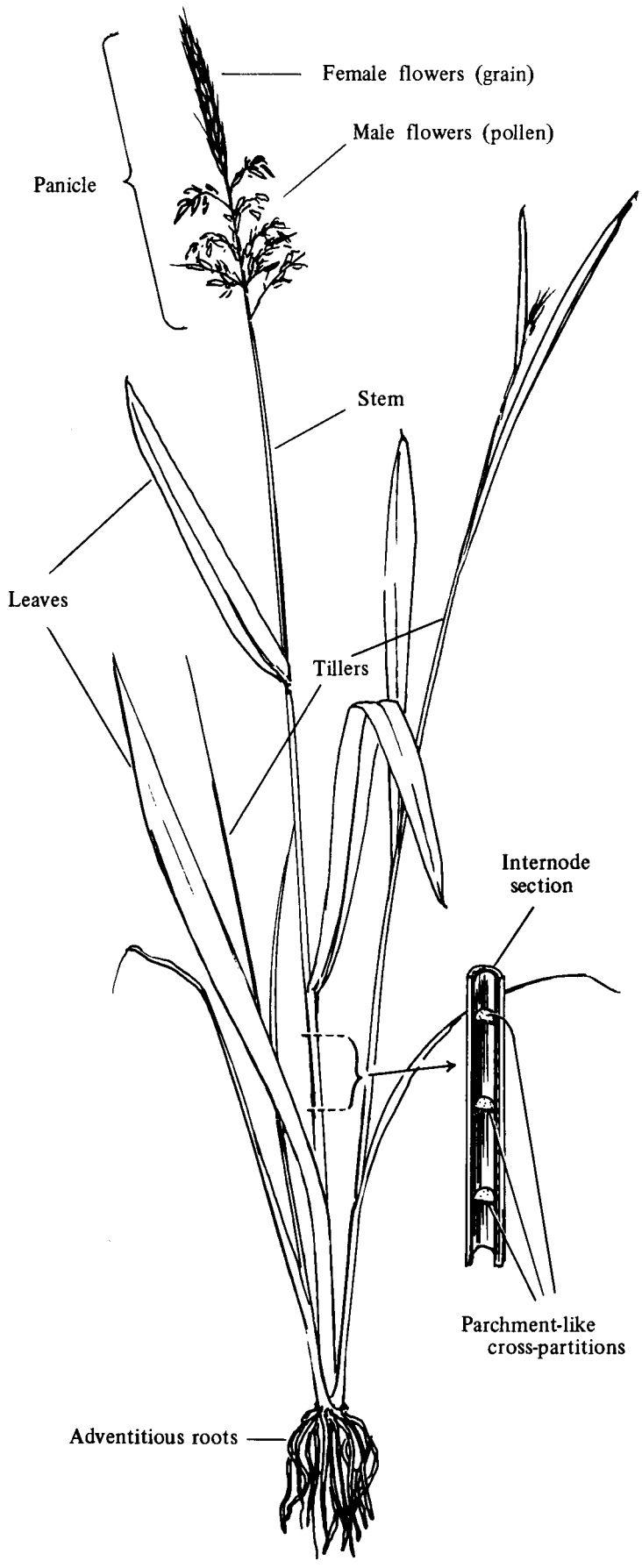
Commercial Production of Wild Rice

Agricultural Extension Service
University of Minnesota



On The Cover

The outlined portion on the Minnesota map and the dot in Le Sueur County in southern Minnesota indicate the areas where wild rice is commercially grown.

About The Authors

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MINNESOTA LEADS the world in wild rice production. In 1972, the state produced 80 percent of the world's supply. Canada produced 18 percent, and Wisconsin provided 2 percent. Table 1 shows 1940-1972 wild rice harvests from natural stands using the canoe and flail method. Flails are sticks of regulated size used to strike rice into a canoe.

Cultivating wild rice commercially was suggested in 1852. Serious attempts were first made about 1960. In 1968, approximately 900 acres were in production. Acreage increased to 17,000 in 1972. Table 2 shows 1968-1972 wild rice harvests from cultivated stands. Production from cultivated stands first exceeded natural stand production in 1971.

From natural stands, approximately 50 pounds/acre is an average harvest. In 1972, cultivated yields averaged about 220 pounds. Many growers obtained 700 pounds/acre.

Table 1. Wild rice harvested from Minnesota natural stands, 1940-1972[1]

Year	Amount (1000 lb)	Year	Amount (1000 lb)	Year	Amount (1000 lb)	Year	Amount (1000 lb)
1940	1,586	1949	684	1958	1,037	1967	2,629
1941	20	1950	553	1959	2,067	1968	1,195
1942	337	1951	532	1960	2,031	1969	981
1943	34	1952	446	1961	2,772	1970	1,485
1944	400	1953	1,340	1962	1,324	1971	1,217
1945	240	1954	3,110	1963	3,216	1972	1,001
1946	400	1955	1,235	1964	1,285		
1947	540	1956	3,942	1965	1,087		
1948	1,038	1957	1,037	1966	924		

Source: Minnesota Department of Natural Resources

[1]Unprocessed (35-50 percent moisture)

Table 2. Wild rice harvested from Minnesota cultivated fields, 1968-1972

Year	Acreage	Production (1000 lb)[1]
1968	908	90
1969	2,645	400
1970	5,202	910
1971	8,705	1,520
1972	17,000	3,740

[1]Unprocessed (35-50 percent moisture)

Plant Description and Growth Pattern

Wild rice (Zizania aquatica L.) is a native Minnesota plant. It's not closely related to rice (Oryza sativa L.). Like rice, it is an annual grass that grows in flooded soils. The plants may grow 8 feet tall. They may have several tillers. Stems are hollow except at the nodes where leaves, tillers, roots, and flowers appear. The internodes are divided by thin parchment-like partitions.

The mature roots are straight and spongy. They lack root hairs. They are generally whitish. However, they may be rust colored because of oxidized iron deposits around the roots.

Leaf blades vary in width from 1/4 to 1 1/2 inches. These have a prominent, off-centered midrib. Mature plants usually have five to six leaves above the water.

Flowers are borne in a branching panicle. Female flowers are at the top. Male flowers are at the bottom (Figure 1). Cross pollination normally occurs. Female flowers become pollinated before male flowers on the same panicle have released their pollen. The grain is cylindrical and approximately 1/2 inch long and 1/16 inch wide. However, the size varies greatly.

The grain begins to germinate underwater when temperatures are 38-40°F. This is usually in mid- to late April. The first one to three leaves remain submerged. In mid-May, one to two floating leaves are produced. In early June, erect leaves appear above the water. The panicles begin emerging in mid-July to early August. The grains ripen unevenly during a 2-week period. Harvest begins in late August. Some Canadian types planted in Minnesota mature 2 to 3 weeks earlier.

In natural stands, matured grains shatter (fall) easily from the plant. Thus, it's necessary to harvest these types several times whether these are in natural stands or cultivated fields. Most cultivated fields now are planted with types which are partially resistant to shattering. These are harvested once with rice combines modified for wild rice.

Figure 1. These are wild rice panicles. The upper compact portion is about 6 to 10 inches long. It contains the female flowers which produce grain. The lower branched portion contains the male flowers which produce pollen.

Selection and Construction of Fields

Site selection: The site should be flat so 6- to 12-inch water depths can be maintained. A preliminary topographic survey should be made. This indicates whether a site is flat enough. Some grading may be possible. However, grading is expensive and may expose subsoil. The site should allow for late summer drainage for harvesting equipment.

An acceptable water source must be available. Most growers pump water from a stream or lake. Permits from the Minnesota Department of Natural Resources are necessary to use surface or ground water. One requirement is ownership of land next to the water source. Wells can be used. However, they are expensive to drill. Often in production areas, wells have an insufficient recharge rate.

Water quality is important. Natural stands usually grow where water has 40-200 parts per million (ppm) alkalinity, a sulfate ion concentration under 10 ppm, and a 6.8-8.8 pH.

Wild rice grows well on soils ranging from peat to clay. However, to hold water, a layer of impervious soil is needed beneath the topsoil. Many peat soils used range in pH from 5 to 8. They are often low in phosphorus and potassium, and growers may need to add these elements.

Land preparation and dike construction

Brush and small trees are often cleared in winter. Then, vegetation is sheared with a bulldozer. In spring, a rototiller is used to prepare the land. Rototilling is preferred to plowing. Plowed organic soils frequently float when flooded. After the soil is worked, a second, more detailed topographic survey can establish contour lines for dikes providing 6- to 12-inch water depth.

Often land slope limits diked areas to 25 acres or less. Where slope does not limit the areas, drainage often requires open ditches at intervals within a field. Proper intervals depend on soil type and drainage factors.

The dikes are frequently built with a dragline or backhoe. Dikes bordering a field should allow for access roads. These dikes should have a 3:1 (a 1 foot drop for every 3 feet horizontal distance) side slope and be 12 inches higher than water level. The top width should be at least 8 feet in organic soils and 6 feet in mineral soils.

For organic soils, dikes should be built 3 to 4 inches higher to allow for settling. Inside dikes need a top width no more than 2 feet. They should follow or drop slightly from the contour toward the outlet. This facilitates drainage.

Establishing Stands the First Year

Seedbed preparation: Fields should be prepared the summer or fall before the first crop. This allows preparation time and decomposition of sod or other materials. Rototilling 4- to 6-inches deep is most satisfactory. The final seedbed should be devoid of ridges and hollows to assure good drainage.

Fertilization: Soil tests cannot always indicate nutrient levels after soils are flooded. However, these tests can help determine fertilizer needs. Peat soils are usually low in phosphorus and potassium. If this is the case, 60 pounds each of phosphate (P_2O_5) and potash (K_2O) should be applied in the fall or during seedbed preparation. Fertilizer should be incorporated 2- to 4-inches deep with a disc or rototiller. Present wild rice types lodge if excessive nitrogen is applied. No nitrogen should be applied the first year unless the field was previously cropped. In the following years, only 30-45 pounds/acre should be applied when plant internodes begin to elongate. This is usually the first or second week of July. Ammonia nitrogen, such as ammonium nitrate, is most desirable.

Seed source and handling: New fields should be planted with types which are the most resistant to shattering. Seed is available at harvest time from growers. If seed is stored (even for a short time), it should be placed in water to assure later germination. Wild rice for fall seeding is usually placed in stock tanks filled with water. Seed stored for spring planting can be put into 50 gallon drums. Numerous small holes in the drums allow water circulation. The drums are placed in pits 10-feet deep. The pits are filled with water. Do not allow mud to cover the seed. Oxygen is necessary for seed respiration during storage. Poor germination results if the water freezes. The seed can also be stored in tanks filled with water kept at 33° to 35°F. Water should be changed every 2 to 3 weeks.

Seed dormancy prevents germination until after 3 months of cold storage. After dormancy, germination

can be determined. A known number of seeds are placed into a pan of water at room temperature. However, optimum germination occurs at slightly lower temperatures of about 63°F. High quality seed will have at least 70 percent germination in 3 weeks. To help avoid weeds, plant only weed-free seed.

Method, date, and rate of seeding: After surface water is drained from the seed, the moist seed is mixed with oats. It's seeded with a bulk fertilizer spreader or an airplane. Fall seeding is successful when seed is incorporated 1 to 3 inches into a prepared seedbed with a harrow. If seed is left uncovered during the winter, germination can be reduced by cold temperatures. Wild rice will not emerge from depths greater than 4 inches. If the seed is incorporated, it's not necessary to flood fall-seeded fields in the fall. Also successful is seeding by airplane into flooded fields in early April. Then the seeding rate should be increased 15 to 20 percent, since many seedlings float to the water surface.

Generally with a bulk fertilizer spreader, 25 to 30 pounds/acre of seed is the right amount if the seed contains 50 percent moisture. Higher seeding rates sometimes cause lodging. Seed should not be allowed to dry below 27 percent moisture during seeding. Otherwise, reduced germination results.

Water management: Six to 12 inches of water is pumped into fields in early April. Lodging increases when water depths are greater than 18 inches. Recommended pump capacity is 15 to 20 gallons/minute/acre. A continuous flow is not necessary. Water is added only to compensate for percolation, evaporation, and transpiration.

Water usage varies considerably. In Clearwater County, 22 acre-inches of water are required. This includes rainfall, but not 8 acre-inches returned to streams at harvest drainoff.

Fields can be drained in August when the grain is beginning to fill. Drying takes about two weeks, but drying time varies with different soil types.

Managing Second Year and Older Fields

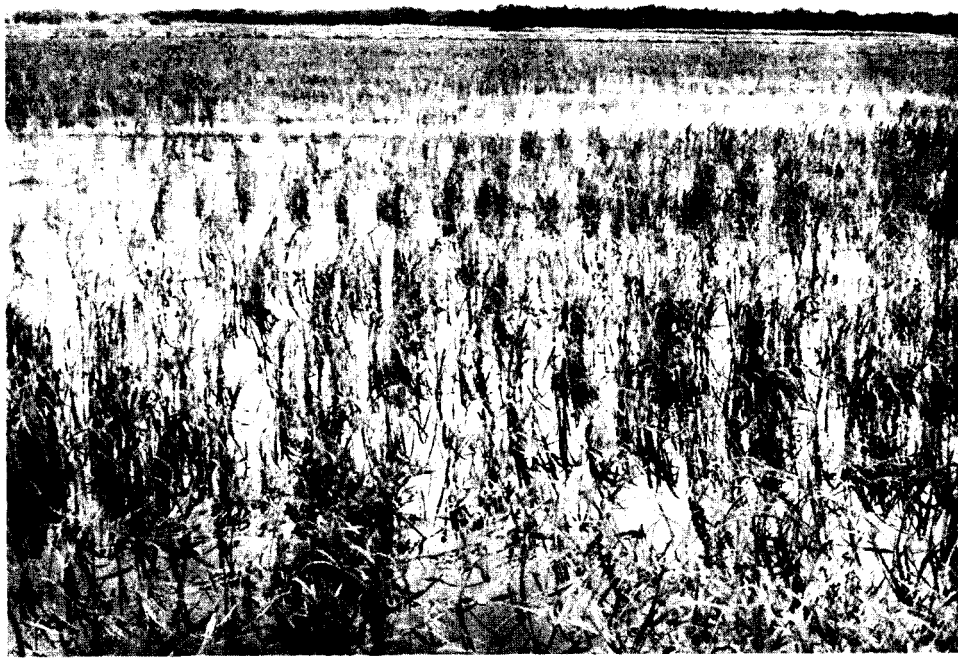
Tillage: Fields should be rototilled after fall harvest to incorporate straw and help control cattails. This allows earlier spring flooding. Working fields in the spring is usually impossible because of wet soil. If cattails become a problem, a field may have to be taken out of production for a year and fallowed.

Fertilization: Older fields should be fertilized just as first year fields.

Thinning: Fields, both shattering and partially shatter resistant types, reseed themselves. Approximately 500 to 1000 pounds of seed/acre fall to the ground before harvest. This results in dense stands in following years. For maximum yields, the population must be thinned. Thinning equipment is pulled through the water to uproot seedlings in the floating leaf stage. Most equipment reduces plant populations to five to six plants/square foot (Figure 2). Remaining plants are in a checkerboard design or rows. Experiments show that 6 inch plant rows with 24 inches between the rows give good yields and less lodging than with narrower spaces between rows.

Water management: This is the same as that described for first year fields.

Figure 2. This second year field has been thinned to reduce plant population.



Harvesting

Shattering types are harvested several times with a picker-harvester. This machine knocks mature kernels from the plant with a reel. The seed is caught in a series of long, narrow troughs.

The partially shatter resistant types are harvested with modified rice combines when average grain moisture is about 45 percent. Combine modifications include lengthened reel arms and extensions bolted onto the tracks (Figure 3). Wild rice requires slower reel speeds than does rice. Special wagons haul grain from the combines to trucks (Figure 4). The grain is immediately transported to processors.

Weed Control

Rototilling after harvest helps control cattails. Other weeds can be reduced by water depths of at least 6 inches. Herbicides have been tried, but wild rice is less tolerant than rice. Presently, no herbicides are registered for use.

Dike weeds can be controlled by mowing or applying 2,4-D amine at 1 pound/acre. Canada thistle and perennial sow thistle can be controlled with 2,4-D at the early bud stage or earlier. Avoid chemical drift onto wild rice.

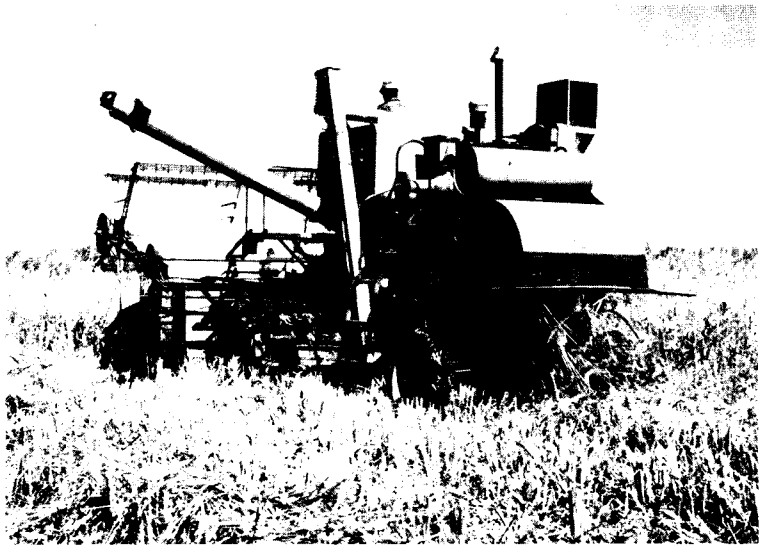
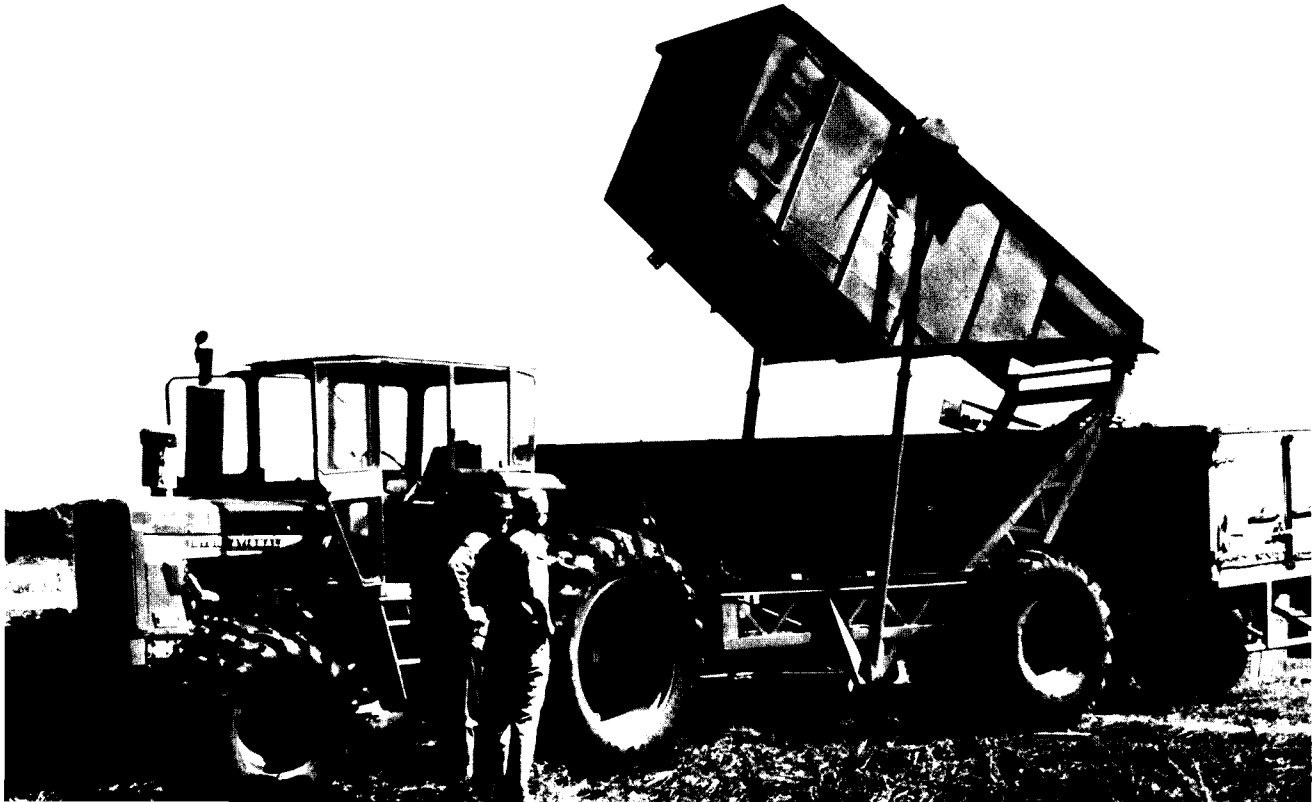


Figure 3. A rice combine can be modified for wild rice. The reel arms are extended. Extensions are bolted onto the tracks for better support.

Figure 4. These special wagons can be brought directly to the combine in wet fields and then pulled to waiting trucks.



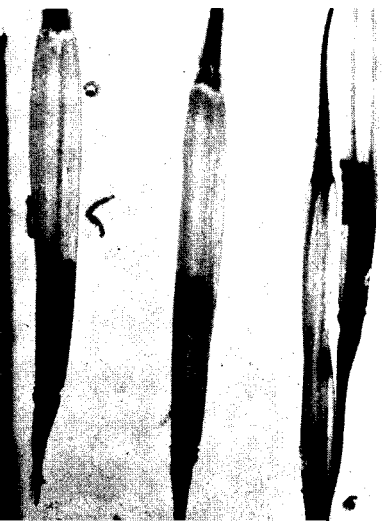
Diseases

Leaf blight caused by several species of Helminthosporium and stem rot caused by Helminthosporium sigmoideum can be severe after the first crop (Figure 5). Thinning helps but does not prevent severe losses. Removing plant debris or fallowing every other year may be necessary where climatic conditions favor these diseases. Leaf and head smut caused by Entyloma sp. has been observed, but resulting yield reduction is not known. Disease resistant varieties are not available.

Ergot, a common disease of cereals, also occurs on wild rice. However, wild rice is affected by a different species (Claviceps zizaniae). The fungus infects florets, and large ergot bodies (sclerotia) replace the kernels. Ergot bodies contain a toxin poisonous to man. Fortunately, the disease is not severely prevalent. Also, the ergot bodies are usually separated from grain during harvesting and processing because they are much larger than the kernels. If bits and pieces are detected, they can be floated out with water.

Figure 5. Severe leaf blight infection and stem breakage is evident here. Leaf blight is caused by Helminthosporium.

Figure 6. Eggs from the wild rice worm moth are readily visible when infested wild rice florets are held toward the light. Control should begin 14 to 21 days after eggs appear.



Insects and Other Pests

The wild rice worm (Apamea sp.) is the major insect pest. It has caused severe losses. The larvae feed on developing kernels. Malathion at 1/2 to 1 pound/acre or carbaryl (Sevin) at 1 1/2 pound/acre provide good control. Spraying should be done 14-21 days after eggs become visible in the hulls (Figure 6). The wild rice midge (Cricotopus sp.) can also cause damage before plants emerge from the water. Chewed leaves are evident when this insect is present. Malathion can provide control.

Other insects attacking wild rice presently are of no economic importance. These include leafminer (Hydrellia sp.), stem maggot (Eribolus sp.), and stem borer (Chilo sp.).

Blackbirds can cause severe losses. They can be controlled by recommended sound devices.

Land that was formerly covered by brush is now covered by wild rice. The above is a field of wild rice about the middle of July. The ditch from which soil was taken to build a dike can be seen in the foreground.

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