Mânomin (Cree)

Ghínázë (Dëne)

Wild Rice

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A unit in the series:

Rekindling Traditions:
Cross-Cultural Science and Technology Units

Series Editor

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CURRICULUM CONNECTION

Grades 8-11:
habitat, ecosystems, plants, water quality, sustainable development, structure & design, and nutrition

OVERVIEW

The local wild rice industry is used to promote respect for Aboriginal knowledge and to teach ideas from ecology and biology, so students will become informed about an important northern industry. Students apply their knowledge first hand during site visits to a wild rice stand and to a processing plant. The nutritional value of wild rice is learned when eating dishes students prepare. Duration: 2 weeks of classes, plus 3 field trips (trial planting nearby, visit to wild rice stand and processing plant).

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TABLE OF CONTENTS

PURPOSE

This unit is designed to enrich students' understanding and appreciation of Aboriginal science and technology, and to encourage students to continue their studies in school science in the future. Knowledge (past and present) of growing, harvesting, and processing of wild rice forms a bridge between Aboriginal and Western views of nature. The unit makes a connection between everyday life in a northern Saskatchewan community and ecology and biology content in the school curriculum. At the same time, technological literacy is given special emphasis. The unit should demonstrate to students that they can achieve at Western science without setting aside their Aboriginal values and knowledge.

GOALS

1. To bring in a local wild rice harvester to focus students' attention on wild rice.
2. To systematically present the wild rice industry in a way that makes students feel it is part of their community, and in a way that makes them feel confident about knowing some of its science and technology.
3. To develop an interest in wild rice as a healthy food.
4. To involve Elders and the community people as a valid resource of knowledge.
5. To involve students in the planting of wild rice.
6. To introduce ecology or biology content expected for the class.
7. To get students to interact with their environment and their community.
8. To introduce students to career possibilities related to science and engineering.
9. To analyse water samples.
10. To acquaint students with the industry's need to be inventive with its harvesting technology.
11. To acquaint students with the technology and business end of wild rice production.
12. To develop language skills by making connections between a student's first and second language by using known events to which the two languages refer.
13. To have fun eating some of the recipes for cooking wild rice.

OBJECTIVES

1. Students will be able to properly sequence the 9 stages in the life cycle of wild rice.
2. Students will remember some of the details related to: a productive habitat, harvesting, processing, and food value.
3. Students will become aware of the fact that the Saskatchewan wild rice industry is "organic farming" and follows the principle of "sustainable development."
4. Students will develop greater respect for Elders or other knowledgeable community members who have handed down information to them.
5. Students will accurately use both common-sense terms and appropriate scientific terms, depending on the context they are in.
6. Student will respect the environment by not causing any damage.
7. Students will estimate how many seeds are in a kilogram of seeds, and calculate how many bags of seed to buy for a particular stand of wild rice.
8. Students will be able to write accurate and fairly detailed stories about what happens to the harvested wild rice grains between leaving the stand, and being sent to the packagers for distribution around the world.
9. Students will be able to repeat the dietary advantages of wild rice.

BACKGROUND INFORMATION

processed wild rice grains
(photo by Dark Horse Studio)

Wild rice seeds were imported into Saskatchewan in the 1930's to provide food for ducks and muskrats. The purpose was to increase the population of ducks and muskrats to improve hunting, trapping, and tourism, which certainly helped some local economies in the north. Today Saskatchewan is Canada's major producer of *naturally grown* wild rice. Each year's yield brings in about one million kilograms. This is relatively small compared to the cultivated growing conditions of wild rice paddies in Minnesota and California where about seven million kilograms are produced by each state. However, Saskatchewan's naturally grown (organic) wild rice has a higher quality, and therefore it enjoys higher status and higher prices internationally.

Long before Europeans came onto First Nations lands, Aboriginal peoples harvested and processed wild rice in what is now the southern parts of Québec, Ontario, and Manitoba, and the eastern half of the United States. Wild rice was particularly plentiful in a region Europeans called "the wild rice bowl" (what is now Minnesota, Wisconsin, and Canadian land just north, in Ontario and Manitoba). At the time of contact, the First Nations peoples who inhabited the wild rice bowl belonged to the Algonquian and Siouan language groups. Pre-contact history involved inter-tribal clashes over who had jurisdiction over certain wild rice areas. Crop failures were known to have had devastating effects on the welfare of tribes (Schultz, 1979). Of the many First Nations who relied on wild rice, the Ojibwa nation was the largest producer at the time of contact. Ojibwa people called this grain cereal "mano'min," a word now borrowed by some Cree communities in northern Saskatchewan who call wild rice "mânomin." (The word has also been spelled manowin, mahnowen.)

In Pinehouse Lake, Saskatchewan, people consider a wild rice stand to be their garden. Consequently some Elders in Pinehouse use the Cree word "Kistigân" (garden) to refer to wild rice. Elsewhere in Saskatchewan, wild rice is usually known as "mânomin" in the Cree language. We use the term *mânomin* throughout this unit. You are encouraged to accumulate other indigenous words and expressions to incorporate into your lessons and assessments, learning them yourself as you go along. The validity of the community's Aboriginal knowledge and your students' cultural identities are enhanced by the non-trivial use of appropriate language.

History

Pinehouse Lake

It was in 1899 that the first European missionary visited Pinehouse Lake, then called Snake Lake. At that time the community's inhabitants were mostly Chipweyan. Unfortunately, a smallpox epidemic occurred during the late 1800's. This decimated most of the population and scattered many of the survivors to other adjacent communities such as La Ronge, Beauval, Île-à-la-Crosse, etc.

In 1935, the arrival of Tom Natomagan, a Métis, was followed by many other Métis, Cree, French, and German people. They settled in areas surrounding Pinehouse Lake, such as Bar Lake, Southend, Souris River and Sandfly Lake. Pinehouse Lake became predominantly a Cree community that speaks the Y dialect. Because of its location on the Churchill River system, Pinehouse Lake became a major trading post and service centre during the fur trade era. The people lived a traditional lifestyle, hunting, fishing, trapping, and gathering edible berries and plants, including the harvest of wild rice. Realizing that the name Snake Lake was keeping away many potential buyers, traders, and sports enthusiasts from the south, the people renamed the lake “Pinehouse Lake.”

The traditional lifestyle at the time encouraged individuals to approach life and living from a holistic understanding of their environment. People envisioned themselves as a part of, not separate from, other life forms in their environment. Their needs for food, shelter, clothing, good health, and good social relationships, were based on cultural spiritual values and the belief that each value was part of their lifestyle. Trapping, hunting, and gathering were pursued to meet physical, emotional, mental, and spiritual needs, all of which resulted in access to food, shelter, and clothing.

The community as well was seen as a holistic entity. It was not traditionally divided up into little organizational compartments where each part competed for attention, but instead, it was obvious how each of the parts fit together to make a community. In the past, Aboriginal communities had not distinguished between community needs and the needs of its members. The two were not separate. They were part of the whole life style of the people. The purpose of the community was to show love, to care, to share, to support, and to provide healthy outlets for the social and creative needs of the people.

In 1939, the people of the region decided to get together to form a village. The construction of a church in 1944 and a school in 1948 brought the people from their outlying cabins into close proximity of the church and school. The children who were once taken by missionaries to Beauval or Île-à-la-Crosse at the age of six, were now able to stay with their families to pursue their education in their newly formed village. Until 1961, the main source of transportation was dog sled or horseback. It was also during the 1960's that housing development began with prefabricated units being constructed in the proximity of the church and school.

Today, the village of Pinehouse has a population of approximately 1000. A Coop store, constructed in 1954, provides food, clothing, hardware and some household goods and furniture for the local inhabitants. A radio station, wholly operated by local people, attends to social and creative needs of the people. There is a health clinic with local personnel to provide some medical support, as well as “fly-in” doctors to provide medical expertise. The school houses 400 students (K-12), 23 teachers, and approximately 12 support staff. Many of the local inhabitants still pursue vocations or leisure activities related to, for example, hunting, fishing, trapping, berry picking, and wild rice harvesting, in much the same way as people did earlier in the 20th century. Those who have chosen other careers are employed in the mining, forestry, and construction industries. With the expansion of the grade 12 program five years ago, more employment opportunities have opened doors to students choosing to pursue post-secondary education in fields such as dental therapy, computer programming, trades, forestry management, education, business management, and social work.

While the community has managed to maintain its Aboriginal language and traditional dance, very few members of the present generation have maintained the more traditional lifestyle. The traditional ideology of Pinehouse has been transformed by the road (to Key Lake Mine), by television, by government programs and services, by independent housing programs, and by the church.

Pinehouse takes great pride in speaking and maintaining its language, Cree (Y dialect). The people know that the language houses their stories, their humour, their value system, and their sense of identity as a community. Many families return to their cabins during the summer months to teach their children the knowledge and information that has been passed on from generation to generation, particularly how to live independently from others but in harmony with Mother Earth. Although all cultures change as the community evolves, one must keep those traditions and values that give identity to the group. When the school curriculum acknowledges and reflects the community's knowledge base, language, and value system, teachers can achieve relevance for students and instil self-esteem and a sense of pride in their culture and community.

While the modern generation is less and less dependent upon hunting, gathering, and harvesting as a way of living, there is still the need to be part of the environment. There is still that tie to the community, to family, to one's traditional language, to customs, and to traditions that make Pinehouse Lake home for the offspring the founders of Snake Lake.

Mânomin in Saskatchewan

Because wild rice was first imported into Saskatchewan by people (rather than by nature), there are interesting stories around how and why this happened. Most of the people who were directly involved (e.g. John Stonhocker, and Conservation Officer Irving) have passed away. The following history was put together from the clear recollections of Kaz Parada of La Ronge, who was a commercial prospector in northern Saskatchewan in the mid 1900's. Kaz changed his vocation in 1967 when he took over La Ronge Industries. At the time, La Ronge Industries was a 3-year old business that specialized in wood working, with wild rice as a sideline (at Little Potato Lake initially). The wild rice part of the industry grew and expanded steadily through the years under Kaz's management. He retired in 1993.

At the end of Kaz's first year with La Ronge Industries, 4,000 lbs of wild rice was harvested in the Potato Lake region and sent to Manitoba for processing. In those days, no harvesting machinery was allowed on the lakes (a government regulation for commercial wild rice, a regulation that wouldn't change until 1979). Consequently Kaz learned the Aboriginal canoe method from his mentor John Stonhocker. The canoe method went like this: the person at the front of the canoe would pull the canoe through the wild rice, while the person at the back would use two wooden sticks to bend the plants into the canoe and shake the top part of the plant (its panicles). The ripe grain would drop onto the floor of the canoe. Kaz remembers harvesting 6 bags a day by working 8 hours before exhaustion set in. (Today with air boats, 6 bags are harvested in 15 minutes!) The canoe method continues to be used today by some First Nations in Minnesota who market their product as not only organically grown, but as hand picked.

In Kaz's early days (the 1960's), the wild rice industry was an employment creation program initiated by the provincial government. Thus there was pressure to expand to other lakes besides Potato Lake, in order to create more jobs. By 1969, Kaz's wild rice stands were found in Pinehouse Lake and as far as Île-à-la-Crosse.

Kaz recalls Stonhacker's story about job creation being the reason wild rice was first brought into Saskatchewan by conservation officer Irving in the early 1930's. The region needed to attract hunters for its tourism industry. Because the water level in the north was low at that time (making it amenable for wild rice), and because the population of wild ducks depended on the food available to them, people thought that wild rice would attract ducks, which in turn would augment tourism and thus create jobs.

As time went on, the industry expanded to more lakes. There was a growth rate of about 10% per year. For instance at Pinehouse Lake, Jerry Tinker leased a wild rice stand from La Ronge Industries in 1969.

By the end of the 1970's with the advent of airboats for harvesting, the wild rice yield was up to 300,000 lbs for Saskatchewan. Kaz was there when the regulations on mechanized harvesting were lifted, and he became involved in modifying airboats from Ontario and US to meet the conditions of northern Saskatchewan. This research and development was aided by Bill Reid's work at the College of Engineering, University of Saskatchewan. During the 1980's, people from all over the world came to La Ronge Industries to find out the latest achievements in airboat design. This immeasurably helped the Canadian industry in the manufacture of airboats. It also inspired people to grow wild rice crops in the western side of northern Saskatchewan, for instance, regions around Beauval and La Loche.

Not only did Kaz need to be creative with designing airboats, he also needed to be vigilant about international market conditions and the competition from the US industry. As a consequence, he helped to establish the International Wild Rice Association (in 1980) which led to co-operation in marketing, and thus an increase in markets all over the world for all players in the industry in North America.

Kas has observed that over the years as the wild rice industry expanded into the north country, traditional fishing, hunting, and trapping practices have decreased, along with the family outings that traditionally accompanied those activities. The technology of wild rice harvesting today does not encourage the traditional family outings that occurred seasonally in the past. These outings brought family members closer together. The modern wild rice industry poses an additional challenge to families: the wages earned during the short harvesting season (August and September) are not easily saved so that the money can be spent during the whole year.

Habitat of Mânomin

The conditions for growing mânomin in Saskatchewan are as complex as the balance of nature itself. Mânomin is particularly sensitive to a whole cluster of environmental conditions. Generally speaking, mânomin needs: (1) slow-moving rivers or shallow lakes that have water moving in and out; (2) climatic conditions (not too severe) that allow for a sufficient growing period of just over three months (100 days); (3) sufficient oxygen in the sediments where roots can take hold (stagnant ponds or sloughs don't work); (4) clear water to allow sun light to pass through to the seedlings; (5) water that has low salt content, water that is neutral (or slightly basic) in pH (its acidity concentration), and water that has no pollutants; (6) protection from wind and waves; and (7) few competing plants (such as perennial weeds). Different conditions become more important than others during different parts of the growing cycle of mânomin (see the life cycle information below). For example, different depths of water will affect the growth of mânomin, as shown in Figure 1 (taken from page A17; i.e. page 17 in Appendix A). For more details on habitat, refer to pages A16-A32.

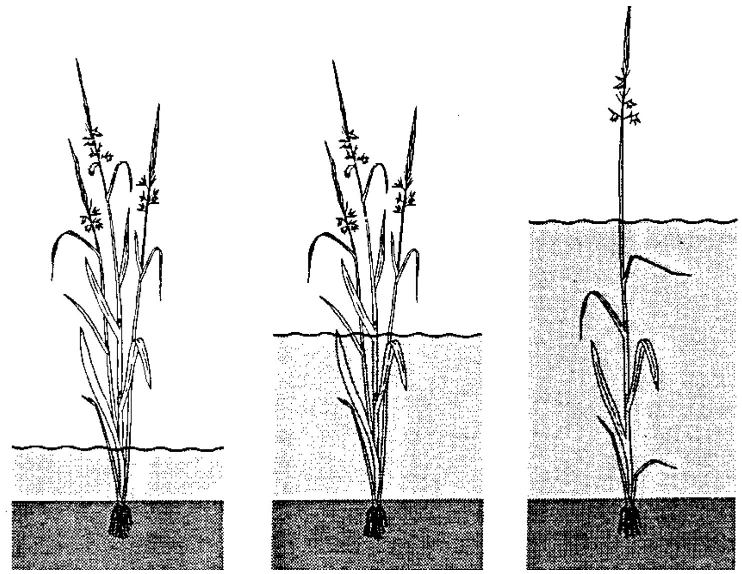


Figure 1. Mânomin growing in different water depths

Students in grades 11 and 12 may be interested in how some of these characteristics are assessed. For instance, the amount of salt content in the water can be estimated by measuring how well the water conducts electricity. The more salts dissolved, the more the water conducts electricity. There are gadgets to measure this conductivity. The concentration of acid in the water is measured by pH paper or by a gadget that indicates the water's pH level. The amount of oxygen available in the sediment can be estimated by measuring a chemical property of the substances that make up the sediment (an "Eh" reading, in millivolts). The chemical theory of oxidation/reduction explains all of this.

Due to mânomin's specific environmental needs, its preferred habitat will be populated by other plants whose presence signals good growing conditions. These plants include: yellow water lilies, water milfoil, and certain pond weeds. Thus, the habitat of mânomin demonstrates a balanced ecological system.

Characteristics of Mânomin

In General

Mânomin is an annual plant (cereal grain) that must develop from seed each year. Both the old and present-day technologies of harvesting mânomin cause seeds to drop back into the water for next year's crop. One of its peculiar characteristics is its germination process. Development of the seed (**germination**) is triggered by three to four months of freezing (or almost 0 °C temperatures). The seeds will not germinate if kept at warmer temperatures.

In the Culture of Western Science and Technology

Common white rice originally from Asia is called *Oryza sativa*. It is only distantly related to mânomin – both are members of the grass family, according to scientists.

The species of mânomin that grows in Saskatchewan is called ***Zizania palustris*** (one of four species/varieties found in North America; p. A6). Its hollow cylindrical stem and long narrow leaves resemble those of wheat, oats, and barley (all originally from Asia and all members of the grass family, by the way). A species of mânomin endemic to Asia, *Zizania latifolia*, is a perennial, and the roots are often eaten as a vegetable. Although *Zizania palustris* grows in Saskatchewan's boreal forest now, it is not native to this region. Therefore, you'll not find it listed in *Plants of the Western Boreal Forest and Aspen Parkland*.

Figure 2 shows a drawing of *Zizania palustris*. It has 3 **panicles** (flower heads). Each panicle has both a **female floret** and **male floret** (see pages A5 and A13 for details). (Corn, another member of the grass family, has the male and female florets reversed.) The *Zizania palustris* florets grow out of the end of the main **stem** or out of the end of a branched stem called a **tiller**. The better the growing conditions, the more tillers are produced (see Figure 1, from p. A17). Reproduction (**pollination**) occurs between the female floret of one plant and the male floret of *another* plant. Here's the Western science explanation for how it happens (pp. A13-A15). In July the flowers mature on the plant from the top down. Thus the female floret matures before the male floret *on the same stem or tiller*. This usually prevents **self-pollination** from occurring. The wind blows some of the pollen from a mature male floret on one plant to a female floret on another plant. This process of **cross-pollination** results in a healthier gene pool.

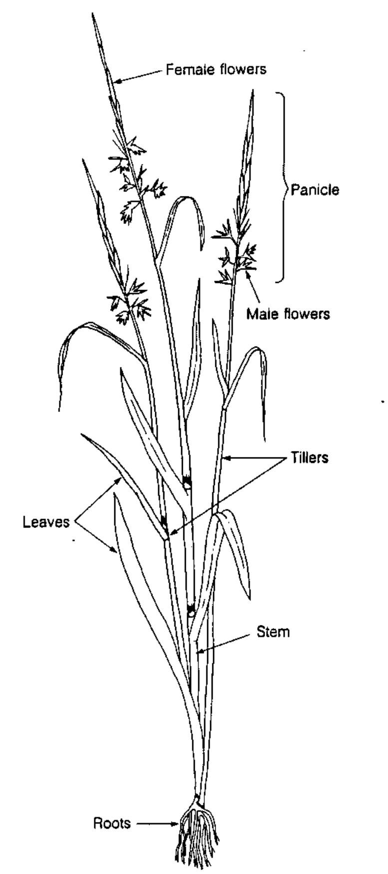


Figure 2. *Zizania palustris*

Life Cycle and Habitat

The life cycle of mânomin can be described scientifically as going through 9 stages (described on p. A15): germination, floating leaf, aerial leaf, tillering, early flowering, pollination, grain formation, maturity, and seeding. These 9 stages are summarized here (see pages A17-A29 for more details). Environmental conditions can adversely affect the plant differently at each stage of its development. These habitat characteristics are also mentioned for each stage.

1. **Germination** stage. Germination occurs only after several months of cold temperatures (below 5 °C), most often in mid-May. When germination begins, it takes place very rapidly. Over the first 3 or 4 weeks, leaves sprout from the seed upward toward the water surface, as the roots anchor the plant into the sediment below.

The plant is completely under water during this time and is vulnerable to the availability of sunlight getting through to it. Thus, water clarity is important. As well there should be few plants (weeds) growing and little accumulated straw sitting around on the sediment, both of which will block out the sunlight. An absence of surface algae or scum is good. The sediment should have sufficient oxygen in it to promote root growth. The most important feature of the habitat at this stage, however, is the water depth – it cannot be too deep (not over 1.8 m). A depth of about 1 m is ideal, though the water level could be as low as 60 cm.

Whatever the depth is, it should remain fairly consistent, not varying more than 90 cm throughout the growing season. A gradual drop of water level during the whole summer is normal and does not affect the crop, as long as the drop is not more than about 90 cm.

Water circulation is an important habitat feature. Mânomin grows well in lakes and streams where there is some water movement. In northern lakes, natural water circulation occurs in the spring and fall. Oxygenated surface water and nutrients are carried below and enrich the sediment. Water circulation also carries away dead plants. This prevents the accumulation of straw from last year's crop. If the water moves *too quickly*, the sediment is washed away and the roots don't get a strong hold at the bottom of the lake or river.

2. **Floating leaf** stage. Finally, long, thin leaves reach the surface of the water, lie flat, and collect sunlight. The stem and other leaves continue to grow under the water. The plant is vulnerable to strong winds and waves at this point, so it should be grown in a sheltered area, such as bay. Also, a sudden rise or fall in water level of 15 cm (6 inches) can damage the young plants.

3. **Aerial leaf** stage. By the end of June, the stem and leaves begin to be seen sticking above the surface. They continue to develop during the aerial leaf stage.

4. **Tillering** stage. Additional branched stems (tillers) often form over the next 3 weeks. The more shallow the water, the more tillers produced (see Figure 1). The more weeds present, the less tillers produced.

5. **Early flowering** stage. Within a week (mid-July) the female and male florets emerge on the panicle. This is the time when the florets develop, the female slightly ahead of the male; the higher ones sooner than the lower one on the stem or on the tillers.

6. **Pollination** stage. By the end of July, pollination begins and continues for about 1 week. Successful pollination leads to the development of the plant's grain. (Described above in the section "In the Culture of Western Science and Technology."

7. **Grain formation** becomes evident in early August but takes about 4 to 6 weeks before the grain ripens.

8. At the stage of **maturity** harvesting can begin, usually at the end of August when the kernels at the *top* of the panicle are dark brown or black and fall off easily. These grain seeds are now mature. These are harvested quickly because they easily fall into the water for next season's crop, instead of into a harvester and off to market to be sold. A "wild rice harvester," as some mânomin agriculture workers call themselves, drives a harvester (usually an air boat; see pp. A47-A50) through a crop about once a week collecting the grain as it matures down the plant. Harvesting continues for about

2 to 4 weeks, up until a bad frost damages the remaining crop. Highly skilled, precision piloting must occur; for example, you have to maintain a straight line with little overlap between sequential passes over the crop (in spite of cross winds) and all this at a constant speed between 18-21 kph, no more no less (a difficult enough task driving a car with a speedometer!!). Pages A54-A57 provide more details.

If there are strong winds at the maturity stage, the ripe grain will shatter and will become seeds for next year's crop.

9. The last stage, **seeding**, happens naturally in the fall during harvesting (see pp. A36-A40). Also more seeding can occur just before freeze-up. This timing cuts down on the loss of seeds to migrating water birds. The seeds winter over in the mud. Spring seeding should start as soon as the lakes or rivers open and before the seeds begin to sprout. Spring seeding has the advantage of the seeds not being too implanted in the mud or being carried away by currents, but has the disadvantage of risking inclement weather and early development of the seed. Fall seeding is usually preferred by wild rice harvesters. Although seeding was traditionally done by hand, today a number of different mechanical devices have been invented.

Resources

Books:

Archibold, O.W. (Ed.). (1995). *Wild Rice in Saskatchewan: Agricultural Development in Harmony with Nature: A Reference Manual*. La Ronge, Saskatchewan: Saskatchewan Education, Northern Education Services Branch. ISBN 0-921291-13-2. This publication is **Appendix A** in this unit.

Johnson, D., Kershaw, L. MacKinnon A. and Pojar, J. (eds.). (1995) *Plants of the Western Boreal Forest and Aspen Parkland*. Edmonton, AB. (206, 10426-81 Ave.): Lone Pine Publishing. (ISBN 1-55105-068-7). This publication is a useful reference for the plants that compete with wild rice in its niche. Interestingly, for historical reasons, *Zizania palustris* is not an entry in the book.

Schultz, B. (1979). *The Wild Ricer's Guide*. (Out of print but in some libraries.) It has interesting information from a United States' perspective, particularly Aboriginal history and technology.

Internet sites (information):

http://www.agr.gov.sk.ca/crops/special/variety_options/Wrprod.asp
Wild Rice Production in Saskatchewan. Predates Archibold's "Wild Rice in Saskatchewan." Excellent site and photos. Last Update: April 1985.

http://www.agr.gov.sk.ca/crops/special/production_inf/Hvwrc.asp
Wild Rice Harvesting in Northern Saskatchewan**.** Connects with Archibold's "Wild Rice in Saskatchewan." Last Update: March 1989.

http://www.agric.gov.ab.ca/food/nutrit/grain03.html
Describes Alberta's wild rice industry that began in 1981. Topics include: how wild rice grows, harvesting, nutrition, and wild rice at the table.

http://www.barronspecialties.com/recipes.html
Has cooking recipes for wild rice dishes.
http://aquat1.ifas.ufl.edu/zizaqua.html
A scientific site about wild rice that grows in Florida.

Internet sites (commercial):

http://www.abc.gc.ca/expanding/english/grey_owl.html
Grey Owl Marketing Ltd., headquartered in Prince Albert, is owned by 72 Saskatchewan Indian Bands. It is a company built on co-operation. Incorporated in 1984, Grey Owl initially focussed on marketing Saskatchewan Lake wild rice. The Indian bands control the majority of the wild rice harvesting operations. They own 75% of the wild rice processing plant in La Ronge, and 100% of Grey Owl Marketing.
http://www.christmaspoint.com/
Christmas Point Wild Rice Company
Offering a variety of wild rice products growing wild in Northern Minnesota.
http://www.mnwildrice.com/
Minnesota Wild Rice from C & G Enterprises.

ACKNOWLEDGEMENT

Much of the historical information in the *Wild Rice* unit was the result of interviews with local people. The information was gathered for a class project by the 1997/98 grade 12 English class. “Thanks, students.” Thanks also to Yvonne Maurice, our community Elder, and to Rose Smith for taking the time to read and make suggestions. As well, Gordon Healey, your knowledge of the history of Pinehouse was a welcome asset to the project. Thanks to Kaz Parada, La Ronge, for sharing his first-hand knowledge of wild rice in Saskatchewan.

The photograph of processed wild rice in a person’s hands was loaned to the project courtesy of Northern Lights Wild Rice, La Ronge; photo by Dark Horse Studio, Saskatoon.

Last but not least, thank you Glen Aikenhead for initiating and believing in this project and for making it happen. It is a model for all disciplines for the inclusion of community-based knowledge in the school curriculum. It is a model that bridges languages, cultures, and knowledge, by taking the learner from the known to the unknown. I am deeply indebted to you for all you have taught me about teaching and about learning.

Lesson 1: *A Wild Rice Harvester*

The old canoe method of harvesting

Timing
1 class. Just before or during harvesting (late August to early October), or just before spring seeding.

Goals
1. To introduce the unit by bringing in a local harvester to focus students' attention on mânomin.
2. To give validity to local knowledge.
3. To provide information and a point of view to draw upon for Lesson 2.

Objectives
1. Students will pick up various bits of information about mânomin.
2. Most students will be motivated to learn about the industry.
3. (Optional) Students will use the old method to process the harvested mânomin into edible mânomin grains.

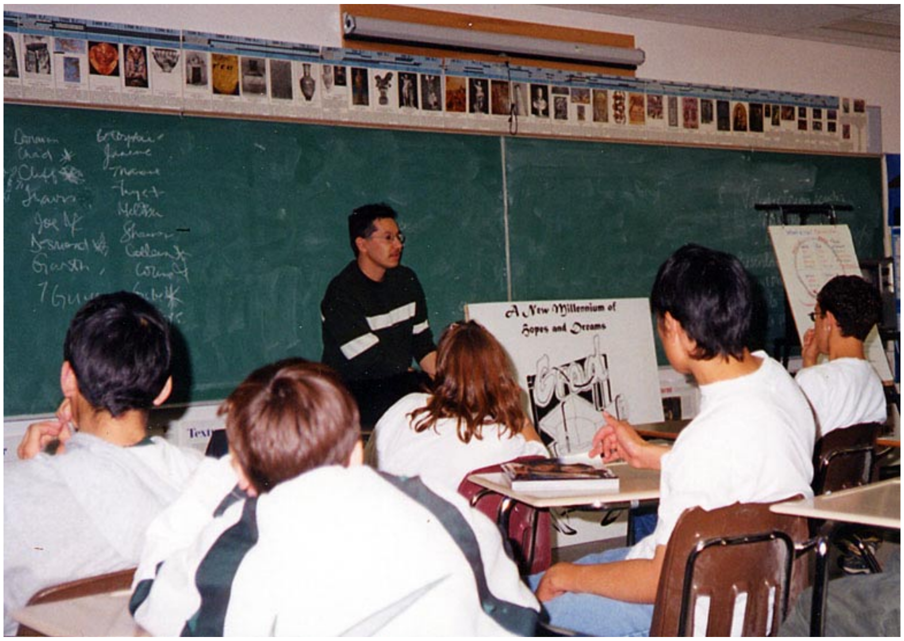
Value to be Conveyed
the community's knowledge can be very useful and important

Instructional Strategies
direct

Lesson Outline
1. Introduce the speaker. (A student may be the best one to do it.)
2. Clarify your expectations (e.g. students will use the speaker's information in future classes).
3. A student will thank the speaker, presenting an appropriate gift.
4. (Optional) As a demonstration or a group activity, process some freshly harvested mânomin into ready-to-cook grains, using a simulation of the old ways. This is what to do. Over a gas camp stove out of doors, heat a wok. Throw in a few hand fulls of freshly harvested mânomin. Toss them around using the wok to ensure the hulls (the husks surrounding the mânomin kernels) are heated evenly. Heat until the hulls are lightly burnt and crisp. A second person wearing thick leather working gloves grabs a hand full of the heated mânomin, lifts it up above the wok to catch any wind there might be, and rubs their hands together. The crisp hulls of the processed mânomin tend to blow away in the wind and the grains of mânomin drop back into the wok and tend to parch (become toasted). If the hulls are not crisp enough and stick to the grain, they will drop back into

the wok, too. Repeat several times to get rid of most of the hulls.

CELs / Subject Integration: technological literacy, Native Studies



Dale Smith talks with a class about harvesting mânomin and its connection to life.

Resources
local person in the industry

(optional part: gas stove, matches, leather work gloves, harvested mânomin)

Teacher Notes
- Choose someone who you think will relate well to your students. A student's parent or relative may be best.
- Contact the person well ahead of time. If it's during harvesting season, a rainy day might work best for the person.
- For the optional activity, it would be best if you could enlist the help of someone who was familiar with this process, perhaps the local industry person who comes in to talk to your students. Be sure to practise the process before doing it with your students.


Modern method of harvesting with an airboat

Lesson 2: *An Overview of Mânomin*

Timing
1 or 2 classes, following Lesson 1.

Goals
1. To systematically present an overview of the mânomin industry, in a way that makes students feel it is part of their community, and in a way that makes them feel confident about knowing some of its science and technology.
2. To develop an interest in mânomin as a healthy food.

Objectives
1. Students will remember where mânomin originated from and where the industry flourishes today. See Background Information, or Appendix A chapter 1. Use the local language as much as possible in this lesson. The Western scientific point of view will be introduced in Lesson 4.
2. Students will be able to properly sequence the 9 stages in the life cycle of mânomin (germination, floating leaf, aerial leaf, tillering, early flowering, pollination, grain formation, maturity, seeding). See Background Information, or Appendix A chapter 2. Change the above vocabulary to conform with local terminology.
3. Students will become aware of the fact that the Saskatchewan mânomin industry is "organic farming" and follows the principle of "sustainable development."
4. Students will remember some of the details related to:
   - a productive habitat. See Background Information, or Appendix A chapter 3.
   - harvesting. See Background Information, or Appendix A chapter 5.
   - processing. See Background Information, Appendix A chapter 7; or the tour of La Ronge Wild Rice Corporation, Appendix B.
   - food value. See Background Information, or Appendix A chapter 9.

   These will be addressed in greater detail later in the unit. This lesson, therefore, is an overview introduction to this information.
5. Students will be aware of future hands-on activities in the unit.

Value to be Conveyed
sustainable development

Instructional Strategies
direct

Lesson Outline
1. Present the information using as many photos, concrete props, and materials as possible. Involve students physically by getting them to display materials or demonstrating sequences of events. Constantly make the connection between the information you present and the visitor in Lesson 1.
2. To help students' personally access lecture information in the future, you might wish to do one of the following: (a) coach students on taking notes during your presentation; (b) hand out an outline of your presentation, leaving room for students to add information as you present it; or (c) hand out the information as a booklet to students.
3. When talking about the food value of mânomin, have students eat a small sample of a dish (dixie

cups and plastic forks).

4. Closure: invite each student to state one new thing they learned about mânomin that interests them. Arranging students in a talking circle might be a natural way to conduct this.

CELs / Subject Integration: communication, Social Studies

Resources

materials: cooked and uncooked mânomin
photos, brochures, posters, etc.
samples of mânomin at various stages in its development, harvesting, and processing, laminated onto bristle board
Appendix A

Teacher Notes

- Draw on your local industry for as many resources as possible. Web sites might be of interest to students (see Resources in the "Background Information" section).
- Cook some mânomin ahead of time, maybe as part of a dish, to serve near the end of the presentation. Recipes are found in Lesson 9.

Lesson 3: *Choosing Where to Plant: Stories from the Past*

Timing
1 class, plus 1 outing to plant seeds (optional)

Goals
1. To identify (in an everyday way) the plants in the place where it's best to plant mânomin.
2. To involve older people in the community.
3. To involve students in a trial planting of mânomin.

Objectives
1. Students will be able to identify the plants that usually grow where mânomin best grows (e.g. yellow water lilies, water milfoil, Richardson's pond weed).
2. Students will develop greater respect for the stories of older people who have knowledge handed down to them.
3. Students will identify this knowledge as the community's valid way of knowing about planting mânomin. This is valuable local knowledge.
4. (Optional) Plant mânomin seeds in a local lake or stream.

Value to be Conveyed
respect for traditional knowledge

Instructional Strategies
direct, experiential

Lesson Outline
1. Relate the local stories to students. The Western science point of view will arise in the next lesson.
2. Depending on the season, plant some mânomin seeds (from their frozen state in a freezer) in a local area that may sustain growth. Seeds often do very well, but only for one year. (The trick is to find a place that will regenerate seeds for ensuing years.)

CELs / Subject Integration: personal and social values and skills, Social Studies, Native Studies

Resources

Teacher Notes
- Gather information and stories from older community members who participated in mânomin cultivation in the early days. Be sure to get permission to retell their stories. Alternatively, you might want to arrange for students to interview people (after coaching them on the proper protocols to follow). For directions on how to prepare students to interview people, see the unit *Asâmak* (Snowshoes) Lesson 3 and the unit *Tth´ën* (The Night Sky) Lesson 1. You might also want to bring someone into your class.

Lesson 4: *The Habitat: Western Science Stories about* Zizania palustris

Timing
1 or 2 classes, but it could expand to much more depending if you wish to explore other ecology-biology content that is on your agenda for the year (optional).

Goals
1. To identify Western science as one of many cultural ways of knowing plants, a way that tries to be universally valid rather than locally valid.
2. To study the important plants related to mânomin and its habitat.
3. To introduce ecology or biology content expected of your class (optional).

Objectives
1. Students will describe 5 plants often found in the habitat of mânomin in the community; (e.g. yellow water lilies, water milfoil, Richardson's pond weed, cattails, spike rush, bladderwort, coontail, bur-reed, duckweed – the community's commonsense words). See pages A24-A28, as well as *Plants of the Western Boreal Forest and Aspen Parkland* pp. 226, 224, 221, 217, 246, 211, 224, 216, & 226, respectively.
2. a. Students will memorize the scientific name for mânomin grown in the community (*Zizania palustris*)
   b. Students will recognize the names of 2 other North American species (*Zizania aquatica and Zizania texana*) and the name of the main Asian species (*Zizania latifolia*).
   c. Students will recognize our common white rice (originally from Asia) as *Oryza sativa*.
3. At any given moment in the lesson when a student or teacher is talking, students will be able to identify the subculture in which the person's words belong; for example: "mânomin" – the community's common-sense culture; "*Zizania palustris"* – Western science; or "black rice" or "wild rice" – one's personal culture). [Emphasis in this lesson is on the subculture of Western science. But conversations will occur that belong to other subcultures, and students are expected to identify these subcultures, so that students will know what language and concepts belongs with what subculture.]
4. (Optional) Students will construct ecology/biology concepts you wish them to learn (e.g. niche, competition).

Western Scientific Value to be Conveyed
a naming system should be universal (it should work any where on the planet)

Instructional Strategies
direct

Lesson Outline
1. Just like a good tour guide taking students into a foreign country, make a game out of crossing a cultural border into the culture of science in which use scientific words such as *Zizania palustris, Zizania aquatica, Zizania texana*, *Zizania latifolia*, *Oryza sativa*, etc. Use this event to identify the 3 or more subcultures within which people will naturally be talking in the classroom, sometimes simultaneously (e.g. Aboriginal science, the community's common sense, personal family knowledge, and Western science). This should be fun for students. By identifying the various

subcultures that we switch between in the classroom, we nurture students' self-identity and encourage them to learn the Western science content. To learn Western science does not mean they have to reject their knowledge from the other subcultures they live in daily.
2. Using as many real materials as possible (or good photographs or diagrams), tell an engaging Western science story about the habitat of *Zizania palustris*. Make your objectives clear to students so they know what notes to take (or help them take these notes). Be particularly careful not to expect too much memorizing of Western scientific terms – just a few key terms from the whole lesson would be fine.
3. Point out the regions in North America where other species of *Zizania* exist. On a world wide scale, introduce students to the 2 Asian rice, *Zizania latifolia* and *Oryza sativa*. (A box of Uncle Ben's Rice would make a good prop for *Oryza sativa*.) You may wish to introduce students to wild rice paddies found in the US, contrasting them with the organic sustainable agriculture of mânomin. The concept of sustainable development applies here.
4. Closure: play a matching game by having students choose and place the correct card (with a scientific name printed on it) next to the material or photo you have on display. (In future lessons and units, get students to print their own cards and let them pose the matching game for other students in the class.)

CELs / Subject Integration: critical and creative thinking

Resources
sample of mânomin
samples (photos or diagrams) of plants in the habitat of mânomin
3 by 5 cards
Appendix A.

Teacher Notes
- Enlist local harvesters (or anyone with a boat) to get samples of the habitat plants you want to introduce your students to. If students have safe access to a rice garden, they could collect such plants. Your speaker (Lesson 1) may have identified some.
- Print Western scientific names of things on cards (3 by 5 inches) for the closure game.

Lesson 5: *Where the Mânomin Grows: A Field Trip*

An aerial view of a mânomin stand. The rows are evident.

Timing
field trip to a stand

Goals
1. To use the ideas from previous lessons in the natural context of a mânomin garden.
2. To collect materials and samples for analysis in subsequent lessons.
3. To get students to interact with their environment and their community.
4. To introduce students to career possibilities related to science and engineering.

Objectives
1. Students will accurately apply both common-sense terms and scientific terms as they interact with, and talk about, the mânomin stand.
2. Student will respect the environment by not causing any damage.
3. Students will systematically acquire and label several 1 litre (or half-litre) water samples in the area.
4. Students will collect (with the owner's permission) mânomin stocks (roots and all).
5. Students will observe the wild life or evidence of wild life (e.g. mallards and muskrats) that feed from mânomin. In short, students will be able to answer: Mânomin is a home to what?

Aboriginal Value to be Conveyed
respect for Mother Earth

Instructional Strategies
experiential

Lesson Outline

1. Before leaving:
    a. make sure students know exactly what they are to accomplish (observation sheets should be ready if needed), and exactly how they are to behave. Role playing a scientist might be helpful (to continue Lesson 4's cross-cultural game of identifying what subculture a person is speaking in) in focussing students' attention and behaviour.
    b. go over the class checklist of materials students are to bring.
2. At the site:
    a. conduct a short fun activity to bring students together.
    b. students will carry out the activities you arranged for them; for example:
        - identify plants whose names are on the 3 x 5 cards.
        - examine the mânomin carefully to identify its parts, its stage of development, etc.
        - for ripe mânomin, collect as much grain as possible.
        - identify wild life in the habitat. A dip net could be used to collect tiny critters that live in the habitat or in the vicinity of the mânomin plant.
        - measure water depth
        - measure flow of water at the stand: Mark 2 points, point A ("up stream") and point B, exactly 10 metres apart. At point A and in conjunction with a timer, a student lightly throws an apple into the water at right angles to the shore and the timer (standing at point B) determines how long it takes the apple to reach directly in front of point B. (If the flow is very slow, food dye may work better.) A recorder takes down the times. Repeat at least twice for a reliable measurement. Students calculate the speed of the water in the mânomin stand, metres per second, and in addition perhaps, kilometres per hour. If the flow is too slow to measure, abandon this activity.
        - good artists sketch some aspect of any harvesting equipment or feature of the habitat (pencil sketches on white hardboard – used for making walls – works best); other students can take photographs with a recyclable camera.

CELs / Subject Integration: critical and creative thinking, numeracy, Art

Resources

small containers for water samples (cleaned out plastic pop bottles);
plastic bags to hold wet plant specimens; materials to label containers and bags
old apples (or food colouring), metre stick, watch with second hand, observation sheets (for measuring the flow of water), white hardboard for pencil sketches
recyclable cameras (about 3)
reference materials; 3 x 5 cards with scientific names printed on them
drinking water (students' responsibility)

Teacher Notes

- Make all the proper arrangements for a field trip. It would be best to have extra adults to help at the water's edge. Students should bring rubber boots to class, several days ahead of time, to wear on the field trip.
- "Ducks taste noticeably better if they have fed on mânomin." Testing this claim could make an interesting science fair project!

Lesson 6: *Follow Up to the Field Trip*

Timing
2 classes following the field trip, (or more depending on how much class time you give to a poster construction activity); plus a little time over the next few weeks to follow up the germination activity.

Goals
1. To organize materials collected at the mânomin stand.
2. To analyse the water samples. pH is used in this lesson, though other tests will depend on the availability of the school's technology. Some ecology kits have very convenient measuring devices for oxygen content, etc.
3. To involve students in germinating their own mânomin.

Objectives
1. Students will make posters etc. out of the plant materials collected. These posters should illustrate some **idea** about the mânomin industry or about the ecology of the stand. Assessment should be influenced by how clearly other students or teachers get the message of a poster.
2. Students will construct the concept of pH (a scale from 0 to 14, indicating one type of chemical activity – "acid-base" activity – that has 7 as its "neutral" point. Samples of household materials will be studied.
3. Students will test the pH of the various water samples, using either pH paper or pH meters.
4. Students will germinate mânomin seeds and determine their quality (% of seeds that germinate).

Scientific Value to be Conveyed
math can make observing more precise, more observations increases our confidence in a result

Instructional Strategies
hands-on, experiential, direct

Lesson Outline
1. Explain how the posters will be assessed (the criteria and who decides) and how long students have to work on them (in class and out of class). Organize students to make their posters.
2. Introduce students to pH from the point of view of the need to measure the pH of mânomin stands, which give wild rice harvesters an indication of the appropriate balance of nutrients. Water with a pH measurement of between 7 and 8 is ideal for mânomin (i.e. neutral or very mildly alkaline), but good crops can develop in water that has a pH between 6 and 8.5 (very mildly acidic to very mildly alkaline. Some water areas in northern Saskatchewan are less than pH 5 and won't support a mânomin crop. Alkaline lakes in southern Saskatchewan would not work either, with a pH over 10.
3. Apply the concept of pH scale to common water-based substances, for example: vinegar, tap water, cleaning substances. Students may likely have studied pH before, and so draw upon their past knowledge here.
4. A fun instance of an acid-base reaction is vinegar with baking soda (or baking powder). The bubbles of carbon dioxide make it look almost like an explosion. Place a few tablespoons of baking soda in a glass. Pour vinegar on top and stand back. Get students to determine if the resulting solution is acidic or basic. It will be one or the other depending on whether you had more vinegar or baking soda to begin with.

5. **Germination** activity. Note: Mânomin seeds must be frozen for several weeks before they will germinate. See pages A37-A38 for some background information.
   - Give each group of students about 10 seeds (mânomin grains) that have been taken out of the freezer within the last 24 hours.
   - Test the pH of a large container of fresh lake or stream water.
   - If the pH is acceptable, students put about 500 mL of this water into a glass jar, one jar per group.
   - Students count their seeds and place them in a jar of this water. Cover the jar to prevent evaporation. Place the jars in the window, so they are all in the same conditions of temperature, light, etc..
   - Students observe their seeds each day and make observations.
   - Change the water every 2 or 3 days (whenever it becomes cloudy).
   - Within a week to 3 weeks, all the seeds that will germinate will have done so. (Seed quality varies depending where and when it was harvested. A 70% rate is considered very good. A range between 23% to 81% is typical for Saskatchewan.) Get each group of students to calculate their percent germination.
   - Pool the groups' data to calculate a class average, and discuss the value of relying on a conclusion based on more readings. Often, other teachable moments will arise when pooling data (e.g. a discussion whether or not to use a group's result if it is terribly different from the others).
   - A variation: If you can get seeds from different areas, investigate which area is best. This investigation will need to be conducted with more exact controls.

CELs / Subject Integration: Math

Resources

materials for the type of posters you wish students to construct
pH paper or meters
glass jars (sealers less that 1 litre, or beakers)
previously frozen mânomin seeds
fresh natural water (enough for the number of groups you have)

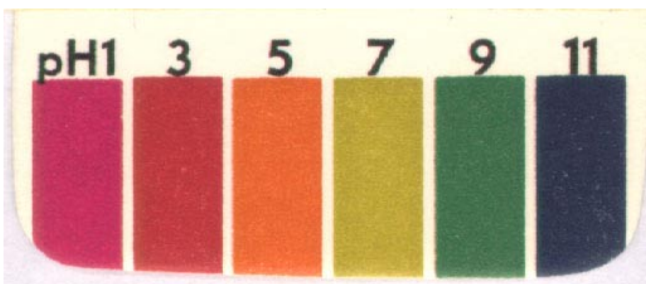
Teacher Notes

- Group work will likely be best.
- The **pH scale** divides water solutions into two categories – acids and bases. The line dividing the two categories is "neutral" and has a pH of 7. Pure water has a neutral pH, for instance. Also, a salt solution such as table salt dissolved in pure water will have a neutral pH of 7. (By the way, the saltiness of water can be a problem for growing mânomin, but saltiness is measured in a completely different way. A salty solution is often called "saline.") Some salts, however, chemically react with water to produce an acid or basic solution.

  Acidic substances chemically react with basic substances to produce water and salt-like substances (the type of salt depends on what acids and bases reacted). Base solutions (greater than pH 7) are sometimes called "alkaline," but acid solutions (less than pH 7) are always called "acidic."

The pH scale is not a linear scale, but an exponential scale (base 10). For each unit change on the pH scale, the acidity changes by *a factor of 10*. This means that a water sample with a pH of 6 is 10 times as acidic as a water sample with a neutral 7 pH. Similarly, a water sample with a pH of 3 is 1,000 times as acidic as a water sample with a pH of 6 (*not twice as acidic*). This is true anywhere along the pH scale between 1 and 14. However, when the pH is lower than 1.0, the acid concentration changes by a factor of 10 for every 0.1 change on the pH scale, and so on until reaching an imaginary acid concentration of infinity at a pH of 0. Similar things happen when the pH is greater than 14, and the imaginary infinity is reached at a pH of 15. These extreme points (0 and 15) can't actually be reached.

Students are not expected to deal with pH numerically like this (unless in grade 11 or 12). They are only to identify the scale with common substances, so they get a feel for the scale; e.g. materials with less than about 1 pH are dangerously acidic while materials with greater than 11 are seriously basic. (Normal stomach fluid, by the way, has a pH of about 1.) The table on the next page shows the different pH values for substances that students will recognize. If any student becomes curious about how our human bodies can have such variation in pH (from 1 to 9) but the blood maintains a constant pH of 7.40, then get them to investigate the curiosity as a science fair project. (The Western science explanation deals with acid-base reactions and buffer solutions.)



- Germination Activity:

  Obtain mânomin seeds much ahead of time and place them in a freezer for at least several weeks in a sealed bag. They can also be stored in a frozen block of ice.

  The day or so before the activity, get a bucket of fresh clear lake or stream water, with a pH close to 7.

COMMON THINGS AND THEIR pH

pH	natural things	store bought things	comments
			*
		battery acid	*
1 —			*_Anything lower is dangerous to humans_
		lime juice	
2 —	stomach fluid (pH = 1 - 3)		
		vinegar	
		lemon juice	
3 —		soft drinks (pH = 2-4)	
		grapefruit & apple juice	
		orange juice	
4 —	acid rain	tomatoes	yellow perch & lake trout die
			brook trout & salamanders die
5 —		coffee (black)	perch, pike, & small mouth bass die
	normal rain water		
		potatoes	salmon, rainbow trout & whitefish die
6 —			snails, crabs etc die
	mouth saliva (pH = 5.5 - 7.5, depending on whether you're eating or not)		
	human urine (pH = 5 - 8, depending on what you ate or drank)		
		milk	
7 —	pure water		
	blood (pH = 7.40)	swimming pools	
		eggs	
	water good for mânomin (pH = 7 - 8)		
8 —			
		baking soda	
9 —	pancreatic fluid (reacts with the stomach fluid going into the large intestine)		
	sea water (pH = 8.5 - 10)		
10 —		normal hand soap	
	stomach antacid solutions from the drug store		
11 —			*_Anything higher is dangerous to humans_
			*
			*
			*
12 —		bleach	*
		household ammonia	*
			*
		liquid drain cleaner	*
13 —			*
			*
			*
			*
		solid drain cleaner	*
14 —		lye, caustic soda	*
			*

Lesson 7: *The Technology of Harvesting*

Timing
1 class

Goals
1. To acquaint students with the industry's need to be inventive with its harvesting technology.
2. To involve students in an authentic math activity.

Objectives
1. Students will be able to identify the harvesting equipment, and will tell accurate stories about the know-how needed by someone who uses the equipment (e.g. how fast an airboat should travel and how difficult this is to attain).
2. Compare the harvesting methods of two people in a canoe (highly sustainable development) with modern machinery. Articulate the technological value of efficiency (cost effectiveness) that goes along with the technology that people choose to use and develop.
3. Students will solve the problem of:
   a. estimating how many seeds are in a kilogram of seeds.
   b. calculating how many bags of seed to buy for a particular stand of mânomin.

Technological Value to be Conveyed
efficiency, using math can help efficiency

Instructional Strategies
direct, group (or individual) puzzle solving

Lesson Outline

1. Either you or a harvester will tell the stories about how to harvest the mânomin, drawing upon the field trip experiences and observations as much as possible. These stories will include how people have made the airboats more efficient and how they have changed their techniques using the airboats. See Appendix A chapter 5.
2. Pose the puzzle: If these mânomin grains were going to be your seeds, how many would be in a 1 kg bag. (Students will need to count out a certain number, such as 30, weigh them, and then calculate how many would be in 1 kg. Combing results into a class average would be a logical thing to do in the culture of science.) Deciding how many to count out raises an interesting discussion about efficiency – the more you count out, the more accurate your result; but the more you count out, the more human resources it takes (time = $). A trade-off must be made.
3. Using the results from the first puzzle, pose a second puzzle: If you own a 8 hectare stand (a small family operation size), and if you wanted to plant 35 plants per square metre, and if the germination rate of seeds is 70%, how many bags of seeds (at 1 kg/bag) do you need to buy? A hectare is a square plot 100 m by 100 m. Have students submit a business proposal for buying their seeds. Group work may work best.

CELs / Subject Integration:
technological literacy, Math

Resources

photos and sketches of harvesting equipment,
local harvester,
a packet of mânomin (to distribute among students for them to count and weigh the grains),
weigh scale (sensitive to a tenth of a gram, if possible),
calculators

Teacher Notes

- Arrange this presentation ahead of time so support material can be in place.
- Some First Nations peoples in Minnesota continue to use traditional methods to harvest mânomin. This is a selling feature of their product. In Saskatchewan, commercial growers were not allowed to use any machinery up until about 1979. Mechanized harvesting is a fairly new phenomenon.

Lesson 8: *Processing Mânomin*

Timing
field trip to La Ronge Wild Rice Corporation, or a photo/script tour of the plant (Appendix B) – about 40 minutes


Ready to send the crop to La Ronge

Goals
1. To acquaint students with the technology and business end of mânomin production.
2. To develop language skills by making connections between a second language of a student and the concrete events to which that language refers.

Objective
1. Students (in groups) will be able to write accurate and fairly detailed stories about what happens to the harvested mânomin grains between leaving the stand and being sent to the packagers for distribution around the world. See Appendix A chapter 7.
2. Students will be able to explain some of the mechanized processes used at the plant; e.g. how a mixture of solid things (hulled mânomin grains, pure mânomin grains, and rocks) can be made to act like a fluid, due to a machine's vibration, due to the air blowing upward through the floor of the machine, and due to gravity pulling down on the solid particles, all at the same time.

Value to be Conveyed
quality control

Instructional Strategies
experiential, direct

Lesson Outline
1. Prepare students ahead of time for what they should expect to do and see, and what you expect of them. Observation sheets or booklets might be a good idea for organizing students' observations when they are at the plant.
2. a. Conduct the field trip.
   b. Alternatively, arrange for your students to see a multimedia tour of the plant by interacting with Appendix B, either with you as the tour guide or students working in groups. For students who need more teacher direction, or as an introduction, you can effectively use Appendix B to conduct your own tour of the plant. The language and detail you use will be tailored to the needs of your students. As a follow-up to this introduction, put students in pairs or triads, selected in a way so they can help each other read the material, explain the material, and keep on task. Compose an assignment or activity to guide their work.
3. Follow up. Have students compose thank-you letters to manager Mr. Bill Plunz.

CELs / Subject Integration: critical and creative thinking, technological literacy, Language Arts

Resources

Appendices A (a PDF file) and B (a Netscape file).

Mr. Bill Plunz, manager
La Ronge Wild Rice Corporation
Box 510, La Ronge, SK, S0J 1L0
phone (306)-425-2283, fax (306)-425-5575

Teacher Notes

- Make all the proper arrangements for a field trip.
- If you are going to use Appendix B, try to tour the plant yourself ahead of time. The photographs in Appendix B will mean much more to you if you have seen the real thing. Here are four of them:

Unloading bags of mânomin into piles called "windrows"

Turning the windrows to prevent rotting, while the mânomin cures

A conveyer belt drops a mixture of pure mânomin (black) and hulled mânomin (brown) into a "cup elevator."

The green machine vibrates to separate pure mânomin from other stuff, then it is bagged (bottom left). The man is doing quality control.

Lesson 9: *Nutritional Value of Mânomin*

Timing
about 1 class, and extending into a lunch hour would be good

Goals
1. To develop interest in good dietary decisions.
2. To have fun eating some of the recipes for cooking mânomin.

Objectives
1. Students will be able to repeat the dietary advantages of mânomin (e.g. compared to other cereals, mânomin is high in protein, carbohydrates, and minerals, but low in fats and oils). See Appendix A chapter 9.
2. Students will be able to follow a recipe.
3. Students will describe their taste sensations when they eat the mânomin dishes.

Value to be Conveyed
good health is important

Instructional Strategies
experiential

Lesson Outline
1. Relate stories about mânomin determining the inter-tribal politics of some First Nations tribes because of its high nutritional value. Mânomin sustained many tribes and was dearly sought after. Schultz's *The Wild Ricer's Guide* is one source that has pertinent information.
2. Hand out your selection of recipes, indicating which ones students would prepare today, which ones have already been made. (See "Recipe Ideas" at the end of this lesson.)
3. Have students prepare some dishes by following the recipes. Heat the previously prepared dishes.
4. Compare the relative nutritional content of mânomin with regular white rice. See Table 1 for data.
5. Eat the fruits of the students' labour. You may want to invite guests, such as the principal, and people in the community, especially those who helped with the unit.

CELs / Subject Integration: technological literacy, Native Studies

Resources
access to the cooking room
recipes for mânomin dishes (see specific suggestions at the end of this lesson, plus a section towards the end of *Wild Rice in Saskatchewan* – Appendix A to this unit).

Here are some recipe books:
How to Cook Wild Rice. Northern Lights School Division, La Ronge.
Northern Saskatchewan Wild Rice. Sask. Agriculture, Extension Service, Box 5000, La Ronge.
Wild Rice Cook Book, La Ronge Industries Ltd, Box 193, La Ronge.

Teacher Notes

- Mânomin expands 4 times in volume when cooked.
- Choose the recipes you think will have the best effect on students.
- NOTE: check on student allergies, and eliminate cooking ingredients accordingly.
- Cook some dishes ahead of time to be heated at school (in a microwave oven).
- Acquire and prepare the ingredients for the dishes you wish students to prepare in class.
- Because the expense may be a critical factor in students' homes, one must be sensitive about expecting families to purchase mânomin for preparing dishes at home.

Table 1. Nutritional Content of Common Rice Varieties

Nutrient	Mânomin		White Rice		Brown Rice	
Protein	12.6	grams	6.7	grams	7.5	grams
Fat	0.9	grams	0.4	grams	1.9	grams
Carbohydrate	73.4	grams	80.4	grams	77.4	grams
Calcium	30	milligrams	24	milligrams	32	milligrams
Phosphorus	320	milligrams	94	milligrams	221	milligrams
Iron	1.5	milligrams	2.9	milligrams	1.6	milligrams
Sodium		-	5	milligrams	9	milligrams
Potassium	181	milligrams	92	milligrams	214	milligrams
Thiamine	0.45	milligrams	0.44	milligrams	0.34	milligrams
Riboflavin	0.63	milligrams	0.04	milligrams	0.05	milligrams
Niacin	6.2	milligrams	3.5	milligrams	4.7	milligrams
Calories	352	kcal	353	kcal	360	kcal

From *How to Cook Wild Rice*

Recipe Ideas

Basic Recipe for Cooking Mânomin

250 mL	(1 cup)	mânomin
1 litre	(4 cups)	water
5 mL	(1 tsp)	salt

1. Wash mânomin by placing in a wire strainer and running cold water through it.
2. Place rice, water, and salt in a heavy saucepan. Bring to a boil.
3. Cover and simmer over low heat for about *50-60 minutes* (until kernels puff open to reveal their white interior).
4. Remove cover. Fluff mânomin with a fork. Cook 5 minutes longer.
5. Remove saucepan from heat and drain.

Makes 8-10 servings. (Provided by Matilda Lariviere, Pinehouse Lake.)

Cream of Mânomin Soup

125 mL	(½ cup)	uncooked mânomin (or 2 cups cooked mânomin)
1 large onion		diced
½ green pepper		diced
2 ribs celery		diced
10 large fresh mushrooms		diced
125 mL	(½ cup)	butter
125 mL	(½ cup)	flour
2 litres	(8 cups)	hot chicken broth
salt & pepper to taste		
250 mL	(1 cup)	light cream (or half and half)

1. Prepare mânomin following basic recipe. Wash mânomin with cold water. Place rice and water in a heavy saucepan. Bring to a boil. Cover and simmer over low heat for about *50-60 minutes* (until kernels puff open to reveal their white interior). Drain well.
2. Saute the onion in butter. Add mushrooms, green pepper and celery, and then cook until tender.
3. Sprinkle in the flour, stirring and cooking until the flour is mixed in, but do not let it begin to brown.
4. Slowly add the chicken stock, stirring until all the flour/butter/vegetable mixture is blended well.
5. Add the rice and season to taste with salt and pepper.
6. Heat thoroughly but gently, stir in the cream, but do not boil.

Makes about 12 servings. (from *How to Cook Wild Rice*)

Mânomin Fruit Salad

3 cups	cooked mânomin
1	11 oz can mandarin oranges, drained
1	16 oz can pineapple chunks, drained
1	3 oz jar maraschino cherries, drained and halved
1 cup	chopped walnuts
1	3 oz package orange-pineapple flavour gelatine. Do not dissolve.
1	13½ oz carton frozen whipped topping
1 cup	miniature marshmallows
shredded coconut	

1. Combine all ingredients, except coconut, in a bowl. Sprinkle with coconut if desired.
2. Salad will keep up to a week if properly refrigerated.

Serves 8-10. (from *How to Cook Wild Rice)*

Mânomin Spinach/Lettuce Salad

250 mL	(1 cup)	mânomin
1 litre	(4 cups)	water
5 mL	(1 tsp)	salt
250 mL	(1 cup)	golden Italian dressing
125 mL	(½ cup)	red peppers, sliced or chopped
250 mL	(1 cup)	fresh mushrooms, sliced
125 grams	(¼ lb.)	bacon, fried to make bacon bits
		Romaine lettuce or spinach (or combination)

1. Prepare mânomin following basic recipe. Wash mânomin with cold water. Place rice and water in a heavy saucepan. Bring to a boil. Cover and simmer over low heat for about *50-60 minutes* (until kernels puff open to reveal their white interior). Drain well. Cool.
2. Marinate the rice in golden Italian dressing for 1 day.
3. Toss the marinated rice with the vegetables, bacon bits, and lettuce or spinach. Season with salt and pepper to taste.

(from *How to Cook Wild Rice*)

Mânomin and Chicken

6	chicken breasts
1 cup	while wine
1 can	cream of celery soup
1 can	cream of chicken soup
1 soup can	water
1 pkg.	onion soup
1 pkg.	Uncle Ben's wild and long grain rice

1. Preheat oven to 350 °F.
2. Mix all ingredients except chicken.
3. Place breasts (cut in two) into mixture in 9x12 inches pan.
4. Bake, covered, ¼ hour; then uncover and continue baking 1 hour or until tender.

(Provided by Rose Smith, Pinehouse Lake.)

Bonnie's Mânomin Casserole

1 cup	celery, chopped
½ cup	green pepper, chopped
4 tbsp	butter, divided
1	10-oz can cream of mushroom soup
1	can cream of chicken soup
1 cup	chicken broth or bouillon
1	4-oz can mushrooms stems and pieces, drained
1	2-oz jar pimento, chopped, drained
dash garlic powder, salt and pepper to taste	
3 cups	cooked mânomin
2 cups	cooked chicken or turkey, diced
1	2-oz package thinly-sliced almonds
1 cup	croutons

1. Preheat oven to 350 °F. Grease a 3 quart baking dish, set aside.
2. Saute onion and green pepper in 2 tbsp butter until onion is golden and transparent, but not brown.
3. Blend soups and chicken broth (or bouillon) together until smooth.
4. Mix all ingredients, except croutons, together gently and put into prepared baking dish.
5. Saute croutons in remaining 2 tbsp butter. Sprinkle over casserole.
6. Bake for 1 hour.

Makes 8-10 servings. (from *How to Cook Wild Rice*)

Mânomin and Ground Beef Casserole

1 cup	uncooked mânomin
1 lb.	lean ground beef, do not brown
1	4 oz. can mushrooms, undrained
1	4 oz. can cream of mushroom soup
1	4 oz. can cream of celery soup
1	soup can of water
½ cup	*each* of diced celery and onion
salt and pepper to taste	
¼ cup	Parmesan cheese (for topping)

1. Blend all ingredients, except the cheese, together in a 2-quart casserole. Top with Parmesan cheese.
2. Cover and bake at 325 °F (160 °C) for 2 hours.

Makes 10 servings. (Provided by Rose Smith, Pinehouse Lake.)

Mânomin Casserole

1 cup	mânomin
2 cups	water
1 can	consommé (beef broth)
1 cup	minute rice
1 cup	celery
½ cup	green peppers
1 medium	onion
1 can	mushrooms, drained

1. Soak water and rice overnight.
2. Sauté celery, green pepper, onion and mushrooms.
3. Mix all ingredients into a casserole dish.
4. Cover and cook in oven at 350°F for 30 minutes (or until rice is cooked).

Serves 4 to 6. (Provided by Rose Smith, Pinehouse Lake.)

Mânomin Broccoli Casserole

1 cup	mânomin
1 bunch	broccoli
1 cup	fresh mushrooms, sliced
½ cup	chopped celery
2 tbsp	Cheez Whiz
1 can	cream of mushroom or cream of broccoli soup
¼ cup	milk

1. Wash and soak mânomin overnight. Drain.
2. Put mânomin into cooking pot. Cover with water. Add pinch of salt.
3. Bring to a boil and simmer until mânomin is tender (30-40 minutes), adding more water if necessary.
4. Drain. Stir in 2 tbsp Cheez Whiz until melted.
5. Mix in can of soup and ¼ cup milk.
6. Peel broccoli stems and cut into bight-sized pieces. Steam broccoli, mushrooms and celery until tender-crisp.
7. Place steamed broccoli, mushrooms, and celery into a large casserole dish. Add mânomin mixture.
8. Bake uncovered for ½ hour at 325°F.

(Provided by Rose Smith, Pinehouse Lake.)

Mânomin

2 cups	mânomin
1 medium	onion, chopped
	salt
6 cups	water
2 cans (284 ml)	mushrooms
¼ cup	butter or margarine

1. In a large pot, add mânomin to salted water and bring to a boil.
2. Reduce heat and let boil slowly for 45 minutes to 1 hour, or until rice has popped and is tender.
3. In a frying pan, melt butter and sauté the onions and mushrooms.
4. Drain wild rice; add the onions and mushrooms. Stir well and serve.

Serves 4. (Provided by Rose Smith, Pinehouse Lake.)

Mânomin Dressing for Game Birds

1 (6 oz.) pkg	mânomin
4 cups	water
½ cup	onion, shredded
¼ cup	butter
¼ cup	mushrooms, sliced
¼ cup	celery, diced
1 can	chicken broth

1. Wash and soak mânomin 3 to 4 hours.
2. Boil in salted water until tender (40 minutes), making sure the mânomin is not sticking (add more water if necessary)
3. Melt butter in frying pan. Add onion and sauté.
4. Add mânomin and season to taste. Mix lightly.
5. Stuff game or fowl.

(Provided by Rose Smith, Pinehouse Lake.)

Mânomin Dressing

1½ cup	mânomin
¼ cup	butter
3 stalks	celery, chopped
1	onion, chopped
1	sweet red pepper, chopped
½ lb	framer’s sausage, casing removed
½ cup	chicken stock
1½ tsp	dried marjoram
¾ tsp	salt
¼ tsp	black pepper

1. Cook mânomin in boiling water for 45 minutes, or until tender. Drain.
2. In a skillet, melt butter over medium heat; then cook celery, onion and red pepper for 3 to 5 minutes.
3. In a bowl, mix together sausage (break into bight-sized pieces), chicken stock, mânomin, onion mixture, marjoram, salt, and black pepper.
4. Transfer to a greased 12-cup casserole. Cover and bake in a 325°F oven for 45 minutes.

Makes about 8 cups. (Provided by Rose Smith, Pinehouse Lake.)

Mânomin Stuffing

½ cup	mânomin	salt & pepper	½ tsp sage
1 qt.	boiling water	½ lbs. sliced mushrooms sauté	2 tbsp fat
			2 beaten egg yolks

Cook mânomin (40 minutes), drain and rinse. Add remaining ingredients and blend well. Stuffs a 2 lb bird.
(Provided by Lena McCallum, Pinehouse Lake)

Mânomin Pancakes

¼ cup	uncooked mânomin
2 cups	water
½ tsp	salt
1	egg, beaten
1 cup	milk
1 cup	all purpose flour
3 tbsp	butter or margarine, melted
2 tbsp	sugar
2 tsp	baking powder
½ tsp	salt

1. Prepare mânomin following basic recipe. Wash mânomin with cold water. Place rice and water in a heavy saucepan. Bring to a boil. Cover and simmer over low heat for about *50-60 minutes* (until kernels puff open to reveal their white interior). Drain well. Rinse with cold water and drain again.
2. Beat remaining ingredients in a medium bowl until blended. (Batter will be lumpy.)
3. Stir in mânomin.
4. Lightly grease heated griddle. Pour batter by ¼ cupfuls onto hot griddle.
5. Turn pancakes when bubbles form, but before bubbles break. Cook until golden brown.

Makes about 10.
Alternative: use your own favourite pancake batter. Just stir in cooked mânomin before frying.
(from *How to Cook Wild Rice*)

Mânomin Muffins

1/3 cup	uncooked mânomin
2 cups	cold water
½ tsp	salt
2	eggs, beaten
1½ cups	all purpose flour
3 tsp	baking powder
2 tsp	sugar
½ tsp	salt

1. Prepare mânomin following basic recipe. Wash mânomin with cold water. Place rice and water in a heavy saucepan. Bring to a boil. Cover and simmer over low heat for about *50-60 minutes* (until kernels puff open to reveal their white interior). Drain well. Rinse with cold water and drain again.
2. Heat oven to 400 °F.
3. Mix mânomin, milk, butter, and eggs in medium bowl. Stir in reaming ingredients just until flour is moistened. (Batter will be lumpy.)
4. Four by ¼ cupfuls into greased muffin cups.
5. Bake in 400 °F oven until muffins are golden brown, 20-25 minutes. Remove muffins from pan immediately.

Makes 12 muffins. (from *How to Cook Wild Rice*)
Alternative: use your own favourite muffin batter. Just stir in cooked mânomin before baking.

Lesson 10: *Debriefing and Review*

Timing
1 class

Goal
To review some of the unit's details.

Objectives
1. Students will have information about the mânomin industry on the tips of their tongues.
2. Students will compare the old methods with the new methods for harvesting and processing mânomin.

Value to be Conveyed
co-operation

Instructional Strategies
indirect

Lesson Outline
1. Assign different groups of students different aspects of the industry (selecting a site, seeding, harvesting, processing, eating, etc.). Get each group to compose a game, such as Pictionary, Charades, Jeopardy, or Trivial Pursuit. You might want to assign each group to one part of the mânomin industry or to the unit, in order to cover all the aspects of your teaching. Decide if all groups will use the same game, or whether they'll be able to choose themselves among the formats you propose. It could be fun to have the groups give themselves a name. See Teacher notes below for ideas on four games.

CELs / Subject Integration: personal and social values and skills

Resources
Compose about 10 "trivial pursuit" cards related to various aspects of the mânomin industry. Choose topics you want students to review.

Teacher Notes
- Here are some ideas to get you started using a game format for reviewing the unit's content.
    a. Pictionary: Involve students in composing words to be drawn, and in deciding how to organize the class for maximum participation.
    b. Charades: Have each group write 2 or 3 facts or terms about the mânomin industry. A student in another group has to act out the fact or term in front of his/her own group to figure out. Keep time limits short. Take turns among the groups.
    c. Jeopardy: Compose categories in which students will compose statements. Decide how many statements per category you'll have ($100, $200, $300, etc.). A 5 by 3 Jeopardy set up will need 15 statements, for instance. Compose a class Jeopardy chart on the overhead or flip-chart paper. Each group designates its recorder. That person writes down (decide how you want to organize this) both the square's statement and the expected question that should be posed by another

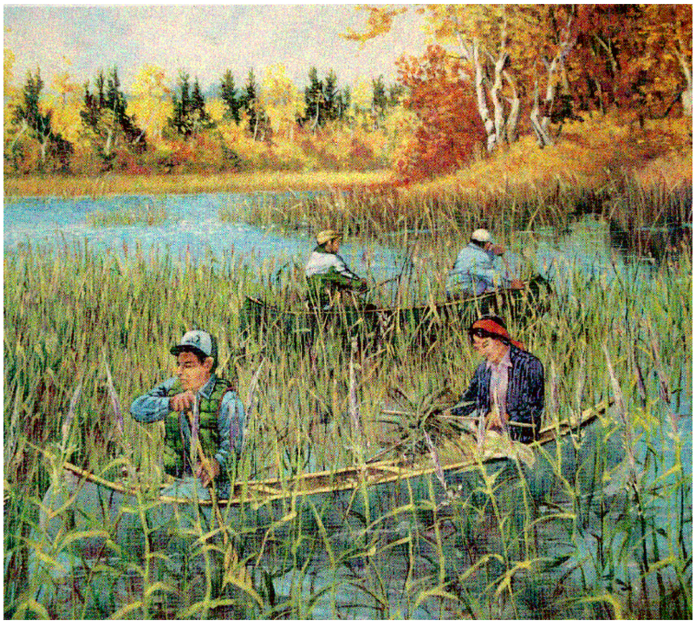
group. During the game, when category C is chosen, for example, then group C's recorder will administer the game while the rest of the group members will hum the Jeopardy theme – to time the group composing the question. The teacher is arbitrator and keeps a record of each group's winnings ($). Organize for maximum participation.

d. Trivial Pursuit: A group composes 5 "trivial pursuit" cards about their assigned part of the industry. Play the game as a whole class, organized into groups, using students' cards and the ones you made up yourself.

- For a group of interested students, an imaginative *science fair project* could be to design a board game that teaches players the content of this unit. For instance, each player moves 1 space per turn, which represents 1 week in the growing season for growing mânomin (100 days is about 15 squares). Different regions of the board represent different stages of growing. A player lands on squares that require picking a card from the top of various piles of cards stacked face down (each card states some positive or negative event that has a consequence for the yield and profit for that year). Each player would keep a public record of gaining or losing money profit or yield. Everyone keeps moving forward on the board, but depending on which cards are picked (the cards are randomly shuffled and stacked upside down as in many board games), some players will have higher profits. Remember to include squares at the end for processing and marketing, including the trip into market and the market conditions.

Churchill River flowing into Pinehouse Lake

Appendix A



Wild Rice in Saskatchewan

Agricultural Development in Harmony with Nature
A Reference Manual

Saskatchewan Education, Training and Employment
Saskatchewan Agriculture and Food

This document is electronically stored as a PDF file on the *Rekindling Traditions* CD and on the internet at http://capes.usask.ca/ccstu.

Appendix B

A Tour of the La Ronge Wild Rice Corporation Processing Plant

Script:	Glen Aikenhead
Consulting:	Bill Plunz, La Ronge Wild Rice Corporation Gloria Belcourt
Photos:	Glen Aikenhead
Production:	Debbie Mielke, Saskatchewan Education, Northern Division
Voices:	Jason Bekkatla & Dallas Hicks, MBC, La Ronge

This multimedia tour is electronically stored as a Netscape file on the *Rekindling Traditions* CD and on the internet at http://capes.usask.ca/ccstu.

CD DIRECTIONS: For Windows, open Netscape and choose File > Open Page. Select the “Choose File” (Browse) button. Locate *Wild Rice Appendix B* on the CD, and open it. Select the “index” file. This is the file that Netscape should open to begin the tour. Open it.

Saskatchewan Education Training and Employment

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Wild Rice in Saskatchewan

Agricultural Development in Harmony with Nature

A Reference Manual

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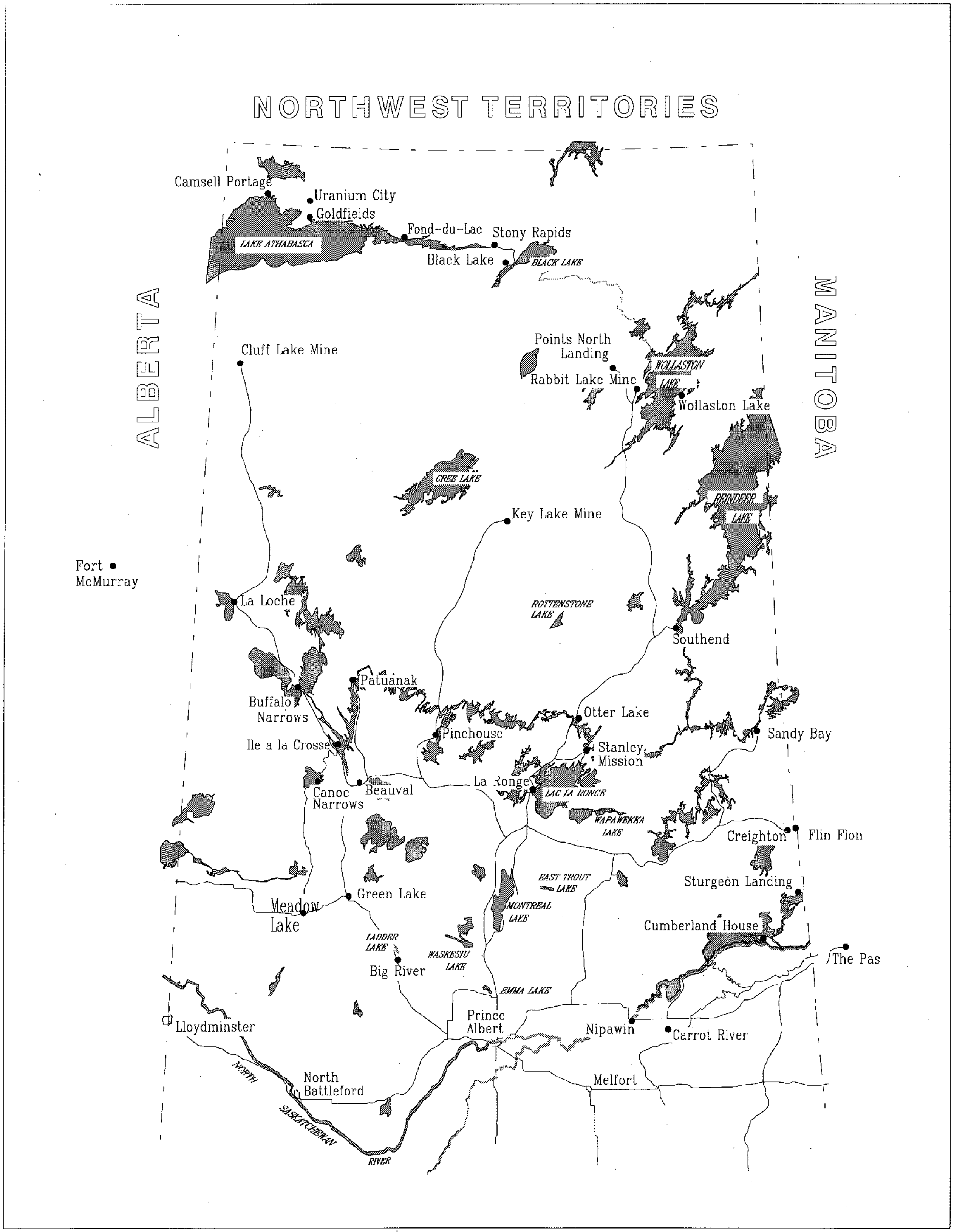
NORTHERN SASKATCHEWAN



Wild Rice in Saskatchewan

Agricultural Development in Harmony with Nature

A Reference Manual

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Employment

Saskatchewan
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Cover art by Myles Charles, Saskatchewan Education, Training and Employment, depicting traditional method of harvesting wild rice before the introduction of airboat harvesters in the late 1970s.

Preface

Wild rice has been a traditional food of the native peoples of eastern North America for generations. Although the crop was introduced into Saskatchewan in the 1930s, it was not until the 1970s that the commercial potential of wild rice was widely appreciated. The wild rice industry began flourishing in earnest in 1978 and has added an important new dimension to the economy of northern Saskatchewan. This has been achieved through the enterprising spirit of the northern entrepreneurs who were willing to invest time and resources in a new endeavour. Provincial government regulations stipulating that growers must be long-time residents of northern Saskatchewan, and the involvement of the Saskatchewan Indian Agriculture Program, have encouraged the participation of Aboriginal peoples in an industry that is in harmony with the natural environment. Saskatchewan is now the leading producer of lake-grown wild rice in North America.

This book is intended as a reference manual of the wild rice industry in Saskatchewan and contains a practical guide to the planting, growing, harvesting, and processing of wild rice, as well as a brief discussion of the economics of a wild rice operation. Recommended procedures for successful crop development are related to the habitat requirements of the plant. Information on efficient harvesting incorporates the latest research on airboat design and operation, as well as practical tips for maintenance. Other topics, such as processing and grading standards, help to complete this general overview of the wild rice industry. The nutritional value of wild rice is described, together with a few recipes that we hope will encourage readers to try this versatile, gourmet grain.

Although Canada officially uses the Metric System (SI), many traditional wild rice growers still use Imperial units of measure. Therefore, with the exception of certain graphics, this text gives units in SI followed by their Imperial equivalents. For the convenience of the reader, a Conversion Chart of common units is provided at the end of the book.

This book is dedicated to the memory of Pab Orcajada, who died in a boating accident on August 4, 1994, while conducting a wild rice research experiment. Pab was the Province's senior Wild Rice Agrologist, working with Saskatchewan Agriculture and Food for many years. He was a strong advocate of research, and it is his support and enthusiasm that has made this book possible.

Acknowledgements

I would like to acknowledge the great contribution made to this book and to wild rice research by my long-time colleague Pab Orcajada, who worked for Saskatchewan Agriculture and Food in La Ronge until his death in 1994.

Advice, assistance, and constructive criticism were received from many members of the northern wild rice community; the comments of Lynn Riese of Canadian Lake Wild Rice were particularly useful.

Gerald Weinstein of Saskatchewan Education, Training and Employment provided editorial expertise and developed and produced the graphs.

Some of the material used in this book was first published in books and pamphlets produced by the La Ronge office of Saskatchewan Agriculture and Food, as well as in the Wild Rice Growers Training Manual prepared by Saskatchewan Education's Northern Education Services Branch. Pab Orcajada and Doug Horner were both involved in the writing of these earlier publications, as well as Gerald Weinstein and Bill Plunz.

The staff of the Northern Education Services Branch of Saskatchewan Education, Training and Employment provided artwork, proofreading skills, and helped in preparing the book for publication.

Keith Bigelow of the Geography Department, University of Saskatchewan, assisted in the preparation of the photographs used in this work.

0.W. Archibold

Contents Page

1. WILD RICE - NORTH AMERICA'S ONLY NATIVE CEREAL

WILD RICE - A CROP WELL SUITED TO NORTHERN SASKATCHEWAN

Northern Saskatchewan is a land of forests and lakes, developed on the glacially-scoured ancient rocks of the **Precambrian Shield**. The shallow lakes and slow-moving rivers provide an ideal habitat for wild rice (Figure 1). This crop, grown in harmony with nature, has added a new dimension to the economy of the region.

Average temperatures during the long days of summer typically rise to 16-18°C (60-65°F), but by late August there is a risk of frost. Soon after, the land lies dormant in the frigid grip of winter, with temperatures commonly falling below -30°C (-22°F). The accumulated snowfalls begin to melt in April. By May, most of the ice cover on the lakes has disappeared (Figure 2), and with it comes the promise of another bountiful wild rice year.

For any mid-latitude grain crop, the growing season must be sufficiently long for the plants to reach maturity before they are killed by autumn frosts. Vegetables such as potatoes and carrots can be grown successfully in small garden plots, but

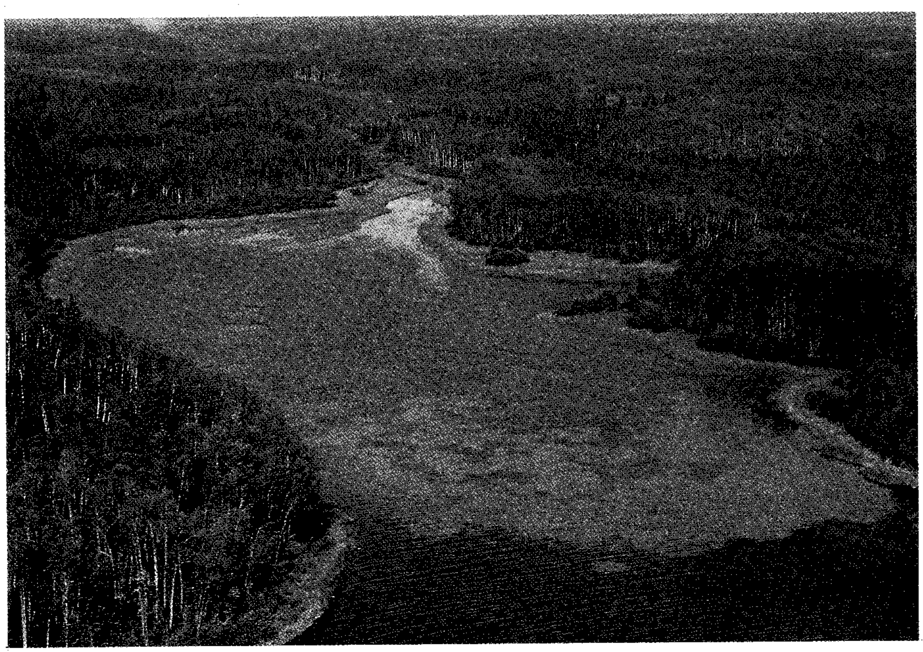


Figure 1 Shallow bays, such as Aubichon Arm near Ile-a-la-Crosse, provide ideal habitat for wild rice.

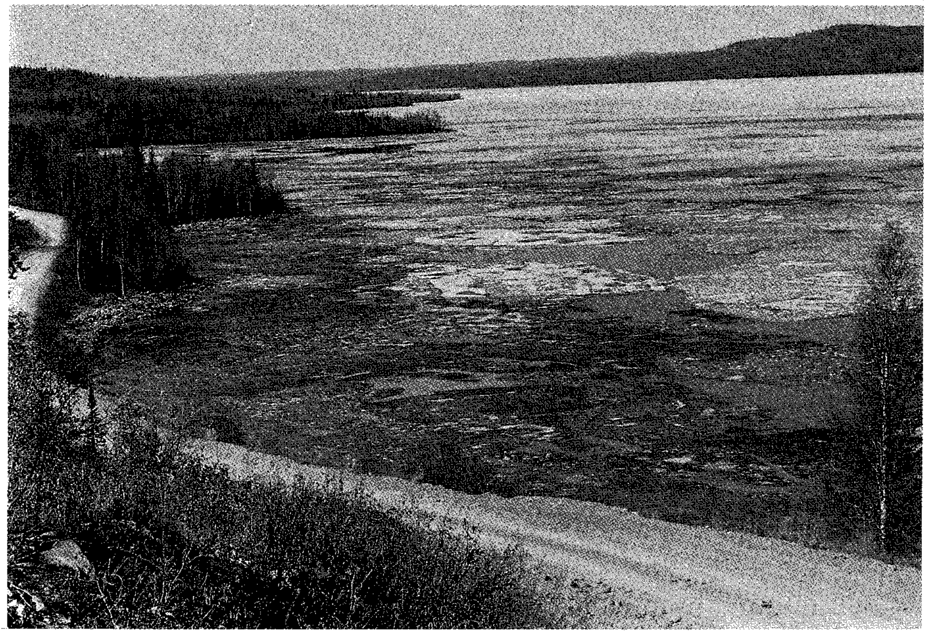


Figure 2 Spring break-up brings renewed activity on the lakes.

climatic conditions and shallow soils limit the opportunities for large-scale agriculture in the north, and the familiar crops of southern Saskatchewan are absent.

The potential for wild rice in northern Saskatchewan is largely determined by physical geography, especially by regional differences in climate and **hydrology** (Figure 3). Climatic conditions become more severe towards the northeast corner of the province. Similarly, lakes and rivers are not uniformly distributed, and characteristics such as depth and water chemistry, which affect the growth of aquatic plants, are quite variable. Consequently, the most favourable areas for wild rice are found along the margin of the Canadian Shield and Churchill River. This is reflected in the distribution of wild rice permits in northern Saskatchewan, although undoubtedly the location of settlements and road access has contributed to the present pattern of activity. The relationship between active permits and potential for wild rice development in northern Saskatchewan is shown in Figure 4.

WILD RICE - A TALL AQUATIC GRASS

The species that grows in Saskatchewan is known scientifically as *Zizania palustris*. The characteristic form of the species is illustrated in Figure 5.

Zizania is a member of the grass family, and its hollow cylindrical stem and long, narrow blade-like leaves resemble those of

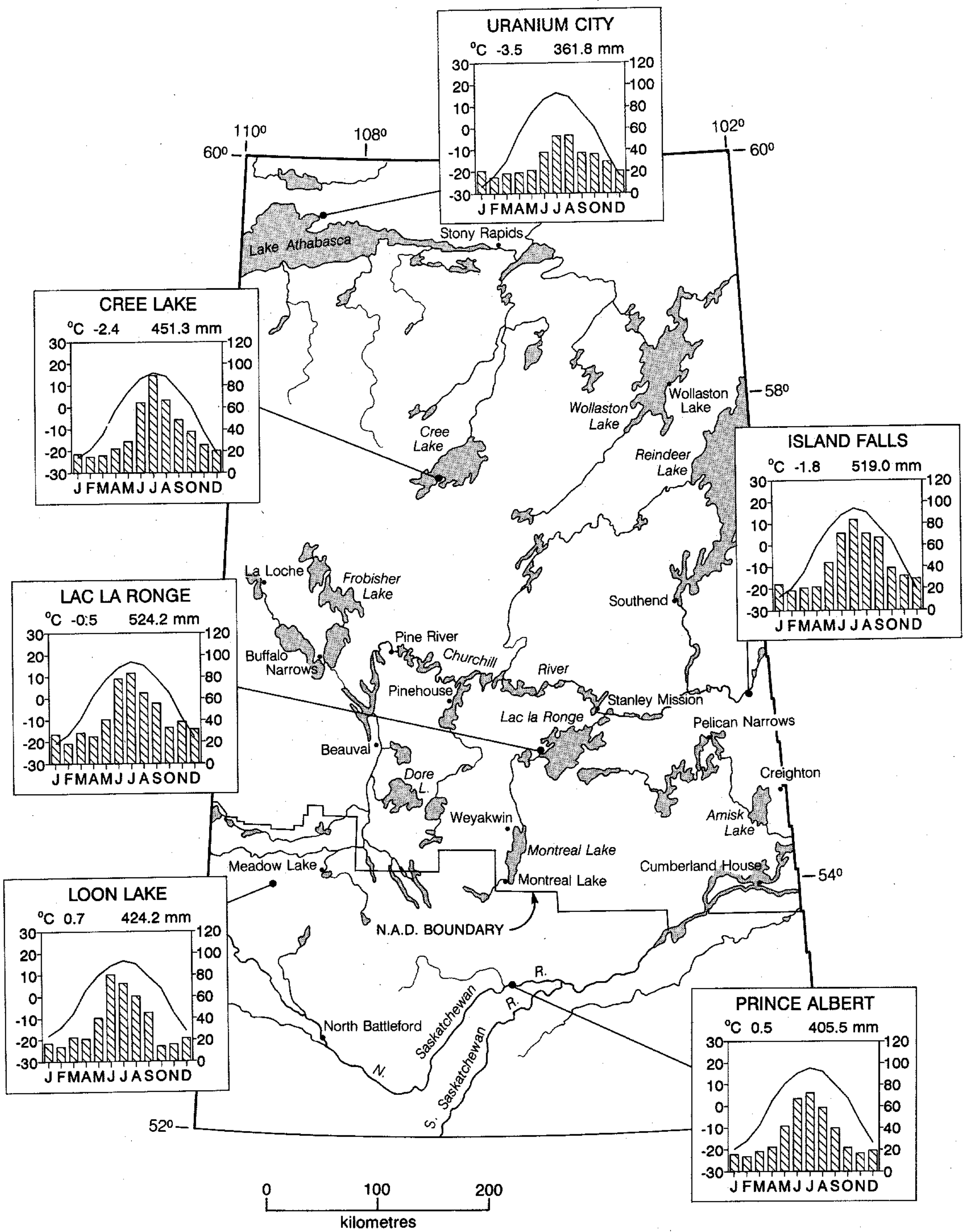


Figure 3 The hydrology and climate of northern Saskatchewan. For each station, average monthly temperatures are shown by the line and average monthly precipitation by the bars. Average annual temperature and total annual precipitation appear below the name of each station.

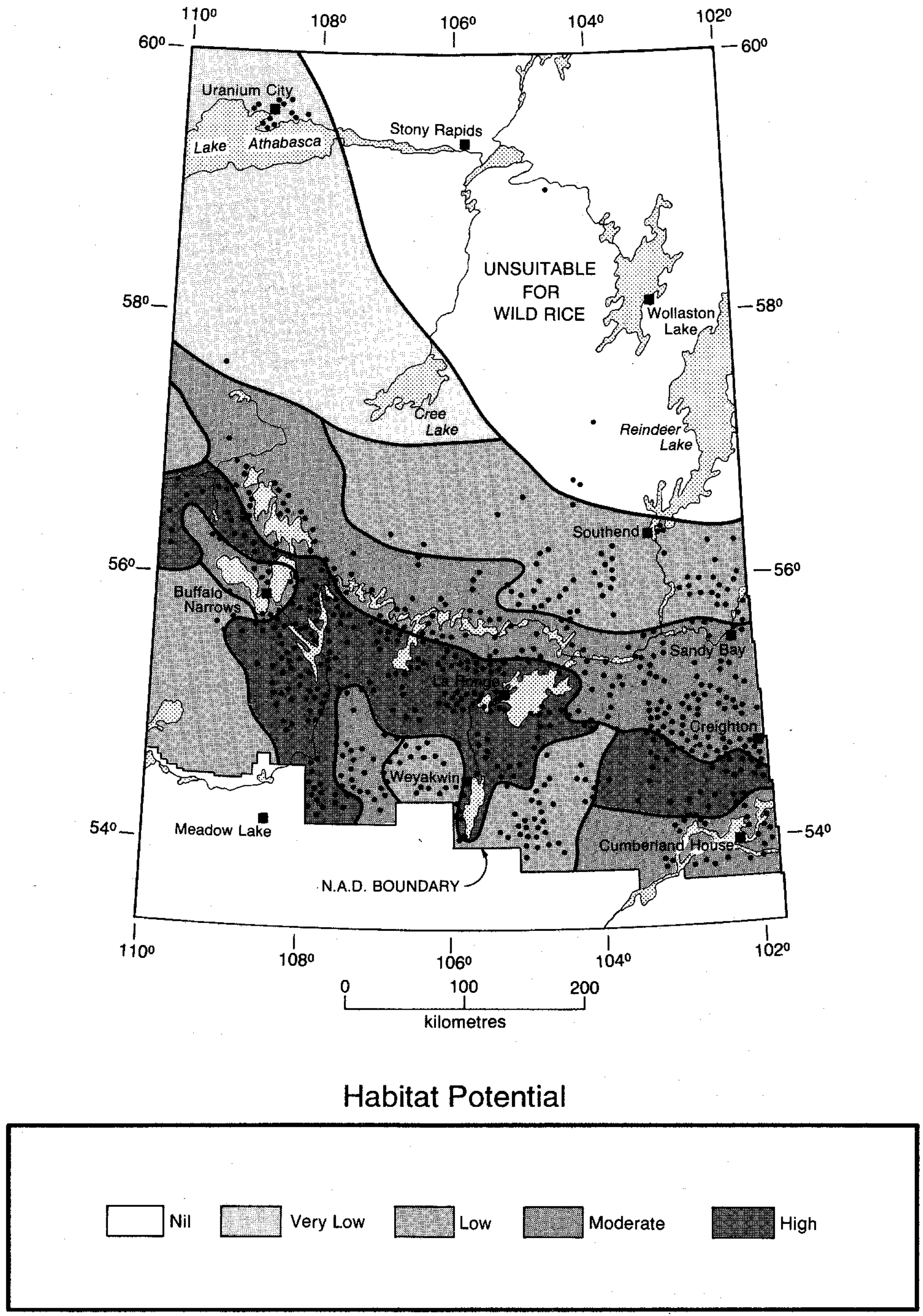


Figure 4 The distribution of growers permits (●) in relation to habitat potential for wild rice in northern Saskatchewan.

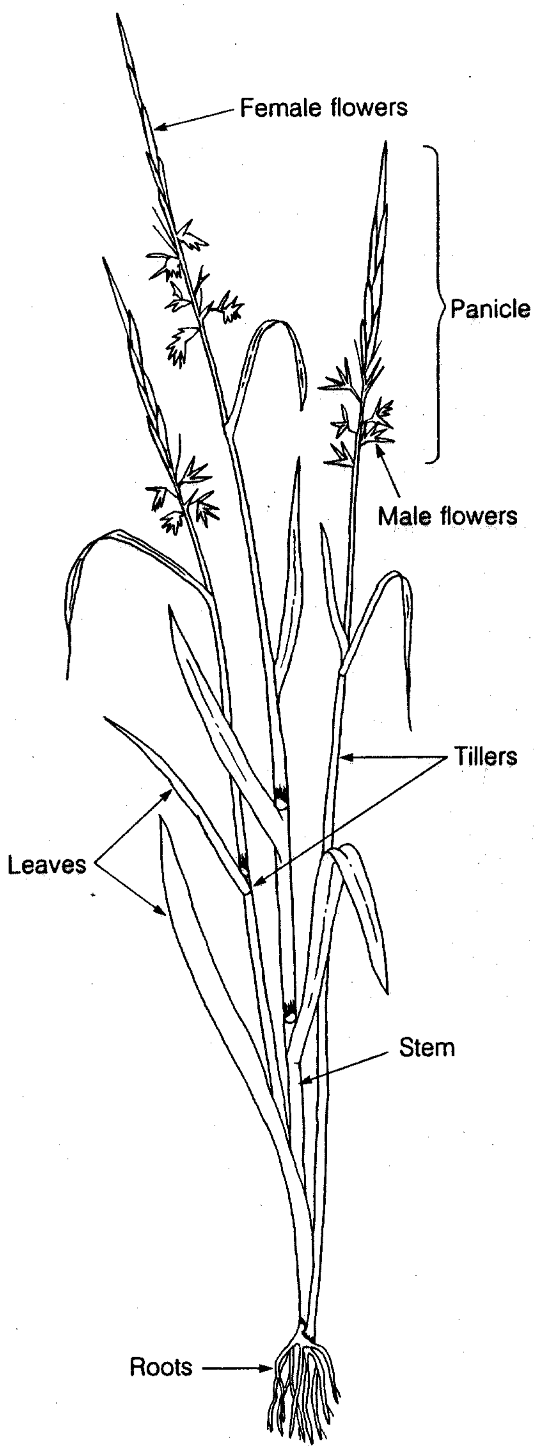


Figure 5 *Zizania palustris*: the commercial species of wild rice grown in Saskatchewan.

wheat, oats, and barley. However, these familiar crops of southern Saskatchewan have all descended from ancestral types that originated in Asia. In contrast, wild rice is native to the Great Lakes region of North America, although its **geographic range** has been extended through deliberate introduction by man over many years. *Zizania palustris* is an **annual** plant that must develop from seed each year. It is the most common commercial species of wild rice in Canada and the northern United States, but other species, distinguished by height and the characteristics of the mature grain, have more localized distributions (Figure 6). *Zizania aquatica* grows in muddy streams and ditches in southern Ontario and Quebec, and *Zizania texana* is a rare, **perennial** species that grows from year to year from long-lived rootstocks. It is found only in the cool waters issuing from a single spring in Texas.

Zizania latifolia, another perennial species, is native to Asia. Its swollen shoots are sometimes eaten as a vegetable, and the plant is also used for forage. Cultivated rice (*Oryza sativa*), the staple grain of South East Asia, is only distantly related to wild rice insofar as they are both members of the grass family.

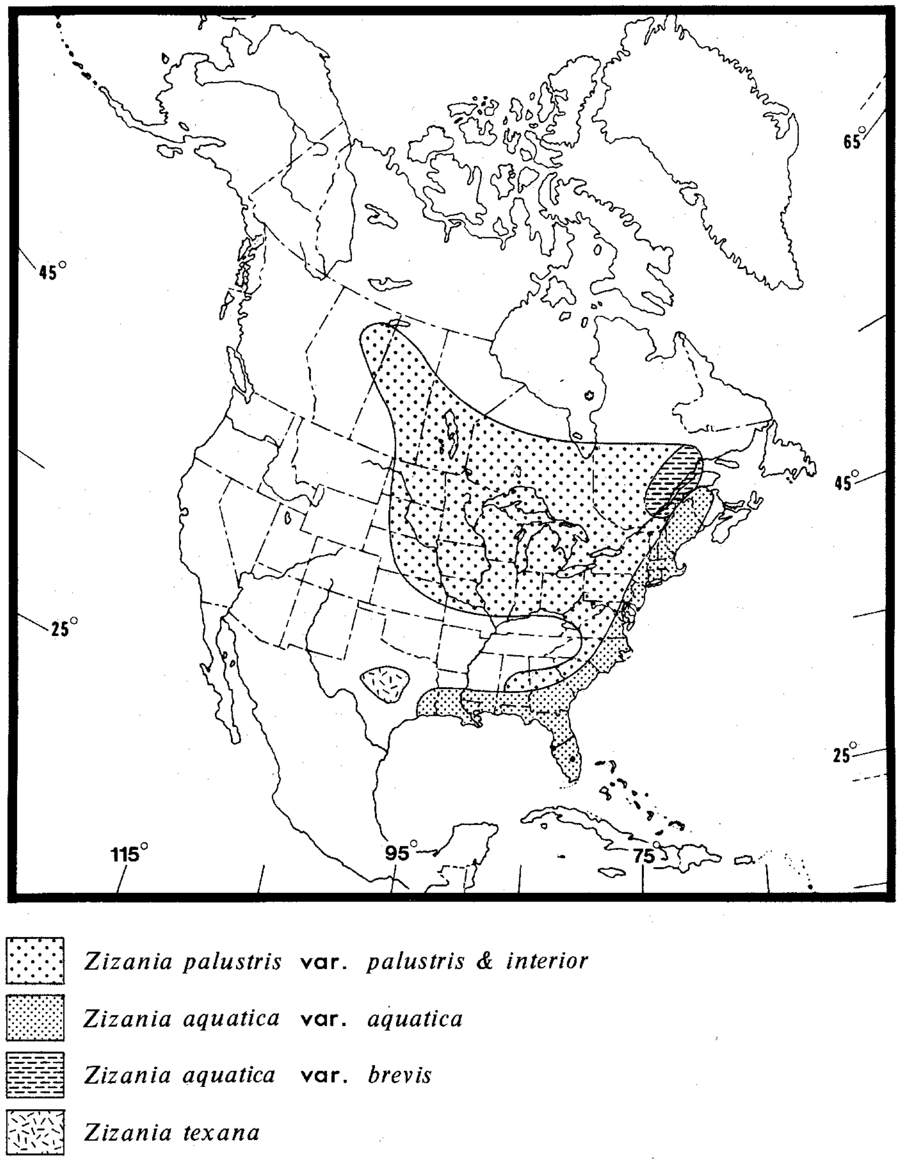


Figure 6 The geographic ranges of wild rice species in North America.

THE GROWTH OF SASKATCHEWAN'S WILD RICE INDUSTRY

Wild rice was introduced to Saskatchewan in the mid-1930s to provide food for muskrats and waterfowl in order to enhance trapping and hunting for northern residents. A few of these early stands persisted into the 1960s, when interest arose in the commercial potential of wild rice.

Commercial harvesting in Saskatchewan began in 1965, and by 1968, had reached approximately 14,000 kg (31,000 lbs). High wholesale prices in the late 1970s, in excess of $15.00/kg ($7.00/lb), spurred enthusiasm. Crop production increased dramatically, both as a result of new stands being established and the greater use of airboat harvesters (Figure 7). Saskatchewan is now the leading producer of wild rice in Canada, with a total of 0.9 million kg (1.9 million lbs) harvested in1993.

Wild rice has been used as a food for centuries in the Great Lakes region, and many stands were established by voyageurs during their explorations of the continental interior. Wild rice is now grown extensively in Saskatchewan, Manitoba, and Ontario. Good production is reported from recently established stands in Alberta, and seeding trials have been carried out in British Columbia, the Yukon, and Quebec. Some local

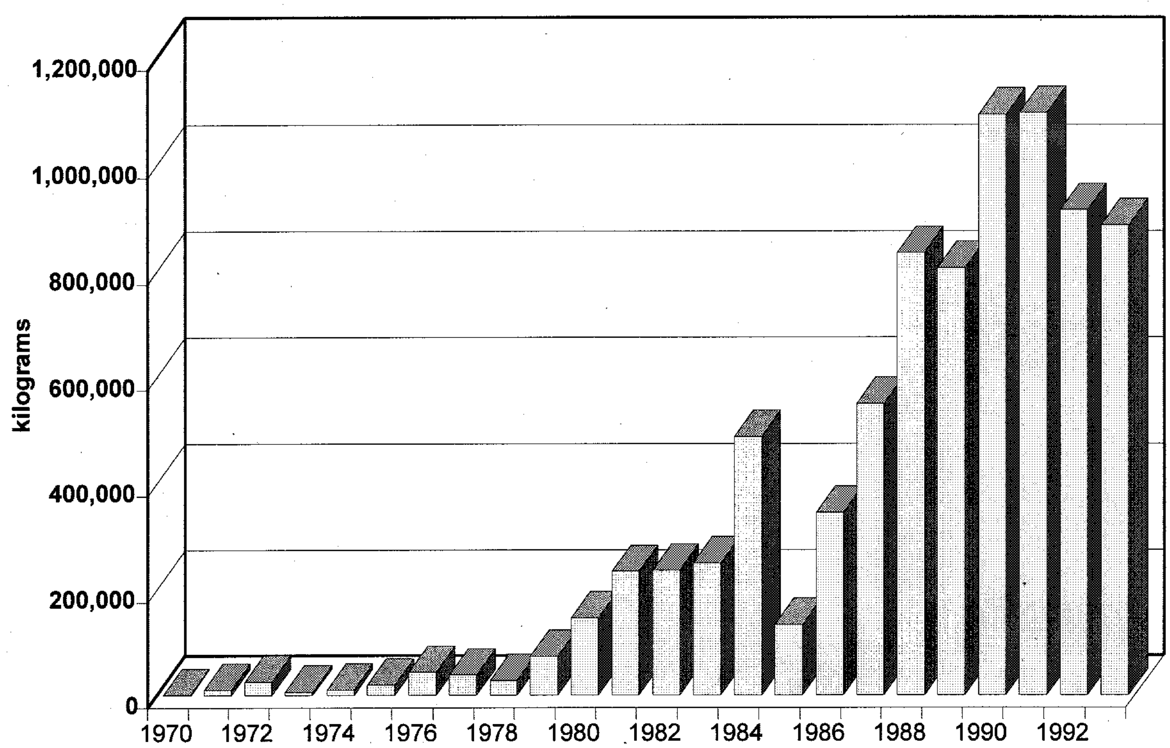


Figure 7 Wild rice production in Saskatchewan 1970-1993.

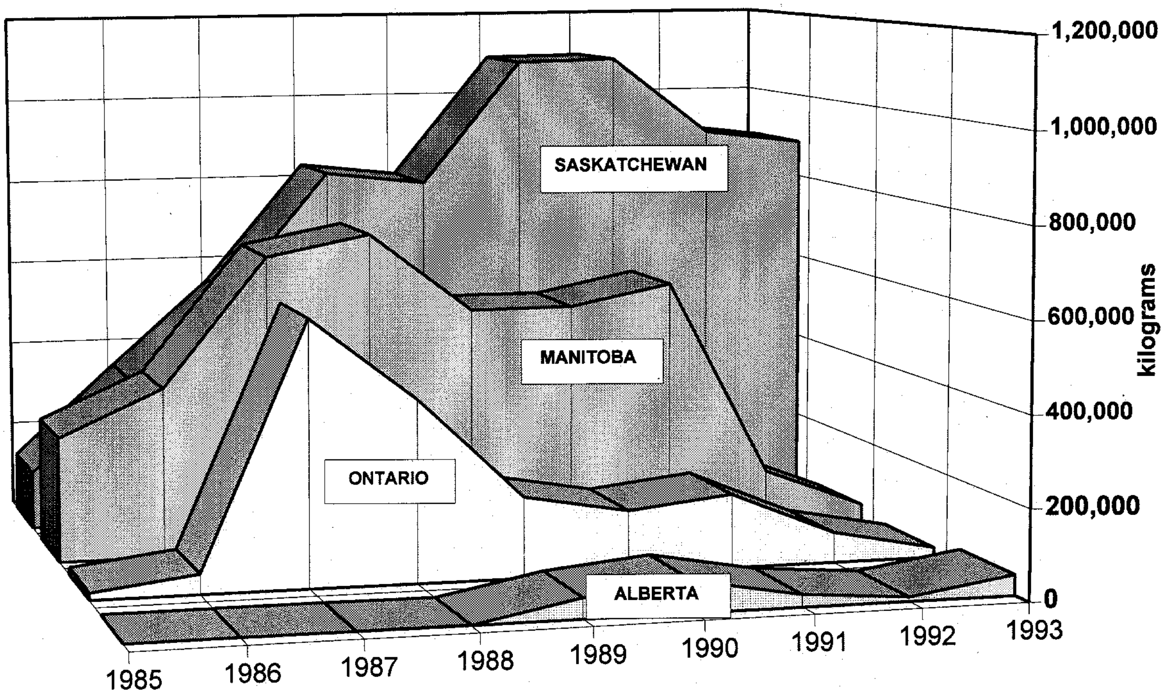


Figure 8 Wild rice production in Saskatchewan, Manitoba, Ontario, and Alberta 1985-1993.

production is also reported from the Maritimes. Annual wild rice production in Canada since 1987 has exceeded 1 million kg (2.2 million lbs); record production was reported in 1991 with nearly 2 million kg (4.5 million lbs) harvested. Saskatchewan production typically accounts for 50% of the Canadian total, but annual yields are greatly influenced by weather conditions. High water levels following excessive snowmelt or heavy rain later in the growing season can reduce yields significantly, and production can be further reduced by strong winds or early-autumn frosts prior to harvest. Dramatic crop failures have occurred in Manitoba and Ontario for these reasons. This is readily seen in Figure 8, which compares wild rice yields in the major producing areas of Canada for the period 1985-1993.

Continued expansion of the industry in Saskatchewan has tended to mask annual variation in production, but large differences in yield do occur at specific sites from year to year. This is clearly illustrated by photographs of a wild rice stand in the Montreal River near La Ronge taken in 1984 and 1985 (Figure 9).

SASKATCHEWAN WILD RICE - A NATURALLY GROWN PRODUCT

Wild rice is sensitive to fluctuating water levels and can easily be drowned or uprooted by rising water. **However, Saskatchewan growers are prohibited from altering water levels without first undergoing a detailed approval process.**

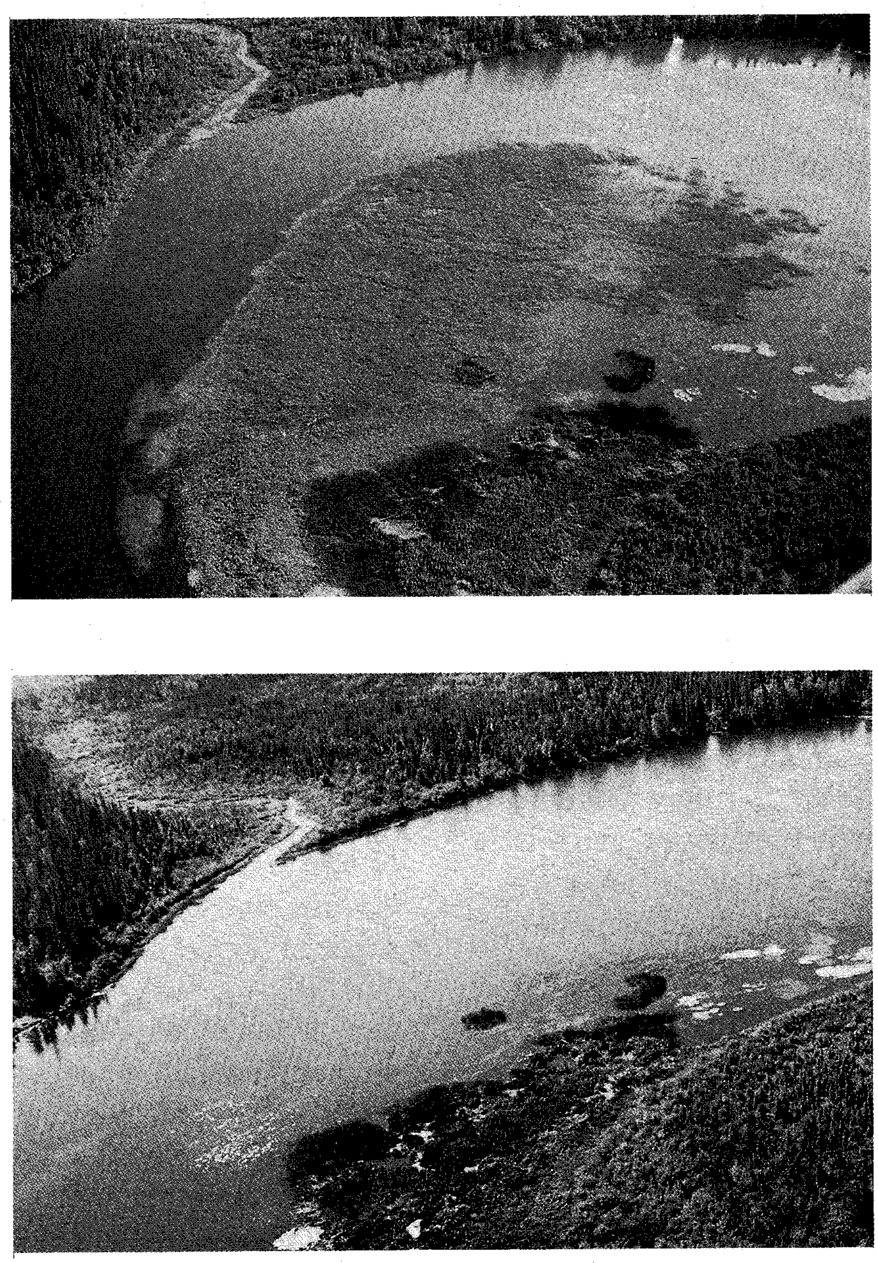


Figure 9 Water depth is critical for growing wild rice as seen in this stand in the Montreal River near La Ronge. High yields can be expected under favourable conditions (upper photograph), but the crop develops poorly when water levels are high (lower photograph).

Wild rice responds to fertilizer and weed control, but **provincial government regulations also forbid the use of any chemicals in northern water bodies**. This policy is stringently upheld by the growers, and the concept of a pristine environment is actively promoted as an important and profitable marketing strategy for Saskatchewan wild rice. Because of this, Saskatchewan wild rice has captured the interest of gourmet and health food industries around the world as a **natural** and **nutritious** product.

COMPETING WITH THE UNITED STATES

Wild rice grown in shallow lakes and streams has been a traditional crop in Minnesota and Wisconsin, and similar stands have been established in Idaho. Fluctuations in yield hampered expansion of the industry in the United States during the early years. In an attempt to stabilize production levels, experiments were begun in the 1950s to grow wild rice under controlled conditions in dyked **paddies**. By 1968, 360 hectares (900 acres) of paddies had been established with yields of 168-225 kg/hectare (150-200 lbs/acre). A variety of wild rice was introduced in 1968 in which mature grains remain on the plant rather than being shed or **shattered** when ripe as is the case with unselected varieties. The nonshattering variety of wild rice grown in paddies is harvested by specially modified combines.

Water depth is carefully regulated during the growing season, and **agrochemicals** are used to maximize yields. The paddies are drained prior to harvest and then reseeded to wild rice in much the same way as other grain crops. Wild rice yields of 1120 kg/hectare (1000 lbs/acre) are typical under paddy cultivation, which is two to three times higher than normally achieved in natural stands. Paddy cultivation has also reduced the problem of unpredictable yields, and this has been an important factor in the expansion of commercial markets for wild rice. By 1980, 5600 hectares (14,000 acres) of paddies had been established in Minnesota, with production in that year totalling 2.6 million kg (5.7 million lbs) compared to 1.1 million kg (2.5 million lbs) from lakes. The year 1980 is significant because paddy wild rice cultivation commenced in California. Within 5 years, production exceeded that of Minnesota, and California is now the leading producer of wild rice in North America (Figure 10).

Over 90% of the world's wild rice is now produced on paddies in these two states. Their combined production in 1993 totalled 12.7 million kg (28 million lbs) compared to approximately 1.0 million kg (2.2 million lbs) in Canada. However, the smaller size of paddy grown wild rice has meant that **Canadian lake wild rice is the preferred choice of the gourmet and health food industries.** With the introduction of mechanization and large scale paddies, wild rice production in the United States is increasingly under the

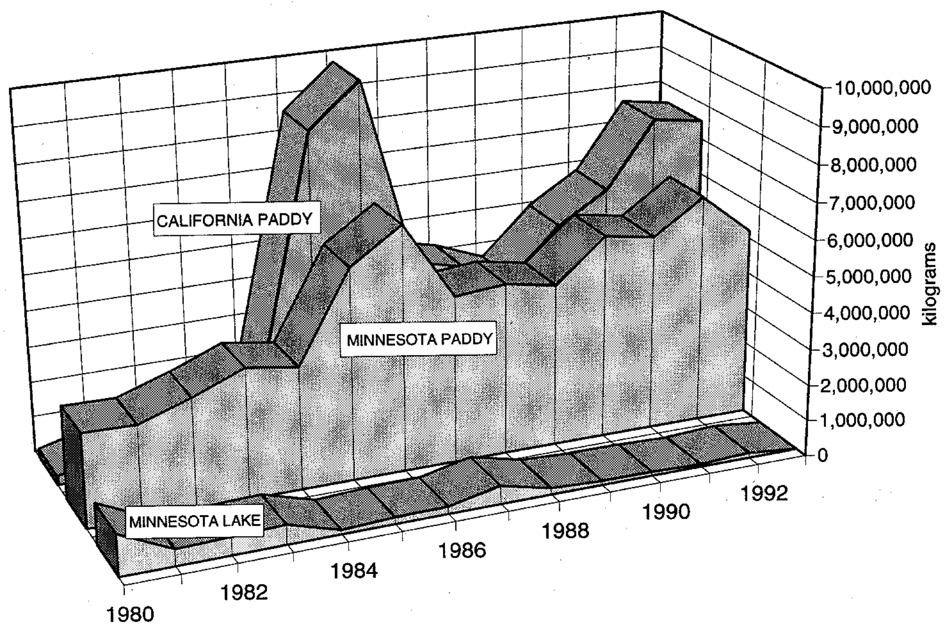


Figure 10 Wild rice production in Minnesota and California 1980-1993

control of non-Aboriginal entrepreneurs and major corporations. However, programs and policies in Canada encourage Aboriginal involvement in wild rice production. This is another important distinction from the United States. In Saskatchewan, the Saskatchewan Indian Agriculture Program (SIAP) has been active in the industry in cooperation with the Saskatchewan Wild Rice Council, a growers' organization with a large Aboriginal membership. Income derived from wild rice has, therefore, become an important supplement to the economy of northern Saskatchewan.

CONTRIBUTION OF WILD RICE TO THE ECONOMY OF NORTHERN SASKATCHEWAN

The Saskatchewan wild rice industry is an important generator of economic activity for the northern part of the province, an area of high unemployment and limited economic opportunities. There are currently 345 northern residents, the majority of whom are of Aboriginal ancestry, who hold permits or licences to grow wild rice. Suitable wild rice habitat covers more than 20,000 hectares (50,000 acres) of waterbodies across northern Saskatchewan, from just south of Cumberland House to Sandy Bay in the east and from Meadow Lake to La Loche in the west. Between 8,000 and 10,000 hectares (20,000-25,000 acres) of this total area are currently in production, indicating that there is potential for expansion of the industry.

In the 5 years prior to 1993, green wild rice sales averaged about $1.5 million annually. In 1993, there were 42 northern residents who generated an income from wild rice of more than $25,000, and some growers reported gross incomes in excess of $100,000.

Every year at harvest time, as many as 1000 northern residents are employed in the harvesting operations which include operating the harvester, bagging, handling, and transporting the product.

Two wild rice processing plants have been constructed in northern Saskatchewan and have been responsible for processing close to 90% of the total production. The processing plant at La Ronge employs about 30 individuals at the height of the processing season, which is generally from September to November. The smaller plant in Denare Beach employs 10-15 individuals during operation. Income from operation of these processing plants is estimated at between $350,000-$500,000 annually.

There are presently more than 250 airboat harvesters in use in the province. Most have been constructed in Saskatchewan, and this industry activity also contributes to the northern economy.

Marketing companies owned and operated by Saskatchewan residents are primarily responsible for developing markets for Saskatchewan wild rice products. As part of their marketing strategy, these companies package some of their product in the province. A number of local residents are employed by a company which undertakes value-added processing and packaging operations in La Ronge.

Pollen is transferred from one plant to another by wind. The grains mature 4-6 weeks after **pollination**. During this time the maturing grain passes through the soft-textured **milk** and **dough** stages until it becomes firm and greenish-black in colour within the encasing hull. The stages of crop development are shown in Figure 13. The first seeds usually ripen by the end of August, and must be quickly harvested because they are readily shed. However, seeds will continue to ripen over a period of several weeks until the plant is killed by frost. Seed loss during harvest is usually

A)

B)

C)

D)

Figure 13 Wild rice seeds start to germinate in the spring. A) The plant reaches the floating leaf stage in June. B) By early July its first aerial leaves develop. C) Flowering starts in late July. D) Seeds begin to ripen towards the end of August.

sufficient to maintain established stands from year to year. Natural losses occur both before and between harvest and often account for as much as 50% of production. Most of this seed will germinate the following spring, but some will lay dormant in the mud for several years allowing good stands to regenerate even after a poor growing season.

Wild rice requires approximately 100 days to mature. The sequence of plant development and the associated activities of the growers are shown in Table 1.

TABLE 1. CALENDAR OF EVENTS FOR THE WILD RICE CROP YEAR IN SASKATCHEWAN

DEVELOPMENT STAGES	GENERAL DATES		GROWER ACTIVITIES
	Date	Day	
Germination	May 15	1	Check water depth. Remove debris that obstructs water flow.
Floating leaf	June 10	26	Changing water depth can be critical. Strong winds could seriously damage crop.
Aerial leaf	June 20	36	Check uniformity of growth. Watch for wildlife that could damage the crop.
Tillering	July 15	61	Observe tiller development. High water levels may reduce tillering.
Early flowering	July 20	66	Observe flower development. Uniform flowering is essential for a good crop.
Pollination	July 30	76	Observe weather conditions. Strong winds, high temperatures, and heavy rain may reduce pollination success and lower yields.
Grain formation	August 5	82	Prepare for harvest. Get harvest equipment ready. Order rice bags and other essential items. Organize for efficient harvesting.
Maturity	August 25	102	Harvesting begins. Before starting to harvest, check ripeness of crop.
Seeding	Late fall Early spring		Fall seeding starts in late September and can continue until freeze-up. Spring seeding starts as soon as the lakes are open.

3. CHOOSING THE MOST PRODUCTIVE WILD RICE HABITAT

Genetic differences in wild rice affect the appearance and productivity of the plants. For example, studies repeated at the same sites over a period of several years indicate that the plants in the western districts of Saskatchewan tend to produce more tillers than those in the east, their stems are thicker, and they bear many more flowers. However, wild rice growing in unmanaged habitats is sensitive to environmental conditions, and this appears to be the most important factor determining crop yield. In the early stages of growth, water depth is critical; the young plants can be drowned or uprooted by wave action. Very hot, dry weather or excessive rain later in the growing season can result in pollination failure, and seed formation will not occur. Mature grains can be lost under windy conditions, and the harvest period is shortened by early frosts.

Regional production statistics in Saskatchewan clearly demonstrate how the

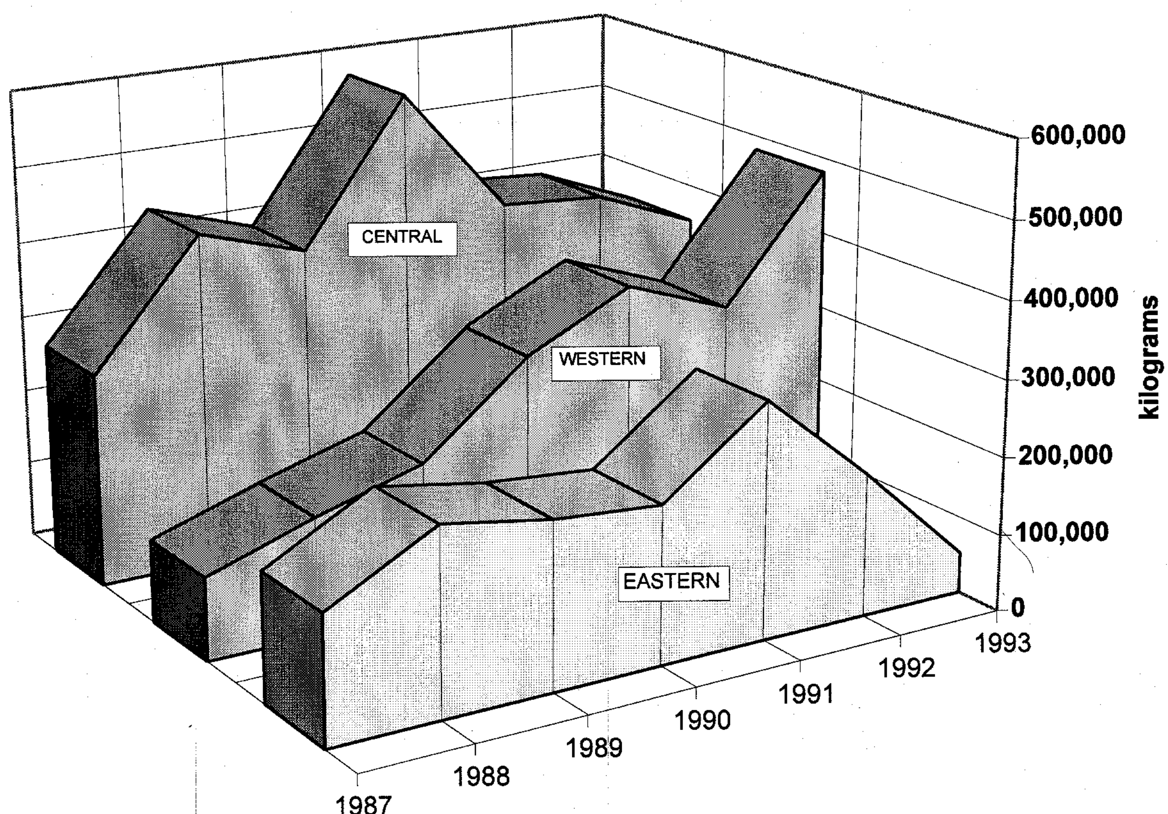


Figure 14 Wild rice production in different regions of Saskatchewan 1987-1993.

yields of wild rice vary from year to year (Figure 14). Production is traditionally highest in the central district, around La Ronge, but in 1993 this dropped to 351,000 kg (774,000 lbs) compared to 481,000 kg (1,060,000 lbs) from Buffalo Narrows and other western sites. Yields were considerably lower in the east, where only 52,600 kg (116,000 lbs) were recovered. Water levels in the central region were very low in the spring of 1993, but many plants were drowned by a rapid rise in lake levels in the floating leaf stage. Conversely, some stands in the west were lost because shallow water made harvesting impossible. Growth was delayed in the east due to cool, cloudy conditions in the spring and summer. Water levels were also much higher than normal throughout the growing season, and many plants in the floating leaf stage were uprooted by strong winds in late-June. Severe frosts occurred in the second week of September, and several growers lost their entire crop. While Saskatchewan's total production went down in 1993, other producing provinces experienced crop failures. Manitoba and Ontario had practically no harvest, and much of the Saskatchewan crop was sold to out-of-province buyers.

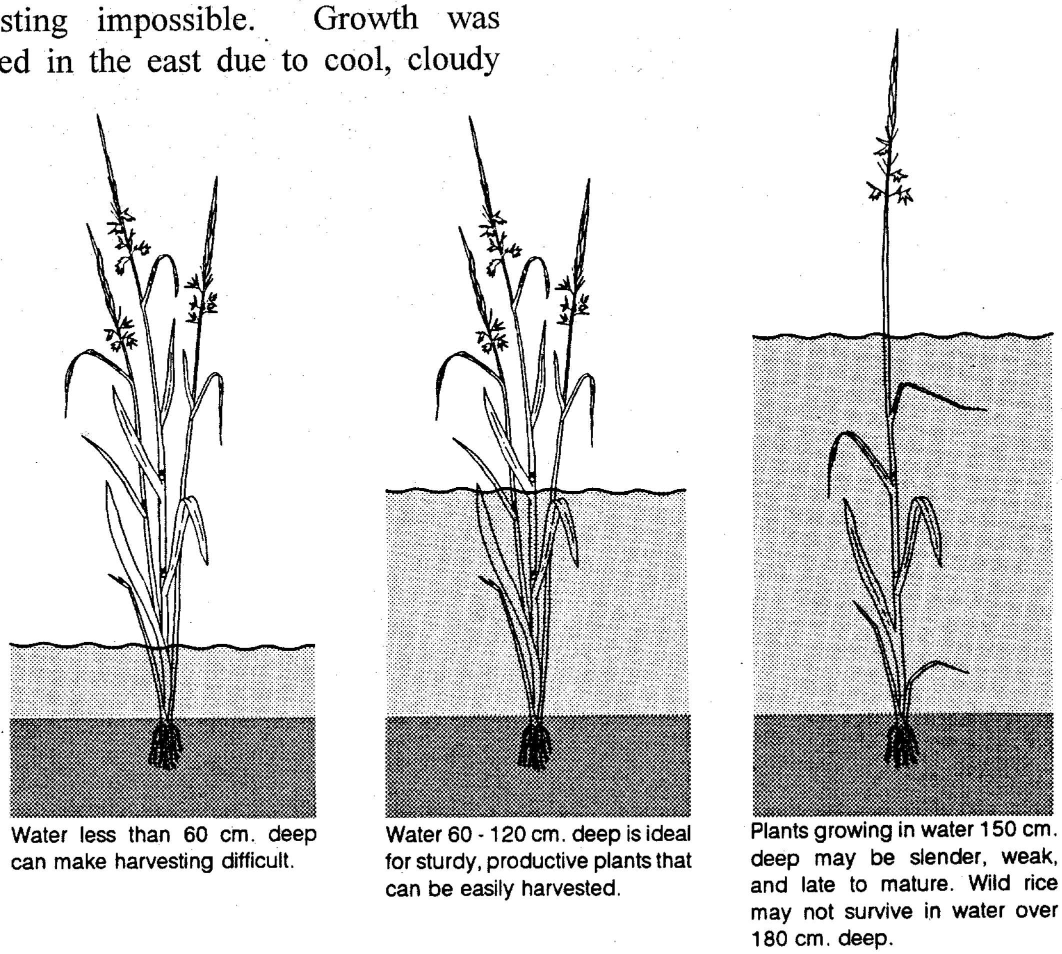


Figure 15 The effect of water depth on the development of wild rice.

Even in years with perfect weather conditions, production at some sites is higher than at others because the growth and development of wild rice is influenced by many environmental factors specific to each site.

WATER DEPTH

Wild rice will grow in water up to about 1.8 m (6 ft) in depth, but water depth is the most critical factor affecting crop development (Figure 15). If the water is too shallow, it will be impossible to harvest the crop. Tillering is reduced in deeper water, and the long spindly plants produce fewer seeds. Water depths ranging from 75-90 cm (2.5-3 ft) are ideal for commercial production where mechanical harvesters are used.

Water depth is most critical in the spring when the seeds germinate. The first leaves that develop are thin and limp and remain submerged. The floating leaves develop a waxy coating which prevents **gas exchange** with the water. In very deep water, light levels are too low for proper growth; the leaves cannot reach the surface, and the plants drown. Wild rice seldom grows where the water level rises and falls by more than 90 cm (3 ft) during the course of the growing season. A sudden rise or fall of 15 cm (6 inches) during the floating leaf stage can damage the young plants. Midsummer flooding allows waves to batter the plants and eventually uproot them.

Figure 16 Stem breakage and lodging are common problems when wild rice grows in shallow water.

In contrast, a significant drop in water level causes the plants to fall over and fail to straighten, called **lodging** (Figure 16). If an airboat harvester is used, the plants will get broken and most of the crop will be lost. A gradual drop in water level during the summer is normal and does not affect the crop.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ The ideal water depth is 60-120 cm (24-48 inches). ■ Water depth should not fluctuate greatly over the course of the growing season. A constant or gradually declining water level is preferred. ■ Sites should be free of rocks, logs, and plant debris which may damage harvesters. ■ **Artificial regulation of water depth is prohibited**.

WATER CIRCULATION

Wild rice grows well in lakes and streams where there is some water movement. In northern lakes natural water circulation occurs in the spring and fall. Oxygenated surface waters and nutrients are carried below and enrich the sediment and deeper layers of the lake. This helps to maintain the healthy ecosystem in which wild rice flourishes. Water circulation will also carry away dead plants; this prevents the accumulation of straw which can smother next season's crop.

In bigger lakes, good sites are often found in bays or sheltered areas where nutrients are carried in by streams or rivers (Figure 17). Stagnant ponds are typically unproductive because of unfavourable sediment chemistry. The absence of **oxygen** causes the sediments to become **anaerobic** and results in germination failure and nutrient imbalances. Fast flowing rivers are also poor wild rice sites because the coarse roots do not provide good anchorage, and the plants are easily uprooted by the currents.

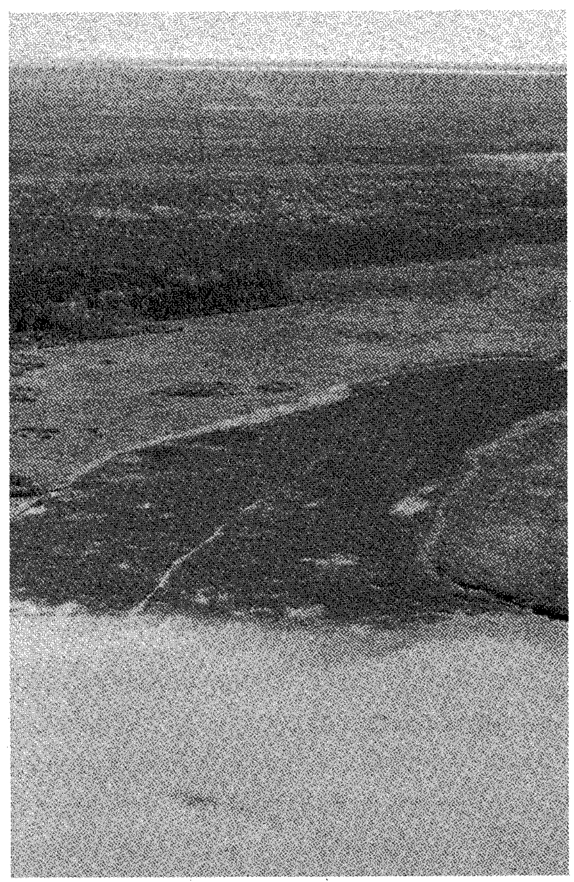


Figure 17 Slow moving rivers, such as Limestone River in eastern Saskatchewan, can be very productive wild rice sites.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ Good sites are often located in sheltered bays on large lakes where water circulation is sufficient to stir up the sediments and carry away dead straw. ■ Good circulation occurs in sheltered bays with inflowing or outflowing streams. ■ The sluggish current in wide, slow-moving streams can provide ideal conditions for wild rice.

WATER CLARITY

The small wild rice plants require sunlight as they begin to grow under water. If the water is too deep or clouded with fine suspended material, there may be insufficient sunlight getting to the bottom of the lake. An unbroken layer of floating algae, scum, or plant debris will also affect light penetration. Conditions like these are bad for growth.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ Water must not be so muddy that light cannot penetrate. ■ Water must be free of algal scum.

WATER QUALITY

Water quality refers to the **nutrient** levels and other chemical properties of the water. Dissolved salts, particularly **sulphates**, and gases like **carbon dioxide** all influence the quality of the water. Wild rice will not grow well in mildly **acidic** water that is low in essential nutrients. Neither will it grow well in **alkaline** and **saline** water. Thus, it is never successful in the sloughs and ponds in southern Saskatchewan.

Water quality can be assessed by using instruments to measure the **pH** and **conductivity** of the water (Figure 18). The pH meter measures the acidity of the water on a scale of 1-14; it provides an indirect measure of nutrient concentrations. Water samples with a pH value of 7 are considered neutral; values lower than 7 are acid, and values higher than 7 are alkaline. Waterbodies with a pH of 7-8 are ideal for wild rice, but good growth has been reported over a pH range of 6-8.5. Very acidic (pH 4-5), nutrient poor water that drains from bogs is not good for wild rice. A conductivity meter measures the concentration of dissolved mineral salts in the water. Best growth occurs in water with a conductivity reading of 100-250 units, but suitable conditions range from 60-300 units. Nutrient levels may be inadequate below 60 units, and above 300 units, some minerals may be approaching toxic concentrations.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES

- Water should be slightly alkaline, with a pH of 7.0-8.0, and a conductivity of 100-250 units.
- Water cannot be salty.
- Water cannot be polluted with industrial oils and detergents.
- **Addition of fertilizers is prohibited.**

Figure 18 On-site measurements of habitat conditions will help to determine site quality.

Wild rice absorbs most of its nutrients from the sediments. It will grow on a variety of sediments, but the most productive stands are typically associated with soft **organic** materials that are easily permeated by roots. This bottom layer should be at least 45 cm (18 inches) thick to allow the root system to develop properly. Good root development is necessary for secure anchorage of the plants. If the sediment is too loose, the plants may pull out easily. Similarly, the plants may be swept away if they cannot penetrate hard substrates. Bare sand, gravel, or rock should be avoided.

The sediment on the bottom of lakes is naturally low in oxygen, and consequently, many chemical compounds exist in a **reduced** (un-oxidized) state. For example, iron is present in its highly soluble **ferrous** form, and this can limit the uptake of more essential nutrients. Wild rice, like most aquatic plants, can supply oxygen to its roots through specially modified, hollow stems. Surplus oxygen transmitted through the plant passes out of the roots and into the sediments. Toxic concentrations of iron, manganese, and other elements are prevented from accumulating in this way. The rust staining on roots is evidence of this process of **radial oxygen loss.** An extreme case of reduction occurs in mud which gives off **hydrogen sulphide** gas when disturbed. Such sediments smell of ‘‘rotten eggs’’ and should be avoided.

The state of **oxidation** is a major factor affecting wild rice production. Many sites which are seeded to wild rice seem incapable of nurturing the crop for this reason. Seeds do not germinate or seedlings die before aerial leaves emerge from the water.

Researchers have used **Eh** meters to measure in millivolts (mV) the condition of the sediment in order to test the productivity of a potential site. Eh meters can be purchased through most scientific equipment supply companies. In normal, well aerated agricultural soils, Eh readings are positive, but in waterlogged sediments Eh readings fall below zero because oxygen diffusion from the atmosphere is limited. Eh readings in productive wild rice lakes are generally above -200 mV, and preferably above - 150 mV. The sediment should be disturbed as little as possible during sampling, and several samples should be taken at each site at depths of between 5-10 cm (2-4 inches).

A piece of iron submerged at a potential site can be used as an alternate and practical method of assessing Eh characteristics. The iron will rust more quickly under well-oxygenated conditions, and this is indicative of a better site.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ An organic sediment about 75 cm (30 inches) thick is ideal, although 20 cm (8 inches) will do. Many commercial sites have more than 1 m (40 inches) of sediment. ■ Avoid very loose ooze. ■ Avoid bare sand, gravel, or rock. ■ The sediment must have a sufficient supply of oxygen for proper root growth. Avoid sediments which smell of "rotten eggs". ■ Test sediment Eh; a reading above -150 mV is considered suitable for wild rice.

PROTECTION FROM WIND AND WAVES

A well-sheltered site is important for wild rice. A lot of wave action will uproot the buoyant young plants, particularly during the floating leaf and early **emergent** stages. Strong winds at harvest time will shatter the ripe grain. Good sites might be found in smaller lakes or bays surrounded by tall trees or behind islands (Figure 19).

However, some water movement can be beneficial. Good stands of wild rice are often found in locations where old plants are uprooted by ice movement during spring break-up. Uprooting the plants loosens the soil and mixes oxygen into it. It also prevents a build-up of dead stems from several seasons of growth. Such heavy straw accumulations can smother the seed and young plants. It also promotes decomposition which diverts oxygen to **bacteria** and other organisms. Straw can be a problem in very sheltered sites; this is discussed further in section 4.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ Wind and waves can uproot wild rice plants and increase shattering losses of mature grain. ■ The larger the lake and straighter the shoreline the more shelter is required. ■ More shelter is required as water depth increases.

Figure 19 Shelter from strong wind and wave action is critical for successful production of wild rice. Islands and tall trees often provide the best protection.

Plant competition

Wild rice is an annual plant with high light requirements and consequently does not compete well with taller, emergent perennials such as spike rush (*Eleocharis palustris*) and cattails (*Typha latifolia*) which renew growth early in the spring. The types of plants growing in the shallow waterbodies can be used as indicators of site conditions. The best **plant indicators** for good sites are yellow pond lilies, water milfoil, and the pond weeds that are known scientifically as *Potamogeton pectinatus* and *P. richardsonii* (Figure 20). Small growths of these plants indicate a good site, but dense patches of fine leaved plants, especially of water milfoil (*Myriophyllum exalbescens*) and coontail (*Ceratophyllum demersum*), as well as Richardson's pond weed (*Potamogeton richardsonii*), may provide too much competition for wild rice by taking up essential nutrients, shading out the seedlings, or entangling the young plants and preventing them from reaching the surface. A site which supports mainly bladderwort (*Utricularia vulgaris*) or white water lilies is likely to be a poor place for wild rice because these plants can grow in nutrient-poor, acidic waterbodies (Figure 21).

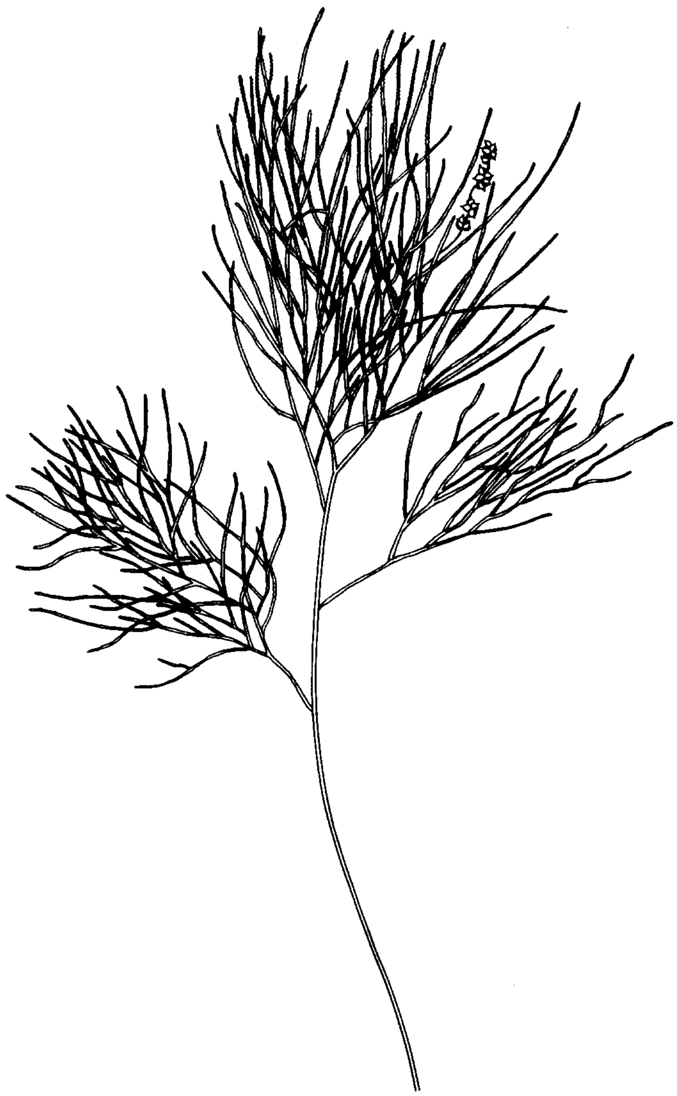
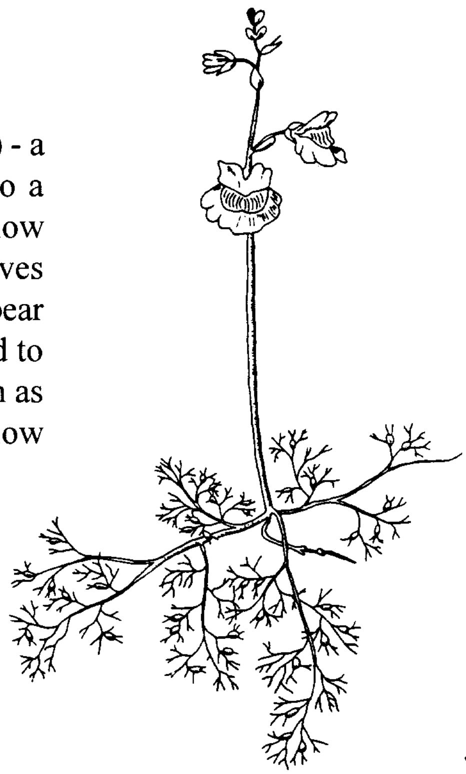
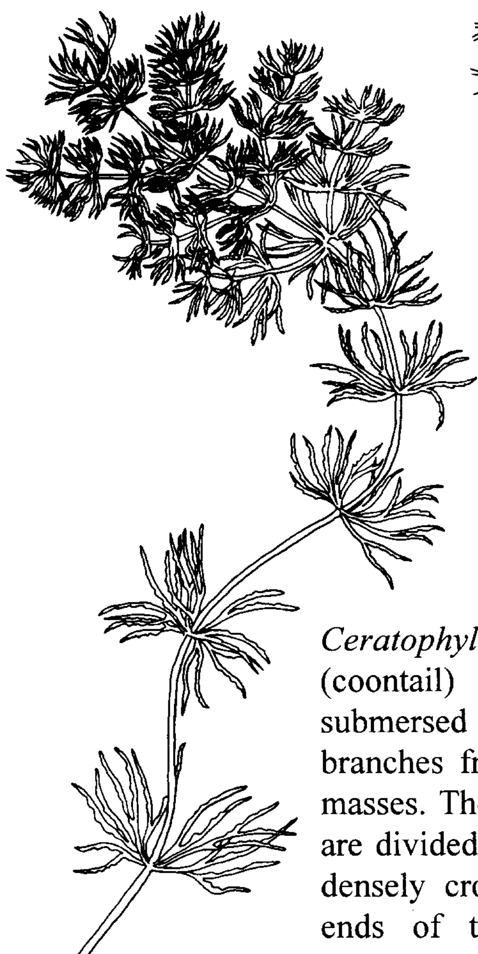


Figure 20 *Potamogeton* spp. - perennial pondweeds with fibrous roots developing from the lower part of the stem. The species found in wild rice habitats are completely submersed, although flowers are sometimes seen projecting above the water. The different species can be distinguished by their leaves. *P. pectinatus* has long threadlike leaves: *P. richardsonii* has broader, clasping leaves and is the commoner of the two species.

Figure 21 Common aquatic plants found in wild rice habitats.

Utricularia vulgaris (bladderwort) - a submersed plant with stems up to a metre in length that float just below the surface of the water. The leaves are small and much-divided, and bear numerous bladders which are used to trap and digest small animals such as water fleas. Clusters of small, yellow flowers develop on long stems.





Ceratophyllum demersum (coontail) - a completely submersed aquatic plant which branches freely to give dense masses. The thread-like leaves are divided, and become more densely crowded towards the ends of the branches. The flowers are very small and seldom observed, but produce abundant fruits that are an important food of aquatic birds.

Myriophyllum exalbescens (water milfoil) - an aquatic perennial plant with elongate, branching stems which arise from a creeping rhizome. The fine feather-like leaves are arranged in whorls or clusters around the stem. Small purplish flowers appear in summer protruding above the water on a short spike.

The presence of water lilies affects a wild rice crop. The shade of the lily pads which float on the water may prevent the growth of the aquatic plants that remain completely submerged. Early germination and rapid development usually allow wild rice to become established before the leaves of the water lilies are fully expanded (Figure 22). However, if large colonies of water lilies completely cover the water surface, they prevent light penetration, the growth of wild rice ceases, and the crop dies.

A similar effect occurs with bur-reed (*Sparganium eurycarpum*), which develops ribbon-like floating leaves as it begins to grow. At this stage, the young bur-reed plants are often mistaken for wild rice, and this can cause further disappointment when what appears to be a promising crop fails to develop (Figure 23).

Small free floating plants such as duckweed (*Lemna minor*) and dense blooms of algae can sometimes interfere with wild rice in the early stages of growth.

Similarly, in very dense stands of wild rice, plants will compete with each other for light and nutrients. This is usually not a serious problem in unmanaged natural stands, but thinning is often required to maximize yields in paddy crops. Stem densities in productive wild rice stands in Saskatchewan typically range from 40 to 60 stems per square metre (4-6 stems per square foot), compared to more than 300 stems per square metre (30 stems per square foot) in unthinned paddies where each plant may develop as many as 50 tillers. Additional information about thinning can be found in section 4.

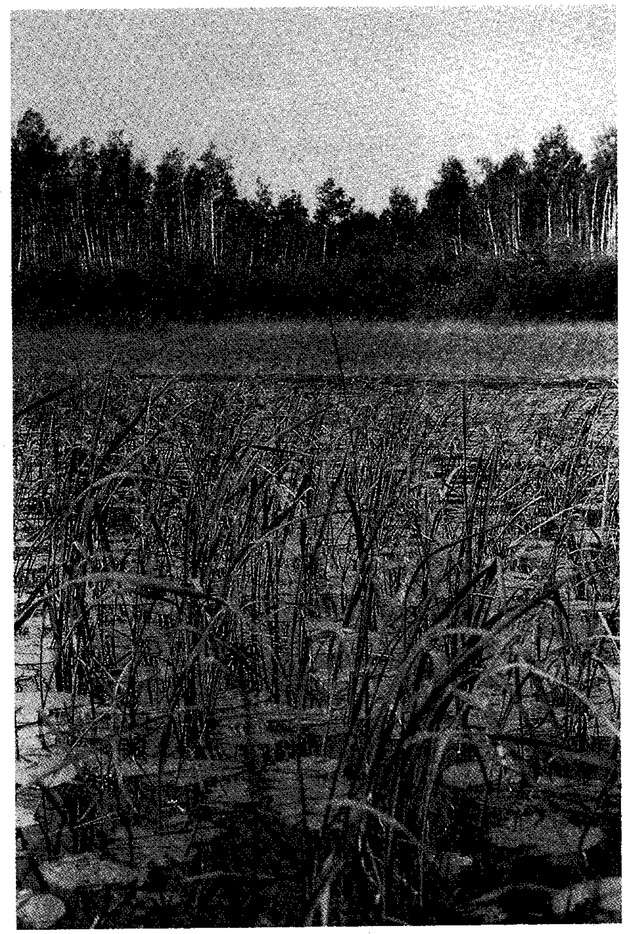


Figure 22 Although waterlilies are an indication of a good site, a thick growth should be avoided as this can shade out the wild rice.

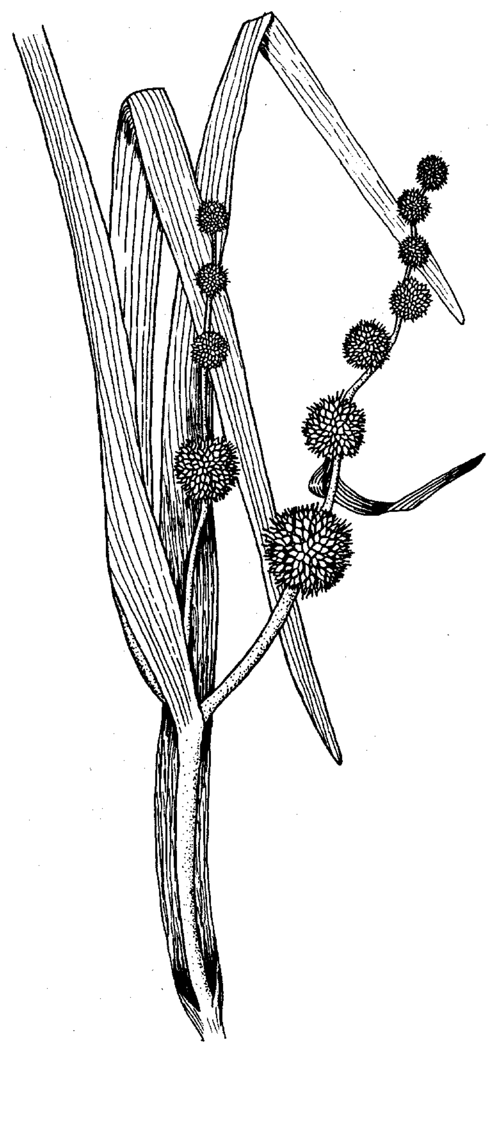


Figure 23. *Sparganium eurycarpum* (bur-reed) - a stout, erect plant that grows up to 1.5 metres (5 feet) tall. It has long thin leaves, which in the young plants float on the surface of the water and are often mistaken for wild rice. The flower head is branched and eventually bears hard spherical fruiting bodies comprised of many small nut-like achenes each of which contains two seeds.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ A site that is naturally devoid of aquatic plants should be avoided. ■ Good wild rice sites usually support yellow water lilies and various pond weeds. ■ Too many plants may be a problem as they will compete for light and nutrients.

ANIMAL PESTS AND DISEASES

Wild rice is relished as a food source by wildlife. Waterfowl, muskrats, beavers, and moose consume the plants. A stand of wild rice provides resting, foraging, nesting, and brooding sites for resident and **migratory** water birds. Ducks feed mainly upon mature seeds, although they will also eat the floating and newly-emerging aerial leaves. However, losses to resident populations are not great, although further damage can occur when migratory birds land in mature stands prior to harvest and shatter the seed into the water. Muskrats can cause considerable damage by clipping the plants at water level as they construct their mounds, and occasionally some stands may fail to establish because of this. Beaver are more troublesome because they can raise water levels by constructing dams. Conversely, beaver dams may serve a useful purpose by keeping water in a lake during very dry seasons. Beavers can also use wild rice for food or building materials for their lodges, and plants can be uprooted when water lily roots are pulled out. Grazing by moose and deer can cause local damage.

Insect depredation and losses from fungal, bacterial, and viral diseases are most prevalent in paddy grown wild rice in the United States, but some damage is reported in Canadian wild rice stands in Ontario and Manitoba. Most damage is attributed to the riceworm (*Apamea apamiformis*) which feeds on the developing grain. The rice stalk borer (*Chilo plejadelus*) feeds on the lower stems of wild rice plants, making them susceptible to breakage or causing incomplete development of the grain. Reduced yields are also attributed to leaf spot, smut, and similar microbial **pathogens**.

Fortunately, these sorts of crop losses are not a problem in Saskatchewan. Easy control can only be achieved with the use of pesticides, but this is expressly forbidden in northern waterbodies. The policy is upheld by Saskatchewan wild rice growers who realize the importance of marketing a natural product.

GUIDE FOR IDENTIFYING PRODUCTIVE WILD RICE SITES
■ Animals such as beavers, muskrats, and water fowl can have a direct impact on wild rice. Check local regulations regarding trapping and hunting. ■ Mechanical scares are prohibited. ■ Insect pests and diseases can only be controlled easily by application of chemical or biological pesticides. **Pesticide use is forbidden in Saskatchewan.**

SELECTING A POTENTIAL SITE FOR WILD RICE

Wild rice, like any plant, will grow under a variety of habitat conditions, and site potential cannot be determined by any single factor. For example, sites with ideal water depths may be exposed to strong winds and wave action or be underlain by sandy sediments. Once a site has been found that seems suitable for growing wild rice, it should be compared with an area that supports a successful crop. The accompanying checklist (Table 2) can be used to evaluate site conditions.

Good crop development can be expected if all factors are at least within the "suitable" range. The best procedure is to test seed the site once the necessary permits have been obtained. Use 7-10 kg (15-20 lbs) of seed at a seeding rate of approximately 18 kg seed/hectare (20 lbs seed/acre) to establish one or two small plots.

Keep a record of site conditions and crop performance in a notebook. Drive a pole into the sediment near the test plots, mark the water depth on it at the start of the growing season and make a note of any changes over the summer together with general weather conditions. Check the performance of the wild rice throughout the growing season. Record the dates when germination and seedling establishment occurred and monitor plant development through the floating leaf, aerial leaf, and flowering stages. Note the general condition of the plants and measure the **stand density** (number of stems in a 1 × 1 metre square or a 3 × 3 foot square) at three or four points within the trial plot. If plants begin to die or disappear, or if they are damaged by birds or other animals, write down the dates when this first occurs. The information in the record book will be useful when deciding if the site is suitable for full scale planting.

If the trial seeding grows poorly or not at all, it would be advisable to test the quality of the sediment and water. Contact the agricultural specialist in your area to arrange for on-site testing for pH, Eh, and conductivity. If more complete testing for specific nutrients is needed, check your phone book for listings of companies that perform laboratory testing, such as the laboratory on campus of the University of Saskatchewan, Saskatoon.

Finally, it should be noted that sites should be accessible by road or boat so that equipment and harvested wild rice can be easily transported. If the site can be reached only by float plane, sufficient wild rice must be harvested to bring in enough money for the operation to be profitable (Figure 24).

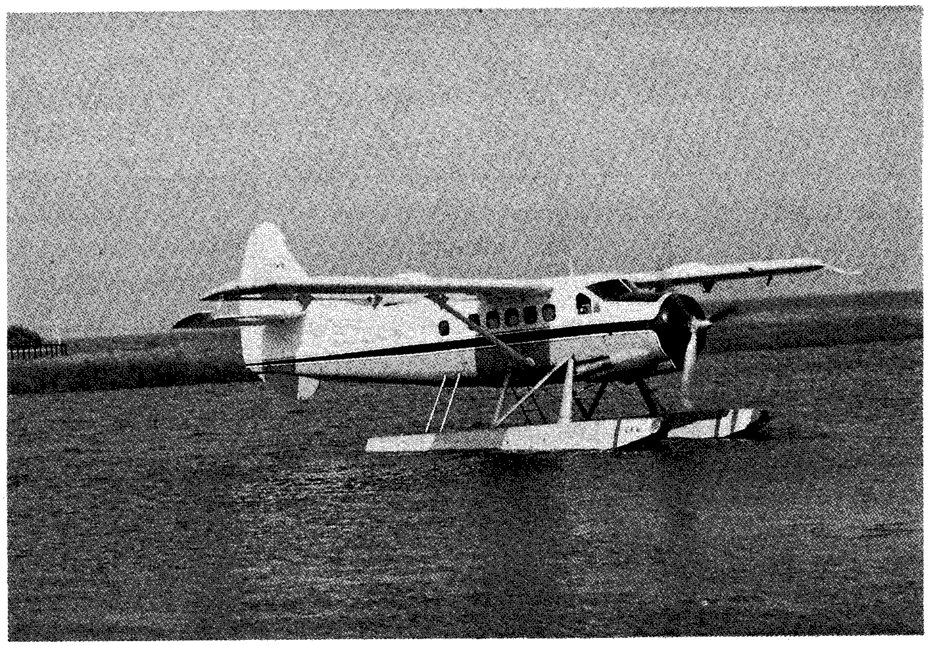


Figure 24 Some wild rice sites may be accessible only by float plane and production levels must justify the added cost of transport.

TABLE 2. WILD RICE HABITAT SUITABILITY CHECKLIST		
CRITERIA	IDEAL WATERBODY	SUITABLE RANGE
Water Depth	75 - 105 cm (2.5 - 3.5 ft)	45 - 75 cm or 105 - 135 cm (1.5 - 2.5 ft) or (3.5 - 4.5 ft)
Fluctuations in Water Depth	Slight and gradual change during growing season	Moderate and gradual change during growing season
Water Clarity	Bottom sediment visible through tea-coloured water	Visibility good at least to 45 cm (1.5 ft)
Water Movement	Water body with continuously flowing inlet and outlet	Water body in which some flow occurs during the growing season
Water Quality	pH 7 - 8 conductivity 100 - 200 units	pH 6 - 7 or 8 - 8.5 conductivity 60 - 100 or 200 - 300 units
Type of sediment	Dark organic sediment mixed with silts and clays	Most types of sediment, except sandy, gravelly, rocky or very light coloured clay
Sediment Firmness	Soft, but forms a ball when squeezed	Soft, and at least half of the material forms a ball when squeezed
Sediment Thickness	Over 45 cm (over 18 inches)	15 - 45 cm (6 - 18 inches)
Sediment redox potential (Eh)	Eh reading higher than -150 mV	Eh reading between -150 mV and -200 mV
Weeds (emergent, floating, and submerged)	Cover less than 10% of site	Cover 10 - 30% of site
Shelter	Bays protected from wind, tall trees around the shore, or small lakes	Sufficient shelter to minimize uprooting of young plants
Accessibility	Good access for truck and boat launching	Area can be reached by truck or boat
SUCCESSFUL DEVELOPMENT MAY OCCUR WHEN ALL FACTORS ARE AT LEAST WITHIN THE SUITABLE RANGE		

4. Growing Wild Rice in Saskatchewan

Before beginning to cultivate wild rice, it is necessary to obtain a permit for the area to be seeded. Permits are available from District Environment and Resource Management Offices or Sustainable Land Management Branch in Prince Albert. The regulations covering wild rice in Saskatchewan are discussed in section 10.

Once a site has been selected and the necessary permits obtained, the process of establishing a commercial stand of wild rice can begin. This requires three main activities. First the site must be seeded. Next the stand must receive proper care and attention to optimize plant growth, and finally harvesting must be carried out efficiently to maximize yields.

Effective Seeding Methods

Seed Selection

Many local strains of wild rice grow in Saskatchewan each having certain growth characteristics that can be observed in specific areas of the province. For example, several different types of flower heads occur, ranging from a single unbranched spike to a densely branched panicle (Figure 25).

Wild rice plants in eastern Saskatchewan commonly develop smaller flower heads than those in the west (Figure 26).

Figure 25 The different panicle (flower head) types identified in studies of lake grown wild rice in Saskatchewan.

Such morphological differences determine the potential yield from each plant, which ranges from about 20 - 100 seeds per stem. Differences in mature seed weight and seed size also occur. This will affect the quality or grade of rice that is produced, particularly if the plants are late maturing. This is the case in the northwestern

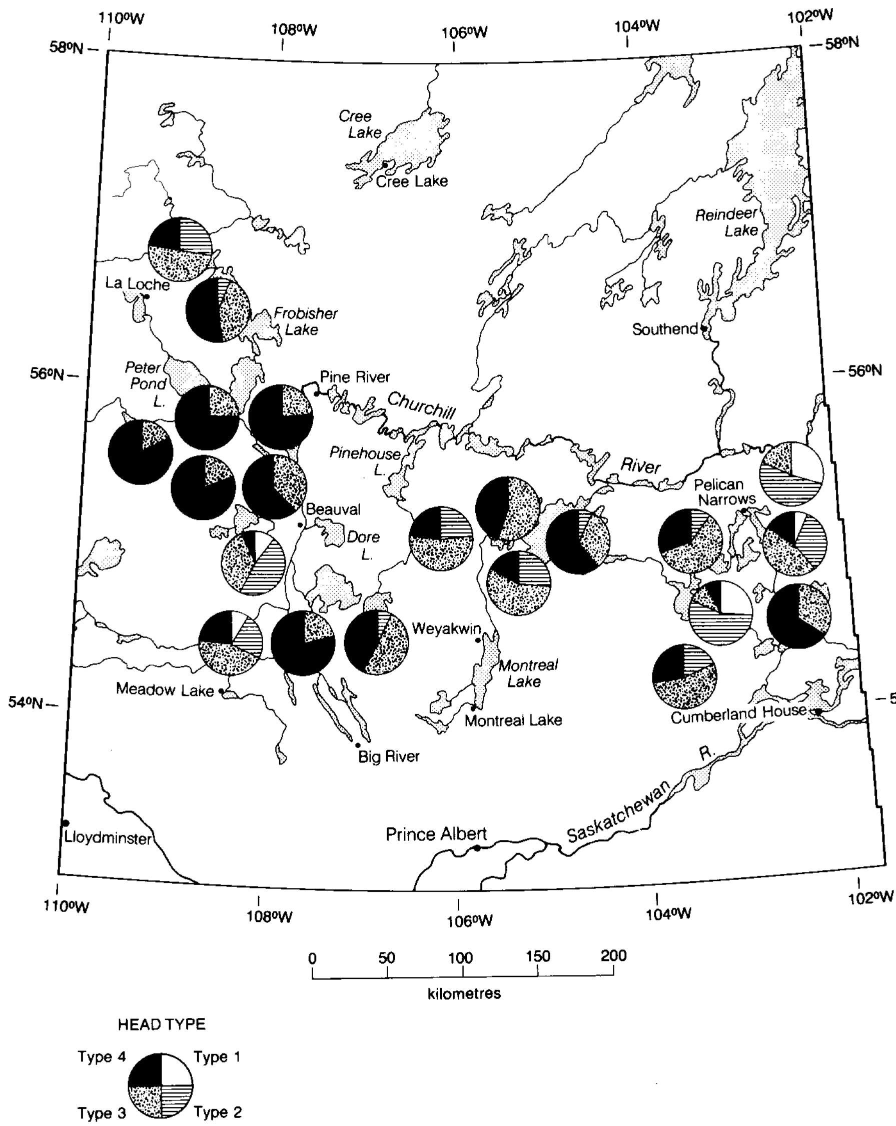


Figure 26 Regional distribution of the four panicle (flower head) types recognized in Saskatchewan.

districts where harvesting often begins 7 to 10 days later than elsewhere in the province (Figure 27).

Maturity dates are important in a climate like that of northern Saskatchewan where late ripening crops may be lost to frost. Grain maturation is spread over a 20-30 day period in late-August and early-September. This is a time when the probability of frost is increasing daily. The average date of the first autumn frost at La Ronge is September 7, compared to August 24 at Stony Rapids 450 kilometres (275 miles) further north. Harvesting

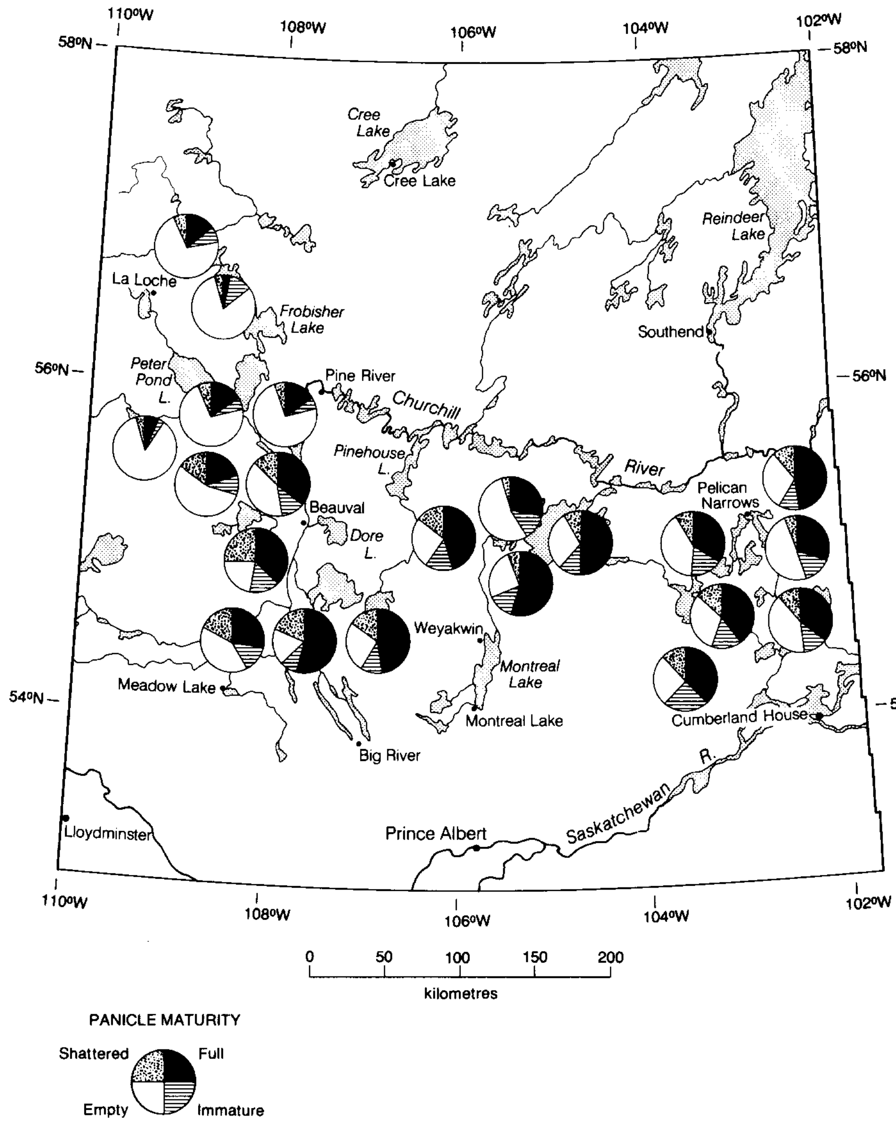


Figure 27 Regional variation in panicle maturity at the end of the 1988 growing season indicated that the proportion of fully developed panicles was highest in the central and more southerly districts. Sites in the west were generally less advanced, but more importantly, many of the panicles had not developed any grain.

typically begins around La Ronge about August 26. Frost occurrence and plant maturation can be plotted as probability curves (Figure 28). The magnitude of severe frost damage is indicated by the area beneath the intersecting curves. The probability value calculated for La Ronge is 18.5%, compared to 42.9% at Stony Rapids. The low probability of successful grain maturation at the latter location would likely preclude the establishment of an economically viable stand of wild rice there.

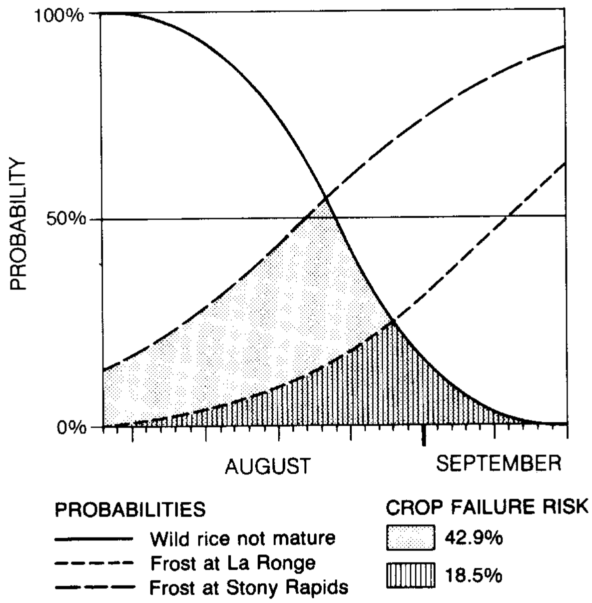


Figure 28 Probability curves to estimate risk of severe frost damage to wild rice crops. The comparison is for La Ronge and Stony Rapids.

Differences between plants are passed to next year's crop through the genetic information that is stored in the seed. When planting new lakes it is recommended that wild rice seed be obtained from a nearby grower with a similar lake, as his plants have proven to be adapted to local conditions. This improves the chances of starting a good stand.

Seed Handling and Storage

Make arrangements with a seed supplier before harvest. Freshly harvested seed matured on the plants contains 40-50% moisture and is greenish-brown and pliable. Mature seeds are soft and easily crushed if stepped on or handled carelessly. The seed should be free of weed seeds, debris, and bacteria. Wild rice seeds rapidly lose **viability** and will not germinate if allowed to dry out. When stored, for even a short period of time, the seed should be submerged in water, preferably in the lake that is to be seeded. Bags of seed that have been submerged for a week or two will take on water and may increase in weight by 5-10%. Wild rice stored in water over the winter may gain weight by as much as 20%. The standard sacks used during wild rice harvesting are made of woven plastic strands. They are ideal for long term seed storage as they will not rot even after being submerged for several months and will also allow water to flush the seed and keep it fresh. However, they may need to be wrapped in wire mesh to prevent muskrats from eating the seed.

Wild rice is naturally dormant and does not germinate until it has been subjected to low temperatures for several months. Freezing does not harm the seed, and even after being frozen solid in ice, it will still germinate. The seeds begin to germinate in the spring and at this time must be planted or moved into cold storage. Germination will often occur while the lake is still frozen. Not only does this interfere with the retrieval of seed, but seeding is also hampered because the young plants are easily damaged.

Time of Seeding

Germination takes place very rapidly. It soon becomes impossible to handle the sprouted seeds as the slender seedlings produce a tangled, fragile mass that cannot be separated. It is therefore preferable to seed the site in the fall. **Fall seeding** follows the natural pattern, allowing the seed to overwinter in the mud where it is subject to normal conditions needed to break dormancy (Figure 29). This is also the most practical time as it eliminates the need for long term storage. The weather in the fall is usually better than in the spring for seeding operations. It also has the advantage that competing natural vegetation can be seen and avoided. The seed may be susceptible to predation from large flocks of ducks and geese, but losses can be reduced by delaying seeding until just before freeze-up.

Spring seeding must be done as soon as possible after the ice melts and before seed begins to sprout. Spring seeding reduces the danger of the seed being buried too deeply in the sediment or carried away by currents, but if seeding is delayed the crop may not have enough time to mature. Seeding directly onto the ice has been successful in some areas. It has the advantage that the density and distribution of the seed can be easily observed, but this may be disturbed by strong winds and ice movement during spring break-up. Some losses can be expected from drying unless it is covered with snow, and the seed must also be stored properly before use.

Testing Germination

Freshly harvested wild rice seed will not germinate until it has been subject to freezing or near-freezing temperatures. The viability of the seed can be tested in the spring by placing a small sample in a jar of lake water and keeping it in a warm well-illuminated place. The water should

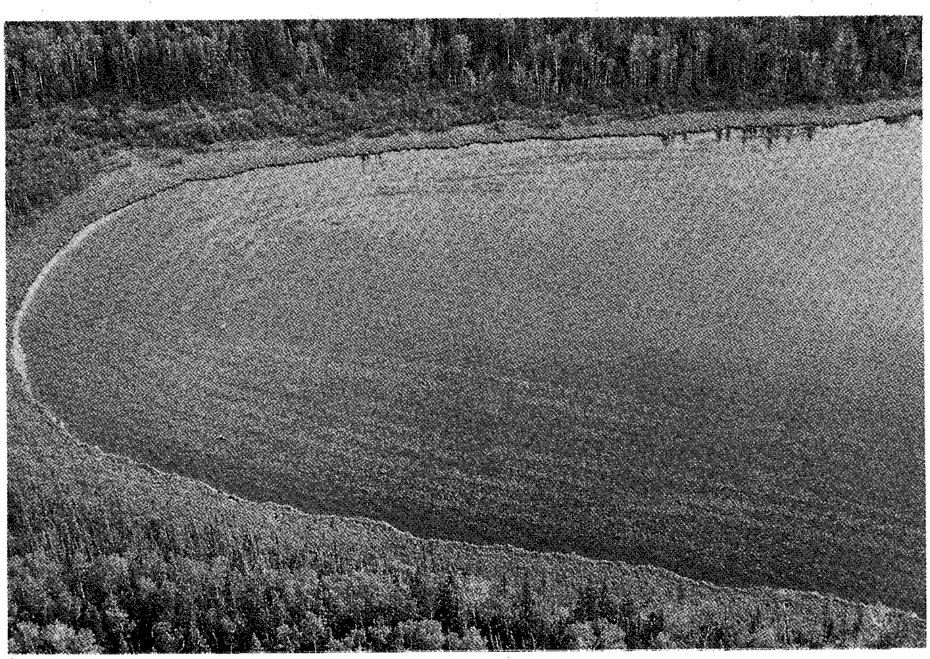


Figure 29 Seeding lines in newly established wild rice stand usually disappear in the second growing season as grain falls from mature plants.

be changed every 2 or 3 days. After 21 days good quality seed should have a germination rate of at least 70%. Regional studies have demonstrated differences in viability ranging from 23 to 81% for seed collected at different sites in Saskatchewan. In addition, the time at which the seed is harvested is important; seed harvested early in the fall is generally of higher quality than that harvested later in the season, because the proportion of immature grains increases as growing conditions deteriorate.

Rate of Seeding

Wild rice intended for seeding sells for about $2.25 - $4.50 per kg ($1.00 - $2.00 per lb), depending on availability, so it is important to use only as much as is needed to establish a viable stand. One kilogram of seed contains about 13,000 seeds (6000 seeds per lb). The recommended seeding rate is 25-35 kg/hectare (20-30 lbs/acre). Assuming a germination rate of 80%, 32 kg of seed are required to establish a density of 30 plants per square metre over a 1 hectare plot (28 lbs to establish 3 plants per square foot over 1 acre). If the water is deep, or the sediment is not ideal, the seeding rate should be increased. Under favourable conditions the plants will produce enough grain to reseed the bottom for a full crop the following season. Normally, it is not until the second year that the site is evenly seeded. Even then it may be desirable to reseed some areas if growth is patchy. However, stand density in long-established sites is often quite variable because of sediment conditions or mats of straw on the lake bed (Figure 30).

Figure 30 Plant performance can be quite variable within a stand of wild rice.

Heavy seeding may not increase yield. When plants grow together too closely, they are more slender and usually single stemmed. They produce no more seed than fewer, well-spaced plants with many tillers that develop from the recommended seeding rates.

Methods of Seeding

Wild rice is planted by spreading seed on the surface of the water and letting it sink. This method is termed **broadcasting**. Good seed will not float, but seed kept briefly out of water can be resoaked to prevent the scattered seed from floating away. The long tapered seeds settle through the water and become embedded in the mud.

Two methods of seeding are generally used: the seeds are broadcast either by hand or by machine. **Hand seeding** requires two people and a canoe or boat loaded with seed (Figure 31). One person propels the canoe, the other scatters the seed on either side. A small handful of kernels is flung over an area of 2 × 2 metres (6 × 6 ft). The seed should be uniformly distributed over the entire plot. Open, unseeded areas will allow ducks to land, and so encourage predation of the developing plants.

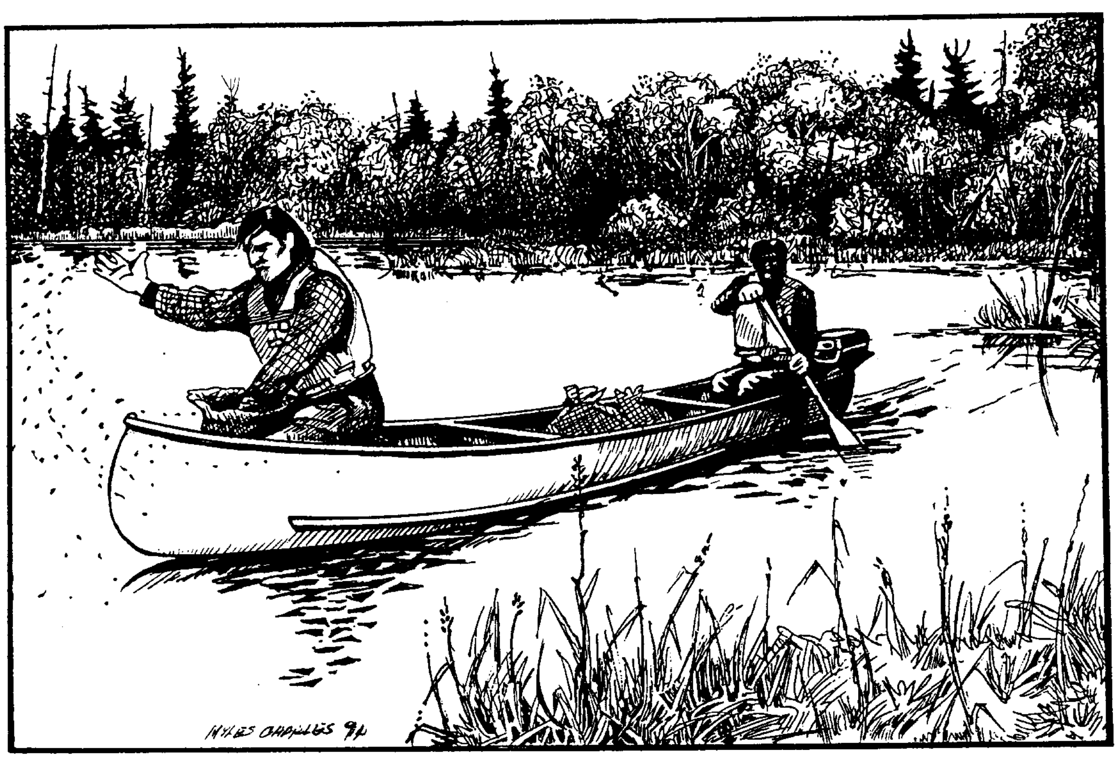


Figure 31 Hand seeding is a good method for test seeding or for seeding small areas.

Mechanical seeding is very popular, but requires a **cyclone seeder**, preferably one that is electrically powered. The seeder is firmly installed in the canoe or boat and requires a 12-volt battery. Two people are still needed, one to operate the canoe, the other to load the seeder (Figure 32). Small outboard motors are preferred as their speed can be adjusted to match the rate of the seeder. Again seeding should be as uniform as possible. A two-man crew can seed about 4 hectares in an hour (10 acres/hour). Cyclone seeders scatter the seed more uniformly than is possible by hand seeding. However, they can easily damage seed that has begun to germinate, and hand seeding is recommended under these circumstances.

Airplanes equipped with seeding attachments can be used for large scale seeding. Normally the seed is simply dropped through a hatch and scattered by the airflow.

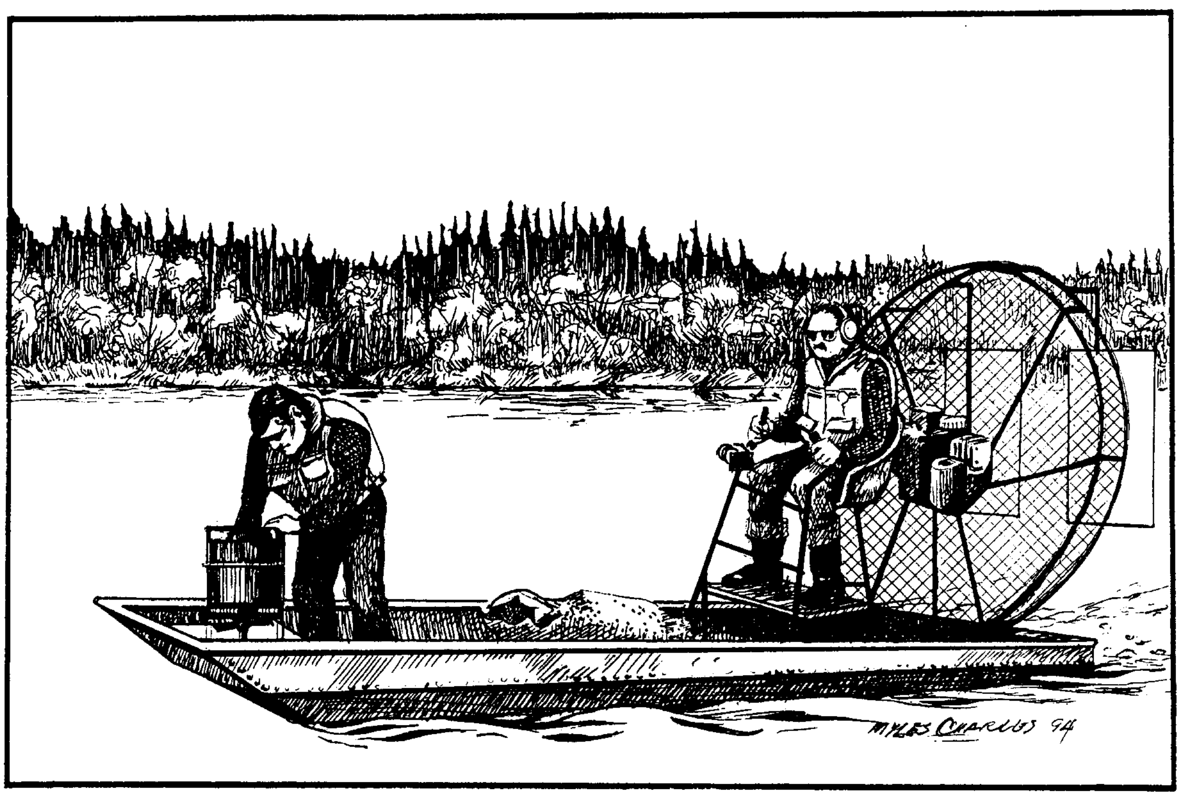


Figure 32 Mechanical seeding with a battery-powered cyclone seeder should be used for full scale planting in larger areas.

GUIDE TO SEEDING WILD RICE
■ Use good viable seed, which is preferably obtained locally. The seed must be kept moist and cool to minimize loss of viability.
■ Fall seeding is preferred because it follows the natural cycle of wild rice.
■ A seeding rate of 25-35 kg/hectare (20-30 lbs/acre) is recommended.

MANAGEMENT OF NATURAL STANDS

Unlike other crops, wild rice does not need much care during its growing stage, although activities such as cultivation, thinning, and straw removal are sometimes necessary to maintain ideal growing conditions. However, regulations prohibit the use of any agricultural chemicals and water depths cannot be altered artificially.

Cultivation

The sediment can be cultivated at the time of seeding or before germination in the spring. Some growers use rakes to uproot weeds and move the mud around allowing oxygen to mix with it. Loose, oxygenated sediment encourages germination and stand development. In most areas the action of ice, wind, waves, and currents cultivates the sediment naturally, creating good conditions for planting wild rice. Studies carried out in Saskatchewan suggest that cultivation does little to improve the crop. Cultivation can only be performed after the ice is off the lake, and by this time many seeds have germinated. Disturbing the sediment will damage seedlings and the effort and expense of cultivation will be wasted.

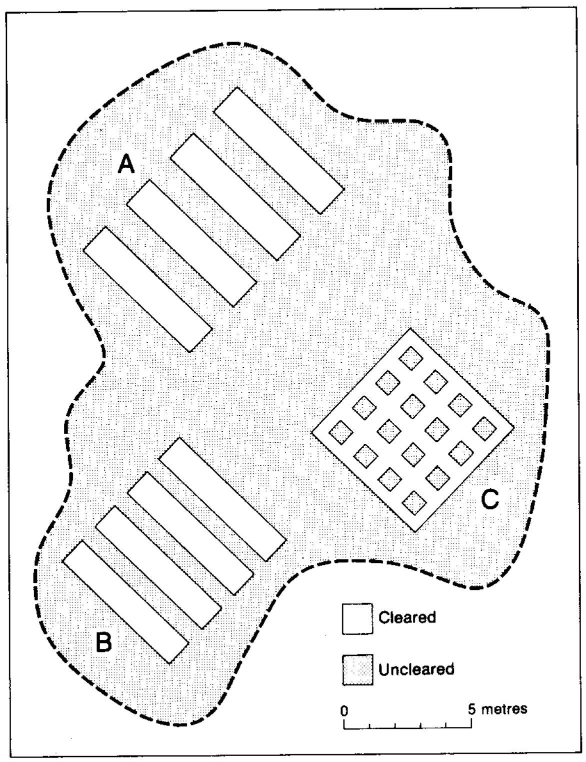


Figure 33 Stand thinning study. In treatment A, strips 1.25 m were alternately cleared of all wild rice with the intervening strips left intact. In treatment B, the cleared strips were 1.25 m wide and the uncleared strips 0.60 m wide. In treatment C, two sets of 0.60 m strips were cleared at right angle to each other leaving a checkerboard pattern of wild rice.

Stand Thinning

Dense stands of wild rice may develop after the first successful year of growth. The wild rice plants compete with each other for nutrients and light, and if they grow too close together they develop fewer tillers and smaller seed heads. In ideal sites the recommended density is 40 plants per square metre (4 plants per square foot). The best way to control overcrowding is to harvest the crop efficiently to prevent excessive quantities of seed falling into the water.

Various thinning treatments have been tried experimentally in Saskatchewan (Figure 33). These treatments, termed A, B and C, effectively removed 50%, 66%, and 75% of the original plants.

The number of tillers increased as more plants were removed, but not enough to substantially increase stem densities. Seed production on the tillers was comparatively low, and because they were typically shorter than the other stems, additional grain loss during harvest could be expected. The areas of open water created by the thinning operations must be calculated into the overall yield of the stand. In these experiments potential yields for the stands decreased with thinning intensity, and all treatment plots were less productive than the undisturbed areas.

Theoretically, thinning should promote increased tillering thereby increasing stem densities and result in higher yields (see

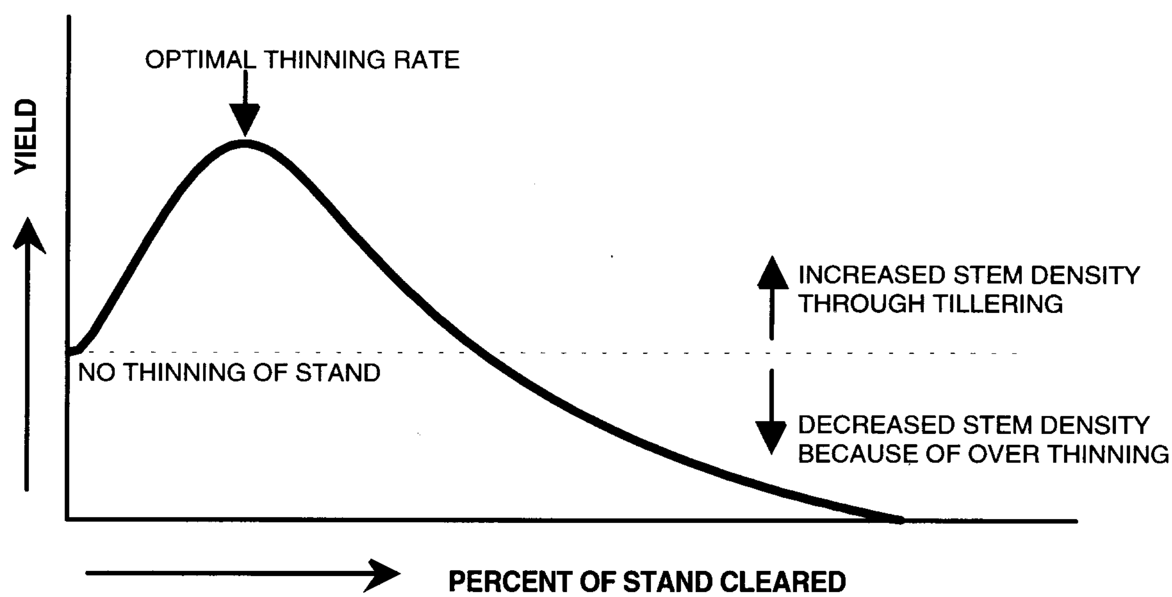


Figure 34 Theoretical response of wild rice stands to different thinning treatments. Yields in denser stands would increase as plant competition is reduced, but this cannot compensate for overthinning. Yields in stands with low initial densities are reduced even further by unnecessary thinning.

Figure 34). Continued thinning fails to stimulate additional tillering, and eventually the density of the stand decreases. As a consequence, production falls. Thinning is usually necessary in very productive stands established under controlled paddy conditions. It is unlikely that thinning is economically worthwhile in most naturally grown wild rice stands in northern Saskatchewan.

Straw Removal
A considerable amount of straw is produced in a stand of wild rice during the growing season (Figure 35). Studies in Saskatchewan have reported straw residues ranging from 1660 to 5400 kg per hectare (1480-4800 lbs/acre). If the straw persists as a floating mat into the following spring, it might shade out new seedlings. If it sinks to the lake bed during the winter, the seeds could be smothered and so prevent germination and growth. This can be a factor in the cyclical patterns noted in long term production records.

Straw decomposition and nutrient release is comparatively slow in cool northern waters. About 65% of the straw mass is lost after 2 years. Shredding the material has little effect on decomposition rates perhaps because the finer material becomes more tightly packed. Complete decomposition will normally take 3 years. Nutrient availability does not always parallel the reduction in straw mass because bacteria and other organisms involved in decomposition will store some

Figure 35 Thick mats of straw which accumulate at the end of a productive growing season can reduce plant performance in subsequent years.

nutrients in their tissues. Reduced oxygen levels in the water and sediment due to straw decomposition is also detrimental to the developing wild rice crop and could account for the patchy distribution of rice seen in some stands.

There is no easy or efficient way to remove straw, although specialized weed harvesters of the type shown in Figure 36 can be used on large plots.

This machine has been tested in Saskatchewan. Typically it takes 15 minutes to load the barge and about 20 minutes to empty it, 5 minutes to pump water out of the bilge and about 10 minutes to travel back and forth to the dump sites. In one day it should be possible to clear 1.5-2.0 hectares (4-5 acres). In these tests, straw clearing increased stand density and individual plants also produced more seeds. However, there was a great deal more straw in the cleared sites when the plants died at the end of the growing season, which suggests that straw clearing, once initiated, may need to be maintained if

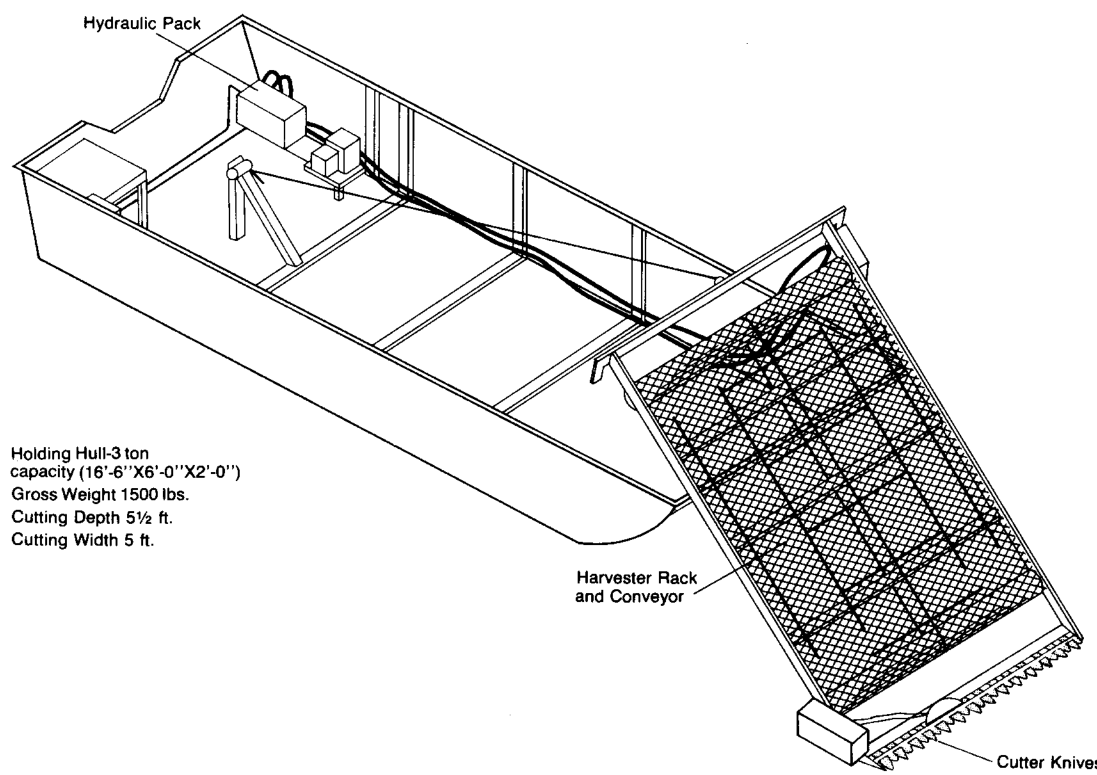


Figure 36 Schematic drawing of a weed harvester that can also be used to remove straw from a wild rice stand.

adverse growing conditions are to be avoided. Based on current prices for wild rice, estimated operating costs of this machine (excluding the original purchase price) do not make straw clearing a viable proposition for regular site maintenance.

Wild rice depends on nutrients that are cycled within the waterbodies, and straw removal, together with grain harvesting, can lead to nutrient depletion. Nutrients tend to be concentrated in the upper part of the wild rice plant, the part that is most easily removed by straw clearing operations. Rather than cutting and dumping the straw on shore, it may be preferable to move it to an unproductive part of the lake. Rake attachments fitted to larger, more powerful airboat harvesters have been used quite successfully in this way (Figure 37).

Although wild rice yields can sometimes be improved through proper straw removal, machines designed specifically for this work are not readily available and the cost of building, transporting, and operating is prohibitive. Clearing sunken straw mats from a site in the spring will damage the seedlings thereby offsetting any yield increases. Straw removal is best performed in the fall, but this is a time when weather conditions may be unpredictable. Consequently, straw management may be justified only at sites which have gone out of production because they are completely choked with straw. Ideally, a site should be selected where winds and currents carry straw away. Often a rise in water level during spring break-up will uproot plants that are still frozen into the lake ice and remove them from the area.

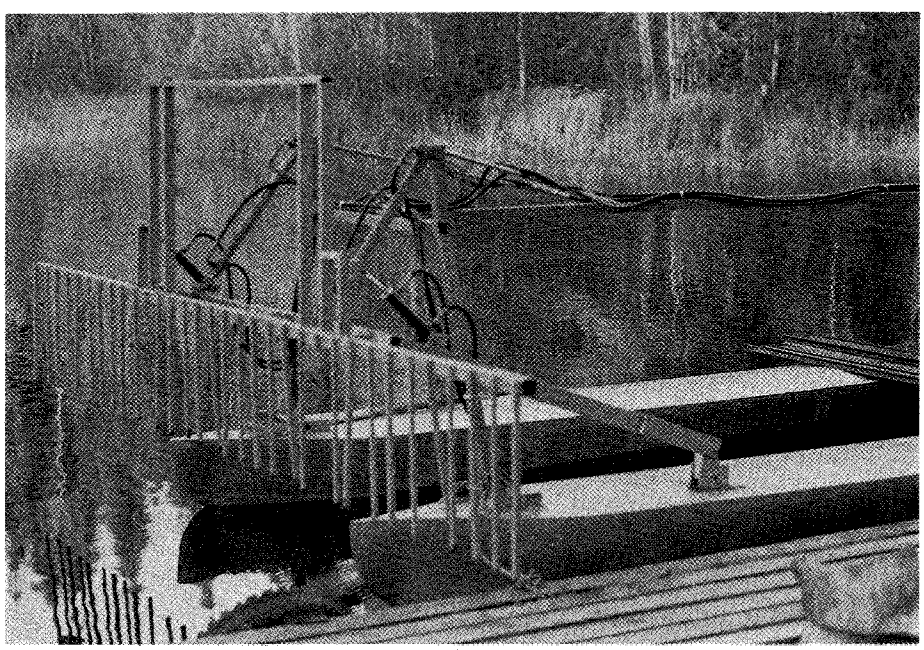


Figure 37 A rake attachment fitted to the front of a large airboat can be used to drag mats of straw out of a stand of wild rice.

Weed Control

Weeds compete with wild rice making it difficult for a stand to establish. Anything that might disturb or cultivate the bottom sediment could help to reduce weed populations. Chains can be dragged over a site for this purpose. Dense patches of water lilies can also be removed by cutting the stems under water. Preliminary tests with herbicides have been carried out in Ontario, but their use is prohibited in Saskatchewan. It is unlikely that any of these methods will provide a permanent solution to weed infestation, and it is probably best to avoid problem areas.

Control of Animals

Beavers are the most troublesome animals because their dams usually raise water levels and cause entire wild rice crops to drown. Muskrats can also cause considerable damage by clipping off the plants around their "push-ups". Waterfowl are mostly of concern in the fall when they consume or shatter ripe grain. Local regulations governing wildlife need to be observed when trying to deal with these problems. Insect pests can be partially controlled by eliminating straw and other favourable overwintering sites, but this is not totally effective. Insecticides are prohibited by law.

GUIDE TO WILD RICE STAND MANAGEMENT
■ Very little can be done to stimulate wild rice growth in natural stands.
■ Cultivation may improve sediment aeration.
■ **Chemical fertilizers, herbicides and insecticides are prohibited in northern Saskatchewan waterbodies.**
■ Thinning is not normally necessary in natural wild rice stands in Saskatchewan.
■ There is no easy way to remove straw from wild rice plots.
■ It is best to avoid weedy sites.
■ Observe local regulations when dealing with animals such as beavers and muskrats.

5. HARVESTING WILD RICE IN SASKATCHEWAN

Harvesting is one of the most important activities in the commercial production of wild rice. Wild rice is different from other crops as it is grown and harvested on water. The traditional method of harvesting was a two-person operation. One person sat in the front of a canoe and paddled or poled it through the stand, the other bent the stalks of wild rice over the side of the canoe with a short, tapered stick and used a second stick to tap off the ripe grain. A skilled two-person team picking in tall wild rice could harvest up to 200 kg (450 lbs) of grain in a day. Experienced harvesters would gently "sweep and slice" the plants to avoid damaging the unripe kernels. The grain would be gathered several times during the harvest season, but even then only a small portion of the manomin or "good berry" crop would be retrieved.

Many types of harvesters have been developed for commercial use. Propeller driven **airboat harvesters** have proven to be the most successful in lake grown wild rice stands. They were introduced to Saskatchewan in the late 1970s. Since that time changing designs and different operating principles have improved performance and increased harvesting efficiency. In 1984, the highest recorded production in Saskatchewan using an airboat harvester was 240 kg/hectare (214 lbs/acre). In 1988, a 4.5 hectare (11 acre) stand, harvested 5 times at an interval of 4 to 7 days produced nearly 2800 kg (6150 lbs), an average production of over 627 kg/hectare (560 lbs/acre). Although some of this increase can be attributed to ideal growing conditions, correct handling of the harvester ensured high yields.

AIRBOAT HARVESTER DESIGN

Today the most widely used airboat harvester design consists of a blunt-bowed, flat bottomed aluminum hull 4 meters long and 1.5 meters wide (12 ft long × 5 ft wide) fitted with a collecting tray popularly know as a **speedhead.** The harvesting swath varies from 2.5-3.0 m (8-10 ft), although speedheads up to 3.6 m (12 ft) are sometimes used. Two **air rudders,** positioned behind the propeller, are manually operated to steer the airboat (Figure 38). The harvester unit should be light and manoeuvrable, plane over the water at the lowest harvesting speed with a large payload, and use a minimum amount of fuel. Most harvesters are now powered by an air-cooled Rotax engine. The propeller must be properly matched to engine characteristics (torque and speed) to obtain maximum thrust for rapid acceleration to harvesting speed. A uniform speed is necessary to achieve high harvesting efficiency, so the engine must have sufficient power to maintain speed as the speedhead fills with grain. The

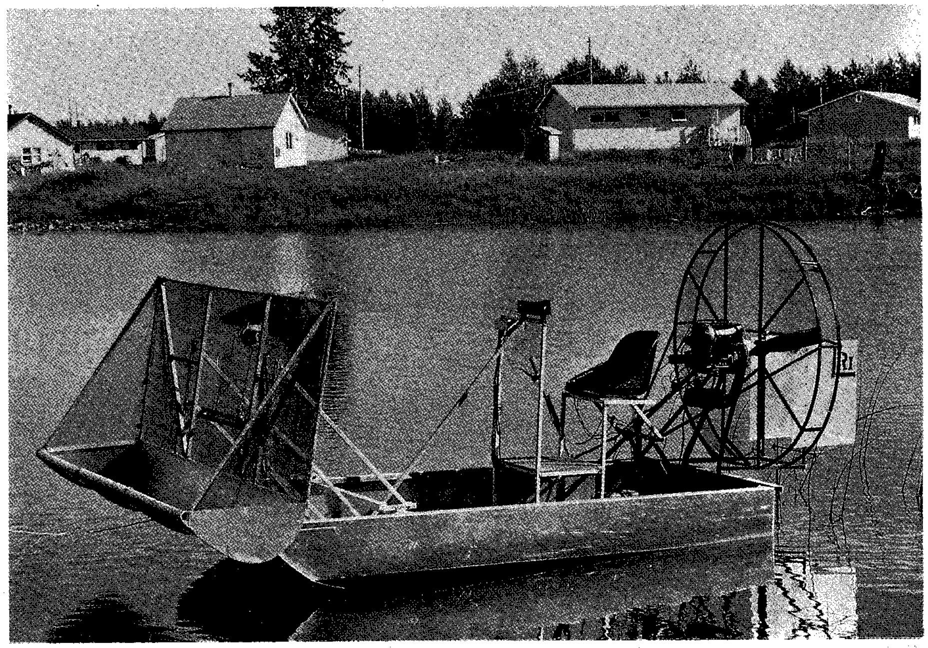


Figure 38 A modern airboat harvester constructed from aluminum and powered by a lightweight Rotax 503 engine.

preferred power system uses a Rotax Model 503 engine equipped with dual carburettors. The propeller is 1.52 m (60 inches) in diameter with a pitch of 1.01 m (40 inches). A two-bladed propeller is normally used, although a more expensive three-bladed propeller will improve performance.

Some growers have constructed larger pontoon harvesters. Their general design incorporates two 6 m × 0.6 m (20 ft × 2 ft) pontoons spaced about 1.5 m (5 ft) apart. The pontoons are linked by engine supports at the rear, the operator's platform in the centre, and the speedhead raising mechanism towards the front.

The speedheads are constructed of a lightweight frame with a shallow tray at the bottom, and are connected to a lifting device mounted on the airboat. The sides and rear of the speedhead frame are covered with window screening material. The speedhead is a passive device in that it has no moving parts. Harvesting is accomplished by the impact of the wild rice plants against the forward lower edge of the speedhead. The dislodged grains fall into the collecting tray.

Plastic fencing (Insta-fence) and **beater bars** can be added to the front of the speedhead at the discretion of the operator (Figure 39). Insta-fence is a large mesh, rigid polyethylene screen, commonly used in gardens. It has square openings about 4.5 cm (1.75 inches) in size. The fence is mounted on a secondary frame to allow its position and slope to be adjusted. Beater bars are constructed from lengths of PVC pipe, 3 cm (1.25 inches) in diameter spaced 20 cm (8 inches) apart. These are mounted across the front of the speedhead in the same way as the plastic fence.

In comparative tests, speedheads fitted with plastic fencing produced the highest yields of grain, with harvester losses reduced to only 10%. There was also less damage to the plants and fewer flower heads were broken off. Plastic fence is effective in all crop conditions: both tall and short rice impacts on the mesh for removal of mature kernels. A rearward slope of 10 degrees is necessary to allow the kernels to fall into the collecting tray.

An important design feature of the speedhead is the point of impact on wild rice plants. Short plants should be struck as close as possible to the water surface in order to reduce harvest losses. A shallow, flat-bottomed collecting tray lowers the point of impact (Figure 40). The height of the speedhead should be easily adjustable by the operator.

The fence attachment can interfere with emptying the wild rice from the collecting tray. Construction and mounting details should include access for emptying; hinges on the upper edge will allow the fence to be swung upwards. Alternatively, the grain can be dumped rapidly if the collecting tray is hinged at the rear. A locking device should be fitted to secure the tray while the harvester is in use.

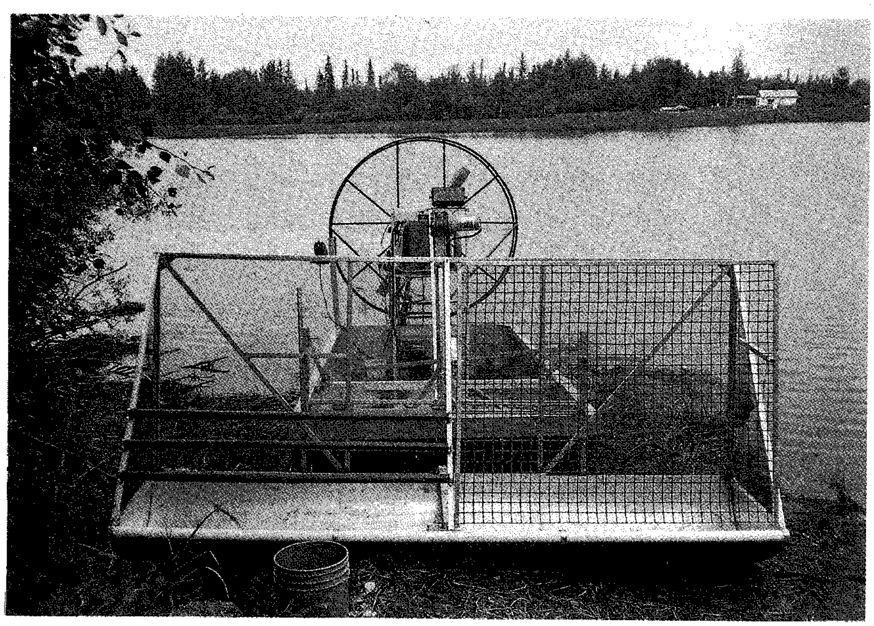


Figure 39 Plastic fencing fitted to the speedhead increases harvest yields, but even under good conditions 35-50% of the crop is usually lost through a combination of **natural processes** and **harvester design** and **operation**. The harvester in this photograph is fitted with beater bars and Insta-fence for use in design research.

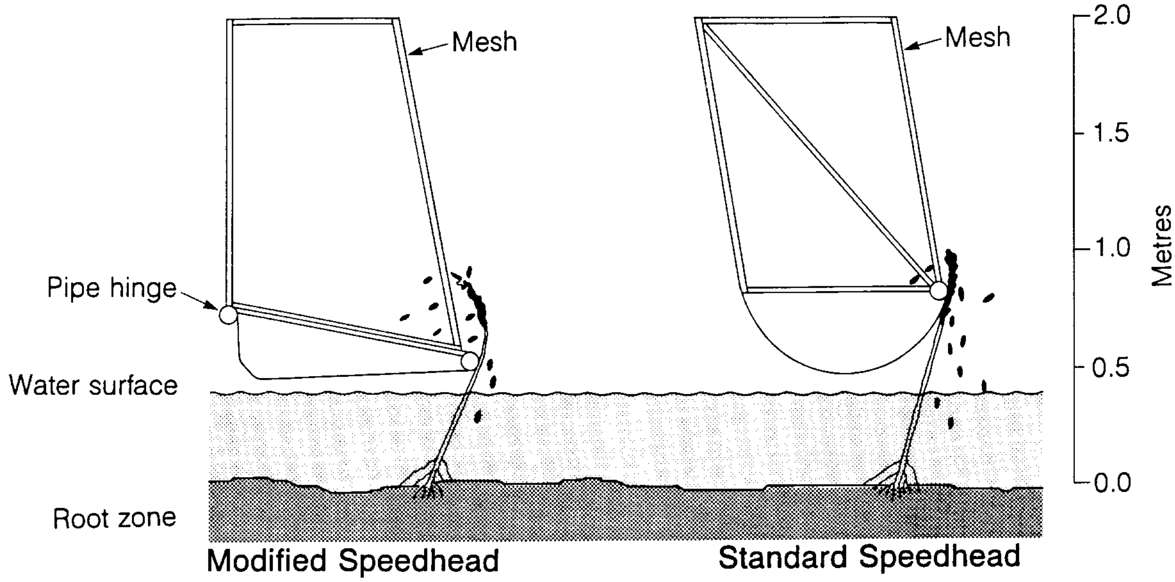


Figure 40 Speedhead design determines the height of impact with the wild rice plants, and this is particularly important when the plants are short.

GUIDE TO AIRBOAT DESIGN
■ Airboat harvesters should be light and manoeuvrable.
■ Plastic fencing fitted to the speedhead increases yields, but should be removable to facilitate emptying.
■ Design the collecting tray to impact plants close to the water surface.

MAINTENANCE OF HARVESTING EQUIPMENT

Maintenance and repair of harvesting equipment should be a regular part of pre-harvest and harvest operations. Airboat harvesters should be checked and serviced often throughout the harvest season. A broken harvester means lost time in the field, lost production, and lost income! A poorly maintained machine will also increase the risk of injury. **Make safety checks an important part of your regular inspections.**

GUIDE TO A REGULAR HARVESTER MAINTENANCE PROGRAM

- Begin by checking the harvester in the spring or early summer, well before the harvest starts.
- Be sure to have the correct service manual for the engine. It will give details needed to keep the engine running properly.
- A good selection of tools is needed to service an engine and other parts of a harvester. Use combination wrenches and socket wrenches to avoid damage to nuts and bolts.
- Keep a good selection of replacement parts on hand. Parts that may need to be replaced include propellers, fuel and air filters, spark plugs, spark control units, cables and drive belts. Also, keep a supply of engine lubricants. It is a good idea to have an assortment of spare nuts and bolts, rivets, and patching material for the boat itself.
- Dirty fuel is one of the most common causes of engine failure. Fuel should be strained through a chamois or felt cloth, especially if it has been stored in a drum.
- Repair small problems as soon as they are detected, before they cause a serious breakdown.
- Check all fluid levels, cooling and drive belts, engine mounting bolts, cables, and the propeller every day **before** starting to harvest.
- Attend local courses on motor maintenance and repair. They will help you spot and solve problems during harvesting.
- If a serious engine problem develops, take the engine to a reputable repair depot as soon as possible.
- Cover the engine and propeller with a canvas tarpaulin when the machine is not in use. The tarpaulin will protect the equipment from weather damage.
- In winter, store the propeller flat in a clean, cool, dry place. Also be sure to store the engine as recommended by the service manual or dealer.
- **Remember, preventative maintenance is the best defence against serious problems in the field.**
- For your own safety **life preservers** should always be worn when out on the water. **Ear protection** should also be worn at all times when operating or near an airboat harvester.

Characteristics of Wild Rice that Affect Harvesting

Seed Shattering

The mature kernels of wild rice varieties grown in northern Saskatchewan shatter very easily. This means that they drop from the panicle, unlike paddy wild rice which requires threshing in much the same way as wheat. Timely harvesting is therefore required to minimize grain losses.

Grain Matures in Stages

Wild rice kernels mature gradually, starting from the uppermost part of the panicle. Ripening begins in early-August, and depending on the weather conditions, will continue for a period of 15-30 days (Figure 41). About 3-6% of the potential yield matures each day. Maximum production can therefore be achieved if harvesting is repeated regularly during the ripening stage. The interval between harvests allows unripe grain to mature and for stalks which have been bent down by the boat to straighten up.

Figure 41 Wild rice kernels begin to darken and shed from the flower head (shatter) when mature.

Tillering

A wild rice plant can develop many stems, particularly in shallow water sites. These tillers are capable of producing the same quality grain as the main stem. However, tillers generally come into flower later; this makes the timing of the first harvest critical.

If harvesting is done too early, it could damage the tillers that are not fully mature, and a large percentage of the crop might be lost.

PLANT CHARACTERISTICS RELATED TO HARVESTING
■ Wild rice kernels turn dark brown or black and shatter readily when mature. ■ Grain matures gradually starting at the top of the panicle. ■ Tillers may be shorter and ripen later than the main stems.

WHEN TO START HARVESTING

In Saskatchewan the wild rice harvest generally starts in the third or fourth week of August. Traditionally, areas in the eastern part of the province begin about one week earlier than in other locations. Harvesting must not begin until the wild rice is mature. The kernels at the top of the panicle should be dark brown or black and fall off easily. Several indicators are used by wild rice growers to decide when to start harvesting. Determine the date when at least 75% of the crop has reached the full flowering stage. Full flowering is indicated by the shedding of pollen from the male flowers, and will normally occur between the third and fourth week of July, depending on conditions during the growing season.

- Get ready for harvest and check the stand again three weeks after full flowering. This visit will give a good indication of when to start harvesting. Normally the grain matures about 4 weeks after pollen is shed.

- Some kernels will be mature when the male flowers below the seed head have started to wither.

- The final thing that should be done by the grower before beginning to harvest is to paddle a canoe through a representative part of the wild rice stand and check the kernels at the top of the panicle. If the grain is firm and dark brown or black in colour, and if it falls when the stem is gently shaken, then it is mature. Harvesting should be started immediately. If the grain is still green and milky it will require a few more days to ripen.

- Floating trays can also be set out to monitor the amount of grain that is beginning to shatter. The trays can be made out of styrofoam or other buoyant material. A long narrow design allows them to be slipped amongst the stems of the plants. Five or six trays can be used at different points in the stand. The trays should be inspected at one- or two-day intervals. Trays 100 centimetres long and 10 centimetres wide (39 × 4 inches) allow a simple calculation of seed loss to be made. An average of one seed per tray is approximately equal to a loss of 7.25 kg/hectare

(6.5 lbs/acre). If a typical first harvest gives 90 kg/hectare (80 lbs/acre), this preliminary loss from natural shattering would represent more than 8%.

If you are still not sure whether the crop is ready to harvest, ask an experienced grower or an agricultural representative for assistance.

REPEATING THE HARVEST

Once the first harvest is completed the wild rice stand must be reharvested regularly. Maximum yields can only be achieved if the area is harvested 4 or 5 times. This means that harvesting would normally occur every 7 to 9 days depending on conditions. If the weather has been continuously hot, the stand should be reharvested no later than 7 days. Ripening is delayed by cool, cloudy weather but it is still advisable to repeat harvesting within 9 days. Harvesting should be postponed when it is raining because there is a tendency for the plants to lodge and get damaged. Plants which have been pushed over cannot be harvested. Windy conditions increase natural grain losses, but are hazardous for airboats, so it is probably better to delay harvesting rather than risk a serious accident.

GUIDE TO HARVEST TIMING

- Prepare to harvest by mid-August.
- Regularly check the maturity of the wild rice stand.
- Start to harvest when kernels at the top of the panicle turn dark brown or black and begin to shatter readily.
- Repeat harvesting every 7-9 days, depending on weather conditions.

OPERATING THE HARVESTER

Harvesting Techniques

The crop must be harvested efficiently to achieve maximum production, and this means covering the entire stand with the least possible overlap (Figure 42). Wild rice harvesting is made difficult by the absence of a clear line of travel across the stand, although subtle differences become apparent to skilled operators.

The widely used practice is to start at one end of a stand and continue to harvest back and forth until the entire stand has been covered. This method allows the operator to establish a reliable line of reference, mainly because the plants that have been

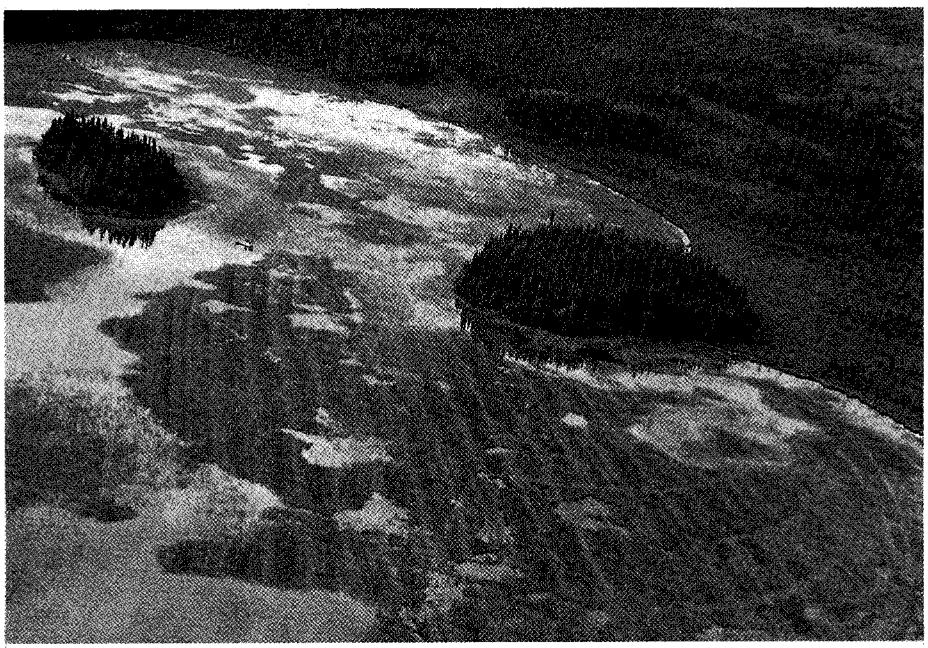


Figure 42 Efficient harvesting requires minimum overlap between adjacent swaths, and no part of the stand must be missed.

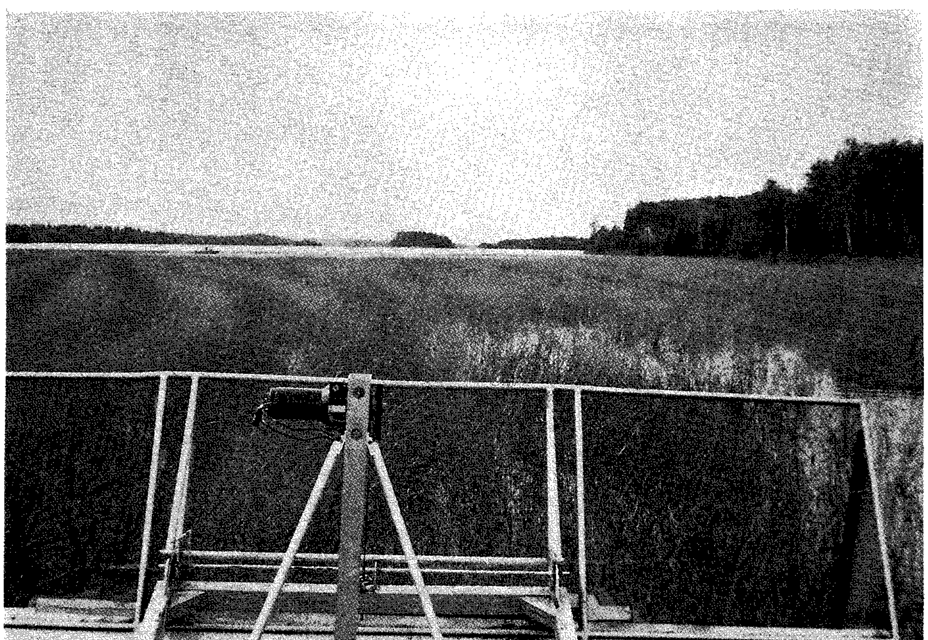
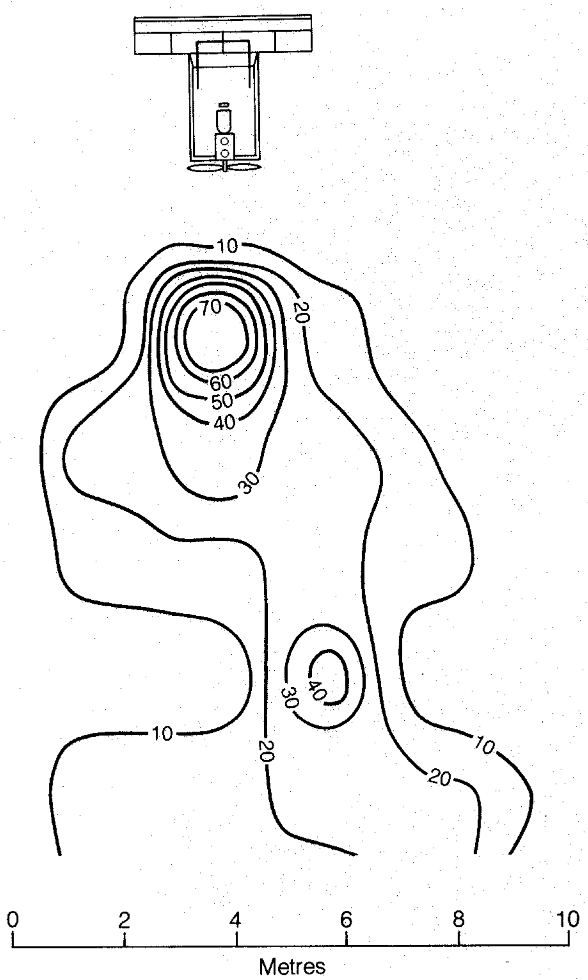


Figure 43 An experienced airboat operator uses slight differences in the colour and wetness of freshly harvested plants to judge the position of the next swath.

Figure 44 Wind speed pattern (measured in kph) generated behind a Rotax 503-powered airboat harvester with straight rudder setting.



recently harvested are still bending and wet (Figure 43). Another useful indicator is the difference in the colour of the stand. Mature grain has a brownish tinge which is lost when the ripe kernels are removed leaving only green immature kernels.

Wind speeds of 70 kph (45 mph) have been recorded amongst wild rice plants during propeller blast trials (Figure 44). Maximum air movement is concentrated

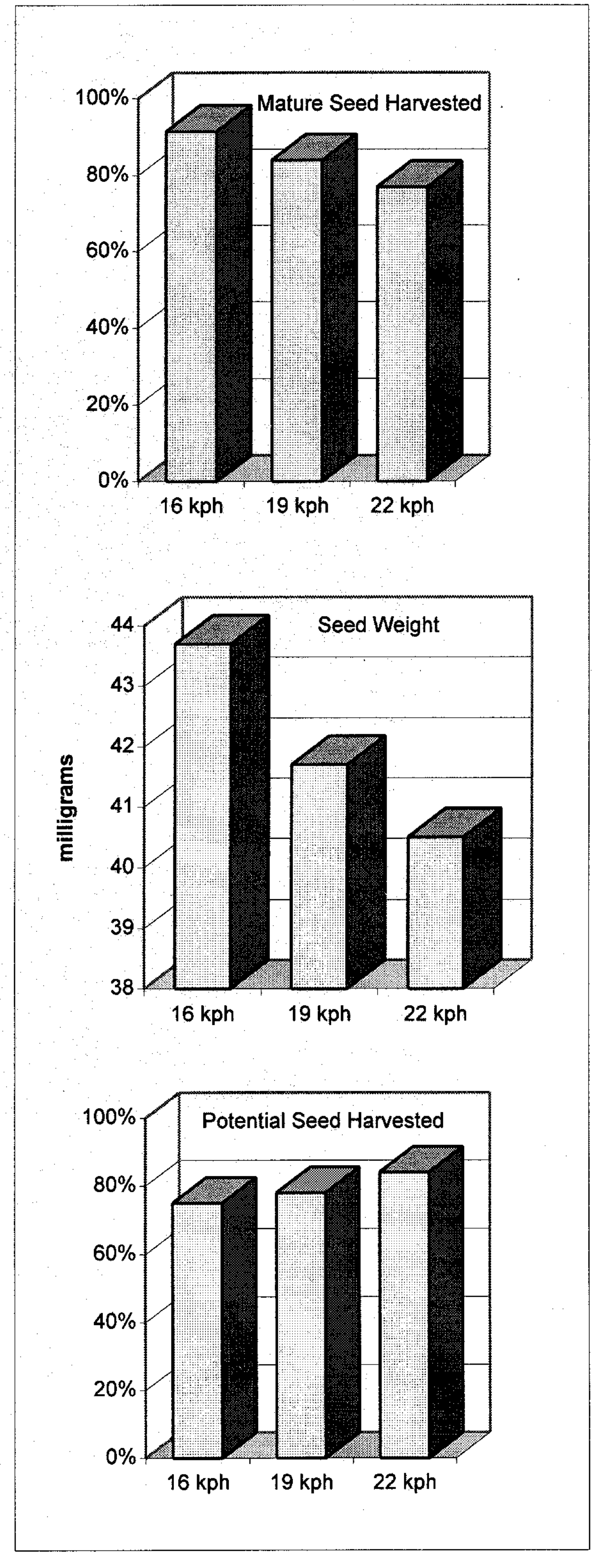


Figure 45 The effect of harvester speed on yield and quality of wild rice.

within the harvesting swath, and grain losses should be minimal along straight passes, providing little rudder movement is required to keep the boat on course. However, mature grain can be easily lost in the wind stream during tight turns at the edge of the stand.

Harvesting Speed

Harvesting wild rice at the correct travel speed increases yield and improves quality. High recovery of good quality grain is achieved if harvester speed is maintained at about 18-21 kph (11-13 mph) as shown in Figure 45.

If the speed is higher than 21 kph (13 mph), damage to the plant results in crop loss because immature seeds are knocked off the panicles, entire panicles are cut off, and plant stems are more likely to be broken. There will always be a few heads broken off the plants with weak or damaged stalks, but if a lot are being collected this clearly indicates poor harvesting technique, and speed should be adjusted.

If the harvester is travelling slower than 18 kph (11 mph), it may not create enough impact to shatter the wild rice kernels into the table. Additional losses occur because kernels which are propelled forward by the impact drop into the water in front of the speedhead.

The density of the wild rice stand can also affect harvesting speed. A speed of about 16 kph (10 mph) is recommended for open stands compared to about 19 kph (12 mph) for a heavy crop.

Prototype speedometers have been fitted for experimental purposes on some wild rice harvesters. They are activated by a rotating drum and are designed to prevent the mechanism from getting entangled in the wild rice plants. A speedometer design is ready for commercial production. Without a speedometer, the role of the operator becomes very important. Experienced operators can establish a "feel" for the right speed after a few trials. Factors such as plant height, stand density, and wind speed and direction must all be taken into consideration when establishing optimum harvesting speed.

GUIDE TO AIRBOAT HARVESTER OPERATION
■ Avoid excessive overlap on adjacent swaths.
■ Minimize rudder use to avoid seed loss from propeller blast.
■ Keep speed within the optimal range of 18-21 kph (11-13 mph).
■ **It is important not to travel too fast when harvesting.**

UNLOADING WILD RICE DURING HARVESTING

At least two people are needed to harvest wild rice efficiently (Figure 46). One person operates the harvester, and the other handles the grain as it is unloaded. A third person may be useful to help with bagging, particularly if the wild rice is unloaded into a boat and has to be brought to shore.

The collecting tray should be unloaded before it is completely filled; this will minimize the danger of tipping the boat. A standard 3 m (10 ft) speedhead holds about 2 sacks of wild rice. Before unloading the wild rice from the collecting tray, leaves, stems, broken panicles, and other debris should be removed. Only clean wild rice should be bagged.

Ideally, the wild rice should be unloaded from the harvester directly on shore at the point of road access, but if the stand is less accessible considerable time will be saved by anchoring a boat or canoe close to the area being harvested. The harvester operator should approach the boat slowly and shut off the engine while the crew positions the collecting tray. Once the harvester is secured, the tray can be lowered and unloaded. Usually the grain is scooped out with a bucket, but in improved speedhead designs the collecting tray tips forward and is self-emptying.

Figure 46 At least two people are required to harvest wild rice efficiently. As soon as the engine is stopped the speedhead can be unloaded, any leaves and stems removed, and the wild rice bagged, weighed, and labelled.

This reduces unloading time, and is especially convenient for shore-based operations where the grain can be dumped onto a tarpaulin or plastic sheet. Ensure that latches are secure and that any attachments such as the plastic fencing screen are in place before the harvester is released.

GUIDE TO UNLOADING FRESHLY HARVESTED WILD RICE
■ Unload collecting tray regularly to reduce risk of tipping the harvester. ■ **Shut off engine when unloading.** ■ Clean out leaves and other debris before unloading. ■ Ensure collecting tray and attachments are secure before returning to harvest.

CARE OF FRESHLY HARVESTED WILD RICE

It is important to let the harvesting crew know what the crop is going to be used for and advise them on how it should be handled. All of the grain should be put into sacks and then weighed. A sack of freshly harvested, high quality wild rice weighs about 27 kg (60 lbs). The sacks should be labelled with the grower's name and date of harvest.

Wild Rice Intended for Seed

Bagged wild rice to be used for seed should be tied tightly and kept moist until it is planted. If it is not going to be used immediately, it should be stored under water in a protected site. The sacks should be weighted down, tied together, and well secured to prevent them from drifting away. Seeding should be carried out as soon as the busy harvest season is over.

Fall seeding is recommended, but if seeding must be delayed until spring extra precautions should be taken for long term storage. It might be necessary to wrap the sacks in wire mesh to stop predation from muskrats. Store the wild rice in a place that is not subject to pronounced seasonal changes in water level so it can be retrieved easily.

Wild Rice Intended for Processing

Freshly harvested wild rice that is going to be sold for processing should be delivered as soon as possible. The wild rice should be checked again for leaves and debris before it is bagged. Care should be taken not to crush or break the grains by piling sacks on top of each other. If delivery is delayed, the sacks should be stored in the shade, preferably off the ground, with enough room for air to circulate between them. Pour two cups of water over them each day until they can be transported; this reduces the chance of spoilage through drying and heating. Spoiled wild rice should not be processed. The sacks should be tied and turned upside down every second day to distribute the moisture evenly when transportation is delayed. Do not overwater. The moisture content of the grain is assessed at the processing plant, and the value of the wild rice is adjusted accordingly. Wild rice intended for processing should never be submerged under water.

Remember that weight is adjusted for overwatering and that wild rice may be rejected if it has foreign matter, is too old, is not properly cared for, or contains excessive green seeds. This is the only policy fair to the growers that deliver good wild rice. The Saskatchewan wild rice industry is based on the concept that **"only quality pays"**.

GUIDE TO HANDLING AND STORAGE OF WILD RICE

- Wild rice intended for seeding must not be allowed to dry out. If it cannot be used immediately it should be stored underwater.
- Wild rice intended for processing:
  - should be cleaned before it is bagged
  - should be kept cool to prevent spoilage
  - should not be submerged
  - should be handled carefully to avoid crushing and breakage

6. MANAGING AN ECONOMIC WILD RICE OPERATION IN SASKATCHEWAN

The size of the wild rice area that is under permit will help determine if the operation should be used for hobby farming, to add to other sources of income, or become a full-time job. In any case, developing the area will require considerable time, effort, and investment. Running a wild rice operation so that there is a good return on investment takes careful planning.

INITIAL CAPITAL OUTLAYS

Wild rice farming requires a smaller investment than an equal sized grain farm in southern Saskatchewan. The waterbodies are leased from the government at nominal rates and less equipment is needed to prepare and tend the crop. The direct expenditures required to establish an efficient operation include the cost of a permit, the cost of seeding, and the cost of harvesting.

The permit fee is presently $0.25 (25 cents) per hectare (about 10 cents per acre). The permit for a typical 40 hectare (100 acre) operation will cost $100. Added to this is the cost of the seed. Assuming a seeding rate of 40 kg/hectare and a cost for seed of $2.75/kg (35 lbs/acre at $1.25/lb) approximately $4400 will be needed to seed a 40 hectare plot. About $350 will also be required if a cyclone seeder must be purchased. The airboat harvester will be the most expensive item; these sell for about $8500. In addition, there is the cost of a boat and motor, about $3500-4000. A good trailer is also needed to move equipment and grain, perhaps another $1500. Costs to set up a well-equipped, self-sufficient operation could, therefore, exceed $18,000.

Getting good seed can be a major problem for a new grower. It is best to purchase seed during the harvest season when prices are lower and its quality can be checked, rather than after harvest or in the spring, when quality seed may be less readily available. One of the best ways to get seed (and good experience) is to work for an established grower during harvest. Because seed is expensive and the suitability of a new site cannot be guaranteed, it is usually a good idea to start with a small operation. Planting only a few bags of seed will minimize losses if the crop is unsuccessful. If the first planting goes well, then the operation can be expanded with some confidence, and with the benefit of locally produced seed.

The main thing to consider in deciding whether to purchase an airboat harvester is the eventual size of the area to be planted with wild rice. A harvester may not be a good investment for an area less than 6-8 hectares (15-20 acres). Consider making arrangements for **custom harvesting** if the area can be easily reached by road. Custom harvesting usually can be paid for with a share of the crop. Small areas with difficult access may have to be harvested by hand. If planning to borrow money to build or buy a harvester, be sure to understand all of the details of paying back the loan, such as interest, security, payment schedules, and late penalties. Talk to people who have taken out loans before borrowing money.

It will be necessary to spend more time near the growing areas as the operation expands. It may be appropriate to set up a permanent or semi-permanent camp site to store food, fuel, tools, and spare parts. Even a modest camp site for rest and meals will improve the attitude and efficiency of all the people working on the crop.

Remember, except for docks, permanent land-based improvements are not allowed in connection with wild rice permits, although permission for temporary shelters may be granted on the recommendation of the local Conservation Officer. The **Wild Rice Allocation Policy** does allow licence holders to apply for permission to build land-based structures which are a direct and necessary requirement of growing and harvesting wild rice.

THE COST OF RUNNING THE HARVESTER

Wild rice needs very little attention during the growing season. The site should be visited to check on water levels and signs of damage from wildlife. Operations such as thinning and straw removal are generally uneconomic, and except under severe conditions, are not recommended. The major expense comes at harvest time.

The **direct cost** of operating an airboat harvester is determined by the price of the fuel consumed and the salaries of the people involved.

The fuel consumption of the Rotax 503 engine, with dual carburettors, developing 6300 rpm and travelling at about 21 kph (13 mph), averages 15 litres/hour. At an average price of $0.55/litre, the cost of fuel consumed is $8.25/hour.

The salaries paid to workers vary widely among wild rice producers. Many producers provide their own labour. Others pay a percentage of the total amount of grain harvested. Assuming that the salary of the harvester operator is $15.00/hour and the bagger is paid $10.00/hour, the cost for labour would be $25.00/hour. Add to this the cost of the fuel consumed ($8.25/hour), and the direct operating cost is $33.25/hour.

A harvester is actually gathering wild rice for only about 55% of the time that it is in the lake. The remaining time is spent turning corners, travelling to and from the unloading station, unloading the grain, minor maintenance, refuelling etc. Time spent for all these activities is referred to as downtime. The **downtime cost**, which is also composed of fuel and labour costs, is estimated at \$27.25/hour; it is lower than the direct cost since the engine is either not running or is running at a lower speed. The cost of broken parts, such as drivebelts and cables, which may be the reason for the stoppage, is excluded from downtime costs.

The return from a wild rice stand can be calculated by combining these costs with the amount of grain harvested (Figure 47). For example, studies have shown that in a 25 hectare (60 acre) stand of wild rice harvested 5 times yielding 8400 kg (18,600 lbs) of grain, the average cost of harvesting is 12.8 cents/kg (5.8 cents/lb). Additional harvesting runs may increase yield, but experience shows that the quality of the wild rice is poorer towards the end of the season. If the same 25 hectare (60 acre) plot of wild rice is harvested seven times for a total yield of 8700 kg (19,200 lbs), then the average cost rises to 15.7 cents/kg (7.1 cents/lb).

ADDITIONAL COSTS TO THE GROWER

Most expenses at harvest time are incurred running the harvester, but the cost of bagging and transport must also be considered. Sacks used for wild rice sell for about 70 cents: each one holds about 27 kg (60 lbs) of freshly harvested wild rice. Added to this are transport costs, perhaps about \$0.10/kg (\$0.05/lb), depending on distance to processing facilities or collecting depots. Thus handling costs for a crop yielding 4500 kg (10,000 lbs) will be \$117 for sacks and \$450 for transport, an additional expenditure of more than \$550.

EFFECT OF STAND SIZE AND YIELD ON OPERATING COSTS

Operating costs include wages and fuel needed to inspect and maintain the site during the growing season and to complete the harvest. Operating costs are directly related to the area under cultivation, and will increase as the size of the operation gets larger (Figure 48).

For the operation to be profitable, the rice must be sold above the cost of production. This critical value is termed the **break-even cost**, and can be computed from total yearly costs and total yearly production:

$$\text{Break-even cost (\$/kg)} = \frac{\text{Total yearly costs (\$)}}{\text{Total yearly production (kg)}}$$

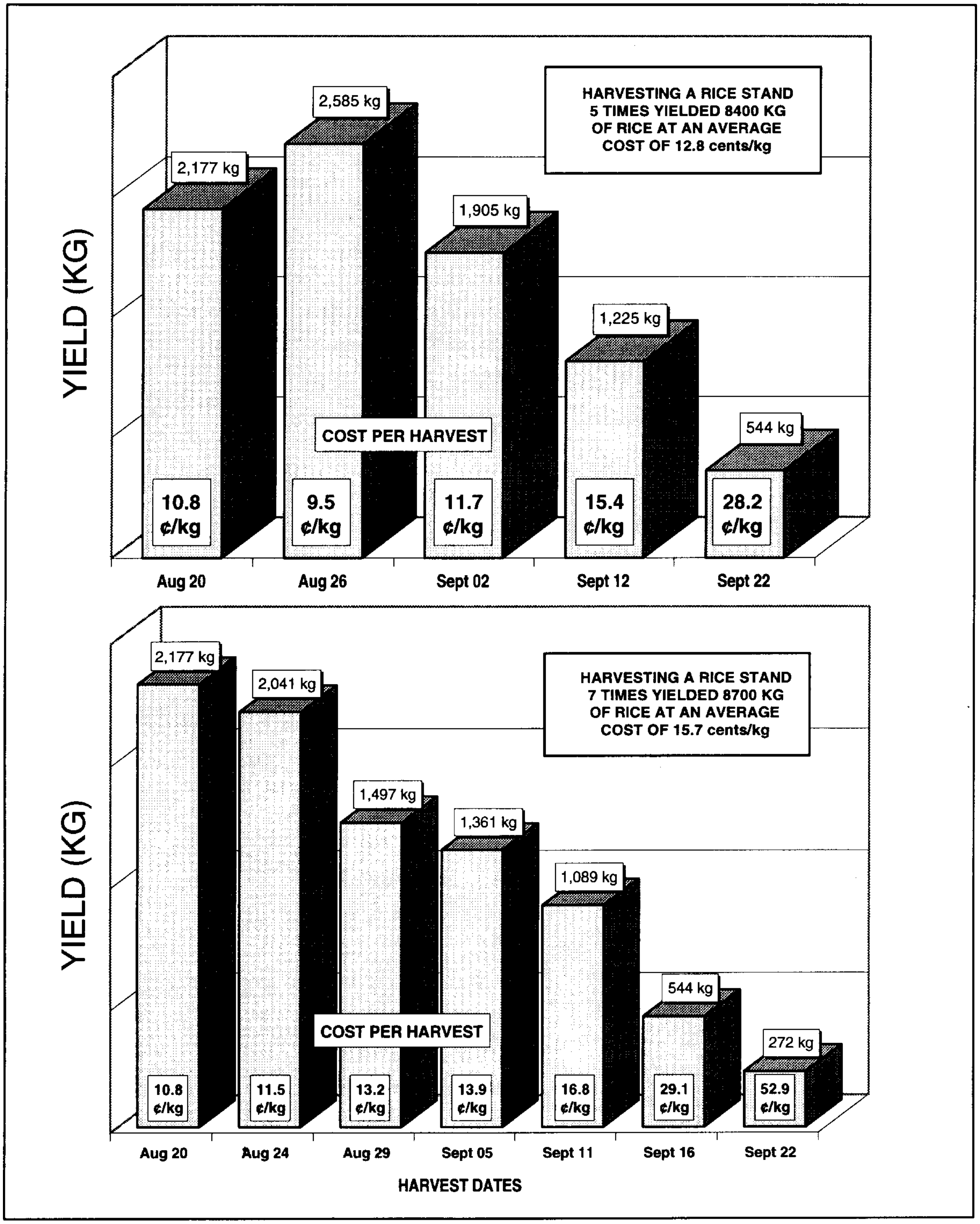


Figure 47 The cost per kilogram to harvest wild rice varies with the amount of grain collected. Although yields increase when a stand is harvested more frequently, this also increases costs, and late harvests can be very uneconomical.

Total yearly costs represent all costs incurred in running the operation, including capital cost of equipment and operating costs, as well as interest on loans and other related expenditures.

Small operations have higher break-even costs. Operating costs and licence fees are proportional to the size of the production area, but capital costs are almost the same for all small operations that require an airboat harvester.

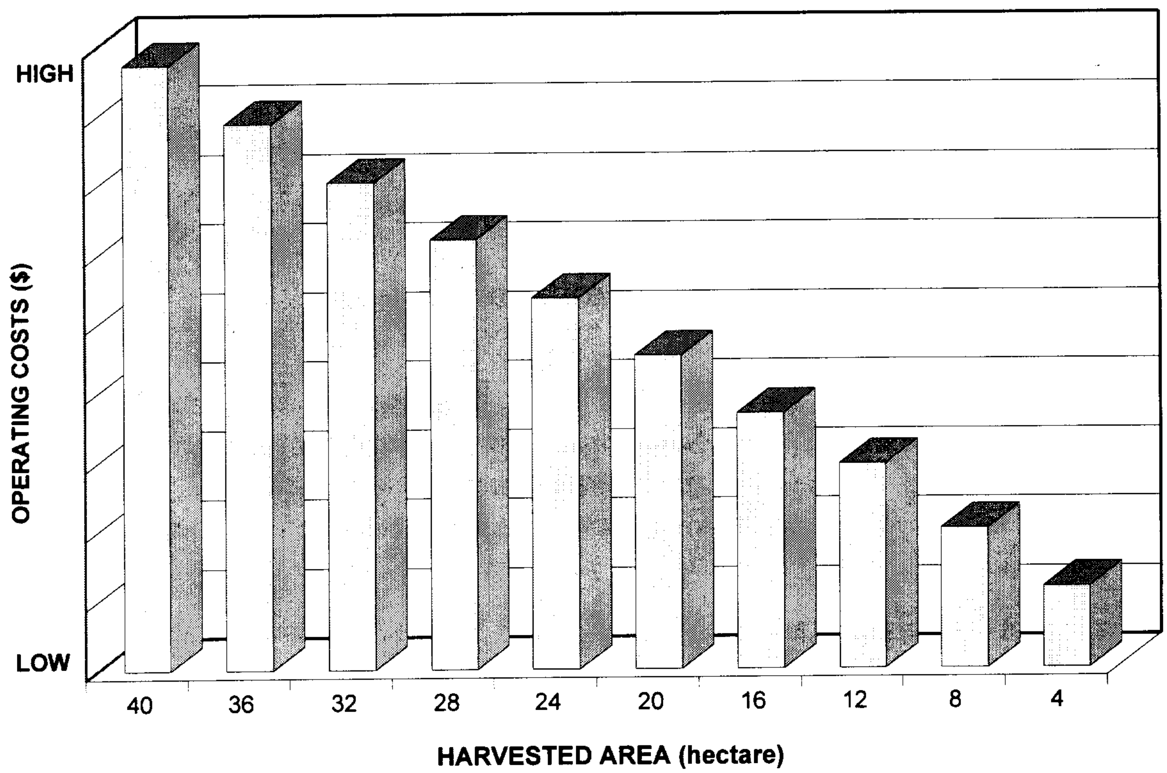


Figure 48 The effect of the size of a wild rice stand on operating costs.

As well, small plots produce a correspondingly small total yield. These two factors increase the break-even cost per kilogram of wild rice produced (Figure 49). In this example, the higher break-even costs in the first few years of operation are based on the assumption that loan charges were paid off over a three-year period. Break-even costs are substantially lower in year 4 because of this.

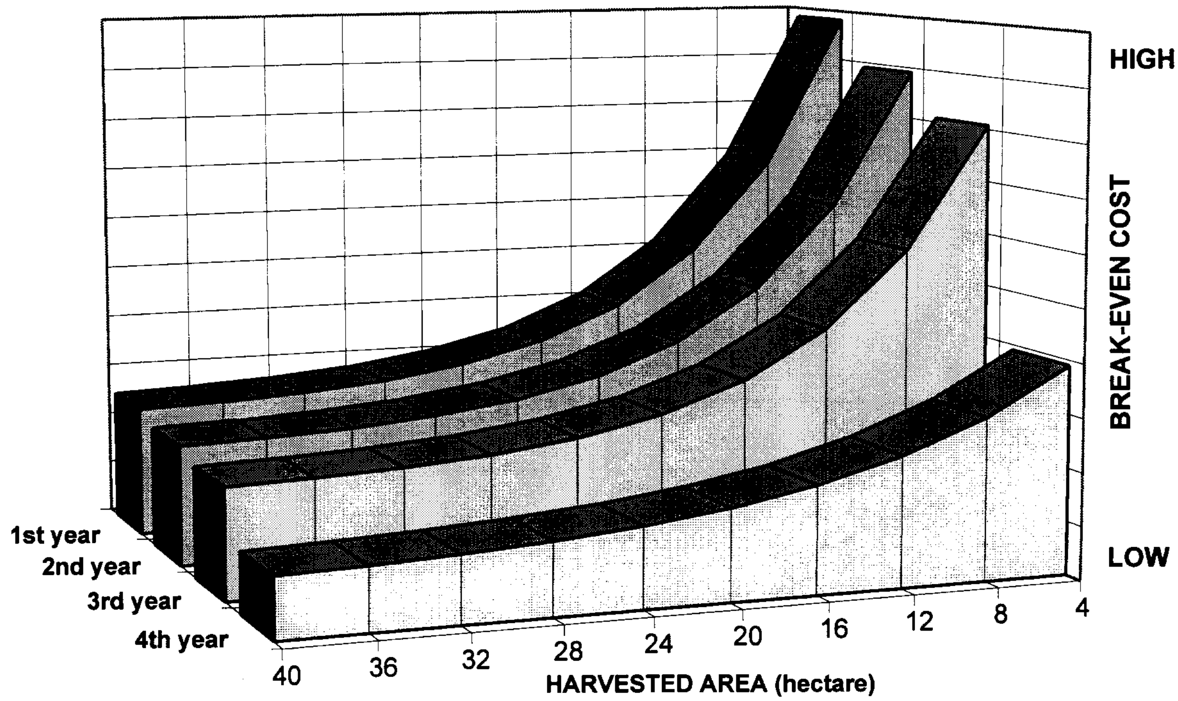


Figure 49 When the harvested area is small, growers have more difficulty reaching the break-even point. Small production areas have lower operating costs and licence fees. However, capital costs remain constant and total yield from small areas is proportionately small, increasing the break-even cost per kilogram of wild rice.

The previous example assumed a theoretical yield of 280 kg/hectare (250 lbs/acre), but this of course varies with growing conditions. If average production is less than 280 kg/hectare, break-even costs will rise accordingly (Figure 50).

Bookkeeping

Keeping records is one of the most important parts of operating a successful wild rice business. Many small businesses and farms have failed because the operator did not keep records that could help in making good business decisions. Good records will show how much money is invested in the operation, how much is owed, and how much profit has been made. Good records are also needed for paying bills and for filing income tax returns.

Bookkeeping does not have to be difficult or complicated to start with, but as the operation expands, more detailed records will need to be kept. The first thing to do is set up a filing system. All bills, receipts, bank records, insurance policies, permits, licences, loan agreements and other

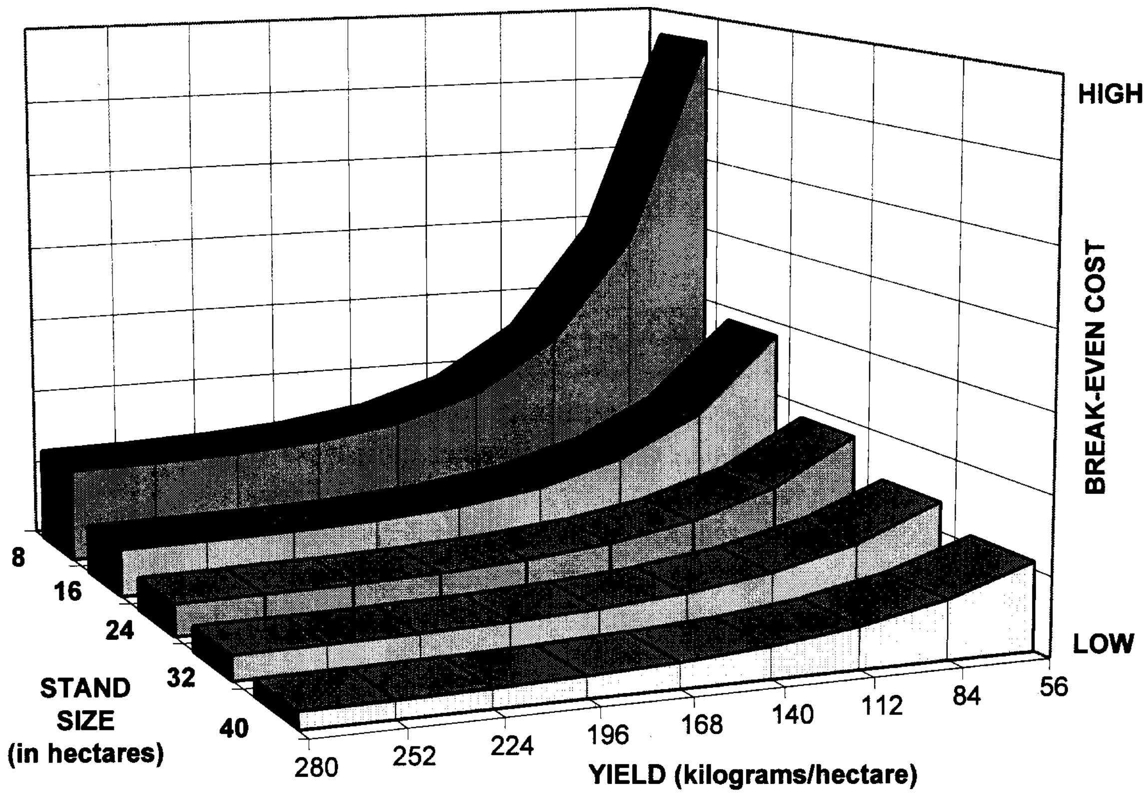


Figure 50 The effect of yield on break-even cost per kilogram of wild rice harvested. For example, if production is lower than 280 kilograms per hectare, the break-even cost per kilogram will increase accordingly.

documents related to the wild rice operation should be kept together in one place. A file system can be as simple as a cardboard box stored in a safe place. File all similar documents together, and arrange them by date, so that they can be found easily.

It is important to have the services of a bank. Find a bank in the most convenient town. A bank or credit union will set up a business account, preferably with separate chequing and savings accounts. The money in the chequing account can be used to cover current expenses, but because they usually pay little interest, it is best to keep only enough money to pay bills in this account.

The money in the savings account earns interest, and it is good practice to keep as much as possible in this type of account. Arrange for the bank to send a statement each month indicating how much money is in the accounts; this can also include a record of the cheques written. The cancelled cheques that the bank sends back are very important. They are proof that bills have been paid and will be needed to show expenses for income tax.

It is a good idea to take a short course on introductory bookkeeping from a regional college. As the operation expands, courses on accounting or small business may prove useful. Seminars and workshops are often presented about various aspects of the wild rice industry (Figure 51). Attending the Annual Wild Rice Conference will keep growers up-to-date on the latest developments in the industry.

GUIDE TO AN ECONOMIC WILD RICE OPERATION
■ Start on a small scale to minimize losses at untried sites. ■ Use the services of a custom harvester until it is profitable to buy a harvester. ■ Keep complete records of all business activities. ■ Enrol in any relevant courses, seminars, and workshops. ■ Join grower organizations to learn how other people deal with problems. ■ Keep in contact with agricultural representatives.

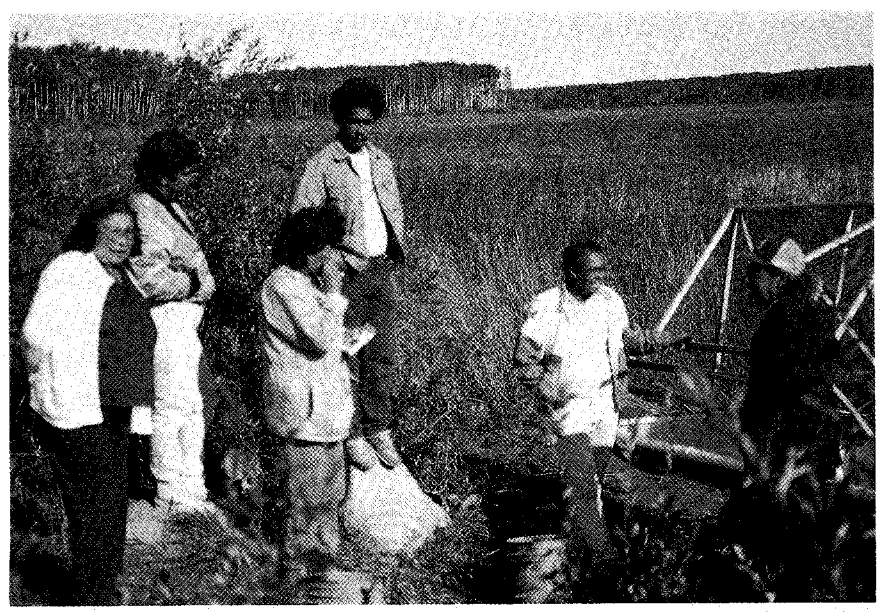


Figure 51 Seminars, conferences, and demonstrations covering all aspects of the wild rice industry are regularly organized by regional colleges in cooperation with Saskatchewan Education, Training and Employment and Saskatchewan Agriculture and Food.

7. WILD RICE PROCESSING IN SASKATCHEWAN

Processing of wild rice begins right where it is harvested. The grade and appearance of the finished product depends a great deal on how the wild rice is handled before it reaches the processing plant. Careful storage is important in that it helps begin the **curing** process. In Saskatchewan, most of the freshly harvested wild rice is transported to the processing plant at La Ronge where the moisture content is checked and the bags weighed (Figure 52).

Freshly harvested wild rice is typically greenish-black in colour and has a moisture content of 35-50%. In the traditional method of processing, the grain was spread out in the sun to dry, and stirred from time to time. Small quantities of grain were then prepared as needed by heating it in a large bowl. It was stirred continuously to prevent burning, and until the heat expanded the kernels sufficiently to separate them from the enclosing hulls. Threshing was done by trampling or dancing on the grain, and the chaff removed by winnowing.

Similar stages are required in modern wild rice processing plants. Not all freshly harvested wild rice is at the same stage of maturity, and it is necessary to pile it in **windrows** to allow it to cure (Figure 53). The windrows are watered regularly to prevent self-heating and drying. They

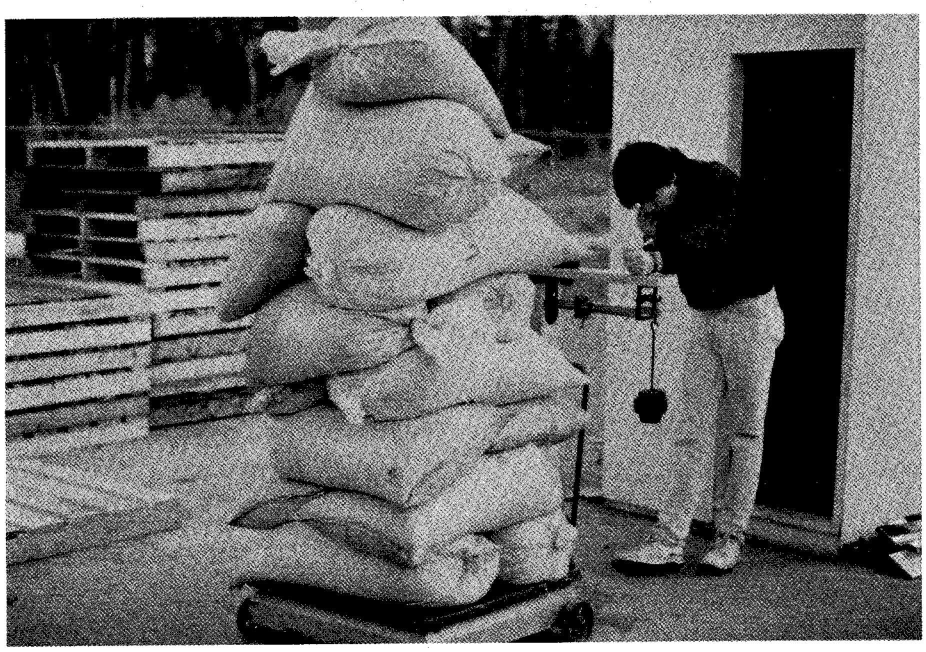


Figure 52 Freshly harvested wild rice is weighed as soon as it is delivered to the processing plant.

Figure 53 Wild rice is piled into windrows, then watered and turned regularly to ensure uniform curing.

must also be turned daily to prevent decay. It is during this 4-10 day period that the wild rice acquires its familiar black colour and flavour. The hulls also begin to loosen.

When the grain is properly cured it passes into the parching ovens. **Parching** removes moisture from the kernels and toughens them so they will not break so easily. In **batch parching** a quantity of wild rice is placed into a drum parcher that operates in much the same way as a cement mixer. A typical batch parcher will hold up to 270 kg (600 lbs) of wild rice. The temperature in the parcher rises gradually to about 350°C (660°F), and the drum is rotated to prevent the grain from burning. After about 2 hours the parched wild rice is dumped out and a new batch is added. Larger processing plants, such as the one at La Ronge, use **continuous flow parching**. This is a more automated system and allows the wild rice to move continuously through the remaining processing stages, ending when it is placed in bags (Figure 54). In continuous flow parching the wild rice moves from the curing piles into a large hopper and then into the parchers. The La Ronge plant operates 4 parchers each about 1 m (3 ft) in diameter and 10.5 m (35 ft) long. Wild rice can be loaded into continuous flow parchers at a rate of 100-180 kg/hr (250-400 lbs/hr).

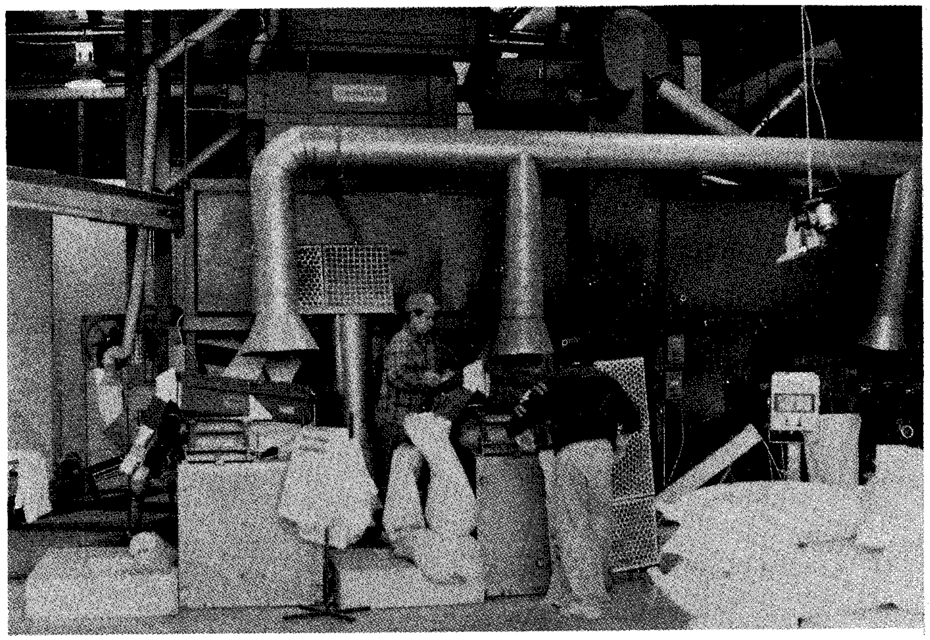


Figure 54 Careful monitoring ensures the highest quality of wild rice leaves the modern processing plant at La Ronge.

The primary purpose of parching is to reduce moisture content to about 7% without fracturing the kernel. In addition, the hull is fully loosened, pigmentation is completed, and the flavour of the grain is brought out. It takes about two hours for the grain to pass through the parcher at temperatures up to 135°C (275°F). Steam retention in closed parchers helps to give a glassy, translucent appearance to the grain.

After parching, leaf and stem fragments are removed by screening, and magnets on the conveyors trap ferrous metals. The hot grains immediately pass into the **hulling** machines where the dry hulls are removed. Dehulling is normally done by passing the grain into a **roll huller**. This consists of two closely-spaced, rubber-faced rollers which rotate towards each other at different speeds. As the wild rice is fed between them the hull is stripped off. This also makes the grain look black and shiny. Some processing plants use a **barrel huller** in which rubber cogs rotating at high speed detach the hulls by moving the rice around. This process will also remove some of the bran and the wild rice is characteristically pale brown in colour. Removing the bran has the advantage of hastening cooking time.

Both the hulls and the kernels fall into an **aspirator** that sucks off the lighter chaff. Once the hulls are removed, the wild rice is **cleaned** by passing over vibrating screens to separate unhulled grain, stones, and other heavy materials. Once broken kernels have been sorted, the intact kernels are **graded** by size on a **gravity table** prior to inspection and packaging. The longest kernels command the highest market prices, as they are preferred by the gourmet culinary trade.

8. CANADIAN LAKE WILD RICE GRADING STANDARDS

Naturally-grown Canadian lake wild rice is generally larger than paddy wild rice grown in the United States, but there is considerable variation between lakes and between different harvests at the same lake (Figure 55).

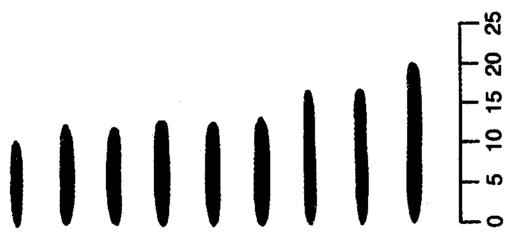


Figure 55 Considerable differences in the size of the mature wild rice kernels have led to the development of grading standards.

For this reason the Canada Wild Rice Council has attempted to regulate product quality by developing grade standards for wild rice. The proposed grading scheme sets out 3 grades for wild rice.

Canada A (good quality size graded) is practically uniform in size, possesses an almost uniform colour and a good aroma typical of wild rice, and is practically free from defects and foreign material. Size designations for **Canada A** wild rice are listed in Table 3.

Canada B (good quality mill run) possesses a good aroma typical of wild rice, does not contain more than 10% by weight of broken kernels and is practically free from foreign material.

Canada C (good quality broken) possesses a good aroma typical of wild rice, contains both whole and broken kernels and is practically free from foreign material. It may contain in excess of 10% (by weight) broken kernels.

Complete details of the proposed scheme are given in the Appendix.

Table 3. Size designations for Canada A lake grown wild rice			
Length of Unbroken Kernels	Width of Unbroken Kernels	Word/Letter designations	Maximum percentage of Broken Kernels
At least 6.4 mm (16/64 inch)	Less than 1.6 mm (4/64 inch)	**Canada AM** (medium)	5%
At least 6.4 mm (16/64 inch)	At least 1.6 mm (4/64 inch)	**Canada AL** (large)	4%
At least 12 mm (30/64 inch)	At least 1.6 mm (4/64 inch)	**Canada AXL** (extra large)	3%

9. FOOD VALUE OF WILD RICE

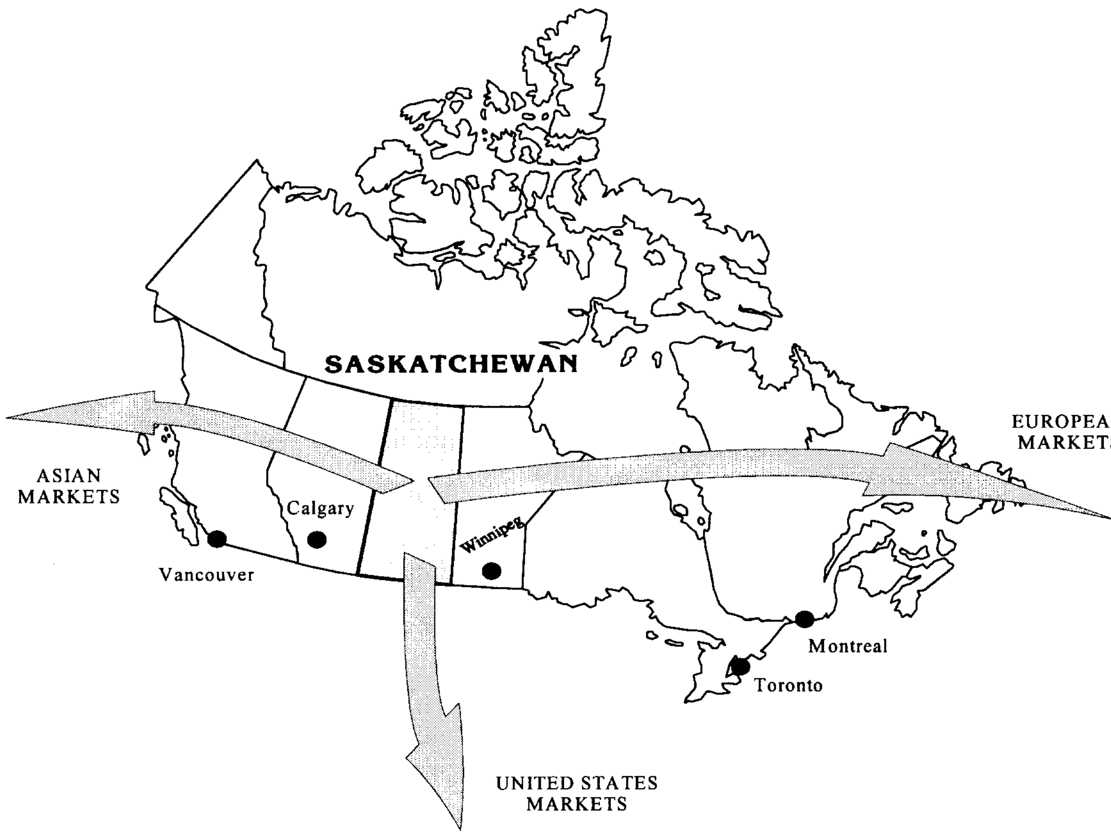
Wild rice has good nutritional value, being high in protein, carbohydrates, and minerals, but low in fats and oils compared to other cereals (Table 4).

The principal constituent of wild rice is starch, averaging about 74% of the dry weight of the kernels. Wild rice is a good source of dietary protein with most amino acids present at concentrations that are adequate to meet daily human requirements. Total dietary fiber levels average 6-7% of kernel dry weight. Wild rice has a relatively high content of essential minerals accounting for about 2% of kernel dry weight. The minerals are mainly present in the **pericarp**, or outer layer of the grain, and some are lost if the wild rice is scarified or polished during processing. Cereals are an important source of dietary B-vitamins, and the thiamine, riboflavin, and niacin content of wild rice exceeds those in most other cereals. It contains less than 1% fats and oils, but has a comparatively high linoleic and linolenic acid content: this is desirable from a nutritional standpoint, but can lead to problems of rancid odour if oxidation occurs because of improper storage. However, properly cured and stored wild rice remains wholesome for several years. One half cup of cooked Saskatchewan wild rice contains only 65 calories and is therefore a natural choice for health-conscious consumers.

Table 4. Typical composition of wild rice and other cereal grains. All values are in grams per 100 grams of dry product.

Chemical constituent	Wild rice	Brown rice	Yellow corn	Hard wheat	Oat groat
Starch	74	78	71.5	66.5	62
Protein	13.5	8.7	9.0	14.5	15.5
Dietary fiber	6.8	5.3	9.5	11.5	11.0
Sugars	1.7	1.3	2.3	1.7	1.4
Oils and fats	0.8	2.6	4.7	1.8	6.5
Minerals	1.8	1.5	1.5	2.0	2.0

Wild rice is usually sold in transparent packages as appearance is an important aspect of its consumer appeal. Grain breakage and peeling of the outer layer of bran to expose the white interior are the most serious quality problems for the processor. Grain breakage can arise from internal stresses during maturation and curing, but most damage occurs during



As well as marketing wild rice throughout the Province and across Canada, Saskatchewan ships wild rice to markets in Asia, Europe, and the United States

Figure 56 Saskatchewan's wild rice markets processing. Broken kernels are separated before packaging, and are either sold as a low grade product, or used to make flour.

Commercially prepared pancake mixes and specialty snack food products, such as puffed wild rice, are also made from Saskatchewan wild rice. Blends of wild rice and white rice are mainly produced from paddy grown wild rice, and are a popular product with the large food companies.

Saskatchewan wild rice is grown and processed without the use of chemical additives, colourants, or artificial flavourings. The large kernels mature m their natural setting helped only by the sun. This image has helped to market Saskatchewan wild rice as the finest in the world. Vigourous promotion at trade fairs and food shows has increased markets for this gourmet grain. Saskatchewan wild rice is sold world wide (Figure 56).

Wild rice is used in a variety of culinary dishes as well as breads, soups, and pancakes. It expands to about 4 times its volume on cooking. Basic preparation starts with washing the wild rice in a strainer under cold running water. One cup of wild rice is added to 4 cups of water with 1 teaspoon of salt and brought to a boil. The temperature is turned down to simmer, and the wild rice is covered and cooked for 50-60 minutes or until it is tender. The kernels will puff open to reveal the white fluffy interior. If a fluffier rice is desired, let stand for up to 30 minutes before draining. Cooking time can be reduced by soaking overnight. Plain cooked wild rice will keep for many days when stored in an airtight container in a refrigerator. A book of recipes has been compiled by Saskatchewan Agriculture under the title **Northern Saskatchewan Wild Rice Recipes.** A few of these and other recipes are presented in the Appendix.

10. REGULATIONS CONCERNING CULTIVATION IN SASKATCHEWAN

Once a suitable site has been confirmed, it is necessary to obtain a permit before seeding can begin. The regulations concerning wild rice cultivation in northern Saskatchewan are different from those that govern agriculture elsewhere in the province. In southern Saskatchewan crops are usually grown on land which is purchased or leased from a private owner. Wild rice is seeded and harvested in naturally occurring waterbodies controlled by the provincial government. These lakes and rivers and the land surrounding them are used by many people~ and a series of regulations produced by Saskatchewan Environment and Resource Management govern their use by wild rice growers. These rules have been written to ensure that wild rice cultivation does not interfere with people that have other interests such as fishing, hunting, and recreation.

Permits to grow wild rice can be obtained from the District Environment and Resource Management Office or the Sustainable Land Management Branch in Prince Albert. Each district office will have a map that shows the locations of wild rice permits held by other people. The application must be approved by the Department's head office. Once approved, the permit gives the right only to seed and harvest wild rice. It does not give any other rights on the water or surrounding land. The permit does not prevent other people from using the water for other purposes. A copy of the forms used to apply for a permit or licence is provided in the Appendix. Successful applicants must submit an annual progress report for their permits; a copy of this form is also appended.

The legal requirements of the wild rice industry in Saskatchewan are set out in the brochure entitled **Wild Rice Allocation Policy.** Details of the policy for Allocation of Resource Lands for Wild Rice Propagation can be obtained from your District or Regional Conservation Office of Saskatchewan Environment and Resource Management.

The main points of the **Wild Rice Allocation Policy** in norther Saskatchewan are:

WHO CAN APPLY TO HARVEST WILD RICE?

- Persons must be at least 18 years of age and have lived in the Northern Administration District (NAD) for 15 years or half their lifetime. However, producers holding permits prior to 1981 may apply for additional permits without regard to the residency requirement.
- Non-northerners who have trap lines in the NAD may Qbtain wild rice permits on their own trap lines only.

PERMITS AND LICENCES

- The maximum amount of land that can be held by a person is 400 hectares (about 1000 acres). Growers presently having permits covering more than 400 hectares will have their allocation frozen at current levels.
- A corporation, partnership, or cooperative may hold up to 400 hectares for each member to a maximum of 2000 hectares.
- Wild rice permits are issued on a first-come, first-serve basis and are renewed annually unless the permittee fails to seed or properly develop the crop (allowing for special circumstances).
- Permits will be issued to only one grower on lakes of 65 hectares (160 acres) or smaller.
- Upon application, permits will be changed to licences after four years. To qualify the grower must demonstrate that the area is commercially successful by submitting annual **progress reports** on the approved form (a copy is provided in Appendix 3). Only one licence is issued per individual; it covers all sites registered to that individual, and normally expires after 10 years.

PERMIT AND LICENCE FEES

- Fees are charged on an annual basis for each year of the licence or permit.
- A permit holder will be charged $0.25 (25 cents) per hectare (about $0.10 or 10 cents per acre) for any area held under a wild rice permit.
- A licence holder will be charged $2.50 per hectare (about $1.00 per acre) for any area held under licence.
- The minimum annual charge for each wild rice permit will be $5.00. A licence will cost a minimum of $25.00 per year.

GENERAL CONSIDERATIONS

- Suitable identification of boundaries must be maintained between adjacent producers.
- Buffer zones at least 200 m (about 650 ft) wide free of wild rice must be maintained on either side of existing cabins, docks, public access points etc. Buffer zones of at least 400 m (about 1200 ft) wide on either side of developed areas such as communities and cottage subdivisions will also be closed to wild rice operations.
- Use of fertilizers, herbicides or pesticides is not permitted.
- Standard crop management procedures, such as mechanical straw removal and weed control, will normally be allowed.
- Regulations limit the construction of buildings, trails, and structures to alter water levels.

ADDITIONAL CONSIDERATIONS

- The wild rice allocation policy excludes production in important fishery and wildlife areas.
- Wild rice will not be allowed in areas where it is desirable to maintain the natural environment, in areas with high recreational usage, or within provincial parks.

APPENDIX

CANADA WILD RICE COUNCIL

CANADIAN LAKE WILD RICE GRADE STANDARDS
Adopted May 12, 1990 Industry Standards (Optional)

(1) For the purposes of these standards,

(a) "wild rice" shall be the processed product resulting from curing, parching, and hulling seeds of *Zizania Aquatica L.* and *Zizania Palustris L.* and in which the product moisture does not exceed 11 percent by weight wet basis;

(b) "Canadian Lake Wild Rice" means wild rice that was harvested from natural bodies of water in Canada.

(2) The grades for wild rice are optional but, if declared, the grade names thereof and the standards thereof are as outlined in sections (3) to (6).

(3) Canada A (good quality size graded) is the name for the grade of wild rice that is practically uniform in size; that possesses a practically uniform colour; that possesses a good aroma typical of wild rice; that is practically free from defects; and that is practically free from foreign material.

(4) Canada B (good quality mill run) is the name for the grade of wild rice that possesses a good aroma typical of wild rice; that has not more than 10 percent by weight of broken kernels; and that is practically free from foreign material.

(5) Canada C (good quality broken) is the name for the grade of wild rice that possesses a good aroma typical of wild rice; and that is whole and broken kernels; and that is practically free from foreign material. It may have in excess of 10 percent by weight of broken kernels.

(6) Definition of terms

"broken kernel" means a part of a kernel which is less than 6.4mm (16/64 inch) in length;

"good aroma" means that the wild rice has a clean aroma typical of properly processed wild rice, free from any objectionable odours;

"practically free from defects" means that the wild rice has no greater percentage of broken kernels than that set out in the table to this section for the size designation and contains no more than 10 percent by weight of kernels which do not meet any of the requirements for Canada A wild rice;

"practically free from foreign material" means not more than 0.01 percent by weight of sand particles, chaff, empty hulls, seeds of other plant species, insect matter or other foreign material is present in any sample of wild rice;

"practically uniform good colour" means that no less than 95 percent by weight of the kernels are of a uniform colour;

"practically uniform in size" means that the wild rice complies with one of the size designations set out in Table 1.

TABLE 1: Size Designations for Canada A Wild Rice

Length of Unbroken Kernels	Width of Unbroken Kernels	Word/Letter Designations	Maximum % Broken Kernels
At least 16/64 inch (6.4mm)	Less than 4/64 inch (1.6mm)	Canada AM (medium)	5%
At least 16/64 inch (6.4mm)	At least 4/64 inch (1.6mm)	Canada AL (large)	4%
At least 30/64 inch (12mm)	At least 4/64 inch (1.6mm)	Canada AXL (extra large)	3%

Appendix : Saskatchewan Wild Rice Recipes

Basic Cooking Directions

Put wild rice in a strainer and rinse with cold water. Add 4 cups water to 1 cup wild rice and bring to a boil. Cover, reduce heat, and simmer for 50-60 minutes until rice is tender. Remove from heat and drain. For a chewier rice, reduce the cooking time. For a fluffier rice, let stand (covered) for at least 10 minutes before draining. Wild rice expands to about 4 times its volume on cooking.

Quick soak method:
Wash the required amount of rice under cold running water. Stir rice into 3 times the amount of boiling water. Parboil for 5 minutes only. Remove from heat. Let soak in the same water (covered) for 1 hour. Drain, wash and cook as directed in recipe.

Traditional Wild Rice Pancakes

1/4 cup	wild rice
1/2 tsp	salt
1 1/2 cups	boiling water

2	eggs	1 tsp	salt
2 cups	buttermilk	1 tsp	baking soda
2 cups	flour	2 tsp	baking powder
2 tbsp	sugar	2 tbsp	butter, melted

Follow the "quick soak method" to prepare wild rice. Cook rice until soft and partially puffed. Beat eggs, stir in buttermilk. Mix together flour, sugar, baking powder, baking soda and salt in a separate bowl. Gradually add flour mixture to liquid, beating until smooth and it forms a thin batter. Stir in melted butter and cooked rice. Drop onto hot buttered griddle.
Makes 16-18 pancakes.

Wild Rice Salad

1 cup	wild rice	**dressing:**	
4 cups	water	1/4 cup	oil
1 cup	diced celery	1/4 cup	vinegar
1 cup	grated carrots	1 tsp	dry mustard
1/2 cup	diced onion	1 tsp	oregano
1 cup	frozen peas, thawed	salt and pepper	
1 cup	chopped cooked meat (if desired)		
1 cup	mayonnaise		

Cook wild rice and water according to basic directions, then cool.
Combine rice, vegetables, and meat and toss gently. Combine the dressing ingredients in a tight-sealing jar and shake until mixed. Pour dressing over rice mixture, toss, and refrigerate until ready to serve. Just before serving, add mayonnaise. Makes 8 servings.

Stove Top Spanish Wild Rice

1 cup	wild rice	1 can	mushrooms, sliced
1 can (14 oz)	tomatoes	1	small onion, sliced
1 cup	beef bouillon	1/2 cup	green pepper, sliced
1 tsp	Worcestershire sauce	1 tsp	sugar
dash	soy sauce and hot sauce (or salt and pepper) to season		

Combine rice, tomatoes, bouillon, and seasonings and bring to a boil. Reduce heat and simmer for 40 minutes. Add mushrooms, onions, and green peppers and simmer for an additional 15 minutes. Serve with either meat or fish dishes. Makes 4 servings.

Oven Baked Wild Rice

3 tbsp	butter	2 cups	fresh mushrooms, sliced
1 1/2 cups	wild rice	2 cups	water
1 can (4 oz.)	water chestnuts, sliced	3 cups	beef or chicken bouillon
1/2 cup	celery, chopped		

Melt butter in a large casserole. Add rice and vegetables and mix well. Add liquids and bake at 325 ° for 1 1/2 to 2 hours. Makes 8 servings.

Honey Garlic Chicken and Fruit Stir-fry

2 cups	cooked wild rice	2	chicken breasts, skinned and cubed
2 tsp	oil	1/2 cup	red and green bell peppers, cut in strips
1/2 cup	onions, chopped	2 tbsp	soy sauce
2	cloves garlic, minced		
1 can (14 oz.).	peaches in pear juice		
1/2 cup	green grapes, halved		
2 tbsp	honey		

In a frying pan or wok, stir-fry chicken and garlic in hot oil for 3 minutes. Add onions and peppers and stir-fry until cooked but still crisp. Add peaches with juice, grapes, soy sauce, and honey and heat. Add wild rice and stir just until heated through. Makes 2 servings.

Wild Rice and Fish

1/4 cup	finely chopped celery	50 ml
1/4 cup	finely chopped onions	50 ml
1 tbsp	butter or margarine	15 ml
1/2 cup	dry bread crumbs	125 ml
1/2 tsp	finely shredded lemon peel	2 ml
4 tsp	lemon juice	20 ml
1 tsp	parsley flakes	5 ml
1/4 tsp	curry powder, dash of pepper	1 ml
1/4 tsp	salt	1 ml
1 cup	cooked wild rice	250 ml

Saute the celery and onions in butter or margarine. Add remaining ingredients. Mix well. Bake with your favourite fish dish or use as a stuffing.

Wild Rice Beef (Venison or Lamb) Stew

2/3 cup	uncooked wild rice	1 can (14 oz)	mushrooms, undrained
1 tsp	salt	4	carrots, quartered
4 cups	cold water	2	stalks celery
2 lbs	lean beef, venison, or lamb	1	onion, large chopped
3 tbsp	butter or margarine	10	peppercorns
2 tbsp	seasoned flour	1/4 cup	parsley or 1 bay leaf
1 clove	garlic, minced	2 cups	bouillon or beef stock
1 - 8 oz can	tomato sauce	1/2 cup	dry sherry/dry white wine or juice

Cook wild rice, water, and salt according to basic directions. While rice is cooking, cut meat into pieces for stewing, brown in butter or margarine over high heat. Sprinkle meat with seasoned flour. Place meat and remaining ingredients, except rice and wine, into a heavy casserole. Cover and bake in a preheated 300°F (150°C) oven for 2 hours. Add cooked rice and wine, bake for an additional hour. Season to taste. Makes 6 servings.

Apple Pork Chops Wild Rice Casserole

3/4 cup	wild rice	4	pork chops
1 cup	apple juice	dash	salt and pepper
1/4 cup	dry white wine/apple cider	2	tart apples, chopped
2 cups	onion broth or soup		

Combine rice, juice, wine, and onion soup in a large casserole. Arrange pork chops on top of rice. Season with salt and pepper. Cover and bake at 325 ° for 1 hour. Add water during baking if necessary. Arrange chopped apples on top, cover, and continue baking for 30 minutes longer. Makes 4 servings.

Wild Rice Fruit Dessert

4 cups	wild rice, cooked	2 cups	miniature marshmallows
1 can (14 oz)	fruit cocktail, drained		
1/2 cup	mandarin orange segments	1 cup	whipped cream
1 can (14 oz.)	cubed pineapple, drained	1/2 cup	halved maraschino cherries
1/2 cup	chopped nuts		

Mix rice with fruit (except cherries), nuts, and marshmallows. Cool mixture in refrigerator. Fold in whipped cream and top with cherries. Refrigerate until ready to serve. Makes 8 servings.

Honey Nut Wild Rice Loaf

1/4 cup	honey	1 tsp	baking powder
1/4 cup	butter, softened	1 tsp	salt
2	eggs	1/4 tsp	ground cloves
1 1/3 cups	cooked wild rice	1/4 tsp	ground mace
1/2 cup	chopped pecans	3/4 cup	milk
1 1/4	cups whole wheat flour (white if desired)		

Cream butter and honey in mixing bowl. Beat in eggs, until smooth. Stir in rice and nuts. Mix flour, baking powder, salt, cloves and mace in small bowl. Stir flour mixture, 1/3 at a time, alternating with milk, into egg mixture until combined. Pour into greased loaf pan. Bake at 325°F (165°C) for 50 to 60 minutes or until toothpick comes out clean. Makes 1 loaf.

Saskatchewan Environment and Resource Management

WILD RICE APPLICATION
Annual Permit or Term Operating Licence

1. Name: ______________________ Telephone: ____________
   Address: ______________________ Hospitalization No.: ____________
2. I do hereby make application for a permit/licence to cultivate and harvest wild rice in the area described/located as follows:
   Name of Water Body: ______________________
   Location (please attach map): ______________________
   ____
   Total Area: ______________________ (Not to exceed 400 hectares)
3. (a) I am the legal age of 18 years, and have resided within Saskatchewan for the last 6 months.
   Yes _______, No _______
   (b) If applying within the Northern Administrative District, do you qualify as a Northerner (for criteria see Policy)?
   Yes _______, No _______
4. (a) Have you any wild rice areas presently under permit within Saskatchewan?
   Yes _______, No _______
   (b) If yes, give total area (hectares of all permits) ______________
   (c) **Renewal Permit #** ______________
5. If access is across private land, please attach copy of approval from landowner, in writing.
6. List intended improvements to the area requested (*Department approval **must** be obtained **prior** to establishing any improvements, i.e. docks, trails, etc.) ______________
   ____
7. I agree to pay $_________ annual permit/licence fee, and submit a Progress Report annually before permit renewal will be considered.
8. I am applying for this permit/licence on behalf of myself and no one else.
9. Are you employed by the Department of Environment and Resource Management: Yes___ No___
   If yes, please comply with Conflict of Interest Guidelines.

I hereby declare that the above statements are true and correct and made for the purpose of obtaining a permit/licence and I am prepared to comply fully with the terms of the permit/licence which may be issued.

Date: ______________ 19___ ______________________
Applicant's Signature

Conservation Officer's Report and Recommendations

1. Special conditions to be incorporated in the permit or licence.
   ____
   ____
   ____
   ____
   ____
2. Permit/Licence to expire ____________ 19_______
3. (a) Permit fee collected $______________
   (b) Licence fee collected $______________
   (c) Field Receipt # ______________

Date: ____________ 19___ Approved by ______________________
Conservation Officer
District ______________________

cc: Sustainable Land Management Branch, Prince Albert

LANDS-27
Revised 062494

Saskatchewan
Environment
and Resource
Management

WILD RICE PROGRESS REPORT
FOR THE 19___ GROWING SEASON

(To accompany payment for wild rice permit or licence renewal)

1. Name:__________________________ Address:____

   Phone:_________________________ ____

2. Permit/Licence No.:__________ Area covered by Permit/Licence:____________________ ha.

3. Name of Lake/Bay:__________ Location:____

4. Activities within Permit/Licence Area:

   (a) Total Area Seeded/Established to Date:___________ ha.

   (b) Total Amount of Wild Rice Harvested ____________ kg.

   Amount Sold ____________ kg. To Whom:____

   ____

   Amount Used for your own Seed ____________ kg.

5. Do you Own a Wild Rice Harvester? Yes ___ No ___

6. How is Wild Rice Transported from your Lake? Land ___ Air ___

7. Please check off any Wild Rice Production Problems that you had this **Crop Year**:

   High Water Levels___ Low Water Levels___ Beavers___ Poor Germination___ Straw Problems___ Strong Winds Reduced Harvest___

   Frost___ Mechanical Problems with Harvester___ No Wild Rice Harvester Available___

   Other Problems____

8. Please list Site Improvements **NOTE:** (Department approval <u>must</u> be obtained <u>prior</u> to establishing any improvements such as docks, and other structures):

   ____

Date:________________ Signature:____

NOTE: CONVERSION FACTORS TO USE

2.2 lbs. = 1 kg. 2.5 acres = 1 ha.

LANDS-28
Revised 06/28/94

Glossary

Acid	A substance that can donate a hydrogen ion; most typical acids are sour and are compounds of hydrogen (H) with another element. (see **pH**)
Adventitious roots	Extra roots which develop from an unusual place. In wild rice, this is generally the lower part of the stem.
Aerate	To supply or impregnate with air. Wild rice grows best in water and soil which has been aerated by waves, wind, and currents.
Aerial leaves	Leaves that grow above the surface of the water.
Agrochemical	Chemical compounds applied by the grower. These include fertilizers, herbicides and pesticides, all of which are prohibited in Saskatchewan wild rice production.
Agrologist	An agricultural specialist who can give advice on the best places and ways to grow crops.
Air rudder	Steering device on an airboat harvester that works by deflecting the airstream created by the propeller.
Airboat harvester	A light, manoeuvrable boat driven by an air propeller and equipped with a collecting tray. (see **speedhead)**
Alkaline	Water or soil that has a pH above 7.
Anaerobic	Living or functioning in the absence of air or free oxygen.
Annual plant	A plant which completes its life cycle in one year. During this time the plant grows, flowers, produces seeds, and dies.
Aquatic plant	A plant that lives in water or in waterlogged environments.
Bacteria	A microscopic plant-like organism. Some types cause the decay of organic material, others take nitrogen out of the air and convert it to a form that can be used by plants.

Bank statement	A report from your bank (usually prepared each month) that lists all transactions, that is, money paid out, money deposited, and any service charges.
Beater bars	Plastic pipes installed across the speedhead to increase impact on the wild rice plants, and hence increase yields. Now mostly replaced by plastic fencing.
Biomass	The weight of plant material (including leaves, stems, and other tissues) that is present at a site.
Break-even cost	The price at which a product (e.g. wild rice) must be sold in order to cover costs of production.
Broadcasting	The scattering of seed evenly over an area to be planted.
Capital	The amount of money or property used to operate a business.
Capital outlay	The amount of money used to purchase property or equipment to operate or expand a business.
Carbon dioxide	An atmospheric gas that readily dissolves in water and is used as a source of carbon in the manufacture of organic compounds through plant photosynthesis.
Cleaning	The stage in wild rice processing at which debris and chaff are removed.
Conductivity	A measure of the amount of electricity that will pass through soil or water. This is used as an indirect measure of dissolved minerals.
Cultivate	Modifying growing conditions in order to improve crop development.
Curing	The stage in wild rice processing in which freshly harvested grain is allowed to ferment and ripen before parching. (see **parching)**
Custom harvesting	Harvesting another person's wild rice for a fee or share of the crop.
Cyclone seeder	A mechanical device used to broadcast seeds.

Debris Unwanted material.

Direct cost The actual cost of performing a task, excluding all overheads.

Dough stage Period in the development of a wild rice plant when the seed has a soft consistency.

Downtime cost Costs incurred that are associated with, but are in addition to, the expense of performing a task.

Eh scale A measure (in millivolts) of the chemical state of oxidation in a waterlogged sediment, primarily used by researchers.

Embryo A miniature plant within a seed.

Emergent plants Aquatic plants in which some plant parts (typically stems and leaves) protrude above the water's surface.

Ferrous The typical form of iron compounds in poorly aerated, waterlogged sediments. In this form, the compounds are very soluble and may be toxic to wild rice plants.

Floret A single flower, usually one that is part of a panicle or similar type of flower cluster.

Gas exchange The process whereby growing plants take in carbon dioxide and release oxygen. Normally, gas exchange occurs between the plant and the atmosphere, but submersed aquatic plants rely on gases dissolved in the water.

Genetics The science or study of inheritable characteristics.

Geographic range The general area in which a species can be found. The actual distribution will be determined by specific site conditions.

Germination The sequence of events in a viable seed that leads to growth of an embryo and development of the seedling.

Grading The sorting of processed wild rice kernels by size and other characteristics.

Habitat The natural environment of a plant.

Hectare	A metric measure of area, 100×100 metres.
Hulling	A stage in the processing of wild rice in which the papery cover of the kernel (hull) is removed.
Hydrogen sulphide	A poisonous gas formed in waterlogged sediments which can be easily detected by its characteristic smell, like "rotten eggs".
Interest	Costs incurred for the privilege of borrowing money.
Licence	A legal document that entitles a successful wild rice grower to operate his business on a provincial waterbody for a period of 10 years upon payment of annual fees.
Lodging	A condition in which plants are bent, by wind or other causes, and subsequently fail to straighten.
Manomin	An American Indian word for wild rice.
Migratory	To travel away from an area and return in a regular cycle.
Milk stage	Period in the development of a wild rice plant when the seed material is a whitish fluid with the consistency of milk. The developing seed eventually becomes thicker and turns to a soft "dough" as the grain matures.
Nitrogen	An element essential for the growth of plants.
Northern Administration District	A former provincial government district that covered the northern part of Saskatchewan, usually abbreviated as NAD.
Nutrient	Any chemical element which a living organism requires for growth.
Organic	A carbon compound associated with living organisms.
Oxidation	A process which affects the composition and properties of chemical compounds.

Oxygen An atmospheric gas required for plant and animal respiration. Oxygen diffuses slowly into submersed sediments creating anaerobic conditions that can be detrimental to plant growth. (see **Eh**)

Paddy An artificial wetland surrounded by a low embankment in which water depth can be regulated by precise grading, the use of drain tiles and sluices, or other means.

Panicle An inflorescence or flower head, common in the grass family, that has a branched axis.

Parching A stage in the processing of wild rice when the kernels are dried and roasted to develop the flavour.

Pathogen Any disease-causing organism, usually bacteria and viruses.

Perennial plant A plant that survives from year to year and typically produces seed each year.

Pericarp The outer wall of the ripened grain.

Permit A legal document that is required prior to seeding or operating a wild rice business in provincial waterbodies. Permits must be renewed each year for the appropriate fee.

pH scale A measure of the acidity (or alkalinity) of a substance. Values less than 7 indicate an acid condition: those greater indicate an alkaline condition.

Plant competition The situation in which plant growth is affected by the common demand of two or more individuals on a limited supply of resources.

Plant indicator Plants that can be used to assess the potential quality of a site for a particular purpose.

Pollination Transfer of pollen from a stamen (or male plant part) to a stigma (or female plant part).

Precambrian shield The geologically ancient granites and other rocks which outcrop throughout northern Saskatchewan.

Progress report	A form giving complete details of a wild rice operation that must be filled in each year before a permit or licence is renewed.
Radial oxygen loss	The loss of atmospheric oxygen from the roots of aquatic plants; a process which aids growth under anaerobic conditions.
Reduction	A chemical process that is characteristic of waterlogged sediments and which can cause problems of toxicity and nutrient imbalance for plants.
Saline	Water or soils that contain unusually high concentrations of soluble salts such as sulphates.
Scarify	To mechanically scratch or damage the outer surface of the grain.
Security	A document or item held by a creditor as guarantee of his right to payment.
Sediment	The material deposited on the bottom of a water body.
Shattering	The shedding of mature kernels from the flower head.
Speedhead	The collecting tray and attachments mounted on the front of an airboat harvester.
Stand density	The number of plant stems in a given area (usually recorded as the number of stems per square metre).
Sulphate	A chemical compound of sulphur and oxygen.
Tiller	A secondary stem arising from the lower part of a main stem.
Viability	The potential of a seed to germinate.
Weed	Any unwanted, troublesome, or useless plant that hinders the growth of the crop.
Wild Rice Allocation Policy	The document that provides the legal regulations governing the wild rice industry in Saskatchewan.
Windrows	A heaped row in which wild rice is laid to assist proper curing.

Zizania The scientific name for the wild rice genus. The species of this member of the grass family are:
(a) *Palustris* with varieties *palustris* (northern) and interior;
(b) *Aquatica* with variety *aquatica* (southern);
(c) *Aquatica* with variety *brevis* (estuarine); and
(d) *Texana* (Texas).

CONVERSION TABLE

Metric unit to Imperial unit			Imperial unit to Metric unit		
From	Multiply by	Gives	From	Multiply by	Gives
Linear					
millimetre	0.039	inch	inch	25.4	millimetre
centimetre	0.39	inch	inch	2.54	centimetre
metre	1.09	yard	yard	0.91	metre
kilometre	0.62	mile	mile	1.6	kilometre
Weight					
gram	0.035	ounce	ounce	28.0	gram
kilogram	2.2	pound	pound	0.45	kilogram
tonne	1.1	ton	ton	0.91	tonne
Area					
square metre	10.76	square foot	square foot	0.09	square metre
hectare	2.47	acre	acre	0.4	hectare
square kilometre	3.86	square mile	square mile	2.59	square kilometre
Volume					
litre	0.22	gallon	gallon	4.55	litre
Agricultural					
kilogram per hectare	0.89	pounds per acre	pounds per acre	1.12	kilogram per hectare