often under-represented in surface trapping surveys. It is found at INDU, and undoubtedly it also occurs in the area of the Grand Calumet River.

Muskrat, *Ondatra zibethicus* (Linnaeus).—The muskrat is common in the marshes, streams and ponds of northwest Indiana (Lyon 1923; Krekeler 1981; Texas Instruments 1975–80; Whitaker et al. 1994). Whitman et al. (1990) trapped it along ponds in Miller Woods. Mierzwa (pers. comm.) saw a road-killed individual on Route 12 near the Gary Regional Airport. Their population in the Calumet River basin could increase if the river is cleaned up.

Southern bog lemming, *Synaptomys cooperi* Baird.—Lyon (1923) did not record this species from INDU, but Rand & Rand (1951) recorded it based on their identification of skeletal remains. Krekeler (1981) recorded it as uncommon in areas with lush ground cover of grass and in bogs, but we do not believe

that he ever saw a specimen. Texas Instruments (1975–80) did not capture any bog lemmings. Whitaker et al. (1994) did not trap any, and apparently no specimen is available as yet from INDU. Whitaker et al. (1994) did find bright green fecal pellets, probably from this species, at a razed residential site on Waverly Road on 28 February 1988. Meadow voles produce dull green or brownish fecal pellets. The name bog lemming is a misnomer. It is not primarily or even often found in wet areas. It has a broad range of habitats from woods to rank meadows and dry *Andropogon* fields.

Murinae
(introduced mice and rats)

Rattus norvegicus and *Mus musculus* are introduced exotics and are usually found in habitats created or disturbed by humans, such as in buildings or cultivated fields.

Norway rat, *Rattus norvegicus* (Berkenhout).—This is the common rat associated with garbage dumps, barns, grain storage units and suburban warehouses. It is a major pest almost everywhere that it occurs. It ruins foods and other materials and carries disease. It is common in larger cities and on farms in northwest Indiana. Lyon (1923) did not trap or see any rats but said that residents reported them. Krekeler (1981) reported them as common around farms, suburbs, and ditches. None were reported during the Texas Instruments studies. Whitaker et al. (1994) found rat droppings in abandoned buildings. Mierzwa et al. (1991) took one Norway rat at the Big Marsh/Indian Ridge area.

House mouse, *Mus musculus* Linnaeus.—This mouse has been transported around the world by humans. In Indiana, it is very common in cultivated fields when adequate cover is available; but, unlike the prairie deer mouse, it vacates immediately once the cover is removed. The prairie deer mouse and house mouse are the primary small mammals of the Indiana corn and soybean fields (Whitaker 1967), although *P. leucopus* is sometimes present as well. The species also invades beaches, offshore islands and estuarine areas.

Lyon (1923) took two individuals, both in foredune areas; and Texas Instruments (1975–80) took five from young foredunes. Surprisingly, none were taken in any of the plots in the 24 habitats studied by Whitaker et al. (1994). Their only records were sight records at residential areas and some from Chellberg Farm. Two individuals were taken among 70 mammals from snap traps at Pinhook Bog by Whitaker and Mumford in 1978 (Mumford & Whitaker 1982). It is clear that the house mouse is not abundant along the Indiana Lakeshore, probably because of the lack of agricultural land present. The same is probably true in the Grand Calumet River basin, as Mierzwa et al. (1991) recorded only one house mouse. It was found at the Big Marsh/Indian Ridge site.

DIPODIDAE
(jumping mice)
(previously Zapodidae)

Meadow jumping mouse, *Zapus hudsonius* (Zimmermann).—Lyon (1923) concluded that *Z. hudsonius* was almost certainly present in the Lakeshore region. Texas Instruments (1975–80) reported four individuals from young foredunes and 23 from the transmission corridor. Whitaker et al. (1994) took 15 individuals from three habitats, 13 of which came from one plot in aquatic shrublands. Whitaker and R.E. Mumford took one at Cowles Bog and five at Pinhook Bog in the fall of 1978, and one from a flat depression behind the foredunes east of the Bailly Generating Station in October of 1974. The meadow jumping mouse was not taken by Mierzwa et al. (1991), but it is undoubtedly present in the Grand Calumet River area.

CARNIVORA
(carnivores)

The raccoon is abundant and obvious, but the other carnivores of the Grand Calumet River area are difficult to assess and count. Large carnivores are much less abundant than small mammals, and they are usually among the first to disappear as humans develop the land, because of habitat loss, trapping and hunting. They are often thought of as problem animals and killed by the general public. For some species, roadkills may give us the best assessment of status.

The carnivores of northwest Indiana that may be present in the Grand Calumet River basin are grouped in five families, the Canidae (coyote, two species of foxes, domestic dog), Procyonidae (raccoon), Mustelidae (two species of weasels, mink, badger), Mustelidae (skunk), and the Felidae (bobcat, housecat).

CANIDAE

Coyote, *Canis latrans* Say.—The coyote has always been present in Indiana, but in recent years its populations have increased. There are early reports of wolves and coyotes at INDU; however, wolves are long gone and there was no confirmed record of coyotes prior to the work of Whitaker et al. (1994). These authors report that one was seen by Noel Pavlovic at Toleston Dunes on 7 August 1990, and that Lakeshore rangers have seen them several times near the Heron Rookery, starting in June and July of 1990. Dan Fagre saw one in a cornfield just south of INDU in 1991. It is not clear yet whether coyotes have taken up residence at the Lakeshore; but if not, it appears to be only a matter of time until they do. Unfortunately, Rand & Rand (1951) found no canid bones to help determine whether coyotes or wolves or both inhabited the dunes in pre-settlement times. Mierzwa et al. (1991) did not report coyotes, and it is not clear whether they now live in the Grand Calumet area.

Red fox, *Vulpes vulpes* Linnaeus.—Red and gray foxes are often confused because the gray fox has some reddish coloration. The red fox is easily identified because it is red above with a white tail tip. Lyon (1923) reported red foxes at INDU. Whitaker et al. (1994) reported them from five different habitats at the Lakeshore, and one was found dead along the roadside in 1984–85. Four were seen from a helicopter during the 1991 Lakeshore survey for deer. Mierzwa (pers. comm.) saw a red fox dead on the road on Route 312 east of Cline Avenue on 27 September 1990, and he saw a skull found at Clark and Pine East on 23 April 1991. It is not clear how common this species is in the Grand Calumet River area.

Gray fox, *Urocyon cinereoargenteus* (Schreber).—The gray fox lives in woods and probably inhabits the forests of INDU. Lyon (1923) did not mention this species, but Texas Instruments (1975–80) recorded it on the basis of tracks. Whitaker et al. (1994) reported it at Howe's Prairie on 11 August 1987; and more recently, Dan Fagre saw two east of Dune Acres. The gray fox could occur in the Grand Calumet River region in a wooded area such as in Miller Woods, but its presence is less likely than the red fox because of the scarcity of mature woods.

PROCYONIDAE

Raccoon, *Procyon lotor* Linnaeus.—The raccoon is abundant at INDU and at the Indiana Dunes State Park in campgrounds and other visitor sites. Apparently raccoons were not always so common; Lyon (1923) says "residents state that a few 'coons' are taken each season for their fur. I have no personal knowledge of the animal and I have never been fortunate enough to find foot prints that might have been made by it." Krekeler (1981), Texas Instruments (1975–80), Whitman et al. (1990) and Whitaker et al. (1994) all stated the raccoon was common at INDU; and it should be common in the Grand Calumet River area. Mierzwa et al. (1991) found raccoon tracks at wetland margins during their study.

MUSTELIDAE

Least weasel, *Mustela nivalis* Linnaeus.—The least weasel is a tiny prairie species with a one inch-long tail. Dice (1928) reported the first least weasel from Indiana in Wells County. Lyon (1936) reported this species only from Pulaski and Wells Counties. There is an earlier record for Porter County (Mumford & Whitaker 1982). The specimen is in the Field Museum in Chicago (112538) and was taken by A.L. Rand on 10 June 1950 (Rand & Rand 1951). This species has been taken sparingly throughout the northern three-quarters of Indiana. The first individuals from INDU were collected during the Texas Instruments studies: one from the young foredunes, and one from the black oak/swamp forest. This species favors open fields and feeds heavily upon meadow mice, so foredunes are suitable habitat. The latter habitat is atypical. Another least weasel was killed by a cat on Route 275E, N of U.S. Route 20 in October 1990 (Whitaker et. al. 1994). This species should occur in the Grand Calumet River area.

Long-tailed weasel, *Mustela frenata* Lichtenstein.—This is the most common weasel in Indiana, and it is found throughout the state. It has a much longer tail than the least weasel, which is the only other weasel known in Indiana. Lyon (1923) states, "These animals are fairly common in the region although I have never seen any." He reported that a trapper had taken about 200 individuals in the past three winters in the dunes region but that only two of them were in white pelage. Texas

Instruments (1975–80) did not report this species. Whitman et al. (1990) observed a long-tailed weasel climbing on fallen timber in Miller Woods. Whitaker et al. (1994) took six long-tailed weasels in traps in three habitats and observed tracks of four: one at Howe's Prairie and one in upland forest. This species should be fairly common in the Grand Calumet River area.

Mink, *Mustela vison* Schreber.—The mink is much larger than the long-tailed weasel and has a bushy tail. Lyon (1923) collected a dead mink and said that several minks are trapped each year in the Lakeshore region. Texas Instruments (1975–80) took two from Cowles Bog. One was seen at Dune Acres on 9 January 1988 in a cattail marsh, and an adult and three young were seen along a marsh on Kemil Road in 1990 (Whitaker et al. 1994). The mink should be present in the Grand Calumet River area.

Badger, *Taxidea taxus* Schreber.—Lyon (1923) listed the badger as recently occurring in the Lakeshore region, and Brennan (1923) reported an individual from the Furnessville Blowout. In the fall of 1986, a badger was found near a trash can in a parking lot at INDU (Whitaker et al. 1994). However, its claws had been removed, probably indicating that it had been transported there from some other locality. A badger was found dead in Porter County on Highway 30 about nine miles west of Highway 49, 0.5 mile west of 600 West (at the center of section 23) on 7 September 1990. On two occasions Whitaker et al. (1994) recorded signs that may have been made by badger: tracks in black oak forest at Howe's Prairie on 11 August 1987, and excavations in dry prairie at the proposed campground on 14 July 1987. Larry Reed, a veterinarian at Westchester Animal Clinic, treated a badger captured in the east unit of INDU during 1990. On 9 April 1989, a badger was seen by Mark Harbin and Andrea Halcarz west of the parking lot near the entrance to Dune Acres. It disappeared from view but apparently entered a burrow at the base of a tree on a sandy bank. Badger populations have been increasing in recent years, and these records all indicate that the badger could occur in the area of the Grand Calumet River.

MEPHITIDAE
(skunks)

Striped skunk, *Mephitis mephitis* Schreber.—Lyon (1923) reported skunks as common at INDU and noted that a number were taken each year for fur. Texas Instruments (1975–80) collected two skunks and saw tracks in black oak/swamp forest and in red maple swamp forest. Krekeler (1981) stated that they forage along the beach of Lake Michigan. Whitaker et al. (1994) took two in traps and observed another. It is surprising that none were recorded as roadkill. Skunks surely inhabit the Grand Calumet River basin.

FELIDAE
(cats)

Bobcat, *Felis rufus* Schreber.—The bobcat is exceedingly rare; and it is listed as endangered in Indiana, although individuals keep turning up. The bobcat is recognizable by its short, or "bob" tail, which contrasts with the long tail of the housecat (although an occasional housecat has lost its tail). The latest confirmed records are from Monroe County (1970), Perry County (1975), Jefferson County (1982), Lawrence County (1 record in 1982, 1 in 1994, 2 in 1995, and 1 in 1996), Parke County (1987), Crawford County (1988), Warrick County (1990), Dekalb County (1993), Steuben County (1993) and Washington County (1995). Among numerous unconfirmed reports (most probably erroneous) are two from LaPorte and two from Starke Counties. It is unlikely, but not inconceivable, that the bobcat still exists in wooded areas of the Lakeshore; but it is probably not found in the Grand Calumet River area because of development, lack of forest and habitat fragmentation.

Housecat, *Felis silvestris* Schreber.—Truly feral populations of housecats seldom exist in the eastern United States. Most housecats that forage afield have a house or other building that serves as a home base. There are numerous housecats in the Grand Calumet River area. Housecats are exotics, and as such control might be considered if they become a problem to native animals. To date, there is no indication that the housecat is a problem in the Grand Calumet River area, but it could become one due to the prevalence of buildings nearby.

CERVIDAE
(deer)

White-tailed deer, *Odocoileus virginianus* (Zimmermann).—The white-tailed deer was

extirpated from the state before 1900 (Mumford & Whitaker 1982). Re-stocking deer in Indiana began in 1934 when 35 deer were released in seven counties. By 1955 more than 400 deer had been introduced into 22 counties. Population estimates for the state were 900 in 1943, 1200 in 1944, and more than 2900 in 1946. A deer season opened in 1951 when the deer population of the state was estimated at 5000. By 1966, deer were probably present in all counties; and they have continued to multiply, thereby becoming very abundant in recent years.

Texas Instruments (1975–1990), Krekeler (1981) and Whitaker et al. (1994) all indicated that white-tailed deer were common at INDU. Deer were counted by aerial census in 1982, 1984, 1988, 1989, 1991 and 1992. The counts were 85, 29, 214, 349, 166 and 207 deer in those years. The actual populations were larger but it is not known what proportion of the deer was observed, and only about 75% of the Lakeshore was flown. Whitman et al. (1990) saw deer tracks also.

THE HABITATS

At the southern end of Lake Michigan, east of Chicago and east of the Gary/Hammond area, lies the Indiana Dunes National Lakeshore (INDU). Chicago and Gary areas are two of the more highly-developed and heavily-polluted regions of the world. The area was once composed of extensive series of dunes, and classic studies of plant and animal succession were done there (Cowles 1899; Shelford 1912a, b); however, by the middle of the 20th century, the entire area was being developed. Senator Paul Douglas was instrumental in establishing INDU in the area between Gary and Michigan City. Since then, much land has been acquired, many buildings have been razed, and some of the land is being converted to resemble its original condition.

Some of the larger species are not restricted ecologically, but they could occur in any of the terrestrial habitats. Others are more restricted or are characteristic constituents of only a few of the habitats. Some of the mammals with relatively little ecological restriction, at least within an area as small and as varied as the Grand Calumet River basin, are the eastern cottontail, *Sylvilagus floridana*; raccoon, *Procyon lotor*; long-tailed weasel, *Mustela frenata*; striped skunk, *Mephitis mephitis*; and white-tailed deer, *Odocoileus virginiana*.

Mammals likely to be found in the various habitats of the Grand Calumet River basin are listed below separately for each of the habitats. These lists are derived from information in Whitaker et al. (1994), Mierzwa et al. (1991), Mumford & Whitaker (1982), Hoffmeister (1989) and from personal observations (1994).

Agricultural land and old fields.—The plots designated as agricultural areas by Whitaker et al. (1994) in INDU were actually early seral "old fields" rather than cultivated areas, *per se*. Canopy was entirely absent in all of these plots, but scattered shrubs were present in some. The dominant plants were grasses and forbs. In northern Indiana, the meadow vole is the most abundant species in lush meadows, and 90 individuals of this species occurred in the nine plots in this habitat (Whitaker et al. 1994).

Mammal species likely in agricultural fields in the Grand Calumet River basin are the meadow vole, *Microtus pennsylvanicus*; prairie vole, *Microtus ochrogaster*; northern short-tailed shrew, *Blarina brevicauda*; masked shrew, *Sorex cinereus*; meadow jumping mouse, *Zapus hudsonius*; and the eastern mole, *Scalopus aquaticus*

Prairie.—There is a great deal of prairie or grassy oldfield in the Grand Calumet River area with Dry Prairie often grading into or alternating with Wet Prairie.

Dry prairie: The majority of the dry prairie along the Grand Calumet River is on the low dunes between swales or marshes. Dry prairies include a variety of species of grasses and forbs. Cover is often good in this habitat, providing ample hiding spots for small mammals. Marram, sand reed grass or little bluestem dominated most of the plots sampled by Whitaker et al. (1994) at INDU. The little bluestem plots were probably more similar to dry prairie near the Grand Calumet River than the more typical dunes grasses. The dominant small mammal in Dry Prairie at INDU was the prairie deer mouse, *Peromyscus maniculatus*, followed by the white-footed mouse, *Peromyscus leucopus* (Whitaker et al. 1994). Prairie voles occurred, perhaps somewhat surprisingly, in only one of the 11 plots sampled. The generally sparse cover in many of the plots accounts for both the abundance of deer

mice and the low number of prairie voles. The prairie deer mouse is the one small mammal of Indiana that is more abundant in areas with less plant growth, and prairie voles thrive only in areas of good plant cover.

Signs observed at INDU in this habitat could have been from the bog lemming, *Synaptomys cooperi*. The thirteen-lined ground squirrel now inhabits primarily mowed areas such as golf courses, lawns, pastures and roadsides. Its occurrence in dry prairies in the dunes might indicate that this habitat was a pre-settlement habitat for this species.

Mammal species likely to be found in dry prairie in the Grand Calumet River basin are the prairie deermouse, *Peromyscus maniculatus bairdii*; white-footed mouse, *Peromyscus leucopus*; prairie vole, *Microtus ochrogaster*; thirteen-lined ground squirrel, *Spermophilus tridecemlineatus*; woodchuck, *Marmota monax*; least shrew, *Cryptotis parva*; Franklin's ground squirrel, *Spermophilus franklinii*; southern bog lemming, *Synaptomys cooperi*; coyote, *Canis latrans*; red fox, *Vulpes vulpes*; least weasel, *Mustela nivalis*; and American badger, *Taxidea taxus*.

Wet prairie: Wet prairie areas contain various grasses and forbs as the dominant plants, and they often contain significant amounts of shrubs such as willow or aspen. Some of the major grasses are *Calamagrostis*, *Panicum*, *Aristida*, *Phalaris*, and *Agrostis*. Cattails and rushes were also dominant in one plot. Cover ranged from fair to excellent.

The most abundant mammal species taken in wet prairie by Whitaker et al. (1994) was the masked shrew. Mumford & Whitaker (1982) earlier (27–28 April 1977) used 1508 snap-traps for two nights and took 60 meadow voles, 22 masked shrews, 16 white-footed mice, and ten short-tailed shrews. Most of the traps were in grass sedge meadow, which included clumps of willows. The voles were feeding extensively on the willow fruits. The fruiting twigs were 0.5–1.0 m high, and the voles were getting the fruiting heads by cutting off the twigs, pulling them down, and recutting them until the heads were reached, leaving cuttings 4–15 cm long in piles with the fruiting leaflets and parts of the fruits on top of the piles of twigs. The stomachs of the mice were full of this material.

Mammal species likely to be found in wet prairie in the Grand Calumet River basin: meadow vole, *Microtus pennsylvanicus*; masked shrew, *Sorex cinereus*; northern short-tailed shrew, *Blarina brevicauda*; white-footed mouse, *Peromyscus leucopus*; meadow jumping mouse, *Zapus hudsonius*; and the southern bog lemming, *Synaptomys cooperi*.

Lowland terrestrial shrub.—There is a fair amount of terrestrial shrubland in the area of the Grand Calumet River. Shrubby species expected might be willow, aspen, red maple, or red ozier dogwood (*Cornus stolonifera*), and a variety of grasses and forbs are likely. No species of mammal was dominant or even abundant in the lowland terrestrial shrubland. The white-footed mouse was the most abundant mammal, but only six individuals were taken.

Mammal species likely in lowland terrestrial shrubland in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus) and eastern cottontail (Sylvilagus floridanus.*

Upland terrestrial shrub.—There is a fair amount of upland terrestrial shrubland in the area of the Grand Calumet River. Four plots sampled by Whitaker et al. (1994) in upland terrestrial shrubland all were in highly disturbed transition stages between grassy oldfield or savanna and wooded habitats. One plot was highly productive, yielding 44 individuals of four mammal species. The nine shrews and 33 meadow voles taken there clearly reflected the former field habitat rather than the present transitional shrub stage, and these forms will undoubtedly disappear from this area as the transition toward more woody vegetation continues in this plot. A total of 14 species (including the domestic dog) was found in this habitat, but most were in low numbers. The author suspects that the lack of a well-developed community in shrubland is due to the ephemeral nature of the habitat.

Mammals likely in upland terrestrial shrubland in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), eastern cottontail (*Sylvilagus floridanus*), and white-tailed deer (*Odocoileus virginiana*).

Oak savanna.—Oak savanna is a common habitat in the Grand Calumet River basin, and 15 oak savanna plots were studied by Whitaker et al. (1994) at the Lakeshore. All had a canopy of nearly pure black oak, usually thin.

Table 2.—Likely mammal species of Calumet basin, pre-settlement, present, and likely origin (native, reintroduced native, introduced exotic, extirpated).

Native mammals, probably present in pre-settlement times, but gone now.	Pre-settlement	Now	Status
Rodentia			
Erethizon dorsatum, American porcupine	yes	no	native
Carnivora			
Canis lupus, gray wolf	yes	no	native
Ursus americanus, black bear	yes	no	native
Martes pennanti, fisher	yes	no	native
Lutra canadensis, river otter	yes	no	native
Felis concolor, mountain lion	yes	no	native
Felis lynx, Canada lynx	yes	no	native
Felis rufus, bobcat	yes	no	native
Artiodactyla			
Cervus canadensis, American elk	yes	no	native
Bos bison, American bison	yes	no	native
Native mammals present in pre-settlement times, extirpated by 1900, then reintroduced.			
Castor canadensis, American beaver	yes	yes	reintrod.
Odocoileus virginiana, white-tailed deer	yes	yes	native
Native mammals probably present in pre-settlement times to present.			
Marsupialia—Marsupials			
Didelphis virginiana, Virginia opossum	yes	yes	native
Insectivores—Shrews and Moles			
Scalopus aquaticus, common mole	yes	yes	native
Cryptotis parva, least shrew	yes	yes	native
Blarina brevicauda, northern short-tailed shrew	yes	yes	native
Sorex cinereus, masked shrew	yes	yes	native
Chiroptera—Bats			
Myotis lucifugus, little brown myotis	yes	yes	native
Lasiurus borealis, eastern red bat	yes	yes	native
Lasionycteris noctivagans, silver-haired bat	yes	yes	native
Eptesicus fuscus, big brown bat	yes	yes	native
Lagomorpha—Rabbits and Hares			
Sylvilagus floridana, eastern cottontail	yes	yes	native

Table 2.—Continued.

Native mammals, probably present in pre-settlement times, but gone now.	Pre-settlement	Now	Status
Rodentia—Rodents			
Tamias striatus, eastern chipmunk	yes	yes	native
Marmota monax, woodchuck	yes	yes	native
Spermophilus franklinii, Franklin's ground squirrel	yes	yes	native
Spermophilus tridecemlineatus, thirteen-lined ground squirrel	yes	yes	native
Sciurus carolinensis, gray squirrel	yes	yes	native
Sciurus niger, fox squirrel	yes	yes	native
Tamiasciurus hudsonicus, red squirrel	yes	yes	native
Glaucomys volans, southern flying squirrel	yes	yes	native
Peromyscus leucopus, white-footed mouse	yes	yes	native
Peromyscus maniculatus bairdii, prairie deermouse	yes	yes	native
Microtus ochrogaster, prairie vole	yes	yes	native
Microtus pennsylvanicus, meadow vole	yes	yes	native
Microtus pinetorum, pine vole	yes	yes	native
Ondatra zibethicus, common muskrat	yes	yes	native
Synaptomys cooperi, southern bog lemming	yes	yes	native
Zapus hudsonius, meadow jumping mouse	yes	yes	native
Carnivora			
Canis latrans, coyote	yes	yes	native
Vulpes vulpes, red fox	yes	yes	native
Urocyon cinereoargenteus, gray fox	yes	yes	native
Procyon lotor, raccoon	yes	yes	native
Mustela nivalis, least weasel	yes	yes	native
Mustela frenata, New York weasel	yes	yes	native
Mustela vison, mink	yes	yes	native
Taxidea taxus, American badger	yes	yes	native
Mephitis mephitis, striped skunk	yes	yes	native
Introduced exotics			
Rattus norvegicus, Norway rat	no	yes	exotic
Mus musculus, house mouse	no	yes	exotic

Both the shrub and herb layer varied considerably. Some of the more abundant shrubs were blackberry, blueberry, rose and Japanese honeysuckle. Abundant herbaceous plants were *Andropogon*, *Panicum*, *Carex*, goldenrod and bracken fern. Thirty white-footed mice and 18 prairie deer mice were taken, although the prairie deer mice occurred in only three of the plots. These are the results one would expect since the prairie deer mouse favors sparsely vegetated, dry areas without woody vegetation. The white-footed mouse is a species of the woods, and savanna is a thinly wooded habitat.

Mammal species likely in oak savanna in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), prairie white-footed mouse (*Peromyscus maniculatus bairdii*), prairie vole (*Microtus ochrogaster*), eastern cottontail (*Sylvilagus floridanus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), Franklin's ground squirrel (*Spermophilus franklinii*), and eastern mole (*Scalopus aquaticus*).

Mixed deciduous savanna.—Three plots in mixed deciduous savanna at the Lakeshore all had scattered cottonwoods with little bluestem as the principal herbaceous species (Whitaker et al. 1994). Major grasses in this habitat were old little bluestem, old witch grass and brome grass; and grape and aromatic sumac were among the more abundant shrubs. Cover was fair-to-good in these plots due to the grass. The white-footed mouse was the most abundant mammal, being taken at all three plots with a total of 20 individuals.

Mammal species likely in mixed deciduous savanna in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), prairie white-footed mouse (*Peromyscus maniculatus bairdii*), prairie vole (*Microtus ochrogaster*), eastern cottontail (*Sylvilagus floridanus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), Franklin's ground squirrel (*Spermophilus franklinii*), and eastern mole (*Scalopus aquaticus*).

Upland forest.—Upland forest, mostly oak, is widespread at INDU (Whitaker et. al. 1994). There is relatively little mature forest in the Grand Calumet River basin, but scrubby black oaks in much of the forest in the Grand Calumet River basin grade into scrubby black oak savanna. The shrub layer at INDU was often dense and diverse in this habitat, but it often contained blueberry (*Vaccinium vacillans*). The herbaceous layer was again diverse, although often thin and depauperate, most often providing poor-to-fair cover. The dominant herbaceous plants there were most often Pennsylvania sedge (*Carex pennsylvanicus*) and bracken fern (*Pteridium aquilinum*). The white-footed mouse was the most abundant small mammal in upland oak forest.

Mammal species likely to be found in upland forest in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), eastern chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), raccoon (*Procyon lotor*), red squirrel (*Tamiasciurus hudsonicus*), northern short-tailed shrew (*Blarina brevicauda*), pine vole (*Microtus pinetorum*) and gray fox (*Urocyon cinereoargenteus*).

Lowland forest.—Lowland forest was divided into perennial (contains water more than six months of the year) and ephemeral wet lowland forest and was the second largest habitat after upland forest in INDU (Whitaker et al. 1994). The canopy was usually quite dense but varied in species composition. Common trees were silver or red maple followed by oak, ash, aspen, elm and sassafras. The shrub layer varied from sparse to dense; and it consisted mostly of seedlings of the trees mentioned above plus spicebush, *Viburnum*, *Cornus*, *Ilex*, *Rubus*, blueberries and others. Ground cover varied from fair to excellent; and species composition varied greatly between plots, with graminoid plants ferns being common. The herb and shrub layers were often clumped in hummocks. As usual in wooded habitats, the white-footed mouse was the most abundant species taken, totaling 137 in 27 plots (Whitaker et al. 1994).

Mammal species likely to be found in lowland forest in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), raccoon (*Procyon lotor*), northern short-tailed shrew (*Blarina brevicauda*), opossum (*Didelphis virginiana*), gray fox (*Urocyon cinereoargenteus*) and Eastern chipmunk (*Tamias striatus*).

Wetlands.—There is a variety of types of wetlands at INDU and also in the Grand Calumet River basin, marsh, aquatic shrubland, swamp, panne (depressions among the dunes) and open water.

Marsh: Marsh is prominent at INDU and in the Grand Calumet River basin. The herb layer was most often of cattail (*Typha*), sedges (*Carex*), bulrushes (*Scirpus*) or blue joint grass (*Calamagrostis canadensis*). The canopy was absent in most areas but consisted of scattered willows or elms in a few. The shrub layer consisted of thick buttonbush (*Cephalanthus occidentalis*) in most of the plots, whereas willow was present in one. Muskrats are abundant in many of the marshes, lakes and ditches of INDU, and would be in the basin if the water were clean.

Mammal species likely to be found in marshes in the Grand Calumet River basin are the muskrat (*Ondatra zibethicus*), white-footed mouse (*Peromyscus leucopus*), masked shrew (*Sorex cinereus*), meadow vole (*Microtus pennsylvanicus*), raccoon (*Procyon lotor*) and short-tailed shrew (*Blarina brevicauda*).

Aquatic shrublands: Aquatic shrublands made up a small but significant part of INDU and likewise also of the Grand Calumet River basin. Vegetation was of aspens, willows or oaks; and the herb layer was of blue joint grass, reed grass or cattails.

Mammal species likely in aquatic shrublands in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*) and raccoon (*Procyon lotor*).

Swamp: In the plots in swamp at INDU, (Whitaker et. al. 1994), the canopy was cottonwood and/or black willow (*Salix nigra*). The ground cover was excellent in each case, and it mainly consisted of grasses (blue joint grass or *Phalaris*), sedges (*Carex*) and cattails (*Typha*). Additional collections were made by Whitaker and R.E. Mumford in the fall of 1978 in the swamp just north of Cowles Bog. Three species were taken there, including 33 masked shrews, two short-tailed shrews, and 10 white-footed mice.

Mammal species likely to be found in swamp in the Grand Calumet River basin are the white-footed mouse (*Peromyscus leucopus*), masked shrew (*Sorex cinereus*) and raccoon (*Procyon lotor*).

Pannes: The pannes are shallow depressions among the dunes. They contain water much of the time and are often surrounded by grassy areas and shrubs. The canopy layer is usually absent. Shrub growth is often dense and consists of various species such as red ozier dogwood, willow and St. John's wort (*Hypericum kalmianum*). The herb layer usually forms good cover. A number of herbaceous species were present, including several members of the family Cyperaceae, *Eleocharis*, *Cladium*, *Rhynchospora*, a rush (*Juncus balticus*), strawberry, mountain mint (*Pycnanthemum virginianum*) and others. Five species of mammals were taken by Whitaker et al. (1994) in the three plots in pannes in INDU. The meadow vole was the only regularly occurring species with 13 being taken in two of the three plots. Three white-footed mice were taken in one of the plots, and three prairie deer mice were taken in another.

Mammal species likely to be found in pannes in the Grand Calumet River basin are the meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*) and prairie vole (*Microtus pennsylvanicus*).

Artificial habitats.—Various artificial habitats or developed lands including croplands, residential and industrial areas, right-of-ways and excavated areas are found at INDU and also in the Grand Calumet River basin.

Right-of-ways: Right-of-ways occur along roads, railroads or trails. However, they do not form a distinct habitat. Instead, they pass through and consist of some other habitat such as mature woods, dry prairie, etc. Therefore, many different plants are present, including several grasses and rushes, and several other plant species (*Melilotus*, *Saponaria*, *Solidago*, *Clematis*, *Dryopteris thelypterus*, *Carex*, *Typha*) as dominants in at least one plot. Because of the high variation in these plots, no list of expected species of mammals is given.

Excavated areas: Excavated areas are places of open sand due to human activities. There are three plots in this habitat at INDU (Whitaker et al. 1994), and there are areas with this habitat due to sand-mining in the Grand Calumet River watershed. One of the INDU plots is on the site of a former fly ash seepage area and another is on the site of a steel company acid spill. All three plots completely lack canopy, and two have poor ground cover, with scattered grasses, including little bluestem, sand reed grass and nodding wild rye (*Elymus canadensis*). The third plot has excellent cover of Joe-pye weed (*Eupatorium serotinum*), bullrush (*Scirpus cyper-*

inus) and spikerush (*Eleocharis* sp.). Only two mammals were trapped in plots in this habitat: a meadow vole and a raccoon. As expected, it is not a good habitat for mammals, although mammals do pass through these areas.

RESTORATION POSSIBILITIES

Acquisition of land.—The Grand Calumet watershed, like INDU, was made into an ecological showpiece under the leadership of Senator Paul Douglas. It has been greatly developed and has significant ecological problems. Perhaps efforts could be made under public ownership to obtain parts of the Grand Calumet watershed. It could then be reverted to the original habitat as much as possible.

Fragmentation.—One of the major problems for the Grand Calumet watershed is fragmentation. This has several implications; but most importantly, it inhibits organism dispersal. The fragments of habitat are often separated by areas difficult or impossible for animals (or plants) to bridge. This confines the animals within smaller tracts of land. Under normal circumstances, when populations are eliminated from a patch of habitat, more individuals move in and re-populate. With increased fragmentation, patches of habitat are often not re-populated because there is no available source of emigrants. Fragmentation can also result in inbreeding, due to the lack of new genetic material. Finally, organisms that disperse often die when they are unable to locate suitable habitat after they leave their birthplace.

There are other disadvantages of fragmentation. Fragmentation may allow other animals to penetrate and compete with animals normally found there. An example of this is the cowbird, which penetrates fragmented forests and lays its eggs in nests of other birds.

Attempts could be made to preserve large tracts of habitat in the Grand Calumet basin, especially marsh, dry prairie, wet prairie and mature woodland. Also, special efforts could be made to obtain or to create additional similar habitat between the tracts to allow dispersal. There is little mature forest remaining in the Grand Calumet basin, so its preservation is important.

Endangered/threatened species.—Only one endangered or threatened species of mammal, Franklin's ground squirrel, is known to inhabit the Grand Calumet River area. Two individuals were found by Mierzwa et al. (1991). Both animals were in the dunes between swales. Special efforts might be made to preserve or to create as much dry prairie as possible to help increase populations of this species.

The only other threatened or endangered mammal species likely to occur in the Grand Calumet River basin is the Indiana myotis. This species has not been taken there, but with enough mature wooded habitat, it could survive there. Dry prairie needs to be preserved in the Grand Calumet watershed in an effort to induce populations of Franklin's ground squirrels to live and thrive there.

Efforts could also be made to find and preserve mature woods, especially in the vicinity of Miller Woods, in order to produce as much contiguous mature woodland as possible. This would help all bat species as well as other woodland species.

Exotics.—Exotic plants and animals often compete with and sometimes supplant native species. Therefore, we often wish to eliminate them. There are two exotic mammals in the Grand Calumet River area: the house mouse (*Mus musculus*) and the Norway rat (*Rattus norvegicus*). However, both are uncommon in habitats like those in the Grand Calumet River basin, and efforts to increase natural habitat would help to control them further. Producing and maintaining native habitat would help control these exotic species.

Reintroduction of species.—In order to restore previous habitats and communities, reintroduction could be considered for species previously existing in the Grand Calumet River basin. However, many introductions would not be currently feasible. Species not previously present might not fit into local habitats, so their introductions would not be logical. Each of the ten extirpated species of mammals was considered for possible reintroduction. Because of their size and the present developed state of the area, the following species would be completely impractical for reintroduction at this time: timber wolf, black bear, mountain lion, Canada lynx, bison and American elk. The other four are discussed below.

Porcupine: This species needs extensive woodland to survive, and attempts could be possibly be made to restore it to INDU. This effort would require public education, as

many people have an aversion or bias towards this species (as towards snakes and bats). Since extensive woodland is required by this species, it could not be reintroduced into the Grand Calumet watershed in the near future, except perhaps in the Miller Woods area.

River otter: The river otter can live well alongside humans, and it is currently being reintroduced into Indiana. It requires extensive, relatively unpolluted aquatic habitat (ponds, lakes or rivers). If the Grand Calumet River could be cleaned up and protected, the river otter could be considered for reintroduction.

Bobcat: The bobcat was thought to be nearly extirpated in Indiana, but it is showing up in various counties. There is some evidence that it occurs at INDU. This species can live in fairly close proximity to humans, but it does need rather extensive natural woodland habitat because it moves about considerably. The lack of existing woodland in the Grand Calumet basin does not favor its reintroduction.

Areas of special interest.—There are several areas of ecological interest in the Grand Calumet River Basin (such as Roxanna marsh, DuPont wetlands, and the Grand Calumet Lagoons) because of their high quality habitat for semi-aquatic mammals. To reduce fragmentation, as many areas between these high quality areas, could be purchased or otherwise protected.

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