PREHISTORIC SETTLEMENT ON THE HIAWATHA NATIONAL FOREST, MICHIGAN: A PRELIMINARY LOCATIONAL MODEL

BY

JOHN G. FRANZEN

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SUPERVISOR'S OFFICE
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ESCANABA, MICHIGAN 49829

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Abstract

A verbal/descriptive model of prehistoric settlement patterns is prepared to facilitate cultural resource survey and evaluation on the Hiawatha National Forest. The model is based on ethnohistory, ethnography, and natural resource data. It emphasizes the importance of whitetail deer, moose, beaver, and sturgeon as food resources. Vegetation, soils, water features, climate, and lithic raw material distribution are selected as the variables thought to most influence the location of prehistoric sites. Implications of the model for future survey efforts are discussed.

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Chapter 1

Introduction

National Forests in the eastern Region of the United States have been directed to develop or refine locational models to aid in the management of prehistoric and historic archaeological resources. These models are intended to describe how and why archaeological materials are differentially distributed across the landscape. Models are intended to provide the following benefits: consolidate current knowledge in order to minimize cost and maximize the effectiveness of field surveys conducted to locate undiscovered sites, provide site density information for planning purposes, and provide a settlement pattern context for evaluating field survey results and understanding the function of individual sites. They are not intended as substitutes for survey or evaluation, but as a tool to facilitate these tasks. The following observations by David Clarke (1972:22) are useful in defining the nature and purpose of archaeological models:

> Models are often partial representations, which simplify the complex observations by the selective elimination of detail incidental to the purpose of the model. The model may thus isolate the essential factors and interrelationships which together largely account for the variability of interest in the observations. In general, models serve as heuristic devices for manipulating observations and hypotheses. Models are usually idealized representations of observations, they are structured, they are selective, they simplify, they specify a field of interest and they offer a partially accurate predictive framework.

In the broadest sense, a model can include the intuitiv "largely subconscious mind models which we accumulate through time" and which influence decisions on archaeological survey, test excavation methods, analysis, etc. (Clarke 1972:23). However, such an intuitive, unarticulated model does not meet current management needs. It is essential to convert to a more explicit and testable model.

Prehistoric sites receive priority for modelling on the Hiawatha National Forest because they are much more difficult to locate and much more poorly understood than historic sites. The Forests' west unit (Fig. 1) is the focus for this modelling attempt because past surveys have encountered many more sites here in comparison with the Forests' east unit. Projects also impact more areas annually on the west unit.

However, maps for most environmental variables are included for the east unit (Fig. 11) and much of the discussion of ethnohistory, ethnography, and natural resources is applicable to both units. The major differences between the east and west units of the forest are as follows:

- the proximity of parts of the east unit to the Straits of Mackinac and the Rapids of the St. Mary's River; major focal points of protohistoric aboriginal settlement
- much greater frequency of inland lakes on the west unit
- greater amount of well-drained Great Lakes shoreline on the east unit
- presence of significant clay deposits on the east unit (5.8% of area in Clay Flat Land Type Association compared to .8% on the west unit)
- On the east unit, 53.7% of the area is in Land Type Associations dominated by poorly drained soils, compared to 41.7% of the west unit (L.T.A.'s 3A, 3B, 5, 6, 7, 8, and 10.)

The implicit model currently guiding our approach to prehistoric sites on the Hiawatha is basically the ethnohistory-based settlement pattern model proposed by Fitting (1969) and Fitting and Cleland (1969). Based in large part

on Alexander Henry's (Quimby 1966) account of the seasonal movements o a Chippewa Family in the 1760's, this model suggests that late prehistoric sites will include the following:

1. extensive multi-family summer-fall fishing villages near the Great Lakes.
2. smaller winter and early spring sites in inland areas.

This model has remained very general, and detailed test implications or expectations have not been developed for a settlement system based on this pattern. Previously unutilized ethnohistoric, ethnographic and environmental information is available which may permit refinement of this model.

A major settlement pattern study (Martin 1977) was conducted during the initial efforts at cultural resource management on the Hiawatha, although the study was not structured as a test of the ethnohistoric Chippewa Pattern described above. This study consisted of a detailed analysis of the environmental setting of known sites along the Great Lakes shores. This was followed by a representative sample survey stratified by Ecological Land Units, which are largely based on the soil and topography differences of glacial and post-glacial landforms. No prehistoric sites were located during the "test" of this preliminary model.

As Lovis states (1979:73) "the fact that an intensive, and representative, sample survey of Forest Service owned lands produced no prehistoric sites is an important statement in and of itself." It demonstrated the extremely low density of these sites on a Forest-wide basis, the unsuitability of generalized broad-strata sampling schemes, and the need to focus on more specific micro-environments where sites are more likely to be found.

Important new data has been collected since the studies done by Martin (1977) and Lovis (1979). At the time of these studies, no prehistoric sites had been located in the interior of the Hiawatha away from the Great Lakes Shores. Since then, a number of sites on inland lakes and streams have been located in conjunction with the Hiawatha's annual survey of potentially earth disturbing

projects. To gain an understanding of newly discovered interior sites, it is necessary to develop a settlement pattern model based on all available ethnohistoric, ethnographic, and environmental data, rather than focus exclusively on the locational characteristics of these sites.

The existence of Woodland sites adjacent to the study area that have characteristics of the warm season fishing villages of the Chippewa Pattern has been confirmed by large scale excavations at several sites (Brose 1970; Martin 1980, 1982). It is the patterns of cold season and interior settlement that remain most in question. Although Fitting and Cleland (1969) believe the Chippewa Pattern can be projected back into the early Late Woodland period, their identification of the Pic River, Michipicoten, Shebishikong Sites (Wright 1965) as winter camps is based on little information and these could very well be warm season occupations.

A much more detailed test of the Chippewa Pattern was conducted by Holman (1978) using data from Michigan's northern lower peninsula. Using catchment analysis, the following implications of the model were tested for the Early Late Woodland Mackinac Phase:

1. Sites found in the interior will be high in winter resource potential.
2. Sites found on the coast will be high in late fall resource potential.
3. Sites found on the coast will be high in summer resource potential.
4. Sites found in the interior will be high in early spring resource potential.

(Holman 1978:42)

The implications that winter resource potential would be high for interior site catchments, and summer and late fall potential would be high for coastal site catchments were confirmed. However, warm season resource potential was also high around interior sites and early spring potential was high just about everywhere (Holman 1978:153-55). Citing the flexibility characteristic of many hunters and gatherers, she does not rule out the possibility of alternative warm season and early spring locational strategies (Holman 1978:155).

In part because of the flexibility anticipated in the study area's prehistoric settlement patterns, a verbal/descriptive approach was chosen for initial model development. This type of model was selected for use on the Chequamegon National Forest and has certain advantages (Ryden et.al. 1983). It is flexible, well suited to early efforts where little is known about some variables, and is easily refined as additional information becomes available. More quantitative approaches involving optimal foraging theory or linear programming were considered inappropriate because of data availability and the assumptions about the behavior of human beings and resources that they require (see Bettinger 1980 for summary of assumptions).

The emphasis of this project is to utilize the maximum amount of information available to create a verbal/descriptive model of prehistoric settlement. It is intended as a starting point and an interim management tool until more refined statements are possible. It emphasizes the use of ethnohistoric, ethnographic, and environmental data to create a model that can help us not only to identify locational patterns, but also understand the reasons for such patterns. Analysis of existing survey data might reveal possible patterns, but might not help us understand them. For example, the sample survey conducted by Lovis (1979) provided a probabilistic statement of the extremely low density of sites away from water features, but did little to explain this.

This model is intended to serve as a source of hypotheses to guide both future survey and excavation. It will be based on the selection of some critical resources and environmental constraints thought to be the most important determinants of site location. These resources will be selected in the basis of ethnohistoric, ethnographic and ecological literature. The model is intended to be heuristic and it is not anticipated that it would ever be fully tested or "proven". It's goal is to produce a verbal description of different site types and their expected location. In general, ethnohistoric, ethnographic, and ecologic information has been underutilized in past efforts. Failure to consider

the full range of such data is likely to result in selection of irrevelant variables for survey stratification or the analysis of survey, testing, or excavation results. This study will focus on inland areas away from the Great Lakes shores, where settlement patterns are least understood and Forest Service management activities are most frequent.

Chapter 2

Ethnohistoric Background

One of the most widely used ethnohistoric sources for the Upper Great Lakes is the journal account of Alexander Henry's year spent with an Ojibwa family in 1763-64 (Bain 1901, Quimby 1966). Although obviously deeply involved in the fur trade, nearly all their food was supplied through traditional subsistence practices. The following sites were occupied by this group of 8 persons:

June-Aug. 20	Fishing Stations on Great Lakes, esp. Sturgeon.
Aug.-Sept. ?	Travel to Wintering Ground. Short term campsites, wild fowl and beaver procured.
Sept.-Dec. 20	Autumn - early winter base camp on river 15 miles upstream from Lake Michigan. Beaver, Elk or deer.
Dec. 21	Overnight camp
Dec. 22-23	Temporary camp for Elk processing.
Dec. 24-March	Winter base camp. 60-70 miles inland from Lake Michigan. Beaver, elk, bear, otter.
March-April 25	Movement back toward Lake Michigan. Sugar Camps.
May 6	Return to fishing station on Great Lakes shore.

A similar movement of an Indian group to an inland winter camp in Lower Michigan during 1675 is described by Father Nouvel (Greenman 1957). This inland movement followed a river (probably the Chippewa) and ended in Mecosta or Isabella County where they remained from early December through March.
One of the most detailed accounts of an aboriginal winter settlement pattern in the Northeast is LeJeune's description of a Montagnais band's movement south of the Saint Lawrence River in the winter of 1633-1634 (Thwaites 1959). From November 12, 1633 to April 9, 1634 at least 23 campsites were utilized by their party of 19 as they sought out moose and elk. During the early winter they were forced to depend on beaver and porcupine, but LeJeune indicates that a snowfall

occurring at their 12th campsite "delivered us from famine; for the snow was deep enough to impede the long legs of the elk" (Thwaites 1959: 179). Campsites were apparently moved when game was depleted in the surrounding area and groups needed to spread out so as not to hunt within areas already depleted by another group (Thwaites 1959: 171). Camps were sometimes moved to moose or elk kill locales (Thwaites 1959: 183). When camp was set up, it was necessary to dig down through a "great ring or square" of snow two to four feet deep (Thwaites 1959: 37).

Detailed ethnohistoric accounts like Henry's and LeJeune's are basically non-existent for the study area. However, more general statements support the cold season inland movement of groups for hunting and the orientation of these movements along major river systems in or adjacent to the study area. Goddards' (1976:181) journal of 1766 observes that:

> "About thirty leagues west and south of Michilimackinac, there is a river called Amanistick [Manistique] which the Indians winter in, and has a communication by several small carrying places with Lake Superior."

Similarly, as he passes the mouth of the Menominee River, Goddard (1976:182) observes that "many Indians winter in the neighborhood of this river, being plenty of beaver, martins, bears and ca." As they pass a village on Washington or Detroit Island in northwestern Lake Michigan in late September or early October, a group composed mainly of Ottawas is setting off for their winter hunting (Goddard 1976:182). Likewise, even the Winnebago are observed to go inland for their winter hunt (Carver 1976:81).

Samuel Hearne's (1911:74 detailed description of travels with an Athapaskan group around 1770 illustrates that a level, well-drained campsite was important during these winter journeys:

> To pitch an Indian's tent in winter, it is first necessary to search for a level piece of dry ground; which cannot be ascertained but by thrusting a stick through the snow down to the ground, all over the proposed part. When a convenient spot is found, the snow is then cleared away in a circular form to the very moss; and when it is proposed to remain more than a night or two in one place, the moss is also cut up and removed, as it is very liable when dry to take fire . . .

Rogers (196: 16) describes a similar process among the Mistassini during more recent times:

> When a base tent was erected during the winter, the levelness of the ground was first ascertained. This was done by inserting the handle of a snowshovel into the snow a number of times.

A warm season hunting strategy is suggested by Goddard's (1976:190) observaton of a village at the mouth of St. Louis River on southwestern Lake Superior that was nearly abandoned on July 12, 1767 because the inhabitants were on a hunting expedition. La Potherie (Blair 1911:282-283) also mentions that the young men at Michilimackinac traveled 30 to 40 leagues on a summer hunt. During the winter, hunters from the Michilimackinac area pursued beaver, bear, and deer for both furs and meat (La Potherie in Blair 1911:282-283).

Descriptions of Saulteur subsistence emphasize fish, beaver, and moose. The group at Sault Ste. Marie relied heavily on fishing, but according to La Potherie, "at the approach of winter, they resort to the shores of the lake to kill beavers and moose" (Blair 1911: 280). Perrot supports this, saying the Saulteurs south of Lake Superior hunt beaver and moose, besides relying on fish (Perrot 1911:109). He also indicates that the "northern tribes" hunted beaver during the winter (Blair 1911: 104-106).

Elements of warm season subsistence are also found in early French ethnohistoric accounts. Perrot (Blair 1911:109) mentions that the Cree around Lake Superior hunted moose from the water. La Potherie (Blair 1911:280) indicates that the Saulteurs "dispersed" during the summer along Lake Huron, where they speared sturgeon and gathered birch bark and berries. He also offers a brief sketch of the Menominee seasonal round which included raising "a little corn", sturgeon fishing in rivers using weirs and spears, hunting bear and beaver during the winter, hunting deer at all times, netting pigeons and waterfowl, and gathering wild rice and acorns. (Blair 1911:304-305).

Chapter 3

Ethnographic Background

Recent ethnographic observations of subarctic groups can provide detail on certain practices that augment ethnohistoric sources. The Northern Ojibwa and Cree not only share a common Algonkian background with groups found in the Upper Great Lakes, but a number of their subsistence practices are also similar to those described in ethnohistoric sources for the Great Lakes area. The Canadian Biotic province of the Upper Great Lakes, as a transition zone between the Hudsonian and Carolinian provinces, includes many species and habitats found in more northern boreal forests. Both subarctic and Upper Great Lakes Algonkian groups aggregated into large groups during the warmer months and dispersed into small groups during the winter. The advantage of the subarctic ethnographic accounts is the inclusion of detail on certain practices that is absent in ethnohistoric accounts. Even if subarctic groups may be more water oriented than those in the Great Lakes for reasons like the abundance of impassable muskeg, individual resource-based comparisons can still be made, with caution.

The settlement pattern of the Weagamow Ojibwa during the 1880-1920 period provides details on several aspects of settlement pattern that may be relevant to the study area (Rogers and Black 1976). During this period, the Indians of Weagamow Lake relied on fish and hare because of a scarcity of big game. They utilized a settlement system featuring "home bases" and "satellite camps". Home bases were occupied longer than any other type of site, with satellite camps established as needed to exploit particular resources. These satellite camps usually ranged in size from 1 or 2 families or consisted of males only and were occupied from one night to one or two months (Rogers and Black 1976:23). The system was highly flexible, contracting during times of

abundance and expanding during times of scarcity, both seasonally and in response to long-term population cycles like that of the snowshoe hare. Even the home base system was highly flexible, with some groups using a single major home base, and others using a series of small home base camps or shifting bases, with some occupied during certain seasons and others occupied during several seasons (Rogers and Black 1976:35-36). Winter was the time of maximum scarcity and the time when satellite camps were used the most to widen the exploitation area. During the summer, there were "an array of options....on any of which the availability of immediate food resources was not in question" (Rogers and Black 1976:30). It is suggested that summer was a time when subsistence decisions had considerable "leeway" and did not need to be based on "energy-efficiency factors", although the warm season mobility and aggregation permitted by this abundance may have had an important role by facilitating information exchange and planning that was critical to subsistence pursuits.

Specific descriptions of site placement strategies are available from several subarctic groups. Among the previously cited Weagamow Ojibwa "home base camps were always placed adjacent to waterways, and satellite camps usually were, with the majority "near outlets of lakes, on mouths of rivers, or on points" (Rogers and Black 1976:23-25). A supply of firewood and protection from the wind are cited as key factors in selecting both base camp and satellite camp locations (Rogers and Black 1976:23). Placement of campsites away from water seems to only occur during the winter. Also of interest is Rogers and Black's (1976:11) statement relating to small game and plant foods: "no elaborate techniques were employed, nor were the seasonal movements of the people or group size related to their capture. Small game was taken - shot, trapped, or snared whenever the opportunity occurred". Although snowshoe hare were extremely important during this period, the areas utilized appear to cluster near water features where base camps were located.

The same appears to be true of berry picking areas (Rogers and Black 1976:18). Even though satellite camps were sometimes utilized in procuring these resources, the attraction of other resources and transportation features (water) is obviously influential.

In the eastern Canadian subarctic, Hank (1983) has examined the locational characteristics of historic Cree campsites. He indicates that "major bodies of water play a significant role in site selection year round" (Hanks 1983:351), in part because of the dependability of fish as a food resource. Cree winter camps were located in areas protected from the prevailing W and NW winds, usually on the North and West shores of rivers and lakes. Other factors favoring winter camps are large, dense stands of tall trees, availability of firewood, and a surface free from rocks (Hanks 1983:351). One informant cited a case where an area was good for winter hunting and trapping but was "low, wet, and lacking in cover, and thus unsuitable for fall or winter occupation" (Hanks 1983:351).

An ethnoarchaeological study among the Saskatchewan Chipewyan identified some related site selection criteria that may be relevant to the study area. Level sand terraces elevated above wet areas, referred to as "taitil" or "sandy blanket", were preferred for camps and habitations. Informants cited excellent drainage, a soft carpet of mosses and lichens which provide soft mattresses for sleeping, a park-like atmosphere with good sight distance, and both live and dead trees for building and firewood (Brumbach, Jarvenpa, Buell 1982:22). In south central Quebec, Mistassini winter base camps were approximately 100-200 yards from shore and in areas sheltered by a hill or a thick stand of trees to offer protection from the prevailing west wind (Rogers 1967:9). Because of the wind, the west shores of lakes were preferred, and if a winter camp was located on an east shore, it would be placed farther back from the shore. According to Rogers (1967:9), short-term travel camps were placed no further back from the water in the winter than they were at other

times of the year. Conversely, at least one subarctic group sought exposed breezy spots for summer camps because the wind offered relief from mosquitos and black flies (Rogers 1963:226).

Although it would be unwise to assume that the entire seasonal round of any subarctic group parallels that of prehistoric people in the study area, where similar environmental constraints are present, similar results are possible. In some respects, the differences between the Upper Great Lakes and the subarctic are more in degree rather than in kind, such as the seasonal variations in resource abundance and the need for shelter during the winter.

Chapter 4

Description of Major Food Resources

Introduction

Ethnohistoric sources suggest that the following resources were critical for prehistoric subsistence in the study area: beaver, deer, moose, sturgeon, lake trout, and whitefish. Although small game, waterfowl, and various plant foods may certainly have been important sources of nutrients or calories, they appear to have been less critical in determining seasonal movements and settlement location, especially in light of ethnographic descriptions from the subarctic. To control for possible bias in ethnohistoric accounts, some additional resources were considered on the basis of their probable prehistoric abundance in the study area and their desirability in terms of generalized hunter-gatherer decision criteria (Jochim 1976). Although some might argue that to avoid bias all possible species should be considered in constructing a model, it is generally acknowledged that this is simply not practical (Bettinger 1980:232).

Several food sources that are important in adjacent regions appear not to be important in the study area. Although Woodland Caribou were present in the Upper Peninsula, Baker (1983:615) cites evidence that they were only occasional cold season visitors from the north. Because open areas are so important to the Wapiti, it is assumed they were only a minor presence in the heavily forested Upper Peninsula (Baker 1983:569). Although extremely important to groups farther southwest, wild rice was not a significant factor in the study area, nor was agriculture (Cleland 1983:88). While maple sugar was a critical element in historic subsistence, enough doubt exists about its use in prehistoric times to warrant its exclusion from this model pending additional research (Mason 1985).

Although whitefish and lake trout were critical resources, their spawning habits are not discussed in detail in this report because they now appear to be generally restricted to the Great Lakes. However, there may have been spawning runs of lake trout and whitefish in some rivers prior to euroamerican settlement. A major change in the Great Lakes has been the disappearance of large adfluvial stocks of salmonids (Ryder 1972:625). The term adfluvial refers to non-resident species that spawn in rivers, but unlike anadromous species, they can also spawn in lakes. Some whitefish still spawn in rivers along the north shore of Lake Superior and in inland areas further north. Lake trout apparently only recently abandoned river spawning in certain parts of Lake Superior. During the nineteenth century before habitats were degraded by man, whitefish apparently spawned in some streams flowing into Green Bay (Wells and McLain 1972:894). To the extent that adfluvial populations of lake trout and whitefish were present, fall fishing opportunities could have occurred in non-coastal areas. Likewise, there is some possibility that inland lakes now dominated by warm-water species may have contained lake trout and whitefish. However, in spite of the presence of the "Whitefish" River, records from the 1880's indicate the heads of Big and Little Bay de Noc were dominated by sturgeon and warm water species such as walleye, herring, perch, suckers, and bass (Bertrand, Lang, and Ross 1976:137-138). For the purposes of this model, fall fish procurement is assumed to be a coastal activity which possibly included some lower portions of rivers.

Whitetail Deer and Moose

Analysis of habitat preferences, seasonal variation, and the distribution of major food resources is an essential part of a model. Habitat alteration and major changes in the range of certain species make this difficult. Although moose and deer are both mentioned in ethnohistoric acocunts, moose have largely been extirpated from the study area and whitetail deer have thrived during the last hundred years. It has been suggested that a

succession of large herbivores occurred around Lake Superior, with caribou, moose, and deer gaining dominance respectively, (Baker 1983) but archaeological evidence indicates that moose and deer were contemporaneous. However, it is safe to assume that prior to the logging era, the Upper Peninsula would have been relatively less favorable for whitetail deer than it is today. Animal remains from Late and Middle Woodland and early historic archaeological sites in the Upper Peninsula include both moose and deer, with some indication of an increase in moose as one goes north and east (Buckmaster 1979; Brose 1970; Martin 1980; Martin 1982; Smith 1985; McPherron 1967).

In general, white tail deer prefer a mixed habitat and are subject to the "edge effect". As stated by Bartlett (1938): "it is at the edge of stands of big timber and at the edges of marshes, bogs, and swamps where the heaviest desirable deer cover is found". Diversity is an important factor in the diet of deer (Rogers, Mooty, and Dawson 1981), and considerable seasonal variation occurs in diet and distribution. During the snow free season deer are much more dispersed than during the winter. Seasonal movement between summer and winter ranges averaged 8.6 miles in one Upper Peninsula study (Baker 1983:582). An early researcher (Shiras 1898 cited in Swift 1946) noted a spring and fall movement of deer between wintering grounds along Lake Michigan and summer ranges further north. Wildlife biologists working on the Hiawatha National Forest confirm modern concentration of deer during the winter in the southern portion of the study area (Ellsing 1986 personal communication). Figs. 2 and 12 illustrate the limits of recent major winter deeryards. Since deer are probably more abundant today than in presettlement times and ample winter habitat is found further north, it appears this distribution reflects seasonal southward movement and greater year-round densities in the south. Two Brush fences shown on 1847 and 1851 G.L.O. maps of Iron County, Michigan, end at lake shores or extend between two lakes (Trygg 1969). They are 1 1/2

to 2 miles long and may relate to hunting deer as they move hrough upland areas between summer and winter ranges.

Some preferred deer foods include aspen, ground hemlock maples, willow, and when available, acorns (Baker 1983:588). During late sp ing and early summer, there is substantial aquatic feeding by deer, althou h not to the extent found among moose. Nineteenth century accounts of warm season deer hunting from canoes are frequent.

Deer are much more concentrated during the winter. Swamp conifer forests are preferred by deer for winter yards because they often have less snowpack and more moderate temperatures than more open areas (Verme 1965). White cedar is the only conifer that can support deer if other foods are not eaten. The highest carrying capacity is in large even-aged stands. Deer do winter in other habitats such as hemlock-hardwoods (Westover 1971) but it is assumed that they are of much less importance than swamp conifers. Although old burns contain large amounts of preferred deer browse, during the winter deer may be unable to use these more open areas because of deep snow.

An account written by a trapper who spent a winter 100 miles upstream from Lake Michigan on the Manistique River provides some important data on deer distribution in habitat like that found in the study area. At the time of his visit in 1879, he observed that "scarcely a tree" had been cut in the northern Upper Peninsula except "up about the iron works". (Harding 1941:129). In general, this does predate the expansion of logging into the upper reaches of rivers like the Manistique. That winter, deer were plentiful and in April, as the snow melted, many deer concentrated in bare spots. On the point of a ridge facing southeast, he counted 40 deer visible from one spot. Later, in early June as they floated down the Manistique River, they saw deer at "almost every turn". (Harding 1941:131).

Moose within the study area are likely to have exhibited significant differences from deer in habitat preferences and seasonal distribution.

During the winter, moose in the St. Ignace area of Ontario and on Isle Royale have shown a preference for balsam fir and white birch (Peterson 1955:111-127), and because these species are characteristic of the relatively early stages of forest succession, "old burns" are often preferred habitats. Conifers were virtually untouched from early spring to late fall and during the spring and summer temporary concentrations occurred along lakes and streams for feeding on aquatic vegetation (Peterson 1955:111-116). In contrast to deer, Peterson (1955:112) believes that winter concentrations of moose were voluntary due to food availability rather than enforced by deep snow, with 3 to 5 moose in each "yard".

A study done in New Brunswick where deer and moose coexist in a mixed coniferous-decidous forest region found them utilizing different habitats during the early winter with Moose in open-deciduous areas and deer in dense mixed or coniferous forest (Tefler 1970). Late in the winter, as snow depth increased, they were both found in densely forested situations, but without much overlap in ranges. This is largely explained by differing snow depth tolerances. At depths of 10-14", deer mobility is restricted while depths of 24-28" are required to restrict moose mobility (Tefler 1970). The same study indicates that snow depths of 31-34" were necessary to force moose out of burned or cutover areas preferred for feeding. Although they begin concentrating at shallower depths, by the time snow depths reach 20", deer have serious difficulty travelling and become confined to winter "yards" (Tefler 1970:557).

Based on these data, it appears that deer would be restricted to dense conifer habitat for about 40-50 days in the south part of the study area and about 90 days in the north, based on 11 inch snowfall map (Fig. 3). Moose may have been restricted from 10-20 days in the north and perhaps less than 10 days in the south, but were probably never forced into dense conifers like

deer in the study area. They could remain in preferred habitats like old burns.

Some detailed information on moose hunting techniques used by the Cree in northern Ontario may help model moose procurement in the study area (Winterhalder 1981). Peak kills occurred there during the fall rut and when ideal spring snow conditions occurred. During the winter, moose were usually found in brushy areas, such as the willows and alders along small streams and areas that had burned 2 or 3 years previously. Hunters on foot often skirted shorelines or followed rivers and streams that moose were forced to cross when travelling between upland browse patches (often old burns). During the summer when moose relied on aquatic vegetation and also sought relief from heat and bugs in the water, they were hunted from canoes. The brush and aquatic vegetation associated with beaver ponds made these good moose habitats.

Beaver

Archaeological remains from coastal sites indicate that beaver were a major food source before the historic emphasis induced by the fur trade. The association of beaver with water features during all seasons is of course direct and unequivocal. Beaver populations in northern Michigan are also related to the supply of aspen, their preferred food (Baker 1983:259). Although beaver populations are not cyclic, they are sometimes greatly reduced by Tuleremia during low water periods (Longley and Moyle 1963). Indian peoples in the Upper Great Lakes rated beaver high as a food resource (Quimby 1966:168) and Alexander Henry recounts hunting then by canoe (Quimby 1966:165). Rogers and Black (1976:11) indicate "beaver are relatively easy to capture, especially during the winter, except when the snowfall is abundant". This is because deep snow can make beaver lodges difficult to locate, which is probably not a severe problem in most of the study area. Aspen would be most abundant in areas frequently disturbed by fire or blowdowns.

Black Bear

One of the largest mammals in the study area, the black bear, was probably procured on an opportunistic basis, rather than being the sole objective of hunting excursions. Alexander Henry's "discovery" of a hibernating bear in January of 1764 fits this pattern and Quimby (1966:172) describes it as a "bonus or unexpected gift, valued primarily for its oil". Northern Ojibway groups described by Rogers (1983:94) also procured bear in the winter while they were hibernating. Their lack of mobility at this time of year contrasts with their wide ranging movements during summer and fall. Although large, bear have relatively low population densities and often are solitary (Baker 1983:431-434). A study adjacent to the study area in Alger and Schoolcraft counties revealed a density of 1 bear per 2,200 acres (Baker 1983:434). The best habitat for bears in Michigan is described as "a series of forested ridges with an interdigitation of marshes and swamps" (Baker 1983:433). Mast and berry crops are critical to bear survival and these crops are highly variable. As they noisily climb beech trees to obtain their highly favored nuts, bears are said to be vulnerable to hunters (Baker 1983:437). A nineteenth century reference (Kohl 1956:410) refers to a portion of the study area: "Not far from Grand Isle on the south shore of Lake Superior, there were large and fine beech woods, said to be a perfect paradise for bears and hunters". Kohl's (1956:406) reference to the tradition of a massive bear migration into the eastern Upper Peninsula in 1811 which resulted in 6,000 bears being killed is one of the strangest ecological phenomona found in historic accounts and if accurate, reflects a rare process that has not been recently observed. Such a phenomona could be related to wide spread mast or berry crop failure.

Fish

Although many species of fish occur in the study area, this model will focus on lake sturgeon, with secondary emphasis on walleye, lake trout, and whitefish. Other species, such as suckers, can be seasonally abundant but are less desirable because of small size, low fat content, or numerous bones. They also tend to be available at the same time as other more desirable species. Because of their large size and high oil content, sturgeon rank high on the basis of generalized hunter-gatherer food selection criteria and archaeological and ethnohistoric accounts document their importance in the Upper Peninsula. The great changes in Great Lakes fish populations over the past 100 years hinder our modelling effort. Lake Sturgeon are on the state list of threatened species, and other species which may have spawned in riverine settings in the past are now restricted to the Great Lakes. Current spawning patterns of sturgeon, as well as lake trout, whitefish and walleye probably do not reflect the extent of their prehistoric spawning.

However, a 1979 survey (Schroeder 1985:51) "documented a sizeable spawning run of lake sturgeon upstream to the Steuben area from Indian Lake and the upper river". The Sturgeon began moving upstream about mid-May and reached spawning areas in late May or early June. Stretches of stream with a rocky or gravel bottom are preferred for spawning by sturgeon. Because of habitat alteration and the depletion of sturgeon populations, it seems likely that areas further upstream could have been utilized and other rivers that no longer contain sturgeon may have had sizeable runs. Direct historic evidence for sturgeon procurement in the study area is the "Indian fishing rack" noted at the outlet of Big Murphy Lake by the 1850 General Land Office survey. This is almost certainly a fish weir, and sturgeon weirs were noted during the nineteenth century on other streams in the Upper Peninsula, such as the Ontonagon (Douglass 1820:56).

Northern Ojibwa groups often used weirs, and Rogers and Black (1976:6-9) document the preferred placement of fish traps at narrows and/or rapids. Sturgeon and lake trout were restricted to certain lakes and rivers and the Weagamow Ojibway focused on fall spawning whitefish. After the whitefish run, they moved downstream to lake shores where they spent the winter. It is believed that the use of gill nets under the ice is a relatively late phenomona among the northern Ojibway (Rogers 1983:110).

Plant Foods

Although plant foods may have had a significant role in prehistoric diets, the combined ethnohistoric and ethnographic literature indicate that they may not have had a major role in determining settlement locations. For reasons previously discussed, maize agriculture, maple sugar, and wild rice have been excluded from this model. Wild berries, especially blueberries, are often mentioned as important wild plant foods utilized in the Upper Great Lakes. They are characteristic of dry soils, and recurrent fires there can lead to establishment of "blueberry heaths" (Curtis 1959:34). Blueberries would tend to be associated with the Pine-Oak land class group. They could easily be procured on an opportunistic basis from sites occupied along water features, as was done by the Weagamow Ojibway (Rogers and Black 1976).

Chapter 5

Environmental Setting

Introduction

The environment of the study area is best characterized as a mosaic of habitats resulting from differences in the texture, slope, and drainage of deposits laid down by glaciers and associated water bodies. Added to the complexity of this mosaic is the variability introduced by ecological succession and related disturbing processes such as fire, disease, or wind that cause the vegetational mosaic to shift continuously.

In general terms, the study area lies within the Canadian Biotic Province, a transition zone between the largely coniferous boreal forests north of Lake Superior and largely deciduous forests to the south of the Great Lakes. Mature northern hardwood forests dominated by sugar maple, beech and other deciduous species contrast dramatically with spruce, cedar, and tamarack swamp forests.

Another level of variability is introduced by long-term climatic change. However, for the purposes of this study, it is assumed that in general the modern climatic situation was reached about 2,800 B.P. when "pollen percentages of most types reached values comparable to percentages in modern lake sediments in the region" (Brubaker 1973:129-130). Post-glacial levels of the Great Lakes are another broad scale feature affecting prehistoric settlement patterns in the study area. It is important to identify the location of former high-water stage coastlines that may now be located in inland areas (Figs. 4 and 13). Based on studies done adjacent to the southern part of the study area (Prahl and Farrand 1968), the sequence of high water stages there is relatively well known. Most relevant are the Nipissing (4200 B.P.) and Algoma (3200 B.P.) Stages which would be expected to occur at

approximately 600-605 feet and 590-595 feet respectively (Fig. 4). Modern lake level were reached by about 500 B.C. to 0 A.D. (Mason 1981:79). The post-glacial lake sequence is not as well understood in the Lake Superior basin but it appears a high stage contemporary with the Nipissing level may be expected at about 630 feet A.S.L. in the north portion of the west unit and about 650 feet A.S.L. in the east unit (Hough 1958:256). On the east unit in the Michigan-Huron basin the Algoma stage was approximately 610 feet A.S.L. and the Nipissing stage was approximately 630-635 feet A.S.L. (McPherron 1967:5-6).

The approach used in selecting environmental variables for model development is based on the need to avoid undue complexity. Too many variables make analysis impossible and can also obscure those that are most important. Models are intended to offer simplified representations of a systems in order to understand essential elements. Our approach is similar in some respects to that outlined by Winterhalder (1980) which emphasizes "selectivity and summary parameters" rather than highly detailed description of all aspects of forest ecology. The approach used in this study also emphasizes historical, long-term environmental analysis and the importance of variability and range rather than the static, normative approach found in many studies. The following have been selected as the most critical variables affecting prehistoric settlement patterns during the last 3,000 years:

1. Vegetation
2. Soils
3. Water Features
4. Climate
5. Lithic Raw Material Sources

Vegetation

Vegetation on the Hiawatha National Forest has been classified at levels of detail ranging from 4" = 1 mile (timber type and soil type maps) to the

1/2" = 1 mile Landform-Soil Associations, Ecological Land Types, and Land Type Association Maps. These last 3 systems are hierarchial, with 31 landform-soil zones being combinable into 15 LTAs or 10 ELTs. The main difference between ELTs and LTAs is that LTAs differentiate topography and more explicitly specify vegetation. Choosing a system depends on making trade offs. Soil survey maps and timber type maps are so detailed as to make their use difficult, and do not make potential climax vegetation explicit. However, some diversity is obviously masked by ELT and LTA mapping: they are expected to contain inclusions of up to 25% of other zones (Holem 1980:2-3). The LTA system has been selected for this study. One reason is some evaluation has taken place of the mix of specific habitat types that characterize each LTA (Alyanak and Resovsky 1981). Table 1 indicates the estimated habitat types percent occurrence by LTA, and Table 2 lists the climax overstory for each habitat type.

It is essential to simplify the ecological classification system used for model development as much as possible in order to avoid an overly complex system that masks significant trends. Based on the estimated occurence of different habitat types in each LTA (Table 1), it becomes evident that certain LTA's share similar vegetational composition. It was felt that these vegetational similarities overshadow the differences (mainly slope and landform) that distinguish some L.T.A.'s. Consequently, the 15 LTAs were collapsed into 4 Land Class Groups that appear to reflect the environmental differences that most affect the distribution of the critical resources discussed previously. These differences are mainly based on vegetation, although landform/topographic differences play a role in differentiating 2 of the groupings. Table 3 summarizes these 4 groups and their characteristics. The habitat types listed in Table 1 are key factors in the resource based analysis of these Land Class Groups. These habitat types are especially useful for this study because they are climax types predicted on the basis of

soils, understory and indicat species, and known successional relationships, rather than just a summary of urrent conditions (Coffman, Alyanak, Kotar, and Ferris 1983). This is importa t because of the major changes resulting from logging and fires during the p st 100 years. For example, swamp conifer habitats formerly had a much h gher frequency of white cedar and aspen once covered a much smaller part of the study area than it does today (Hiawatha National Forest 1985:3-8). Figs. 5 and 14 show the general distribution of the 4 land class groupings. More detailed maps at 1/2"=1 mile scale are also available.

Many animal species used for food are highly dependent on plants most abundant in early succession following disturbance. Although many complex factors influence successional paths, probable sequences are known for the different habitat types in the study area (Coffman, Alyanek, Kotar, and Ferris 1983). However, the frequency at which habitat types cycle through the successional sequence may vary a great deal. In some habitats, climax may be stable for long periods of time and in others "climax" may be a misleading concept because it is so rarely attained (Borman and Likens 1979). Comparison of resource availability in different zones requires a consideration of the nature and duration of subclimax cycles, as well as potential climax species.

In the virgin forests of the Boundary Waters Canoe Area of N. Minnesota, fire has been the dominant factor influencing succession. As Heinselman (1973:330) emphasizes: fire largely determined the species composition, age structure, and mosaic of successional stages of the forests, and thus the habitat patterns for wildlife. In this area of Great Lakes Pine and Great Lakes Spruce-Fir Forest (Kuchler 1964), fire scars and ring counts indicate that virtually all of the 1 million acre study area has been burned since A.D. 1595, and that during the presettlement period from 1727 to 1868 there were 5 major fire years which resulted in the burning of 84 percent of the area (Heinselman 1973: tables 3 and 4). Forage or browse plants preferred by

herbivores such as deer, moose, beaver and snowshoe hare are most abundant in early post fire succession and fire also increases the yields of many berry-producing shrubs. (Wright and Heinselman 1973:324). Blueberries growing in old burns and raspberries, which often grow in areas where budworm has killed fir trees, are critical for bear populations.

The average fire rotation in the Boundary Waters area is thought to be about 100 years, with different habitats varying from the 150-250 year cycle of Red and White Pine to the 50-100 year cycle of jack pine. Summer drought is thought to be a major factor in these fires. Based on fossil pollen from a northern Wisconsin lake bed, Swain (1978) identified birch peaks occurring at 120 year intervals between 2000 and 300 B.P. and attributes these cycles to forest fires. Aspen is likely to follow a similar pattern in that it is often associated with white birch in early successional sequences (Coffman, Alyanek, Kotar, and Ferris 1983). Although the presettlement vegetational patterns of the Hiawatha may never be known because of the lack of virgin forests from which to obtain correlations between ring counts and fire scars, fire is likely to have played a similar role in areas dominated by conifers. Disease may have also influenced pre-settlement succession. There have been at least 7 widespread outbreaks of spruce budworm (which attacks both spruce and fir) in the last 200 years in eastern Canada (New Brunswick D.N.R.), and fire often sweeps through affected areas.

However, in contrast to the Boundary Waters where sugar maple, beech, and eastern hemlock are absent, large areas of northern hardwoods are present in the Hiawatha National Forest. Although early successional stages of northern hardwoods habitat types would contain available quantities of food species preferred by herbivores, there is evidence suggesting that these areas are generally less susceptible to disruption, and consequently cycle less often through these early stages which would permit maximum herbivore populations. Mesic northern hardwood forests have been described as relatively resistant to

fire and estimated fire rotation periods for some orthern hardwood forests in New England are extremely long (Borman and Likens 979:201-207). It appears substantial areas of presettlement northern hardwo d forests may have developed ecosystems approaching a steady-state co dition, while such stability would be rare within coniferous forests.

In northern hardwood forests, a process called canopy tree replacement creates a high level of stability at the stand level over long periods of time (Woods and Whittaker 1981:313). Canham (1978;cited in Loucks 1983:21) has calculated that in the mature hemlock-hardwood forests of Wisconsin, fire is a much less frequent cause of disturbance and renewal than patch blowdowns caused by high winds. These are attributed to thunderstorm downbursts and tornados, with the return time for a given point calculated at 1,266 years (Canham 1978).

Although little direct evidence is available in the manifestation of these processes in the study area during prehistoric times, the notes and maps of the General Land Office surveyors offer some clues. These surveys were conducted in the 1840's and 1850's before euroamerican settlement had altered the forest. Copies of original G.L.O. maps on file at the Hiawatha National Forest Supervisor's Office were examined for notations made by surveyors on areas where vegetation had been disturbed. The surveyors used the following designations for disturbance: "burnt", "windfall", and "burnt windfall". Because the extent of each disturbed area was not clearly delineated, only the number of separate notations was counted. These were tallied by the 4 major land class groupings and compared with the percentage of the study area acreage in each grouping (Table 4). As expected, patches of disturbance were infrequent in Northern Hardwood areas, and proportionally much more frequent in the areas with more coniferous species. It should be remembered that these observations refer to a narrow segment of time and could be biased by short-term climatic fluctuation, a disease outbreak (such as spruce budworm)

or the absence of any control for the size of patches. Modern fire records (Table 5) may also be biased but they show a similar trend for the percent of total acres burned in each land class grouping.

An effort was made to provide a rough estimate of the order of magnitude of differences between land class groupings in available browse for herbivore (deer, moose, and beaver). Based on historical data cited earlier, it was assumed that the Pine-Oak land class grouping would have 5 times as much area as Northern Hardwood areas in early successional stages due to disturbance, and that the Wetland Forest and Wetland Forest/Dune and Ridge Complex areas would have 10 times as much area. Land classes also vary somewhat in the percent of the total area where aspen is a major component of early successional stages. Very rough estimates indicate that early succession in Northern Hardwoods is dominated by about 90% aspen, Pine-Oak and Forested Wetland is about 60%, and Forested Wetland/Dune-Ridge Complex is about 45% (Coffman, et al. 1983). Productivity for aspen, as measured by site index was also factored in, with Northern Hardwood soils being about 40% more productive than the other 3 land classes. These rough figures suggest that the Wetland Forest areas will contain nearly 5 times as much optimal early successional habitat for herbivores than northern hardwood areas, with Pine-Oak and Forested Wetland/Dune-Ridge areas containing about 2.4 and 3.7 times as much. This calculation does not take possible differences in the size of patch disturbances into account or differences in the exploitable biomass of the undisturbed portions of Land Classes. It does demonstrate that the predominance of aspen in disturbed Northern Hardwood areas and the higher productivity there does not compensate for the much lower frequency of disturbance.

Soils

Besides the obvious influence on the vegetation differences described above, soil type is perhaps the best indicator of level, well-drained land surfaces. Previously described ethnographic and ethnohistoric accounts suggest that such areas were preferred for prehistoric habitation. Soil type is particularly useful because of the detail with which it has been mapped (1:24,000)

To someone looking for even a small area of level ground upon which to camp, the different habitats present a varied appearance. The ground in many forested areas is very irregular because of small hummocks one to three feet high, even though at a larger scale the landform upon which they occur is relatively level. These small scale irregularities are caused by trees being uprooted (tipped over) by the wind. The movement of the soil attached to their root systems results in mounds of earth adjacent to shallow pits. Restricted rooting caused by a high water table, fragipan, bedrock, or some other restricting layer causes an increased hazard for windthrow (Davis and Frey 1984: 114). Soils on the Hiawatha N.F. with a moderate or severe windthrow rating hazard are likely to have a scarcity of level ground.

The amount of moisture in the soil also influences suitability for habitation. Two factors that influence the moisture level in soil are drainage and permeability. Drainage classifications are based on the frequency and duration of periods when the soil is completely free from saturation. The six drainage classes on the Hiawatha N.F. are very poor, poor, somewhat poor, moderately well, well, and excessive. The moderately well drained, well, and excessively drained soils generally have seasonal high water table levels below 60 inches (Davis and Frey 1984: 112-113). Permeability is measured by the movement of water through saturated soil in

inches per hour. Permeability is described by the following terms:

Very slow - less than .06 inches.

Slow - .06 to .20 inches.

Moderately slow - .20 to .6 inches.

Moderate - .6 to 2 inches

Moderately rapid - 2.0 to 6.0 inches.

Rapid - 6 to 20 inches.

Very rapid - more than 20 inches.

Soils on the Hiawatha inferred to be most suitable for prehistoric habitation have a slight windthrow hazard, are at least moderately well drained and exhibit at least moderate permeability. Soils listed as having a windthrow hazard ranging between slight and moderate were not included. Soils with these characteristics are listed in Table 7. Almost all of these soils are classified as sands or loamy sands, but a few sandy loams are included.

Water Features

Ethnohistoric and ethnographic sources clearly indicate the important role played by water features among aboriginal groups in the Upper Great Lakes. Some of the reasons for this are equally clear: the importance of fishing, use of water features for transportation by canoe, and the dependence of moose and beaver on water for food and shelter. Presence or absence of water features and their varying characteristics are critical variables for this study.

Major rivers whose watersheds dominate the study area include the Indian River and Stutt's Creek (both tributary to the Manistique River), the Sturgeon, Fishdam, Ogontz and Whitefish rivers; all Lake Michigan tributaries (Fig. 6) and the Pine and Carp Rivers (Fig. 15). By far, most of the study area drains south; the Lake Superior tributaries are short with steep

gradients. The AuTrain, Rock,Waiska, and Tahquamenon Rivers have the largest watersheds of the Lake Superior tributaries (Figs. 6 and 15).

The character of these watersheds varies considerably. As Shalk (1977:239) states "there are characteristics inherent in the structure of watersheds (e.g. size and storage capacity) that have long-term, predictable consequences for variance in year to year productivity of anadromous fish". Inland lakes are much more common in the Indian River watershed and the adjacent upper Fishdam. Relatively few lakes are found in the Sturgeon and Whitefish watersheds. The substrate over which they flow also greatly affects the characteristics of major rivers and streams. In areas where bedrock is close to the surface, rivers tend to be wide, shallow, and subject to a great deal of variation in flow because of the immediate effects of surface runoff. Rivers flowing through deeper unconsolidated sediments tend to have a more constant flow and a narrower and deeper channel.

Flow records from gauging stations permit comparison of two of the major rivers in the study area. Seasonal variation in flow between the Indian and the Sturgeon Rivers illustrates the difference between a river with a relatively constant flow and one that fluctuates widely (Fig. 7). The relatively even flow in the Indian results from ground water recharge through a sand and gravel substrate and the numerous lakes within the system. The Sturgeon river flows through many areas where bedrock is close to the surface and there are few lakes in the system. Soils in the Sturgeon watershed tend to be poorly drained unproductive sand and organic deposits.

As a consequence of this flow variation, the Indian is canoeable much farther upstream and for a longer period than the other canoeable streams in the study area (Fig. 8). The upper portions of the Sturgeon and Whitefish are canoeable only during highwater periods. Higher resident fish populations could also be expected and seasonal spawners could remain in the Indian longer than other streams and penetrate farther upstream.

Spawning habitat also varies among river systems in the study area. Resident fish populations in rivers and streams are not significant food sources, and the productivity of anadromous or adfluvial fish for a particular locality is dependent on stream size and the amount of spawning habitat available upstream (Shalk 1977:222-223). Sturgeon, walleye, lake trout, and whitefish prefer a gravel, broken rock or cobble stream bottom for spawning. Although it is likely that a substantial amount of spawning habitat has been obliterated by sand deposition caused by logging and other recent land use, those areas still suitable were probably some of the prime areas in the past. Detailed fishery resource management plans (Bassett n.d.; Bassett and Dombeck 1981) have mapped prime spawning habitat in the Indian and Sturgeon Rivers, and portions of the Whitefish and Fishdam (Fig. 9). More good spawning areas are present in the Indian than the Sturgeon and although the Whitefish River data remains incomplete, presence of bedrock shelf bottom and low summer water levels may limit substantial runs to the lower reaches, as appears to be the case for the Sturgeon. The lower Sturgeon River does contain large rock rubble spawning habitat preferred by sturgeon. The swift, shallow water associated with spawning areas also makes them suitable for weirs and spearing.

Inland lakes are critical factors because of their potential as sources of moose, beaver, and possibly fish. It is assumed that only large lakes and/or those connected to major river system would have significant fish populations. Smaller, poorly connected, or shallow lakes were probably more significant as sources of beaver or moose than fish. The larger and more important food fishes such as lake trout, whitefish, and sturgeon are currently rare or nonexistant in most inland lakes. Most inland lakes are dominated by warm water species which are spring spawners. Sturgeon and walleye are likely species utilized from inland water features.

Lakes on the Hiawatha have been classified according to their temperature, water chemistry, and fish populations as warmwater high productivity, warmwater low productivity, and coldwater. Warmwater high productivity would have the highest fish populations, while warmwater low productivity are often subject to winterkill or are acidic bog lakes. They could be favorable moose or beaver habitat but are poor for fishing. Coldwater lakes are relatively infrequent and would generally have fewer fish and less aquatic vegetation than warm-water high productivity, but could be favorable for beaver depending on the surrounding terrestrial habitats. Although rivers are also classified as warm-water or cold water depending on resident fish populations, this is not deemed a critical variable because of the importance of non-resident species, such as sturgeon.

In summary, the critical features for river systems seem to be flow and the presence of narrows or rapids suitable for fish weirs or spawning. For lakes, the critical variables appear to be size, connection with other features, and productivity. Unproductive lakes or streams could still be favored over uplands for settlement location because of the need for water for cooking and drinking and the use of water features to orient foot travel into interior areas. Even though the ecological changes wrought by logging and settlement have greatly affected the riparian environment, general characteristics such as flow and size are assumed to be relatively constant.

Climate

Climatic factors are especially important for understanding use of the study area during the winter. Although no Stations with complete data (including wind) are located in the interior, records are available from Marquette and Escanaba. (Michigan Weather Service 1966, 1974). Temperature variation during the winter does not seem significant with mean January minimum termperatures ranging from about 12°F in coastal areas to less than

$0^{o}F$ inland. However, on the basis of ethnographic accounts from the subarctic, wind direction is an important factor affecting the location of winter settlements. According to records from Marquette and Escanaba, prevailing winds from November through April range from westerly to northerly, with northwesterly being most common.

Summer winds in the study area are a little more difficult to predict because Escanaba is dominated by a south wind while Marquette is dominated by winds from the west to northwest. This is due, in part, to the influence of on-shore breezes from the Great Lakes. Since Newberry, Seney, and Sault Ste. Marie all also show a prevalence of light westerly winds during the summer, this is the direction inferred for the inland portion of the study area.

Snowfall is also a key climatic variable affecting winter settlement patterns, largely due to its influence on large herbivores. There is considerable variation in snowfall within the study area on a generally north-south gradient (Fig. 3). For example, the average days per season with 16 inches or more snow on the ground ranges from 70 in the Munising area to around 20 in the southern areas. The effects of snow depth on herbivores is a critical factor in winter hunting (see Chapter 4).

Summer drought, besides its effect on stream flow, influences the frequency of forest fires, which in turn influences the distribution of prime deer, moose, and beaver habitat. Generally, summer drought severe enough to permit forest fires in wetland areas occurs about every seven years (Hiawatha National Forest 1985:3-5).

Freezeup and breakup are critical periods in the subarctic because travel over both land and water is impossible (Rogers and Black 1976:29). In the study area, freezup occurs around Dec. 1 in the north and Jan. 1 in the south, with breakup occurring around April 1 in the south and May 1 in the north. These events are highly variable and the dates given here are estimates based on conversations with forest service hydrologists. Among the Mistassini

(Rogers 197) it was of critical importance to be back to where canoes were stored befc e break up. However, overland travel in the study area was probably ea ier than in subarctic areas dominated by muskeg.

Lithic Raw Material Sources

Raw materials suitable for making chipped stone tools are not uniformly distributed in the study area and may have influenced settlement patterns. An understanding of this distribution is also important for understanding variation in lithic assemblages, especially in relation to reduction stages and amounts and sizes of debitage. Previous survey and excavation indicate that chert is the major stone type utilized.

Chert is most readily available in the southeast portion of the study area where Niagaran dolomite outcrops occur at or near the surface, and from nearby shoreline deposits derived from these sources (Figs. 10 and 18). Field checks of modern exposures such as quarries have revealed substantial amounts of chert in the Manistique Group formation, described as "a thinly bedded to massive light buff to brown and gray cherty dolomite" and the Cataract formation, described as "buff to gray dense cherty shaly dolomite and gray shale interbedded with thin layers of gypsum (Sinclair 1960:15). The chert from these sources is highly variable, ranging from an opaque cream or off-white color to a translucent dark brown. The majority found on sites in the area is gray. Much remains to be learned about this material: defining differences between sources, internal variability, and continued mapping of potential quarry or collection areas.

Other raw materials, such as quartz and quartzite, as well as chert from both within and north of the study area, are found in glacial deposits where they are exposed along lake shores or river banks. Cobble or pebble sized chert, quartz, and quartzite could have been obtained from coarse till, medium textured till, and glaciofluvial deposits (Farrand and Bell 1982). The best

exposures would be along lakeshores (Figs. 10 and 18). Chert, quartz, and quartzite in glacial deposits would be mixed with a variety of other materials and the dolomite formations in the study area would provide more abundant, more easily obtainable, and larger sized fragments of chert. The Niagaran escarpment on the east unit is a prominent potential chert source (Fig. 18).

CHAPTER 6

Set lement Pattern Model

Introduction

This section offers a narrative description of the expected types of sites and their location. It is most applicable to late prehistoric times, with decreasing reliability as one goes back in time. An intentional effort is made to focus on a limited number of major site types to avoid undue complexity. Variation and flexibility is emphasized through general descriptions of the range expected, rather than attempting to excessively subdivide into "types" phenomena that may vary on a continuum. The flexibility cited by ethnographers working among subarctic groups is likely to be found in the study area. For example, the location of deer, moose, and beaver during the winter results in at least 2 possible locational strategies which could be emphasized depending on both availability and preference. Opportunism is also a factor for consideration, with foods utilized at a given site reflecting both the major resource sought as well as whatever else became available.

One cannot assume that different site types will always be spatially exclusive. For example, the same area might be suitable for both summer and winter moose and beaver hunting. A given locale could be occupied for multiple or even consecutive seasons, such as a spring and fall fishing station where at least part of the population could remain during the summer. Some Late Woodland archaeological sites in the Upper Peninsula contain resources diagnostic of both spring and fall (McPherron 1967; Martin 1982; Buckmaster 1979).

Another source of variability expected based on the ethnohistoric and ethnographic literature would be in occupational intensity. Sites occupied

during the same season and for the same esources could still vary a great deal, depending on group size and length of stay. Winter camps might be an example, with moves occurring at variabl intervals as local resources were depleted. Sturgeon fishing sites could ary from large villages near river mouths or on the Great Lakes to small camps on the upper reaches of rivers where smaller runs occur. Identification of the major resources exploited is based on previous ethnohistoric, ethnographic, and environmental data. However, these sources include little information on specific site placement strategies within the study area. To model this critical aspect of settlement pattern, general characteristics of hunter-gatherer locational behavior derived from wide ranging ethnographic studies were utilized. The resource attributes cited by Jochim (1976) were utilized in addition to ethnohistoric and ethnographic sources to derive a broad resource use schedule for the study area (Table 6). These include weight, density, aggregaton size, mobility, fat content, and non-food yields like antler and hides (Jochim 1976:23). However, quantitative estimates of proportional resource use based on these characteristics were not made. Like Styles (1982:79-80), we lack confidence in quantitative judgements of prehistoric resource availability because of the bias introduced by habitat changes, extirpation of certain species, etc. Especially difficult are judgements of density, mobility, and non-food yields.

It is likely that during many times of year more that one resource will be sought or procured similtaneously. Even when a single resource is the focus of group activity, opportunities to procure other resources may arise and be utilized. For example, modern Athapaskans are always on the lookout for moose, even while involved with more predictable resources (Jarvenpa and Brumbach 1983:182). As a result of the "multiplicity of requirements" affecting settlement location, most decisions seem to involve "some compromise or blending strategy" (Clark 1972:117). Based on regularities observed among numerous hunters-gatherers, it is thought that these conflicts are often

resolved by locating settlements closest to less mobile, more dense, and less clustered resources (Jochim 1976:61). Satellite extraction camps could be utilized if necessary to procure the more mobile and clustered resources (Jochim 1976:61). Other factors assumed to influence settlement location on a more restricted scale include the need for shelter water, firewood, and a good view to permit the observation of strangers and game (Jochim 1976:49,52). The relevancy of Jochim's (1976) model is enhanced by it's congruence with the subsistence settlement system of the Round Lake Ojibwa in northern Ontario.

Settlement location is not just a function of the particular resource being exploited and the associated locale. In selecting areas for various subsistence activities, an important consideration is the "distribution of other activities" conducted at other times of the year (Jochim 1981:140). Hunter-gatherers in general try to minimize the travel distance in securing the desired resources (Jochim 1976:48-49). The use of canoes or dog teams for transportation may tend to create "exploitation corridors" along travel routes (Jochim 1981:140). Lakes and rivers in the study area may have provided major travel routes during both summer and winter.

Stored food can act as a "magnet" pulling groups toward the locations where storable food is available. Although fish and meat were certainly dried and smoked, accounts of starvation and the seasonal cycle described in ethnohistoric sources seems to indicate that stored food was not extensively relied upon. Perhaps the organizational and technological capabilities of groups in the study area, while appropriate for the processing and storage of small surpluses, were constrained by internal socio-cultural factors which were significant enough not to be outweighed by the potential for whatever increases in storage were possible, given the nature of the fish spawning runs and available technology. Highly efficient processing and storage techniques favor organizational phenomena such as static group membership, tight group

structure, and centralized control (Shalk 1977:235-237), which may have interfered with the organization required for exploitation of other resources, especially during times of scarcity when flexibility was important. If this is the case, the system could be constrained by factors other than simple availability.

Summary Description of Expected Settlement Pattern

Settlement is expected to focus on the sturgeon spawning run during the spring. Other spring spawning fish such as walleye may also be procured at this time. Larger runs are available in the downstream portion of rivers, and decrease as one goes upstream. As the 19th century account of a sturgeon weir on the Ontonagon River indicates, some weirs could be located away from major settlements (Douglass 1820). However, because of the predictability, lack of mobility, and density of sturgeon, settlements are expected to be associated with these locations, which would correlate with relatively narrow or shallow stretches of river with the angular rock or cobbles preferred for spawning. Other resources, such as moose, deer, and beaver could be procured from these locations, depending on associated terrestrial vegetation, but the primary resource determining site location would be sturgeon.

During the summer, a wider variety of resources are available and they are less concentrated. Beaver, deer, moose, and stored fish are available, as well as waterfowl and turtles. A wide variety of plant resources becomes available during late summer and early fall. Open water facilitates travel by canoe. Even though dense fish concentrations are not available during mid-summer, a strong orientation toward water features is expected. Besides beaver, moose tend to concentrate along water features during the summer and feed heavily on aquatic vegetation. Although deer are relatively dispersed during the summer, to a lesser extent they also feed on aquatic vegetation. Modern visitors to the area can attest that a lakeside campsite with an

onshore breeze minimizes the discomfort caused by insects. Some area might permit continued occupation of sturgeon fishing areas through the summer, while others would require a shift to areas where other resources could be obtained. Task specific resource procurement sites for berry picking and chert procurement could be occupied. Lithic procurement would take place in the vicinity of bedrock outcrops and in shoreline areas (Figs. 10 and 18). Locating chert would be easiest in the spring and fall when less vegetation was present and sources could be visited in conjunction with movements to and from coastal areas for spring and fall fishing.

Resources available in the fall may have posed a scheduling conflict. Lake trout and whitefish were available as they spawned in gravel shoals of the Great Lakes. Although there may have been spawning runs in some streams, it is assumed this was mainly a coastal phenomona. Fall is also a time when moose hunting is especially good. Moose enter their breeding season in the fall and this is a time of peak kills among some subarctic groups (Winterhalder 1981). Whitetail deer also breed in the fall and make range shifts towards winter yarding areas, which make it a favorable time for deer hunting. Herbivore weights and fat content are also at their peak in the fall. However, the locational and labor requirements of fall herbivore hunting and fall fishing for lake trout and whitefish may have made it impossible to pursue both. The high density, high predictability, and low mobility of fish runs would favor settlement location near this resource. If herbivores were hunted, it would be from satellite camps or after the run was complete. There is a chance that alternative strategies were pursued, with less than 100% of groups participating in the predominant activity.

All ethnohistoric, ethnographic, and ecological information indicates that winter hunting was essential to survival in the study area. Major winter resources available are moose, beaver, and deer. Supplementary small game is assumed not to greatly influence settlement location. A strong orientation

toward water features is still expected because of preferred travel routes, beaver distribution, and to a lesser extent, moose distribution. However, based on the principle of settlement location near the more dense and less mobile resources, winter camps could also be expected adjacent to winter deer yards. Although task specific deer and moose kill sites could be expected away from water, these winter deer hunting camps would be perhaps the only type of major base camp expected away from water features. Swamp conifer areas with upland ridges or dunes might be preferred. Even in winter level and well-drained soils would be preferred for campsites. Swamps often remain unfrozen under an insulating blanket of snow. Protection from prevailing winds would be a major factor for winter sites. If winter camps were occupied on lakes, the north and west shores would be preferred for protection from the wind. Conifers would offer more thermal protection than deciduous trees. Unlike other times of the year, drinking and cooking water would not be absolutely essential because snow could be melted down.

Less critical in the modelling process are the variety of short-term campsites and task specific sites like big game kill and butchering locales. These may be more difficult to predict. Because they would tend to be smaller in size and possibly less distinctive, less effort was put into modelling their nature and distribution. Some expected characteristics of these sites are as follows:

beaver kill/butcher - associated with water features year round, relatively low weight may permit transport to base camp.

deer kill/butcher - summer - some tendency to be associated with water features, edge effect. Highest density in most frequently disturbed habitats.

deer kill/butcher - winter - swamp conifer areas. Ridges within swamp conifers are preferred travel routes for deer and humans and also offer good vantage points. Deer

concentrate on south facing ridges - late winter, early spring. However, kill and initial processing could also occur in wet areas.

deer kill/butcher - Spring and fall - along edges of deer yards and routes to and from these areas. Ridges offer advantages listed above, plus acorns in fall.

moose kill/butcher - summer - associated with water features, especially lakes and beaver ponds with lots of aquatic plants.

moose kill/butcher - winter - old burns, brushy areas. Some correlation with water features because of "pull" from more dense and less mobile resources there, but not as closely associated with water as in the summer. Highest density in most frequently disturbed habitats.

short-term campsites

along travel routes - highly correlated with water features, especially those connected to other features in network and canoeable. Also, Figs. 19 and 20 show trails noted by original land surveys. (Circa 1850).

Rigid predictions of group size for site types are not appropriate, given the flexibility and variability expected. Winter groupings are expected to be similar to those observed among the Northern Ojibwa: 2 or 3 nuclear families or 12-30 individuals (Rogers 1983:98). Sites associated with spring and fall fishing are expected to include larger groups, although small groups could have also pursued activities such as sturgeon spearing.

Some broad area predictions about site distribution can also be made. Use of water features for transportation and the distribution of sturgeon, whitefish, and lake trout would act as a magnet and "pull" sites occupied to procure other resources, even those not associated with water features. This is a result of the tendency to locate settlements closest to the most dense and least mobile

resources and would result in highest site densities in coastal areas and near the portions major rivers with major spawning runs. Watersheds with an abundance of surface water and consistent flow patterns, like the Indian River, are expected to have higher site densities than other systems. The desire to minimize travel between spring and fall fishing areas could also draw winter settlements toward coastal areas and major rivers.

Implications of Model for Future Survey

Every year the Hiawatha National Forest is required to inventory cultural resources on approximately 20,000 to 50,000 acres where earth disturbing activities are planned. To accomplish this formidable task, we must continually strive to refine our ability to locate sites. Especially difficult is the location of prehistoric sites, which are often not visible on the surface. Shovel testing has been utilized to overcome poor surface visibility and probabilistic sampling has been suggested to overcome the impossibility of shovel testing large areas. Although ample data documents the deficiencies of shovel testing and probabilistic sampling in forested environments, various authors disagree on appropriate remedies (Lovis 1976; Nance 1979; Lynch 1980; Krakker, Shott, and Welch 1983; Alexander 1983; Connolly and Baxter 1983).

We have concluded, as Connolly and Baxter (1983:25) have for some heavily forested areas in the Pacific northwest, that probabilistic survey is "neither theoretically appropriate nor methodologically tenable" for the study area. The problems center around the prohibitive expense of shovel testing at intervals adequate for locating smaller sites and of sampling adequate fractions of project areas. Perhaps just as severe is the unsuitability of probabilistic sampling of a universe which is expected to include small, clustered, unobtrusive, and rare site types (Connolly and Baxter 1983:28). While we acknowledge the drawbacks of shovel testing, no better alternative has emerged for locating sites in areas of poor surface visibility.

The approach used for survey on the Hiawatha has evolved over the past decade, and is based on the results of attempts at early probabilistic sampling (Martin 1977; Lovis 1979). This approach includes shovel testing of certain small areas defined as having a high probability of prehistoric sites and walkover survey of other areas to locate historic sites and provide a control for the bias introduced by limiting shovel testing to certain areas. This control has been provided through the ubiquitous unimproved roads and trails throughout the forest that offer far better surface visibility than could be achieved through shovel testing. A similar dual approach has been developed by Connolly and Baxter (1983) in the Pacific northwest and termed "purposive" and "opportunistic" survey. Although obviously restricted in terms of built in capacity for quantitative estimates of reliability etc., the limitations of such an approach are less severe than those listed for probabilistic sampling in forested environments.

The previously developed model for prehistoric settlement on the forest provides a basis for systematic survey based on current expectations. Besides the examination of road, trails, and other exposed areas in proposed project areas, in order to control for the bias of the purposive approach, we have begun to resurvey some areas recently disturbed by projects (mainly timber sales). This is called "opportunistic" survey by Connolly and Baxter (1983). These areas offer by far the best opportunity for the discovery of those sites that are small, rare, or with low artifact density.

The approach planned will include ongoing analysis of survey and test excavation to refine the model used for guiding purposive survey. Although it is believed preferable to the probabilistic sampling approach, these certainly are still biases inherent in the approach being used. However, there appears to be potential for quantifying these biases and estimating the density of certain site types in different enviromnental zones (Aikens et al 1980). This could be done

based on calculations of how well the exposed or disturbed areas covered are representative of broader areas.

The following are survey guidelines based on current model development. Shovel testing is recommended at 15 meter intervals within 300 meters* of the following:

> water features, including extinct beaches and river terraces (Figs. 4 and 13)
>
> surface exposures of chert bearing bedrock (Figs. 10 and 18)
>
> ridges in wetlands and edges of wetlands (Land Class Groupings 3 and 4) especially within the areas defined as prime winter deer range (Figs. 2 and 12).

Within these areas, soils with a level and well-drained surface have the highest potential for habitation sites (Table 7). Larger scale (1/2"=1 mile) maps are on file at the Hiawatha National Forest Supervisor's Office that show critical features with more accuracy. All known prehistoric sites are located within these areas. The prediction of other possible site locations is less detailed: such as winter moose or summer deer kills away from water (and any associated habitations), overland travel camps, sites within poorly drained portions of forested wetlands, berry picking camps, or other site types. In addition, they are likely to have very low artifact density. Consequently, shovel test survey, either intuitive or probabilistic, is not appropriate for determining the presence or absence of these site types. Walkover survey of roads, trails, or recently exposed surfaces will be utilized for locating these site types. If enough examples are located it may be possible to identify distributional patterns to aid in the formulation of future survey strategies.

*If entire 300 meter area cannot be covered, emphasize areas closest to feature

Just as models are not expected to perfectly replicate the archaeological record, no survey strategy can guarantee that all sites will be found. Working within the constraints of current knowledge and the money our society allocates for cultural resource management, the goal we strive for is to develop a model and a survey strategy that maximize preservation of the prehistoric cultural record.

Conclusion

This model has attempted to reflect the settlement pattern flexibility found in ethnohistoric and ethnographic sources for the Great Lakes area and adjacent regions. It has tried to avoid introducing rigid elements that distort reality. It has tried to limit variables to those likely to be most important, but avoid simplistic assumptions about their effect.

It is almost certain that the existing model where sites are dichotomized into warm season Great Lakes coastal fishing villages and interior winter camps is an oversimplification. There may be warm season interior camps and sturgeon runs would permit fishing villages along major inland rivers. Even within the study area, groups may have followed different patterns, such as focusing on either coastal or interior areas the year round. Although some seasons present a relatively clear-cut choice such as spring sturgeon fishing, other seasons such as summer or fall present a variety of opportunities and even the most efficient alternative may not have been selected by all people during all years. The most efficient alternative could also be subject to short-term variation.

This model does not attempt to control for long-term cultural and ecological change. Even within the past 2,000 years of relatively consistent environment, changes may have occurred, such as the increasing reliance on fall spawning species withing the Late Woodland Period (Martin 1982). However, these represent a change in emphasis rather than use of new resources. Temporal variation in settlement pattern is expected in the study area and the model is certainly less reliable for earlier periods. There are some indications that Archaic settlement

patterns may be more oriented toward inland areas, with large sites there, and smaller sites in coastal areas (Cleland 1974).

This model is not intended as an end but rather as a beginning to more systematic settlement pattern research in the study area. It has provided a great deal of information for use in the evaluation of individual sites as well as for broader site distribution studies. Although speaking of a different type of model, the comments of Keene (1981:191) are relevant to this effort:

> models are valuable, not because they make predictions to a specific degree of accuracy, not because they replicate the archaeological record, but because they enable us to see the actual complexities of our problems (even if we cannot presently accommodate those complexities) and to trace the potential relationships between variables.

By providing information on some of the variables most likely to influence settlement patterns, the verbal/descriptive model presented in this report serves as a tool for more effective management of prehistoric cultural resources.

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Table 1. Estimated Habitat Type Percent Occurrence by LTA

Habitat Type	LTA Number														
	1a	1b	1c	2a	2b	3a	3b	4a	4b	5	6	7	8	9	10
Pinus-Vaccinium-Deschampsia (PVD)				15	15		-	-						-	
Pinus-Vaccinium-Carex (PVC)				15	15		-	-				5	10	-	
Quercus-Acer-Epigaea (QAE)				55	60		-	-				20	20	-	
Acer-Quercus-Vaccinium (AQV)				5	5		-	-						-	
Tsuga-Maianthemum-Vaccinium (TMV)							-	-						-	
Tsuga-Maianthemum (TM)	15	10	35				-	-	10					-	
Acer-Tsuga-Dryopteris (ATD)	65	60	50			20	-	-	25	10				-	
ATD depleted phase	10		10				-	-						-	
Acer-Viola-Osmorhiza (AVO)		15				30	-	-	50					-	
Tsuga-Thuja-Petasites (TTP)						30	-	-		25	5			-	
Fraxinus-Eupatorium-Impatiens (FE-FI)							-	-			5			-	
Tsuga-Maianthemum-Coptis (TMC)		5					-	-			5	15	10	-	
Tsuga-Thuja-Sphagnum Picea-Osmunda (TTS-PO)							-	-			10	15	10	-	
Undeveloped Thuja Climax Types							-	-		50	40	15	5	-	
Proposed Picea-Chamaedaphne-Sphagnum (PCS)							-	-			15	15	20	-	70
Sedge Bogs							-	-			10	5	15	-	
Other Inclusions	10	10	5	10	5	20	-	-	15	15	10	10	10	-	30

Table 2. Climax Overstory for Different Habitat Types. (Based on Coffman, etal. 1983)

Habitat Type	Dominant	Associate	Minor
PVD	jack pine	red pine	white pine
PVC	jack pine	red pine	black spruce, white pine
QAE	red oak, red maple	none	white spruce, white pine
AQV	red maple, red oak	E.hemlock white pine	balsam fir, white spruce
TMV	E.hemlock, red maple	sugar maple white pine basalm fir white spruce	red oak
TM	E.hemlock, sugar maple red maple american beech	yellow birch	white spruce balsam fir white pine red oak N. white cedar basswood
ATD	sugar maple	E.hemlock basswood american beech	yellow birch red maple american elm
AVO	sugar maple american beech	basswood	white ash yellow birch ironwood E.hemlock american elm
TTP	E.hemlock N.white cedar	balsam fir red maple	sugar maple
FE	black ash american elm	red maple	balsam fir white ash
TMC	E.hemlock red maple	sugar maple yellow birch	balsam fir, white spruce N.white cedar
TTS	E.hemlock N.white cedar	balsam fir black spruce	red maple
FI	white ash red maple	sugar maple black ash	balsam fir
PO	black spruce N.white cedar	E.hemlock	white pine
PCS	black spruce	tamarack	N.white cedar
undeveloped Thuja Climax	N.white cedar	?	?

Table 3. Characteristics of Land Class Groupings

1. Northern Hardwood Forest

LTAs			
1a	Northern Hardwood-Hilly	Dominant Landforms:	Moraines covered by Glacial Outwash, Moraines over limestone bedrock-high relief, Moraines over sandstone bedrock
1b	Hardwood-Undulating		
1c	Northern Hardwood-Level		
4a	Mixed-Steep		
4b	Mixed-Undulating		
		Dominant Climax Timber Species:	sugar maple, beech hemlock, red maple, balsam fir, white spruce

2. Pine-Oak Forest

LTA's			
2a	Pine-Hilly	Dominant Landforms:	Outwash sands
2b	Pine-Level	Dominant Climax Timber Species:	jack pine, red pine, red oak, red maple, white pine, hemlock, balsam fir, white spruce

3. Wetland Forest

LTAs			
3a	Clay flats	Dominant Landforms:	Lacustrine Deposits (fine textured), Moraines over limestone bedrock-low relief, organic deposits
3b	Drainways		
5	Lowland sandy loams		
6	Muck		
10	Bogs		
		Dominant Climax Timber Species:	white cedar, hemlock, black spruce, balsam fir, red maple, black ash

4. Wetland Forest/Dune and Ridge Complex

LTAs			
7	Muck with sand ridges	Dominant Landforms:	Wind deposited lacustrine sands and organic deposits
8	Muck with dunes		
		Dominant Climax Timber :	uplands same as 2 lowlands same as 3

Table 4. Patch Disturbance Frequency by Land Class Groupings from 1841-1855 General Land Office Survey Maps.

	Percent of Forest W. Unit Area	Burnt	Windfall	Burnt Windfall	Total
1. Northern Hardwood	42.9	0(0)	8(31)	1(12.5)	9(17.6)
2. Pine	14.9	2(12.5)	3(12)	1(12.5)	6(11.7)
3. Wetland/Wetland Forest	25.9	4(25)	10(38)	5(62.5)	19(37)
4. Wetland Forest/Dune Complex	16.2	10*(62.5)	5(19)	1(12.5)	17(33)
		16	26	8	51

*complex of fires in one township

Table 5. Modern Fire Occurrence, Hiawatha National Forest, 1975-1984.

Land Class Grouping	Frequency	Percent of total burned acres
Northern Hardwoods	31	9
Pine-Oak Forest	32	17
Wetland Forest	28	39
Wetland Forest/Dune and Ridge Complex	9	35

Table 6. Resource Use Schedule

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Beaver	x	x										x
	x	x	x	x	x	x	x	x	x	x	x	x
Deer	x	x	x							x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x
	x	x										x
Moose			x			x	x	x		x	x	
	x	x	x	x	x	x	x	x	x	x	x	x
Sturgeon				x	x	x						
				x	x	x	?					
				x	x	x						
Lake Trout										x	x	
										x	x	
										x	x	
Whitefish										x	x	
										x	x	
										x	x	
Blueberries							xx	xx				
							xx	xx				
							xx	xx				
Bear	x	x										x
	x	x	x	x	x	x	x	x	x	x	x	x

x Available - but no advantage to exploitation at this time

x Some advantage to exploitation at this time

x Clearly best time for exploitation

Table 7. Well-Drained Soil Series With a Level and Permeable Surface Layer, Hiawatha National Foest

East Unit	LTA's	West Unit	LTA's
Alpena	4B	Alpena	4B
Croswell	2B, 7	Blue Lake	1A, 1B, 1C
Duel	4B	Croswell	2B, 7
Eastport	2A, 7	Deerton	1B, 1C
Guardlake	4B	Duel	4B
Halfaday	1C	East Lake	4B
Kalkaska	1A, 1B, 1C, 9, 3B	Eastport	2A, 7
Karlin	1C, 3B	Gilchrist	4B
Manistee	1B, 1C	Grayling	2A, 2B
Menominee	4B	Kalkaska	1A, 1B, 1C, 3B, 9
Ocqueol	1C	Karlin	1C, 3B
Posen	4B	Keweenaw	1B, 1C
Rousseau	1A, 1B, 1C, 2A, 2B, 8	Kiva	4B
Rubicon	1A, 2A, 2B, 3B, 7	Mancelona	1B, 1C
Shelldrake	2B	Melita	1C
Springlake	4B	Menominee	4B
Waiska	1C	Rousseau	1A, 1B, 1C, 2A, 2B, 8
		Rubicon	1A, 2A, 2B, 3B, 7
		Shelldrake	2B
		Wallace	1C
		Yalmer	1C

Based on: Davis and Frey 1984; USDA-Soil Conservation Service 1977

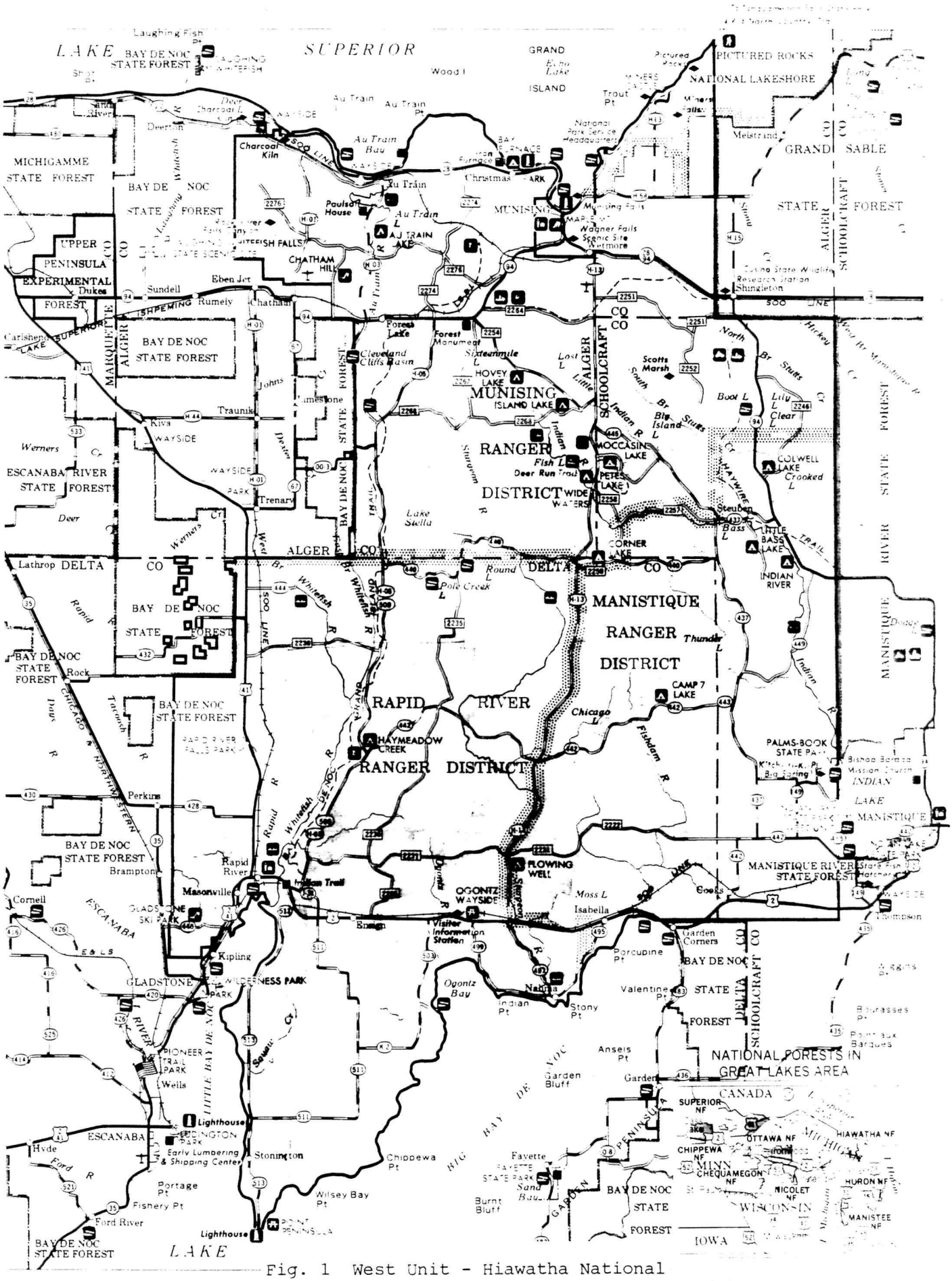


Fig. 1 West Unit - Hiawatha National Forest

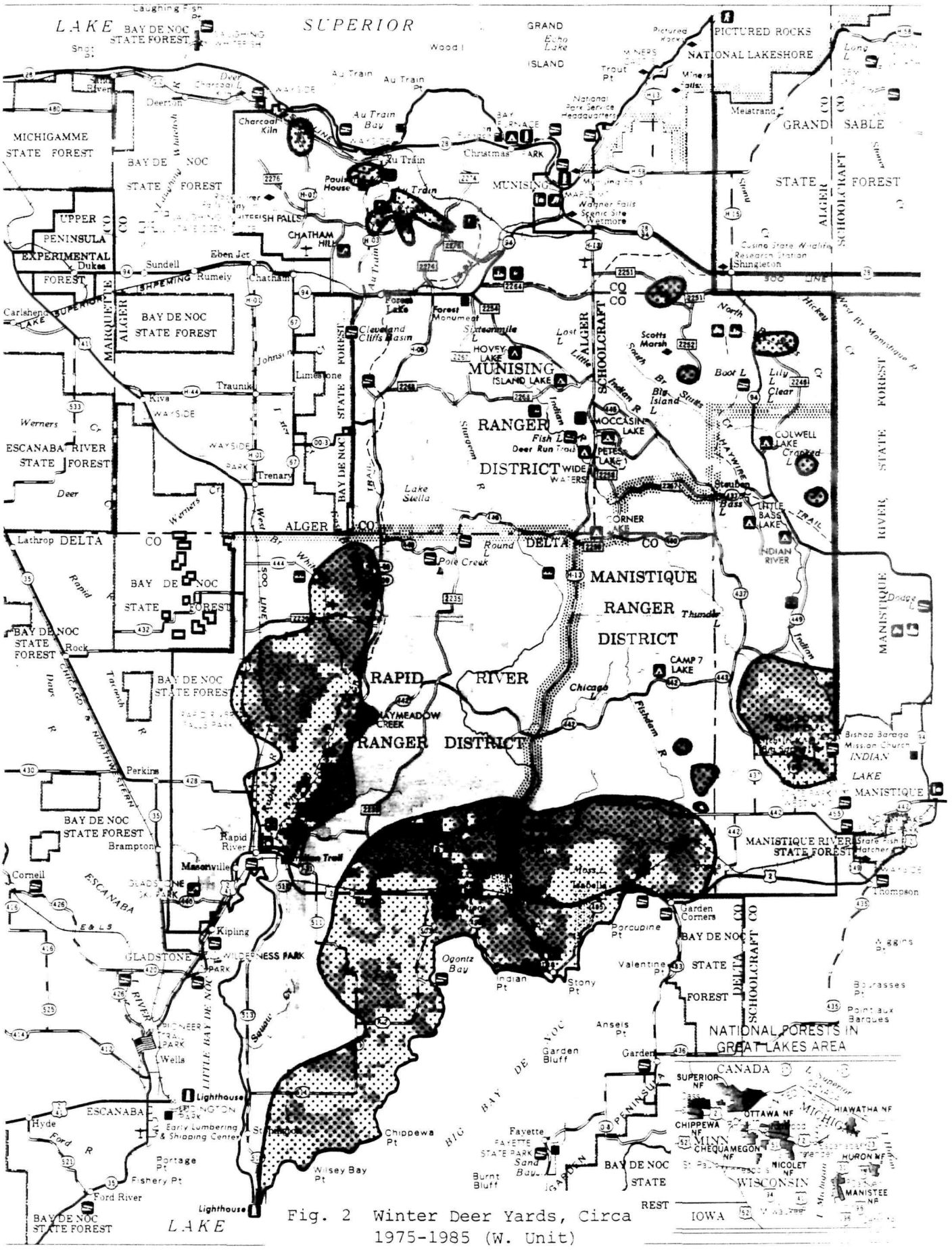
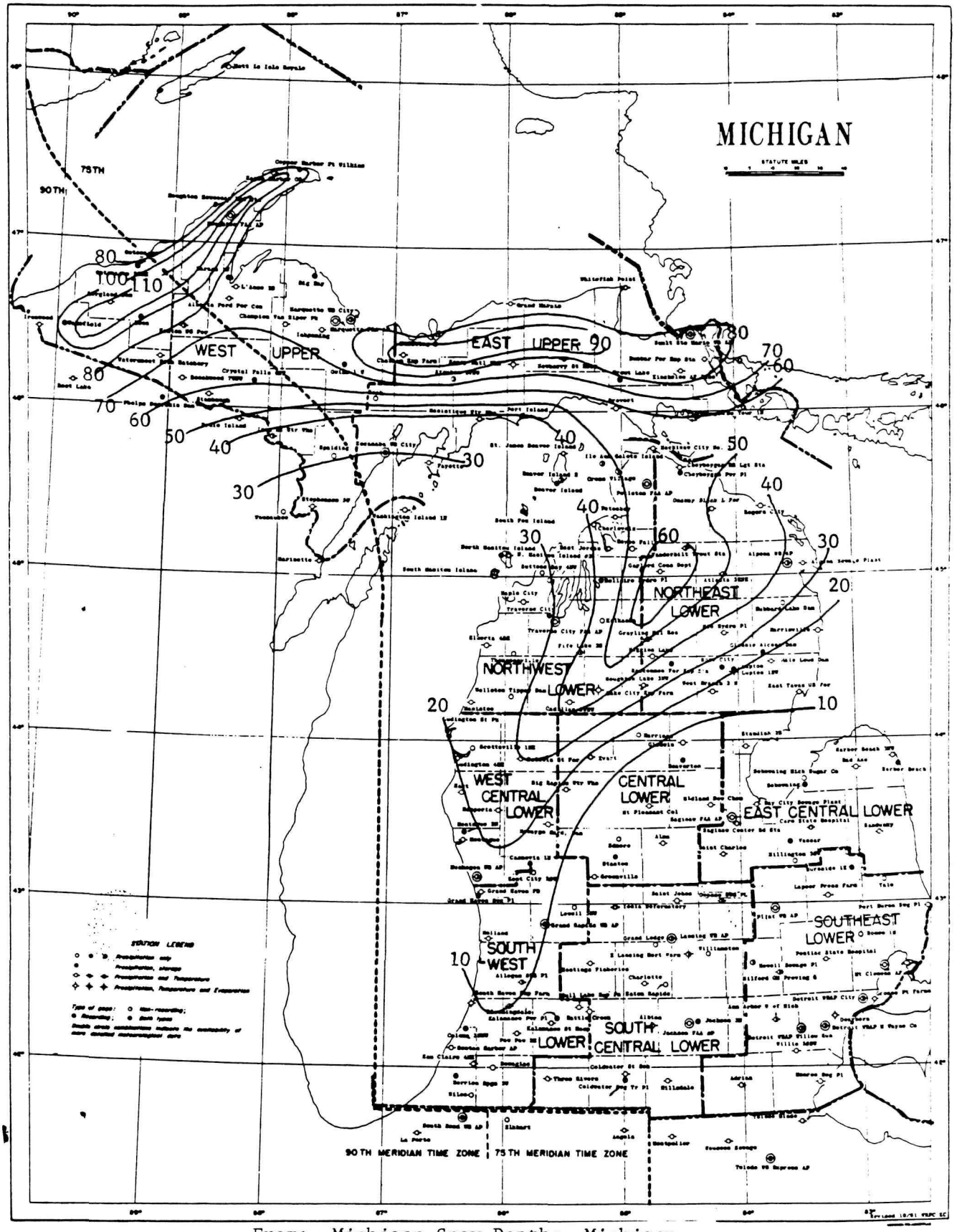


Fig. 2 Winter Deer Yards, Circa 1975-1985 (W. Unit)

Fig. 3. Average Number of Days Per Season With Accumulated Snow Depth on the Ground of 11 Inches or More



From: Michigan Snow Depths, Michigan Weather Service, 1974.

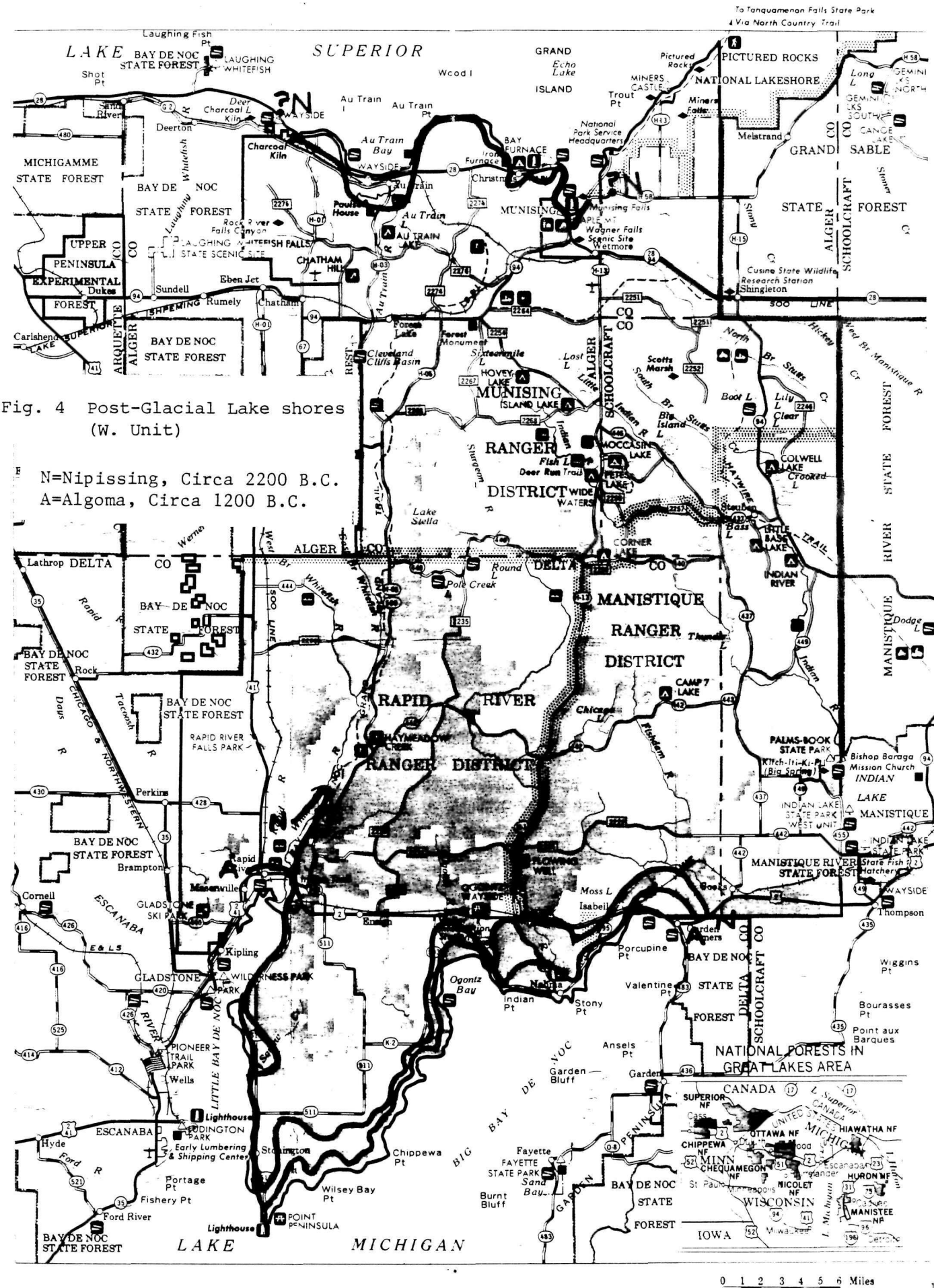


Fig. 4 Post-Glacial Lake shores (W. Unit)

N=Nipissing, Circa 2200 B.C.
A=Algoma, Circa 1200 B.C.

1977

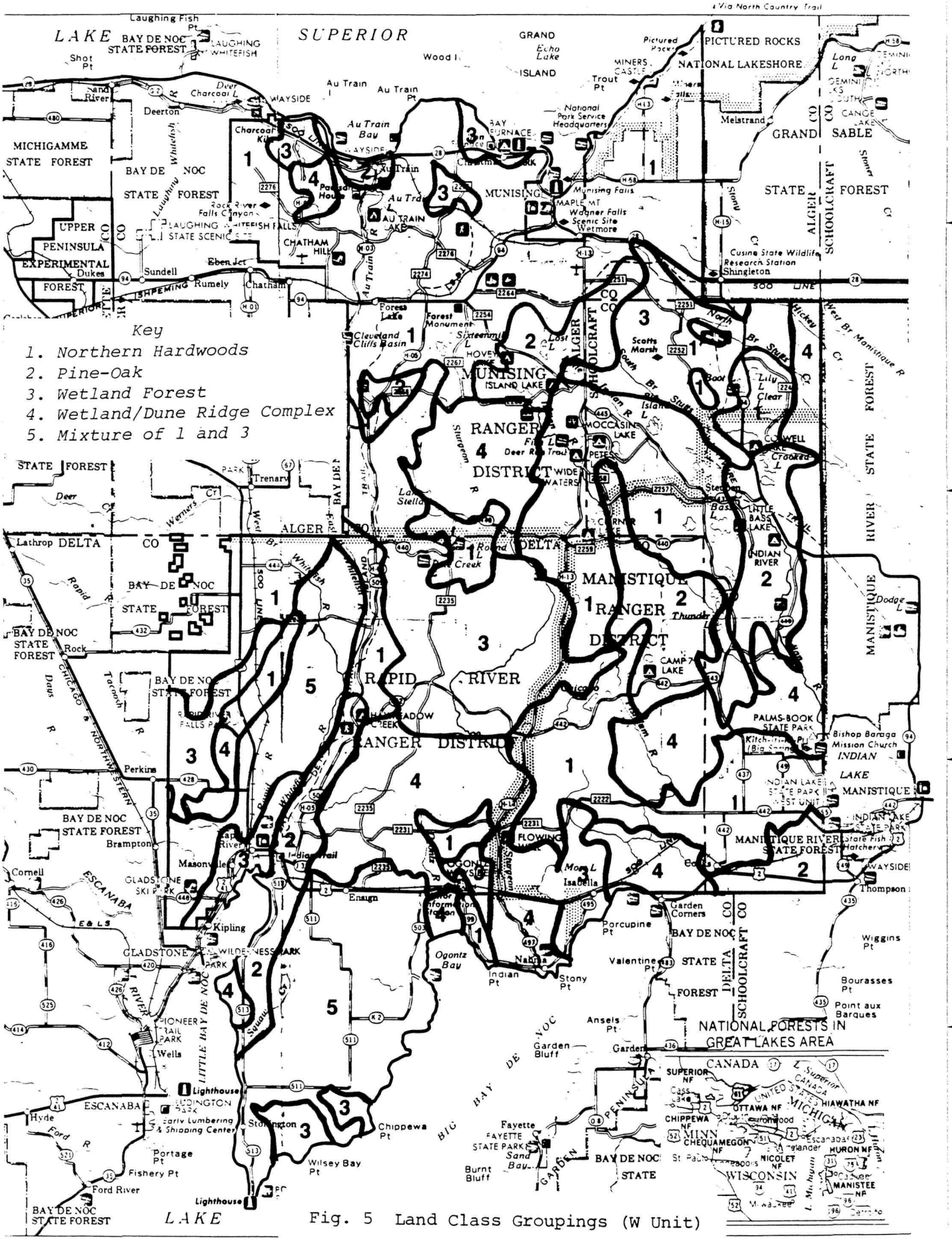


Fig. 5 Land Class Groupings (W Unit)

1977

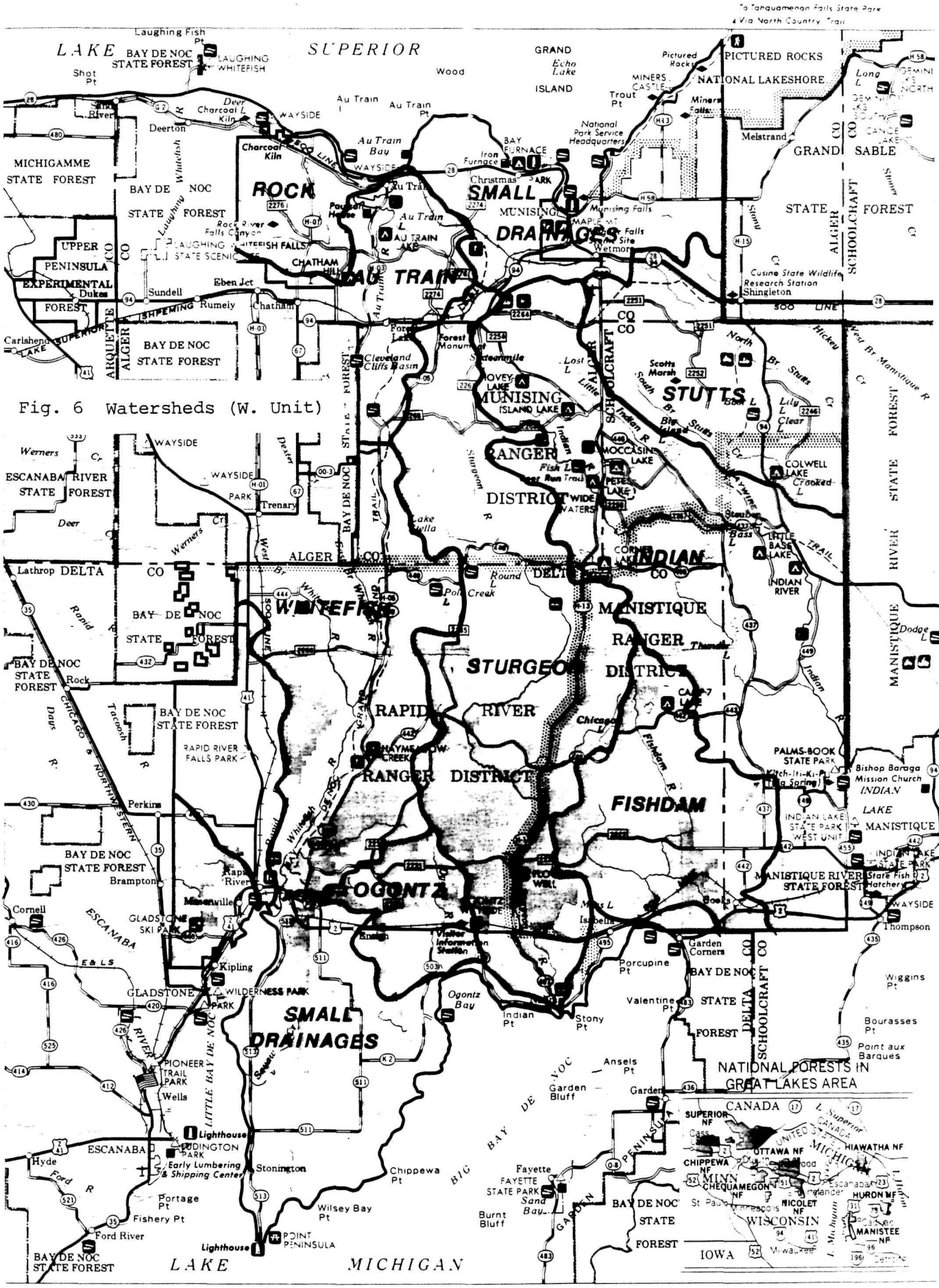


Fig. 6 Watersheds (W. Unit)

1977

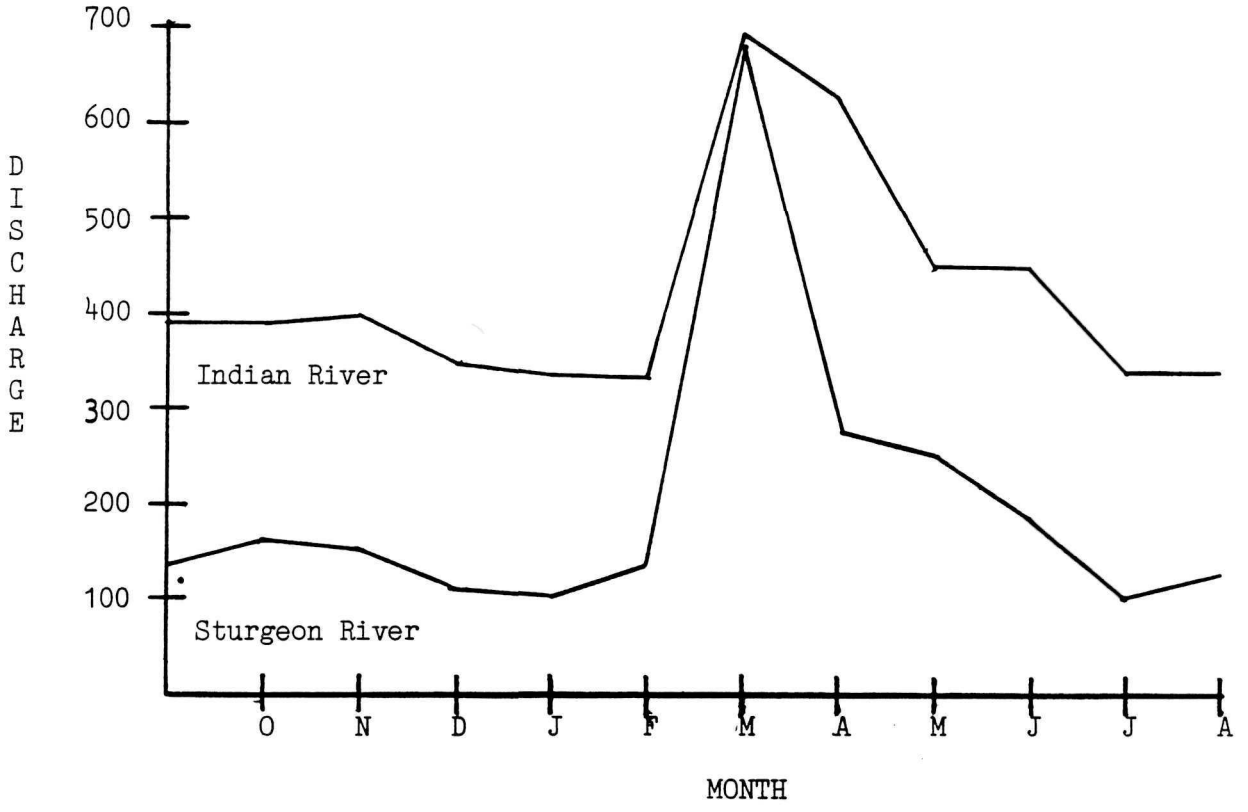


Fig. 7 Mean daily discharge, in Cubic Feet per second, 1951, 1967-1970, Indian and Sturgeon Rivers. (U.S. Geological Survey 1964, 1974).

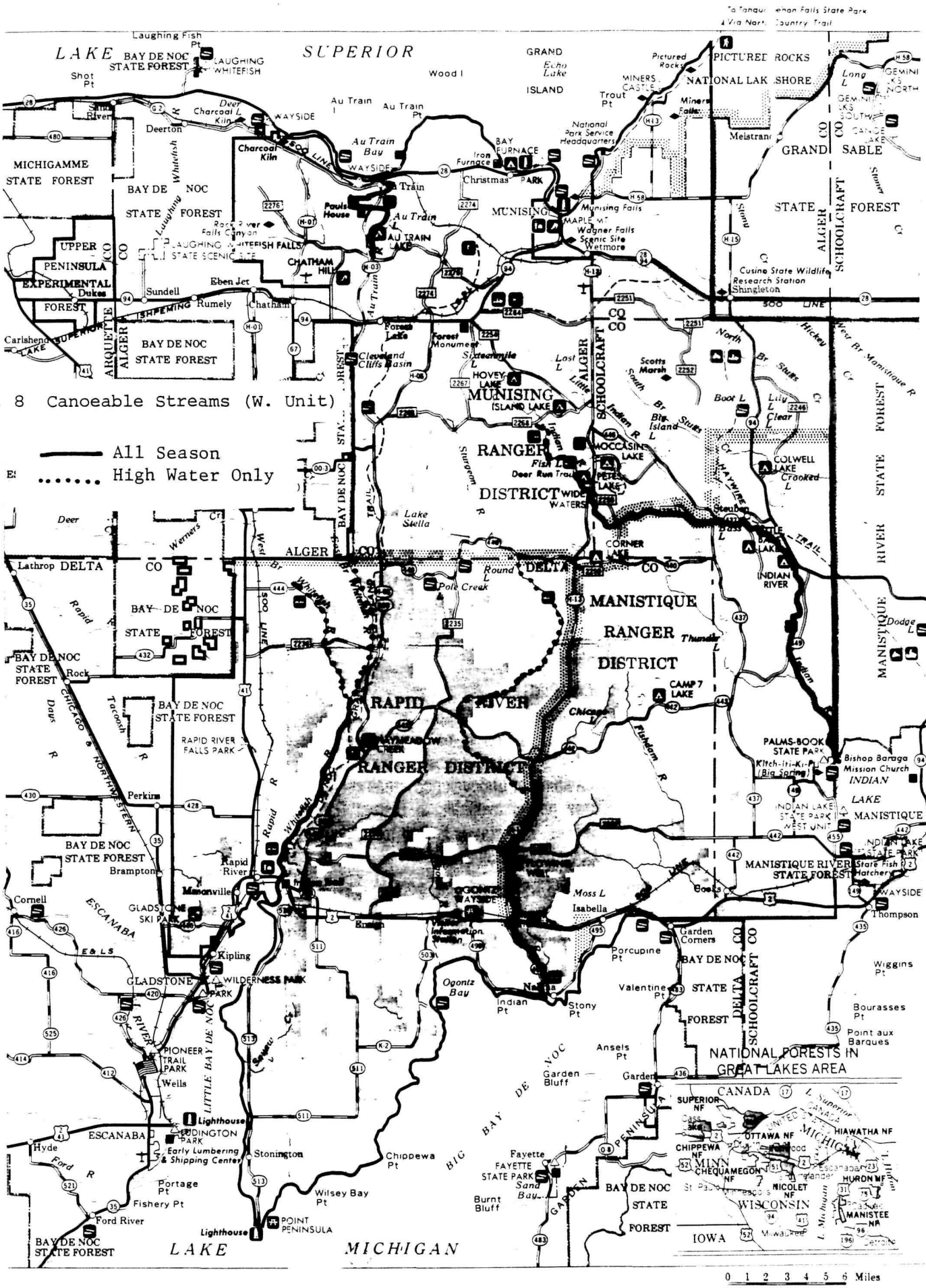


Fig. 8 Canoeable Streams (W. Unit)

All Season

High Water Only

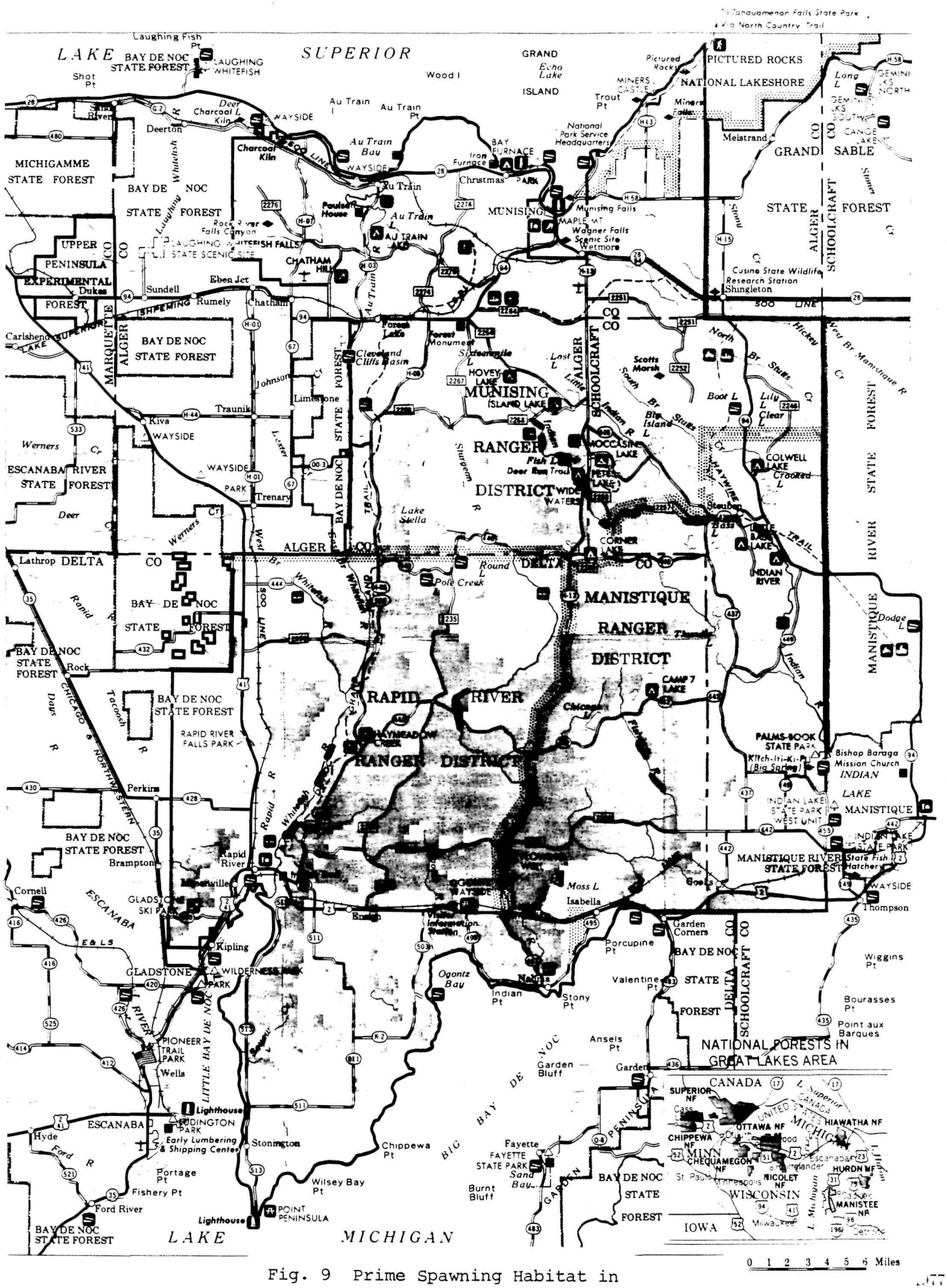


Fig. 9 Prime Spawning Habitat in Rivers (W. Unit)

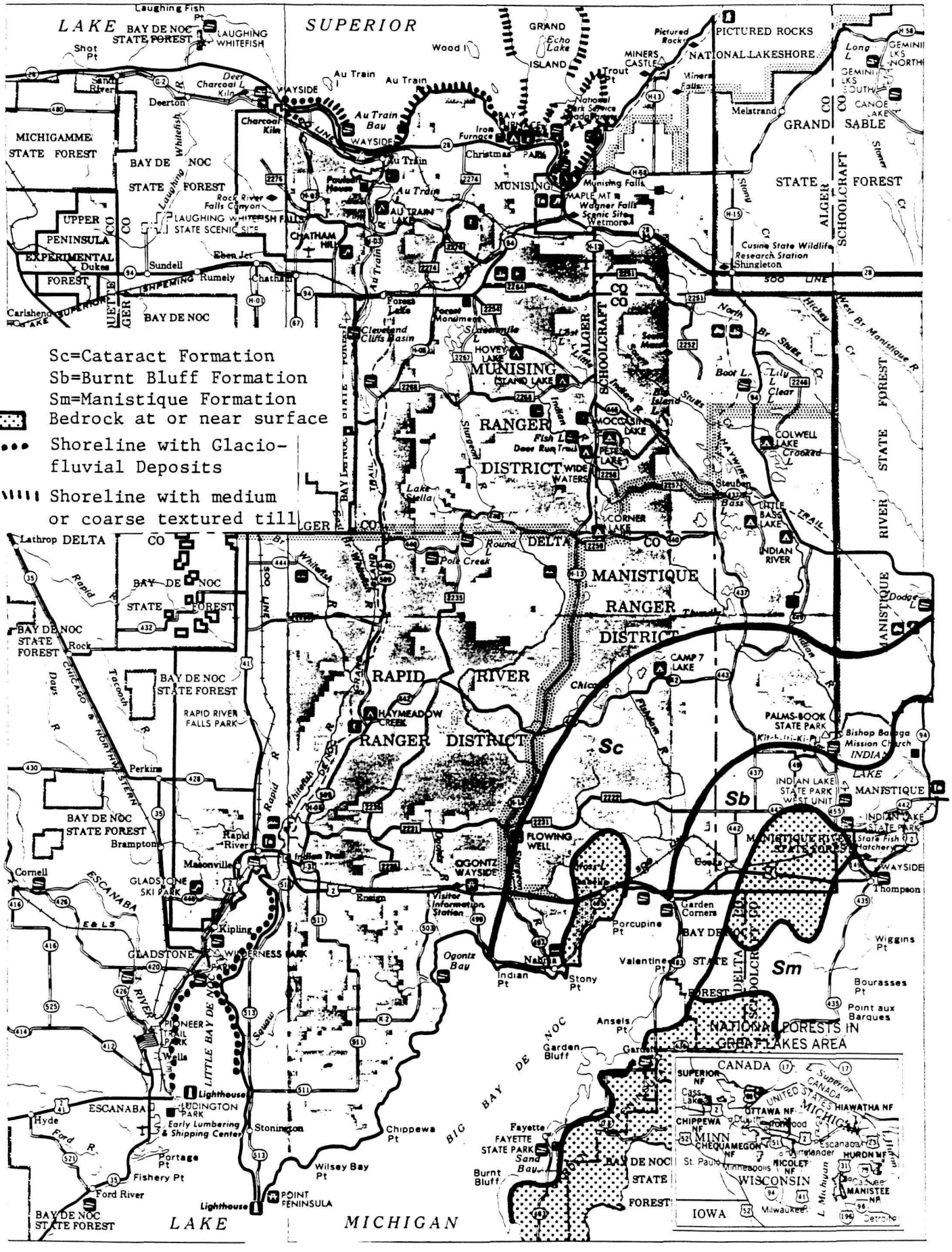


Fig. 10 Sources of Lithic Raw Material (W. Unit)

1977

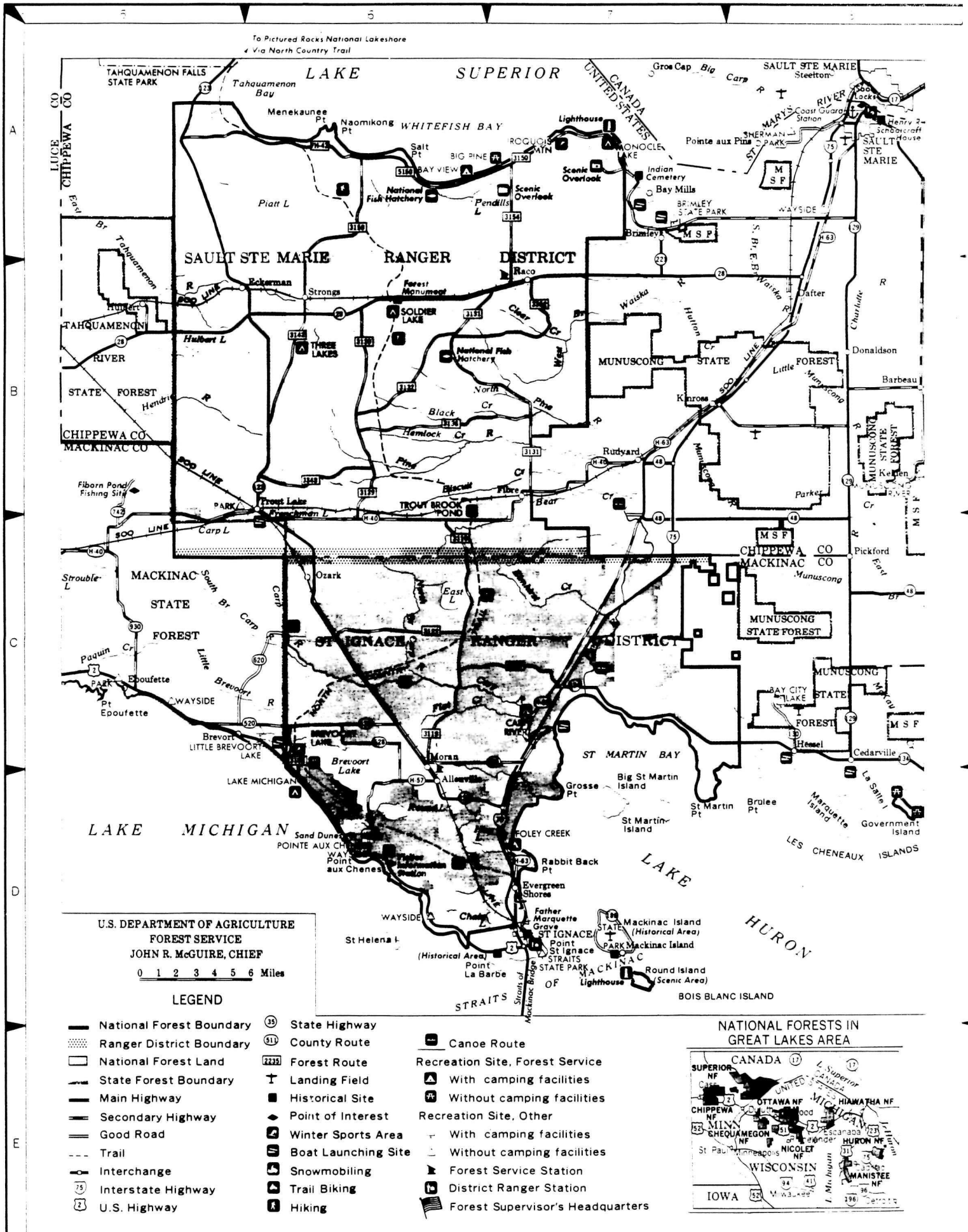


Fig. 11 East Unit - Hiawatha National Forest

1977

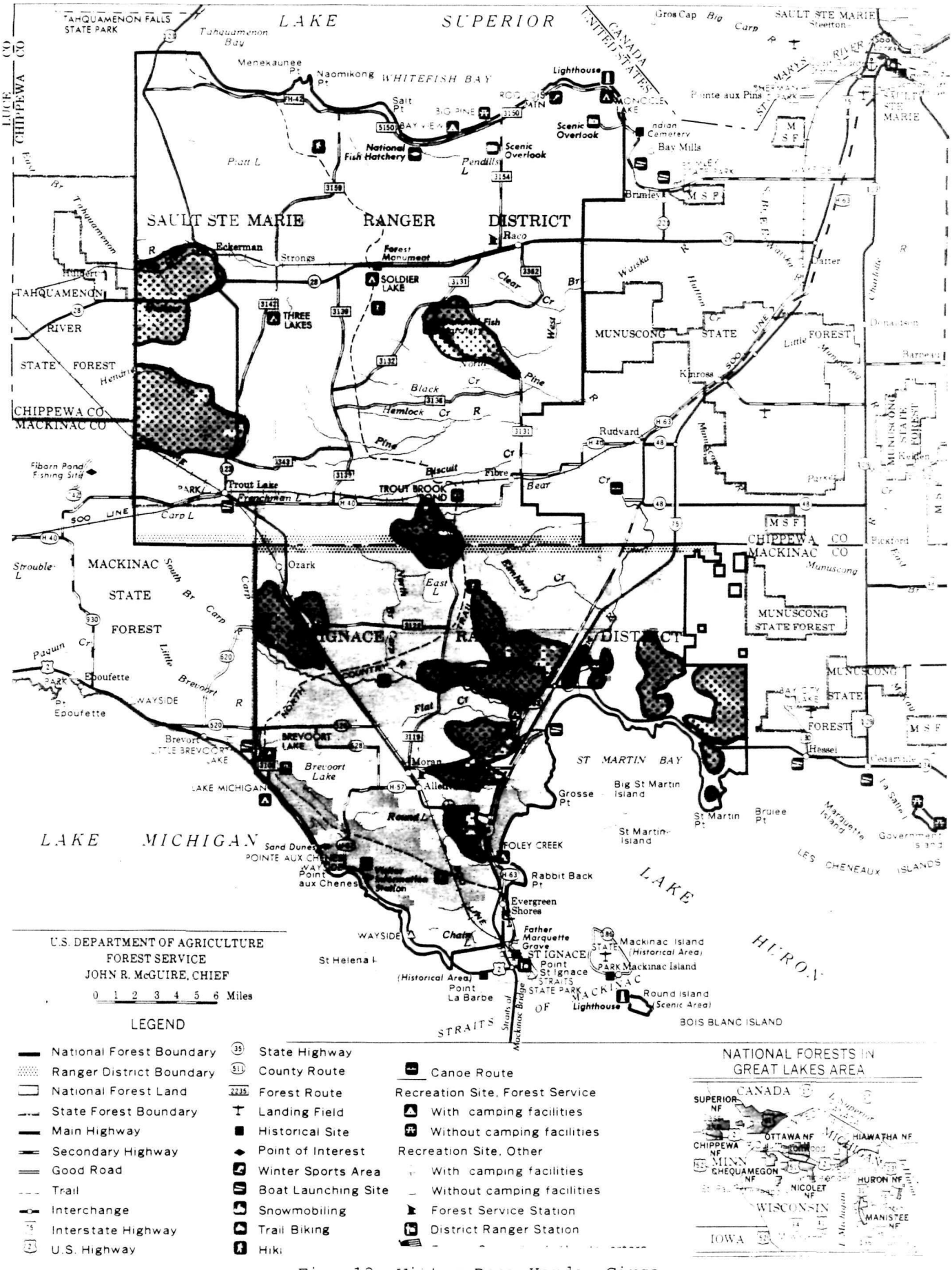


Fig. 12 Winter Deer Yards, Circa 1975-1985 (E. Unit)

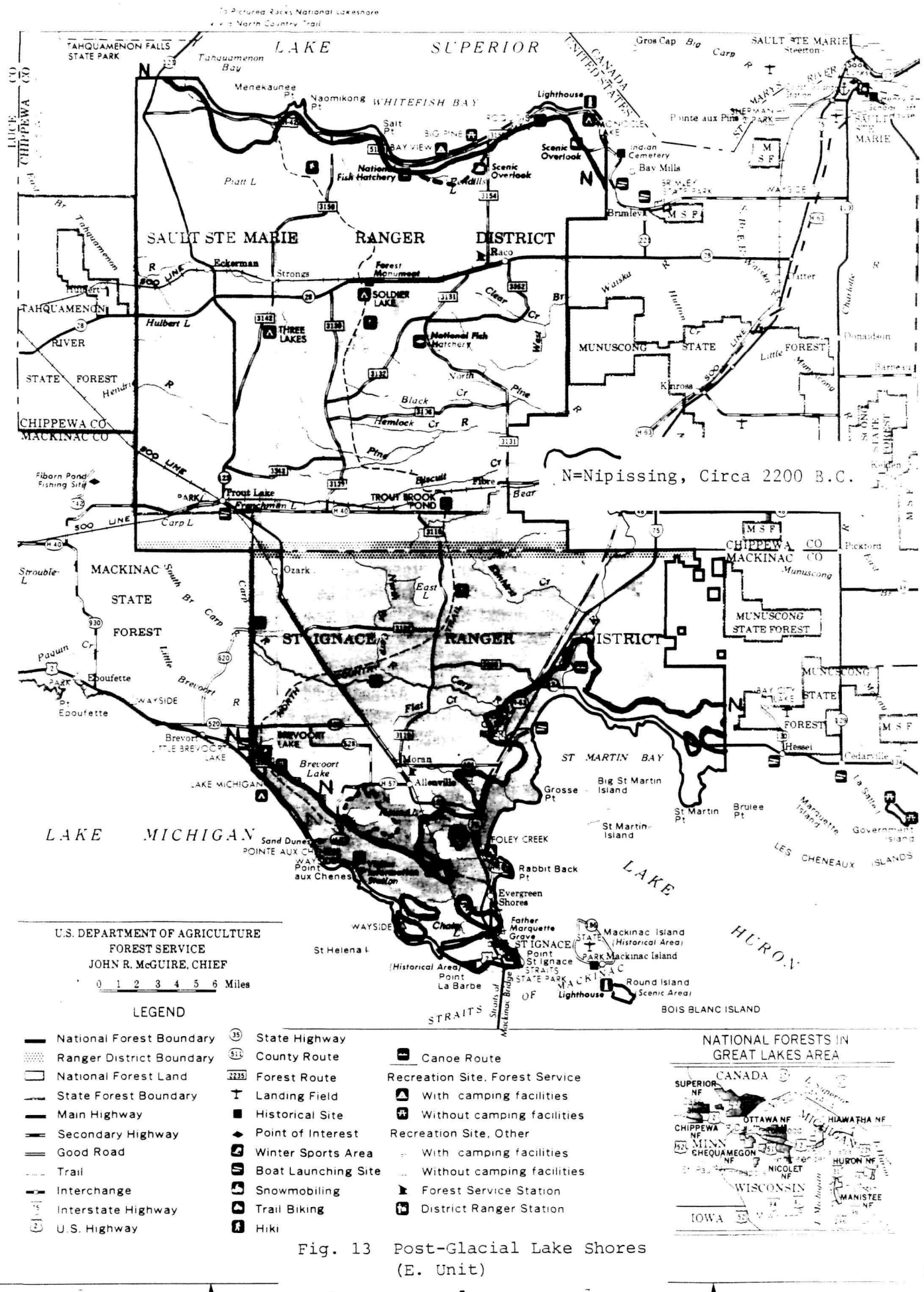


Fig. 13 Post-Glacial Lake Shores (E. Unit)

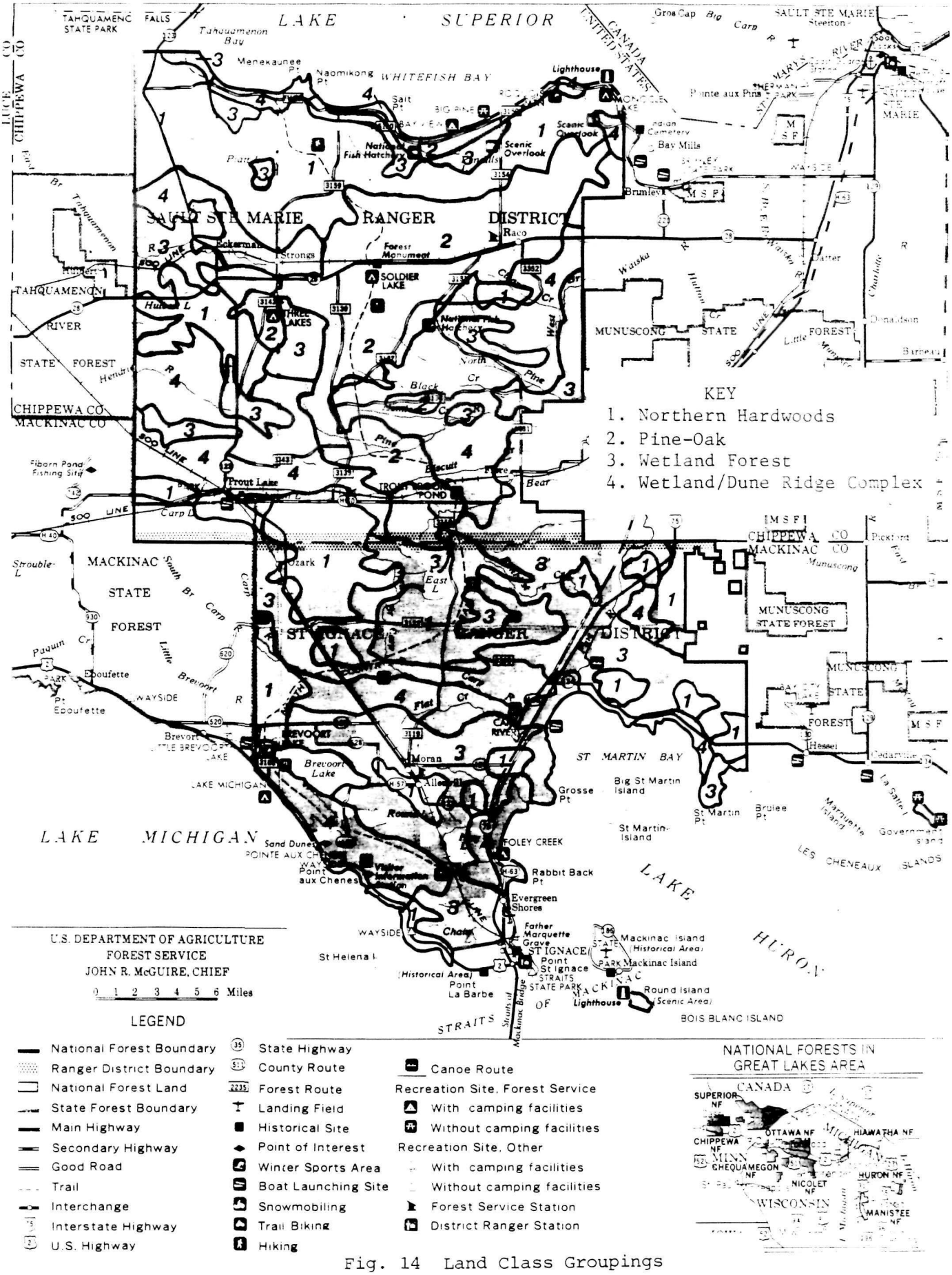


Fig. 14 Land Class Groupings
(E. Unit)

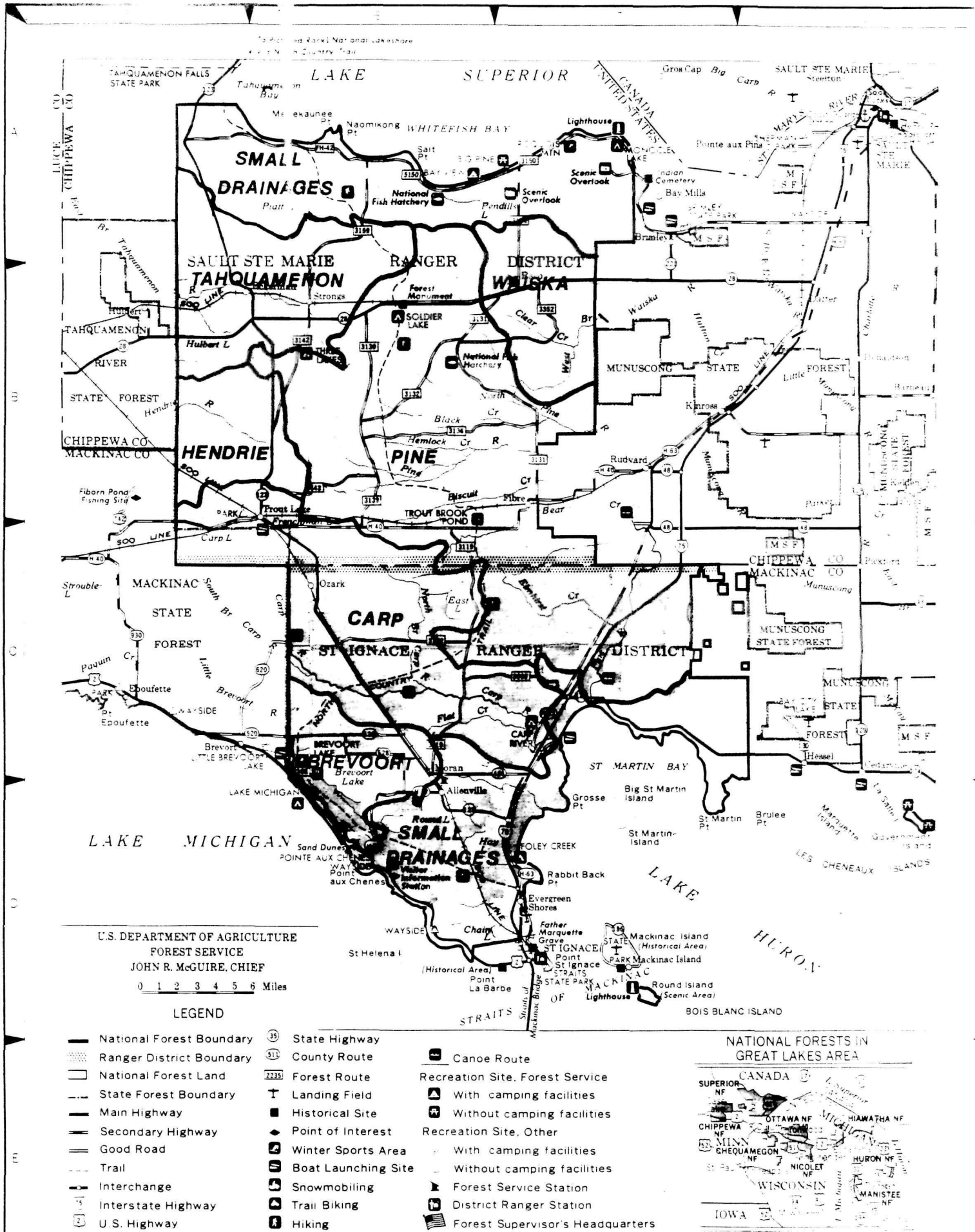


Fig. 15 Watersheds (E. Unit)

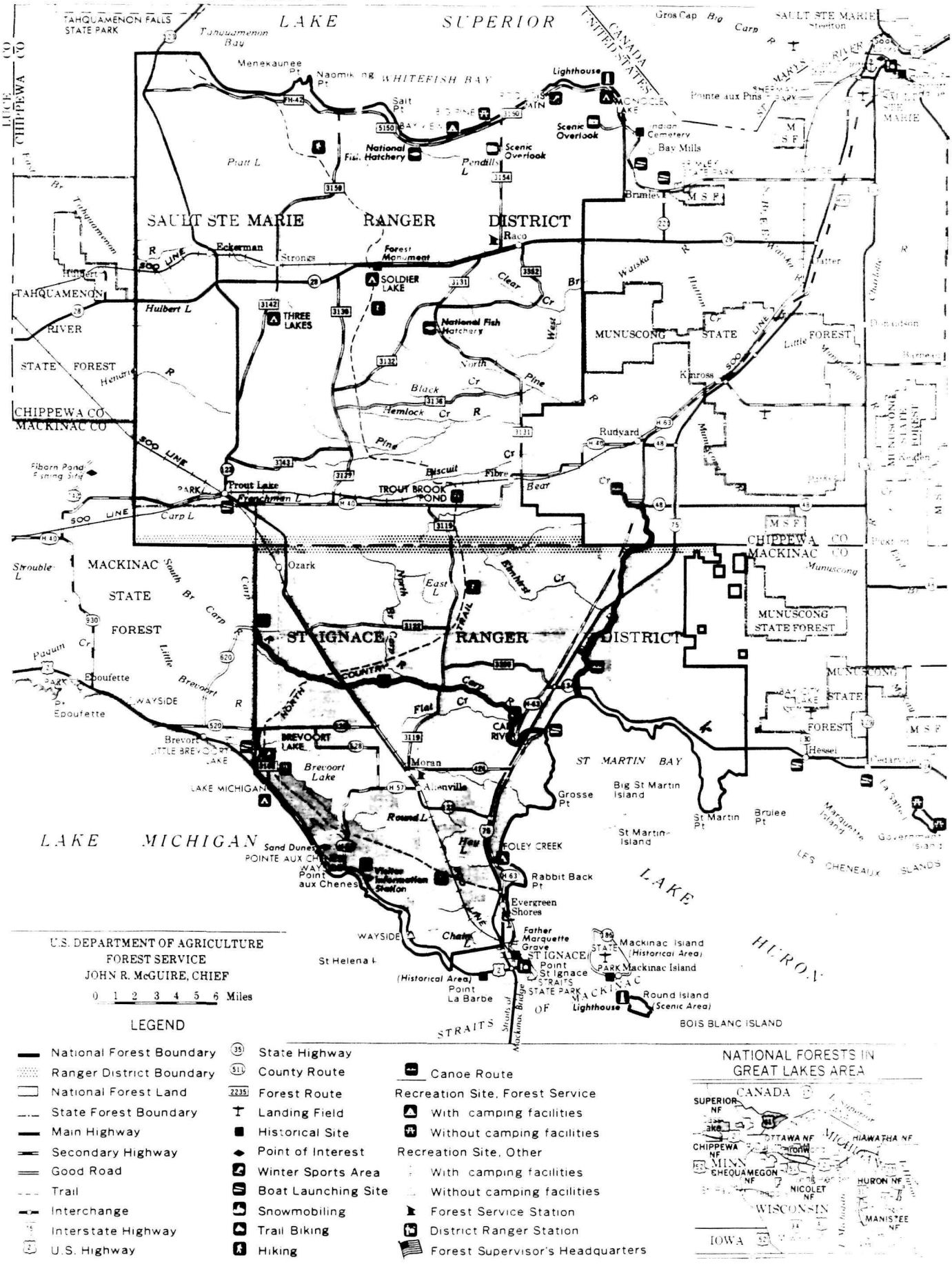


Fig. 16 Canoeable Streams (E. Unit)

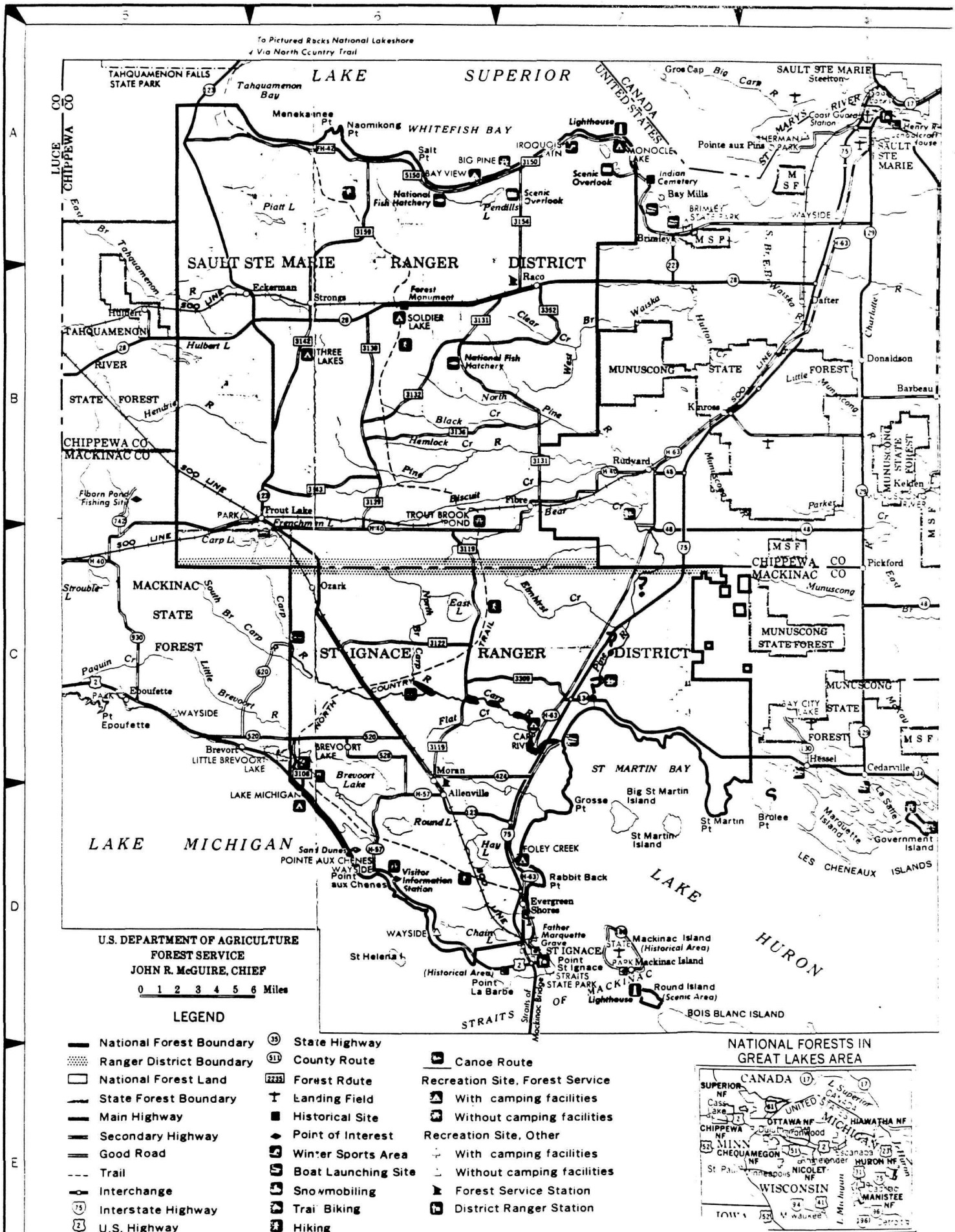


Fig. 17 Prime Spawning Habitat in Rivers (E. Unit)

(incomplete data)

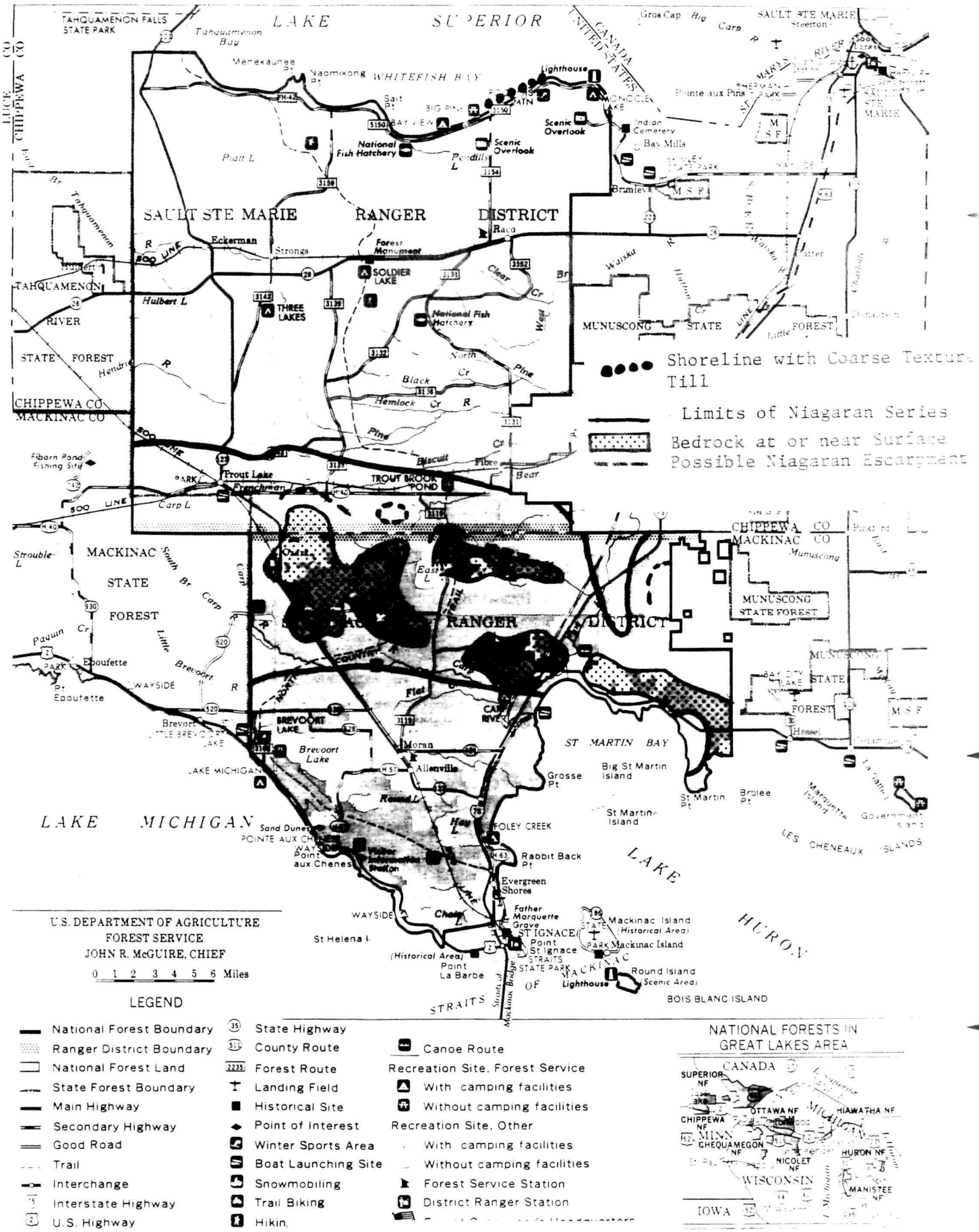


Fig. 18 Sources of Lithic Raw Material (E. Unit)

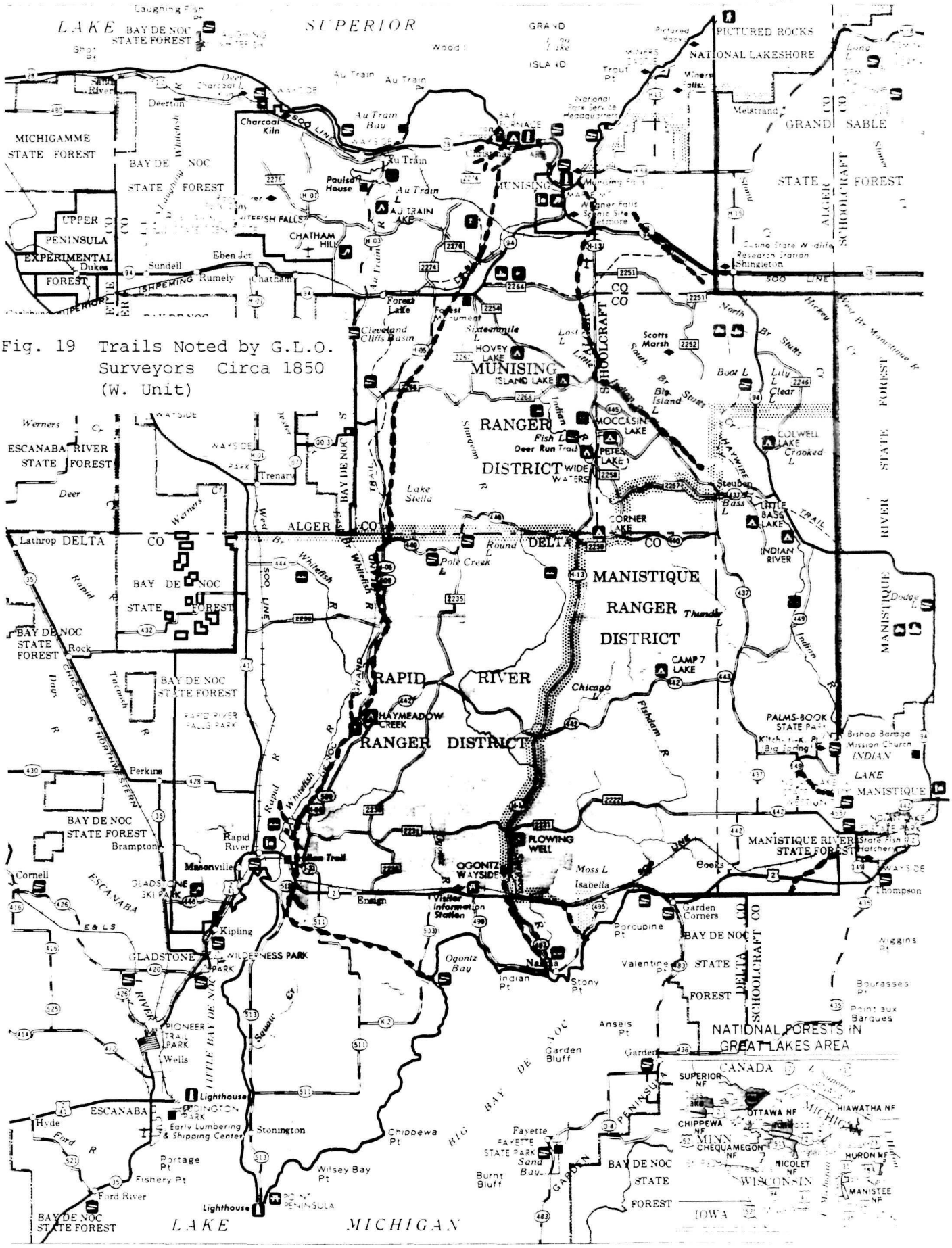


Fig. 19 Trails Noted by G.L.O. Surveyors Circa 1850 (W. Unit)

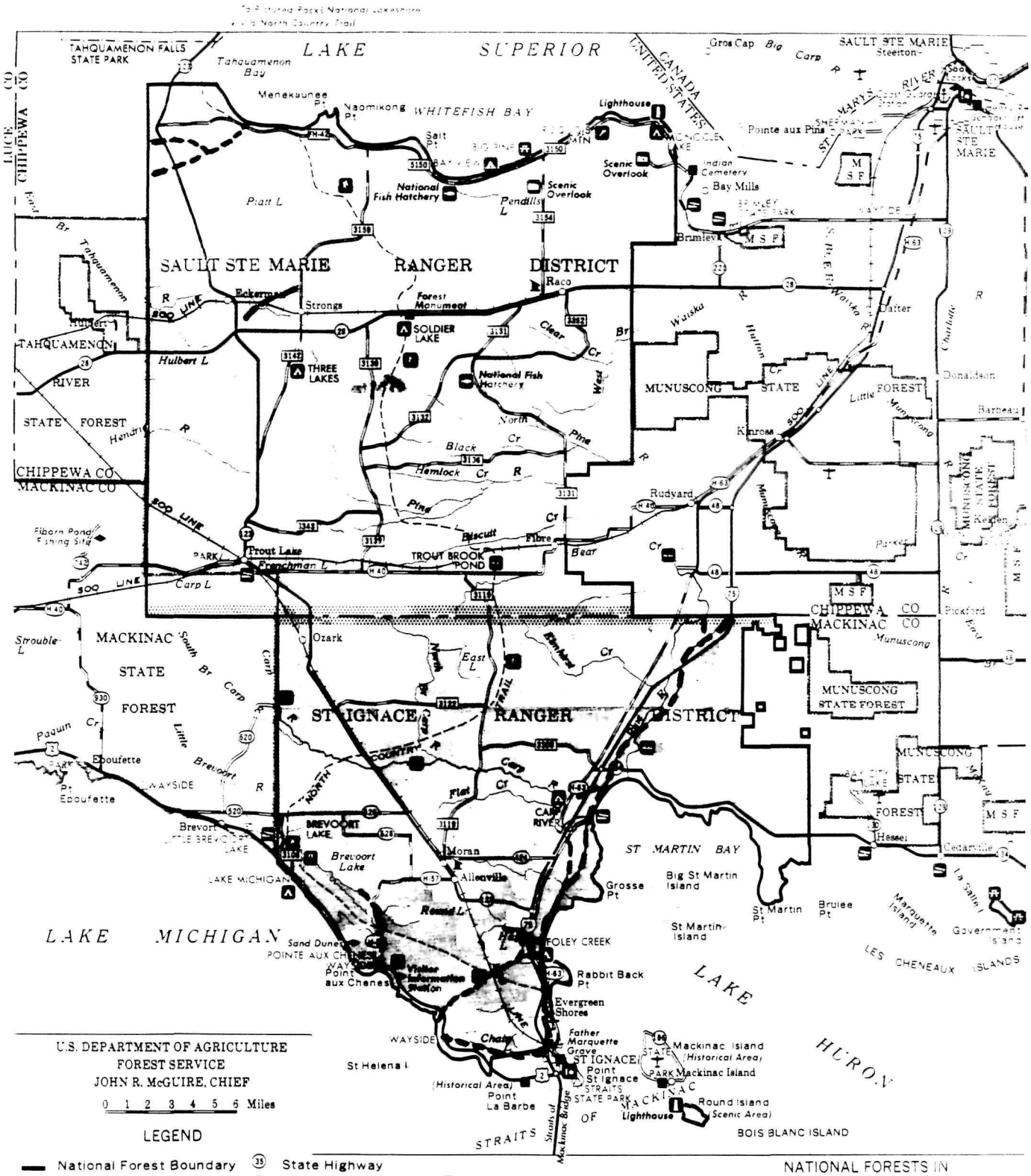


Fig. 20 Trails Noted by G.L.O. Surveyors Circa 1850 (E. Unit)