Dietary Requirements of Historic Wisconsin Chippewa

Introduction:

The diet of the late nineteenth century Chippewa of Wisconsin used venison and fish as staple foods in their subsistence strategy. The problem under consideration is the absolute amount of game and fish that was used for subsistence by an average Chippewa family in Wisconsin in 1887. Nutrient requirements is one measure which may be used to estimate the amount of game and fish, necessary to supplement other known food types, which resulted in a nutritionally adequate diet for the subject population.

Nutritional requirements are a relatively standard unit of analysis which can be used to estimate the amounts of various kinds of foods necessary to ensure the survival of a human population. The units are nutrients, not foods, and therefore are not bounded by cultural preferences. The approach taken here is based upon scientifically derived estimates of amount of different foods required to maintain a healthy population can be calculated. Different foods contain various combinations of different required nutrients. Subsistence strategies, therefore, must be concerned with implicity striving to provide combinations of foods which satisfy basic human nutritional requirements. The "diet" is this satisfactory combination of foods.

This approach allows an independent assessment of estimates available in the historic documents of the nineteenth century. Of particular interest here is the letter of Alfred Brunson to J.D. Doty in 1843. In this letter, Brunson states that:

> The fish and game they subsist upon are worth to them or could not be supplied by other provisions for less value than $100. to each family of four persons, amounting to $100,000.

One goal of this study is to assess the accuracy of Brunson's 1843 estimate of $100. as a monetary compensation for the game and fish portion in the average family's diet. The data generated by this study results in an independent estimate of the amount of fish and game which were needed by each household to maintain adequate nutritional health. The estimate proceeded by Brunson may be evaluated in terms of considering the monetary cost of substituting wild meat and fish with salt pork, the most commonly available commercial meant of the nineteenth century, in order to satisfy dietary requirements.

The major goal of the study is to estimate the amount of wild game and fish which were required by an average 1887 Wisconsin Chippewa household to satisfy their nutritional requirements. The estimates of amounts of game and fish required by a household may be translated into number of individual animals which contributed to the diet of each household. The calculated amount of wild game and fish required for subsistence may be used to calculate the monetary value of wild game and fish given the commercial market value of that commodity in any given year. In this way, we may have a basis upon which to evaluate the monetary contribution of wild meat and fish to the average Wisconsin Chippewa reservation household n 1887.

Methodology:

a) Population Estimates

The population structure of the nineteenth century Wisconsin Chippewa is established through census data provided by Dr. Charles E. Cleland (pers. Comm..). Two different sources are used to compile Tables 1A-1D. Census data is rarely completely accurate. Inconsistencies in such figures are common. It is, in fact, remarkable that there is little variation between he two sources used here.

In the primary source, the population is broken down by age category. This data reports the number of persons living on four Wisconsin Chippewa reservations: Red Cliff, Bad River, Lac Courte Oreilles, and Lac du Flambeau. Population statistics are broken down into the following categories: Male 18 years and older, Female 14 years and older, and children ages 6-16 years. In 1888-1890 the category of "not counted" is present; these individuals are assumed to be infants of five years or younger. Most years 1888 through 1907 are provided by this census data. No data is available for the years 1899, 1901, 1903, 1904, and 1905.

The second source presents the total population for each reservation, the number of dwellings, the number of children (no age range given) and the percentage of subsistence resources which come from hunting and gathering. The data is available for the years 1892, 1893, 1895, 1897, 1898, and 1902.

Population estimates from the first source is used as primary population data because it is critical to consider age ranges in estimating dietary requirements. Different age categories require different amounts of carious nutrients. This source is also primary because is most complete over the period of time when population data is available, ie. 1888-1907. It may be noted that, when data is available from both sources for any given year, the total population figure may vary. The total population figure from the second source is usually higher in this case; these persons are included under the column "Add" since their age range is unknown. In 1907, the number of persons in each category totaled does not account for the total population reported; in this case, the additional persons are included in the Add column. The persons included in this column are not considered in calculations of household composition. This is only one component of the total population which is not included in the calculations of household composition.

It is important to recognize that not all Wisconsin Chippewa are found within the confines of the four reservations considered here. Sporadic population figures indicate that Chippewa people were living at St. Croix, Mole Lake (Crandon), Lake Vidzid, Rice Lake, Shell Lake, and Taylor County. The data for these populations are presented in Table 2. They are not, however, included in household composition calculations because, with the exception of some early twentieth century figures from Rice Lake, the data is not broken down into age categories and household size could not be estimated.

Finally, population figures are probably underestimated in all cases. The Wisconsin Chippewa, although settled in reservation communities, frequently left the community for various hunting, fishing, and gathering purposes. The pursuit of products for sake as well as for consumption, including furs, venison, fish, maple sugar, berries, and wild rice, must be attained outside the community. At any given point in time, therefore, it may be assumed that at least some members of the community would be absent and not included in the census.

b) Household Size

The household is the corporate unit of nineteenth century Wisconsin Chippewa. It is the household, made up of the nuclear family and possibly one or two related individuals, which strategizes to gain enough food for its members.

Household size and composition is estimated by calculating the mean number of individuals in each age category for each reservation in all years reported. The mean number of swellings is also calculated for each reservation; one dwelling is considered to be equal to one household. Finally, the mean number of individuals for each age group is divided by the mean number of swellings at a particular reservation resulting in an average number of individuals in each age group for each reservation. The figures, rounded off, resulted in an average household composition of 1.5 adult males (18 years or older), 2 adult females, (14 years or older), 1 child (6-16), and one infant (less than 6 years old). A total household size of 5.5 individuals is estimated by this method. The results are summarizes in Table 3.

The population from census information of census years between 1888 and 1907 indicates a mean population of 3115 Chippewa individuals, living both on the four major reservation and elsewhere in the state (Table 1A-D; Table 2); the average household size has been calculated as 5.5 individuals. Therefore, in the late nineteenth century, an approximate figure of 566 households may be considered in future analyses.

c) Nutritional Requirements

Dietary standards are recommendations for amounts of various nutrients believed to be necessary for maintaining the health of most of a given population. The nutrient requirements of an individual may be calculated from a variety of sources. Some countries have established their own recommendations regarding daily intake of various nutrients. This study uses the recommended daily intake values established by the Food and Agriculture Organization of the World Health Organization (FAO/WHO), established by the United Nations. The United States Recommended Daily Allowances (US RDA) values are used for protein. The Recommended intake of different nutrients vary somewhat among sources; the FAO/WHO figures are usually slightly lower than those of most developed countries. Recommended nutrient intakes are based upon a normal statistical curve; most developed countries use two standard deviations above the mean to set recommended allowances; the FAO/WHO allowanve4s are estimates of actual needs, with little margin of safety (Reed 1980). Since the FAO/ WHO standards were set in 1973, several studies have indicated that the FAO/WHO recommendation for protein intake is too low (Reed 1980: 160); the US RDA is, therefore, used for protein intake in this study.

The FAO/WHO standards include a large number of nutrients and takes into consideration the age of the individual for each nutrient. Table 4 outlines the recommended daily intake of all nutrients included in the FAO/WHO standard for each of the age categories of the average Chippewa household calculated from population data. These recommended amounts are totaled to establish the amount of each nutrient required for the household. These amounts will be used to estimate the amounts of different foods required by the household to meets its nutritional needs. Certain nutrients are not included in the dietary calculations presented in Table 5 because, in tables of the nutritional contents of foods, some nutrients are not reported. This does not, however, inhibit this analysis.

Vitamins A and D are included in the FAO/WHO standard as essential nutrients to be consumed daily; these vitamins are irregularly reported in food tables. A Previous study of the sources of vitamins and minerals in the traditional Ojibwa (Chippewa) diet has demonstrated that fat-soluble vitamins (A,D, E, and K) are not limiting. This is primarily because they are stored in the body. Furthermore, the traditional diet of wild foods included sufficient amounts of the fat-soluble vitamins (Smith 1984). Traditional Chippewa consume liver, an excellent source of Vitamins A and D. Vitamin A is also high in vegetable foods cultivated in historic Chippewa gardens, especially pumpkins and to a lesser extent, corn. Vitamin D is not considered an essential nutrient for people who have sufficient exposure to sunlight; it may be safely assumed that the subject populated spent large amounts of time outdoors and would not experience any deficiency of Vitamin D. Vitamins E and K are not included in the FAO/WHO standards. Vitamin E is present in most plant sources and in the tissue of herbivorous animal tissue. The primary source of Vitamin K is the bacterial flora of the gastrointestinal tract; Vitamin K is also available from fish oils and other sources of food.

Water-soluble vitamins are usually of more immediate dietary concern. Because these vitamins are not stored in the body in any significant amounts, they are needed with more regularity than fat-soluble vitamins. Vitamin B12 and Folic Acid are included in the FAO/WHO recommended daily intake table; they are not, however, generally included in tables reporting the nutrient content of food. Vitamin B12 is not a concern in the diet of the Wisconsin Chippewa. This vitamin is available only from animal products and any dietary intake of meat, even small amounts, will satisfy the requirement for this vitamin. Interestingly, rabbit meat is high in Vitamin B12 (Lawrie 1981: 8). Folic Acid (Folacin) is a B-complex vitamin which is available in liver and leafy green vegetable; muscle meat contains small amounts of this vitamin.

The remainder of the nutrients in the FAO/WHO Recommended Daily Intake table are considered in Table 5, which reports is the amount of the nutrient available from a variety of food sources considered to be important in the diet of the nineteenth century Wisconsin Chippewa.

d) Food Sources and Dietary Components

The types of food used in nineteenth century Wisconsin Chippewa are known from ethnographic observations, archaeological research, and historic documents. The primary source for this information was recorded by Francis Densmore during her work among the Chippewa of Wisconsin, the upper peninsula of Michigan, Minnesota, and northwestern Ontario in the years of 1905 through 1925 (Densmore 1979). In Wisconsin, Densmore lived among the Chippewa of the Lac Court Oreilles Reservation. Densmore's observations, therefore, come from the specific and immediate environment of the western Lake Superior. Densmore's work is also important because it is very detailed in terms of dietary components and sources of food used at different times of the year. Furthermore, this source is critical because Densmore witnessed the diet in the historic period; this diet was a combination of predominantly traditional wild foods, with the use of some agricultural products. Maize (corn), pumpkins, and potatoes were not a significant component of the traditional diet, but mist be considered as a source of food necessitated by the sedentism which resulted from governmental policy and public pressure. The fact that Densmore worked among the western Lake Superior Chippewa in the twentieth century, more recent than the period of time of concern here, provides reinforcement to the assumption of the importance of traditional foods in the diet. It is generally assumed that the diet of native people has become increasingly influenced by Western industrial culture through time.

Densmore states that: "A typical meal comprised meat or fish, broth, rice with maple sugar, and dried berries prepared in some way" (1979: 40). It appears that while many of the foods used were only seasonally available, they were stored and used the year round. Maple sugar was made in the spring and stored. Berries were harvested throughout the summer and were dried for storage; Densmore says that berries were "used extensively" (1979: 40). Wild rice was "the staple article of food" (1979: 39) and was stored in *makuks* (birch bark containers) in large quantities after its harvest in the fall. Agricultural products, corn, pumpkins, and squash, and white potatoes, were also harvested in the fall and stored; of these, corn was the most important.

Meat was a staple in the diet. Deer was the most important source of meat. Densmore states that, generally, "A good supply of (deer) meat was usually obtained during the winter..." (1979: 43) and was often dried for later use. One of Densmore's informants told her that, in winter, a good hunter would sometimes kill two deer in a day (1979:121). The bear was a highly desired meat and all parts were eaten. Like bear, beaver meat was well likes because of its high fat content. Rabbit was eaten fresh and was also dried with meat and crushed bones combined. The historic Chippewa ate small amounts of ducks, pigeons and other wild birds as well as the meat of all trapped animals, except the marten (1979: 44). According to Densmore, all kinds of fish were eaten, although fatty fish were preferred. In addition to flesh, fish intestines and roe were consumed. Sucker heads were popular. Fish were preserved by drying, smoking, and freezing at different times of the year (1979: 43).

A limited amount of archaeological research is available to reconstruct historic Chippewa subsistence practices. Preliminary results of an archaeological survey of north central Wisconsin indicated the presence of late historic period (A.D. 1870-1900) Chippewa sites (Salzer 1974). A large, lakeshore site, the Badger site (470N20) produced shotgun rifle shells of high caliber, which suggests big-game hunting was practiced. The Strawberry Island site (N7V125), with smaller caliber shells, indicates that small game was targeted on islands in the interior region. There is evidence of the reworking of metals into a wide variety of items, including fishing spoons, suggesting that fishing was important in the interior lakes of northern Wisconsin.

Archaeological investigations were undertaken in the St. Croix area in order to locate historic Chippewa villages in that region (Birmingham 1984). At site 47Bt70, which dates to the late nineteenth century, animal bone recovered indicated the use of deer, muskrat, porcupine, mink, turtle, clam, possibly wapiti, and pike. Muskrat and deer were the most important species; muskrat spears and rifle shells were found at the site. In the lower portion of the midden dating to ca. 1880, animal bone is abundant and there is only a few fragments of tin container fragments. In the upper levels of the midden dating to the early 1900's, tin container fragments increase at the expense of animal bone. This suggests an increased reliance on pre-packaged commercial foods near the beginning of the twentieth century.

The 47BT101 site is a small settlement of six or seven houses dating to the early part of the twentieth century (1907- 1938 by land deed records). A relatively large assemblage of animal bone indicates that, while single elements of sheep/goat and domestic chicken are present, most of the animal food came from wild mammals, fish and turtle. One large mammal could be domestic cow although it could not be distinguished from wapiti. The most dominant mammalian species are white-tailed deer, snowshoe hare and muskrat with small number of porcupine, beaver, squirrels and black bear. One mallard duck and one robin bone are identified. Several fish species, including channel catfish, sturgeon, and sucker are present. A large number of turtle bones are also identified at the site. A total of 268 tin can fragments were excavated

from the site; Espson Salt, RG Baking Powder. Condensed milk, and tobacco were products identified in an analysis of the can fragments (Birmingham 1984).

Archaeological research in the Apostle islands off the Bayfield Peninsula of Wisconsin offers evidence for the historic subsistence patterns of the Chippewa people living along the shore of Lake Superior (Richner 1987). The P-Flat site (47SA47) was an important fishing locality at various times from the late seventeenth century through the late nineteenth century. The occupants are considered to have been local Chippewa fishermen who came from their habitation sites specifically to undertake intensive fall fishing for lake trout and whitefish at the spot. Burbot and lake sturgeon were also caught her in the fall. In one area of the site, spring spawning fish, sucker, sturgeon, and perch, as well as whitefish, are present; this suggests that fishing was also practiced at the site during other times of the year (Smith and Cleland 1982). The density of fish bone at the site is very high, over 100,000 elements per cubic meter is noted. It is unfortunate that no data is available from historic Chippewa habitation sites associated with the Lake Superior shoreline.

The analysis of historic and ethnohistoric documents relating to historic Chippewa hunting and fishing in Wisconsin is a further source of information regarding dietary reconstruction. Harold Hickerson (1965) and Jean Kay (1979) use documentary evidence to examine the role of hunting and fishing to historic Wisconsin Indian diet. These sources are important for providing evidence that different resources were stressed by people living along the shore of Lake Superior and people inhabiting inland Wisconsin forests.

White-tailed deer was a critical resource to populations of both the shoreline and the interior. According to the historic evidence, white-tailed deer was most important to inland dwelling Chippewa. Hickerson states that:

> ...the Chippewa peoples who migrated south from Lake Superior in the eighteenth century came to emphasize at the expense of fishing, which in the smaller interior lakes was neither as dependable nor as rewarding as at the great whitefish and sturgeon fisheries of the Great Lakes" (1965: 48).

It is not surprising that fish were the primary resource of the lakeshore Chippewa people. According to Kay:

> Great Lakes fish populations, particularly of the anadromous sturgeon and whitefish, were unimaginably abundant. Indians hunting in the low-diversity lands adjacent to the Great Lakes were primarily fishermen, who traded fish and maple sugar instead of pelts. Hunting was for them a secondary pursuit (1979: 412).

Kay further addresses the role of agriculture in the historic Wisconsin Indian diet. She states that: "Northern Wisconsin Indians raised only small quantities of corn, but sited their villages short distances from fishing grounds and wild rice beds" (1979: 412). This statement is consistent with Densmore's observations that corn and other agricultural products were a minor component of the diet and that meat, fish and wild rice were of much greater importance.

Ethnographic observations, archaeological findings, and the analysis of historic documents provide the basis for the reconstruction of the major elements of historic Wisconsin Chippewa diet. These sources provide a basis for assumptions about the priority foods in the diet. The data suggests that two mayor strategies are at work. Among the lakeshore historic Chippewa, fish and wild rice are the staple foods in the diet with lesser amounts of deer meat,

whereas among the inland historic Chippewa, deer and wild rice are the dietary staples and fish is of lesser importance. Both groups are use maple, berries, corn, pumpkins, potatoes, calculations of the relative importance of dietary components and the estimates of the amounts of food required to support the household.

e) Nutrient Composition of the Diet

The primary source for the nutritional components of the historic Chippewa diet comes from the "Handbook of the Nutritional Contents of Foods" prepared for the United States Departments of Agriculture by B.K. Watt and A.L. Merrill in 1975. this handbook outlines the content of the major nutrients of the major foods in the diet of the historic Chippewa. Table 5 is a summary of the major nutrient composition of the major foods considered in this analysis. All data is derived from Watt and Merrill (1975).

The nutrient content of major categories of food are used in the calculations in Table 6. Table 6 estimates the amount of different foods used by a typical household using daily nutrient requirements as the limiting factor. These categories are calculated to simplify the data. Venison is used fresh and dried ant eh nutritional make-up of these two forms of venison differ slightly; the average amount of the various nutrients is used in Table 6. Similarly, a variety of different berries are used by the historic Chippewa; am average figure is calculated form the nutritional make-up of blueberries, gooseberries, and cranberries. The average of small mammals is calculated from beaver, Muskrat, and hare/rabbit. Fish nutritional make0up is averaged form raw whitefish, smoked whitefish, small raw lake trout, raw sucker, and raw sturgeon (Table 5).

f) Daily Dietary Intake

The daily dietary intake of the important types of historic Wisconsin Chippewa foods is calculated in Table 6. The calculations essentially attempt to find the amounts of each food category, given assumptions regarding staples and foods of lesser importance, which would be consumed in order to satisfy the nutritional requirements of an average family of 5.5 individuals.

The historic evidence that lakeshore people stressed fish in the diet while inland people stressed white-tailed deer is taken into account in Table 6. The "Inland Chippewa", those people living at the Lac du Flambeau and Lac Courte Oreilles reservations are different form the "Lake Superior Shore Chippewa", who lived at the Red Cliff and Bad River reservations. The prioritization of fish and deer relative to geographic location of settlement and access to resources is a major assumption in the analysis.

It is assumed that a typical family of 5.5 persons would consume not more than three pounds of raw wild rice in a day because, when cooked, it increases in volume and bulk, one third of a pound of maple sugar and berries is considered a generous allowance for daily consumption they are not available in huge quantities at most times of the year. Maple sugar was used to season other foods (Densmore 1979). It is further assumed, given historic and ethnographic data, that corn, pumpkin, and potatoes are a relatively minor, but consistent, portion of the diet; two and one quarter pounds is calculated through nutritional analysis as a reasonable estimate of the daily consumption of these vegetables. According to these ethnographic and archaeological sources, small mammals are not a dominant source of meat, although they are used consistently and are considered to be a staple food. Give these assumptions and nutritional calculations, estimates of the contribution of white-tailed bee and fish are made in Table 6.

g) Dietary Equivalent of Commercial Meat

Salt pork, also called packed pork, was the most commonly used and accessible form of commercial meat in the nineteenth century. The nutritional make0up of salt pork is presented in Table 5. Salt pork is substituted for wild meat in Table 7 in order to estimate the amount of commercial meat which would have been necessary to replace the dietary contribution of wild sources of meat n the diet. The cost of replacing game and fish with salt pork for an average historic Chippewa family is compared to Brunson's estimate of one hundred dollars per year in order to independently assess the accuracy of his statement.

Result of Dietary Analysis:

a) Dietary Reconstruction- Game and Fish

The analysis of the historic Chippewa diet is concerned with the nutritional component of various food types and manipulating the various possible combinations of amounts of foods to satisfy the recommended daily intake for an average family of individuals. Several assumptions are made regarding the relative importance of wild rive, domesticated crops, maple sugar, and berries as previously discussed.

In this analysis, the major limiting nutrient was calories. The amount of white-tailed deer and fish was estimated based primarily upon the amount needed to meet the caloric requirements of the family. The results are presented in Table 6.

Caloric requirements are difficult to meet with the given sources of food primarily because there are no carbohydrates and little fat in venison. The carbohydrate content of fish is about one percent and up to two percent for fatty fish (Muller and Tobin 1980: 201). The other major staple, wild rice, is a source of carbohydrates, and important form of calories, but it is also very bulky. Maple sugar is also a good source of calories because of its high carbohydrate content; it cannot, however, be consumed in large amo8unts, due to its limited availability among other factors.

In Western Industrial diets, much of the caloric intake is satisfied by the consumption of fats. In the diet presented here, fat is not available in large amounts. Fat is, however, a desirable element in the diet. Beaver and near meat was popular among the Chippewa because of their high fat content; similarly, fatty fish were preferred (Densmore 1979). Venison is relatively low in fat content in comparison to domesticated animals toward increased fat retention (Lawrie 1981: 13-14), and 2. because domesticated their animals are fed high-energy "finishing rations" prior to slaughter which increase their fat reserves and, therefore, their taste (Speth and Speilman 1983: 7-8). A larger amount of wild meat is required because it is low in fat.

By meeting the recommended daily intake of calorie, protein, thiamin, riboflavin, niacin, and iron requirements are met by the amounts of food estimated in the dietary reconstruction. The diet is, however, by not completely satisfactory for several reasons. A potential problem with the diet is the very high protein intake; however, the consumption of wild rice, high in carbohydrates, probably ameliorated the production of a high metabolic load of urea produced with high rates of gluconeogenesis (the conversion of amino acids to glucose).

The problem of high protein intake is important in the face of an inadequate amount of dietary calcium; Table 6 indicates the diet was low in calcium. A high protein diet may increase calcium excretion (Draper 1977:31; Lutwak 1982: 278), a condition termed calciuria. Meat contains high levels of phosphorus and a high phosphorus to calcium ration may inhibit calcium

absorption (Lutwak 1982) although opinions are confliction (Linkswiler and Zemel 1979). The consumption of fish bone and the cartilaginous "soft bone" of sturgeon, as well as crushed rabbit bone, observed by Densmore, would be sources of calcium not accounted for in Table 6.

Vitamin C (ascorbic acid) recommended levels are not met in the diet reconstructed in Table 6. The requirement for Vitamin C was probably met, however, when the issue is considered in more detail. Vitamin V content of edible vegetation increase from south to north and, therefore, the meat of northern game animals is higher in Vitamin C than southern commercial meats (Berkes and Farkas 1978: 168). Organ meat, such liver, offals, lymph, glands, testicles, and the adrenal gland are good sources of Vitamin C (Berkes and Farkas 1978, Farmer, Ho, and Nielson 1971; Muller and Tobin 1980). Berkes and Farkas (1978: Table IV: 168) estimate that wild ungulate organ meat may provide as much as 54 mg. Of Vitamin C per 100 grams(245.5 mg./pound) and that lake trout liver is also notably high in Vitamin C (15mg./100g; 68.2mg/pound). Densmore (1979) reports that all parts of the animal were eaten by the historic Chippewa.

The historic Wisconsin Chippewa had non-meat sources of Vitamin C. According to Densmore (1979: 39):

> The Chippewa did not habitually drink the water that they encountered when traveling but boiled it and added leaves or twigs. This decoction was drunk either hot or cold. Among the materials used in this manner were the leaves of wintergreen, raspberry, spruce, snowberry, and the twigs of wild cherry.

Berkes and Farkas (1978) report a similar use of wild plants in tea and many of the leaves used by the Cree are reported to be relatively high in Vitamin C. Berkes and Farkas further stat that:

> ...steeping in vegetation for tea, placing the vegetation in boiling water and removing it from the heat, will maximize the amount of Vitamin C. The longer the steeping time, the more ascorbic acid in the tea (1978: 168).

It may be concluded that the nutrient components of the major and minor categories of foods provided a diet adequate to satisfy the recommended daily dietary requirements in the amounts indicated in Table 6.

b) Dietary Reconstruction- Salt Pork

It is difficult to assess the applicability of the nutritional components of salt port as they are presented in Table 5. Watt and Merrill (1975) report the nutritional composition of salt port as it would be purchased in the latter half of the twentieth century. There is no information on the nutritional composition of nineteenth century salt pork. In the nineteenth century, salt pork contained meat, fat, and bone; feet and organ meat were not included. Good quality pork was generally reserved for fresh meat and lesser quality hogs were used in salt pork. Three grades of salt pork were available for purchase, and considerable variation existed in terms of the quality of the product within each grade as well as between grades. Clear pork was top grade, mess pork was of middle quality and was the most commonly purchased type, while prime pork was the lowest grade used by slaves and other lower economic groups. Salt pork was purchased in barrels which contained two hundred pounds of butchered pork (Hattori and Kosta 1990:85-6). The

nutritional make-up of salt pork as reported in Watt and Merrill (1975) is probably far superior to the nutritional composition of even clear grade pork of the late nineteenth century.

When the nutritional values of salt pork are substitute for all sources of game and fish, it is calculated that an average historic Wisconsin Chippewa family would require three pounds daily to satisfy the recommended daily allowances for most nutrients (Table 7). This figure may be low due to the problems of using modern nutritional values and the variation in the quality of the product in the nineteenth century.

Salt port has a high caloric value because it is high in fat. Each pound of salt pork has a fat value of 370 grams, much higher than lean venison (18 grams/pound) or even beaver (62.3 grams/pound) (Watt and Merrill 1975). Salt pork is lower in protein than wild meat and fish sources. In calculating the daily intake of salt pork, protein and iron are limiting nutrients. In this diet, most of the protein comes from wild rice (73%). Rice and corn are incomplete proteins and are deficient in the amino acid lycine (Reed 1980: 165). The complete protein, salt pork, must be adequately available to supplement these incomplete protein sources in order to satisfy all essential amino acid requirements. A 33.3 gram margin of safety is, therefore, included in the protein component of diet in order to ensure adequate intake. The recommended intake of iron is satisfied by the consumption of three pounds of salt pork per family per day.

In this diet, the recommended intake of Vitamin C is not met; the use of would have been added by the consumption of teas from wild plants. The important source of Vitamin C through the consumption of organ meats would not, however, be available through the substitution of salt pork for wild meat and fish in the diet. Calcium intake is extremely low in the salt pork diet. The potential sources of supplementary calcium, such as fish and rabbit bone, would not be present in the diet outline in Table 7.

Economic Implications of the Diet

a) Game and Fish Diet

Based upon the dietary calculations presented in Table 6, each historic Wisconsin Chippewa family living at the Lac du Flambeau and Lac Courte Oreilles reservations would require approximately 1825 pounds of deer meat yearly. Given that a single white-tailed deer would provide approximately 100 pounds of meat, each family would need to acquire about 18 adult deer each year, or 1.5 deer each month. Two or three fish daily would be sufficient to ensure the consumption of 2 ½ pounds of meat from small mammals suggested in Table 6.

The Chippewa of the Bad River and Red Cliff reservations along the shore of Lake Superior would require approximately 1734 pounds of fish yearly for each family, or about 144.5 pounds per month. Gill net fishing at the P-Flat site, with a four inch mesh, resulted in a catch of whitefish of approximately 420 mm total length (Smith and Cleland 1987), or about 6.3 pounds per individual (Scott and Crossman 1979: 224). To satisfy monthly requirements, 23 lake trout or about 100 whitefish would have to be coaght by each family. Given the historic references to the huge catches of whitefish and lake trout during their fall spawn with gill net technology, such a catch would not be difficult to achieve (Cleland 1987). At the nearby Fond du Lac reservation in Minnesota in the late 1830's, missionary Edmund Ely reports that, in one evening, up to 78 whitefish were scooped from the St. Louis River rapids (Kaups 1984: 73).

Other fish, such as sturgeon (which weighted up to 100 pounds in the nineteenth century), suckers, and walleye would be available to the people of Bad River and Red Cliff through much of the year. Edmund Ely reported from Fond du Lac in May of 1836 that:

> Last week was mostly occupied in fishing- We packed a little over 1 Bbl (over 200 pounds of dressed fish) and dried about 300 pike (walleye) - These were taken in the Rapids with a Scoop-Net. IN about 2 hours from 100 to 200 were taken (Kaups 1984: 73).

While all localities may not have been as productive as the rapids of the St. Louis River, it is clear that, as Kay states, "Great Lakes fish populations, particularly of the anadromous sturgeon and whitefish, were unimaginably abundant" (1979: 412).

In addition to the meat from small mammals taken by trapping, it is estimated that a Great Lakes shoreline Chippewa family would have used approximately 365 pound of deer meat each year (Table 6). Therefore, only about four deer each year would be required by each family.

b) Salt Pork diet

The cost of salt pork to replace traditional sources of wild meat and fish is estimated on the basis of a three pound per day per family consumption rate. In the nineteenth century, salt pork was purchased in barrels, which contained 200 pounds of the product. A typical family would have required 1,095 pounds of salt pork yearly to satisfy dietary requirements. It is estimated that the family would purchase six barrels each year.

The nutritional component of salt pork used in this analysis would be best related to the top grade of nineteenth century salt pork, that is , clear pork. Prices of salt pork varied. In San Fransico in 1851, clear pork sold for $18.00 per barrel (Hattori and Kosta 1990: 86). Six barrels would cost $108.00 per year. It is likely that a higher price was charged to people living in remote areas, where the cost of shipping was high and price competition was low or non-existent. It is not unreasonable to suggest that Wisconsin Chippewa paid about $20.00 per barrel in the early 1850's. it is estimated that to replace wild meat and fish in the diet of an average nineteenth century Wisconsin Chippewa family, a yearly expenditure of $120.00 would required to support the dietary needs of its members.

Conclusions:

This analysis of the diet of the nineteenth century Wisconsin Chippewa results in an estimate of the amounts of various kinds of foods which, in combination, satisfy the recommended nutrient intake level for an average family. Two different kinds of diets have been reconstructed. First, a diet estimated which relies upon game and fish; these foods are considered in different proportions depending upon geographic proximity to the Lake Superior fishery. A second diet which relies on salt pork is also calculated.

The substitution of salt pork for game and fish allow us to assess the accuracy of Brunson's estimate of the cost of commercial meat to the Wisconsin Chippewa in the middle of the nineteenth century. This analysis suggests that Brunson's figure is quiet accurate; a calculated $120./family of 5.5 individuals/year ($22/individual/year) is considered equivalent to Brunson's $100/family of 4 individual/year ($25/individual/year).

The Wisconsin Chippewa of 1887 did not, however, rely solely either on game and fish or on commercial meat. It is clear from the ethnographic and archaeological evidence that commercial meat was not used to any great extent in the late nineteenth or early twentieth centuries. The ethnographic work of Densmore strongly indicated the reliance on game and fish to the early twentieth century Chippewa of the western Great Lakes. Densmore did not record any instances of the use of commercial meat among these people. The archaeological evidence from late nineteenth century Chippewa villages at St. Croix indicate that wild meat and fish dominated the inland economy. Only such commercial products as baking soda, salt, and condensed milk were found in the village refuse areas and few bones of domesticated animals were identified (Birmingham 1984). It is notable that no domestic pig bone, which would indicate the possible use of salt pork, was present in any of the sites.

The value of game and fish in the 1887 Wisconsin Chippewa diet would be best understood by calculating the commercial market value of venison and fish in that year. The data generated in this analysis estimates the amount of these products which would be required for dietary purposes. The population from census information of various years between 1888 and 1907 indicates that approximately 566 households may be considered in future analyses. The 1887 market value of venison and fish, given the estimated number of pounds required each year by each of the 566 households, will be an excellent approximation of the "cost" of dietary wild meat and fish to the average Wisconsin Chippewa household in 1887.

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