

**A GENERAL FOREST RESOURCE  
INVENTORY AND ESTIMATED VOLUMES FOR  
EIGHT COUNTIES ALONG THE MISSOURI RIVER  
IN  
SOUTH CENTRAL SOUTH DAKOTA**



**SOUTH DAKOTA DEPARTMENT of AGRICULTURE  
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And  
RANDALL RESOURCE CONSERVATION & DEVELOPMENT DISTRICT**



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## ABSTRACT

A general forest resources inventory was conducted in eight counties along the Missouri River in South Central South Dakota during the summer and fall of 2002. The inventory was initiated to provide more detailed information about the naturally occurring forests associated with the Missouri River Breaks. Our interests included the fire potential, the amount of Eastern redcedar tree encroachment into pasture lands, and the potential for economic development and product markets for the wood grown in this area.

The results of the forest inventory indicate that although the Eastern redcedar encroachment is a very real issue for landowners, Eastern redcedar trees make up less than 25 percent of the naturally occurring forest resources along the Missouri River. The breaks along this portion of the Missouri River are dominated by hardwoods. This does not preclude the fact that a given tract of land may be dominated by Eastern redcedar trees. It means that, in general, the forests along this stretch of the Missouri River are predominately hardwood trees with the Eastern redcedar trees being more prominent on the upper portions of draws, where they tend to invade traditional pasture lands.

Any wood industries that develop along the Missouri River will be dependent on the forest resources that exist in the area. The industry must consider the forest resources available. Consequently, they will need to understand the diverse mix of wood species that are present in the forest. Industries that utilize a multitude of tree species will be more likely to survive than industries that are "species specific." Industries that utilize and produce low value rough-sawn lumber, posts, compost, shavings, chips, or even wood pallets may be more viable than a company that just utilizes a single tree species such as Eastern redcedar trees.

In addition to these general findings, it must be noted that there is little or no management of the forest resources at this time. There are strong indications that the implementation of forest management plans would benefit forest health, enhance wildlife, and reduce potential fire hazards in the area.



## ACKNOWLEDGEMENTS

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1. Forest Resource Inventory Team - The team that measured the field plots for the survey are:

BEN NOWAKAWSKI, Forester, Team Leader  
NICHOLAS A. RONNING, Forestry Technician  
LEAH BROOKS, Inventory Aide  
GERLAD EVANS, Inventory Aide  
MARY ANTELOPE, Inventory Aide

2. The United States Forest Service provided grants for this project through the Economic Action Program (EAP) and the Cooperative Forestry programs administered by the State Forester.
3. The Randall RC&D was provided a grant to stimulate and develop a local market for the wood resources available in the study area. Their assistance in this project and coordination of local participation was instrumental in the ultimate success of the survey. Their support and continued work on markets will be greatly enhanced by the resource information provided by the survey.



## GENERAL

In 2001, the South Dakota Division of Resource Conservation and Forestry began a project to determine the extent of Eastern redcedar encroachment on range and crop lands, the fuel loading, and the economic potential for utilization of the forest resources along the lower Missouri River. The Fort Randal Resource Conservation Development District, through the South Dakota Division of Resource Conservation and Forestry, received a grant to implement this project in eight counties along the lower Missouri River in South Dakota.

The eight counties inventoried under this grant included; Bon Homme, Brule, Buffalo, Charles Mix, and Yankton on the east side of the Missouri River, and Gregory, Lyman, and Tripp on the west side of the Missouri River ( Figure 2). The land ownership in these counties is very diverse, including holdings by private landowners, tribal agencies, federal agencies, and a state agency. Tribal landowners include the Yankton Sioux Tribe, Lower Brule Sioux Tribe, Crow Creek Sioux Tribe, and the Rosebud Sioux Tribe. The state landowner is the SD Department of Game, Fish and Parks. Federal landowners include the US Army Corp of Engineers and the US Fish and Wildlife Service.

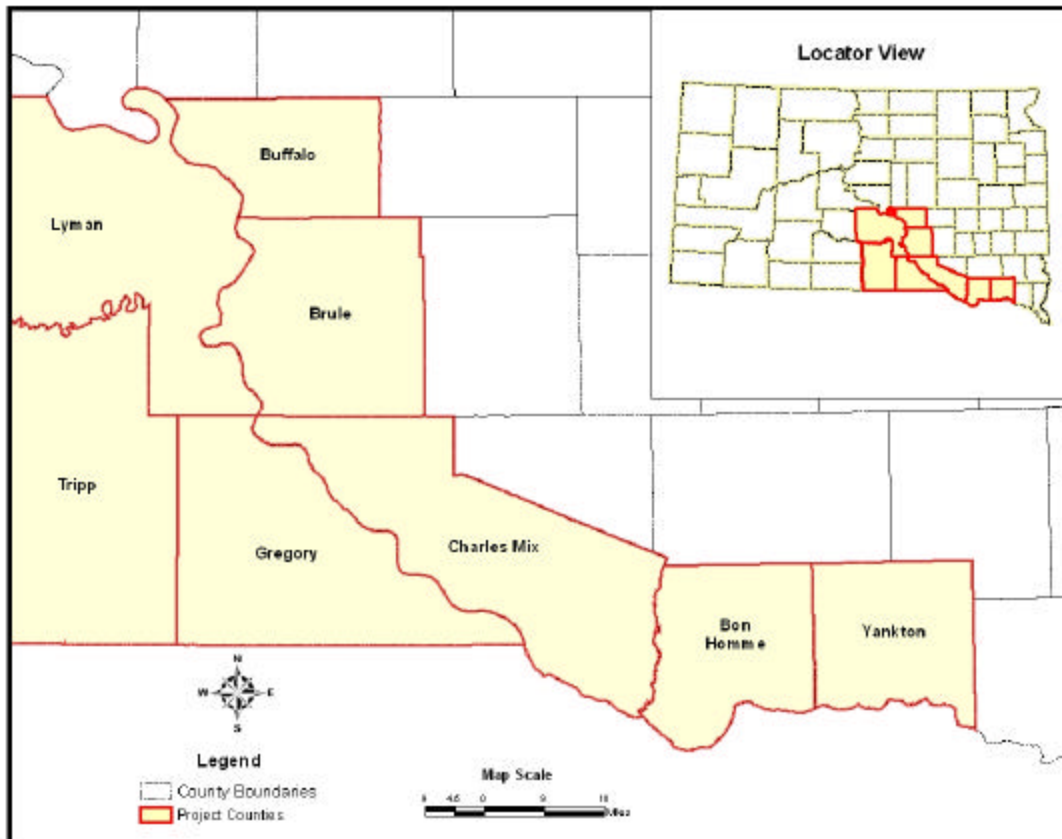
The landscape of the area consists of flat to slightly rolling uplands that break to moderately to severely sloping terrain when approaching the Missouri River, commonly referred to as the Missouri River Breaks. Immediately adjacent to the Missouri River are old flood plains, which are more prevalent in the southern counties of Bon Homme and Yankton.

**FIGURE 1 - Missouri River Breaks**



The soils of the Missouri River Breaks are predominantly fine to very fine textures with clay contents as high as 60 percent. Precipitation for the area ranges from 15 to 28 inches with most rainfall occurring from late March through June. Much of the precipitation during the summer months is attributable to isolated thunderstorms, which may drop 1 to 2 inches of rain in a localized area. Sometimes these storms are severe in nature. Temperatures range from highs of 90 to 110 degrees Fahrenheit during the summer months to lows of 0 to -20 degrees Fahrenheit during the winter months.

**FIGURE 2 - Counties in the inventory project**



## **Inventory**

The inventory of the eight counties was confined to naturally occurring forested areas within approximately ten miles of the Missouri River due to budgetary constraints. This included approximately the first ten miles up the major drainages that flow into the Missouri River. The remainder of these major drainages should be inventoried individually as needs are identified and funding becomes available.

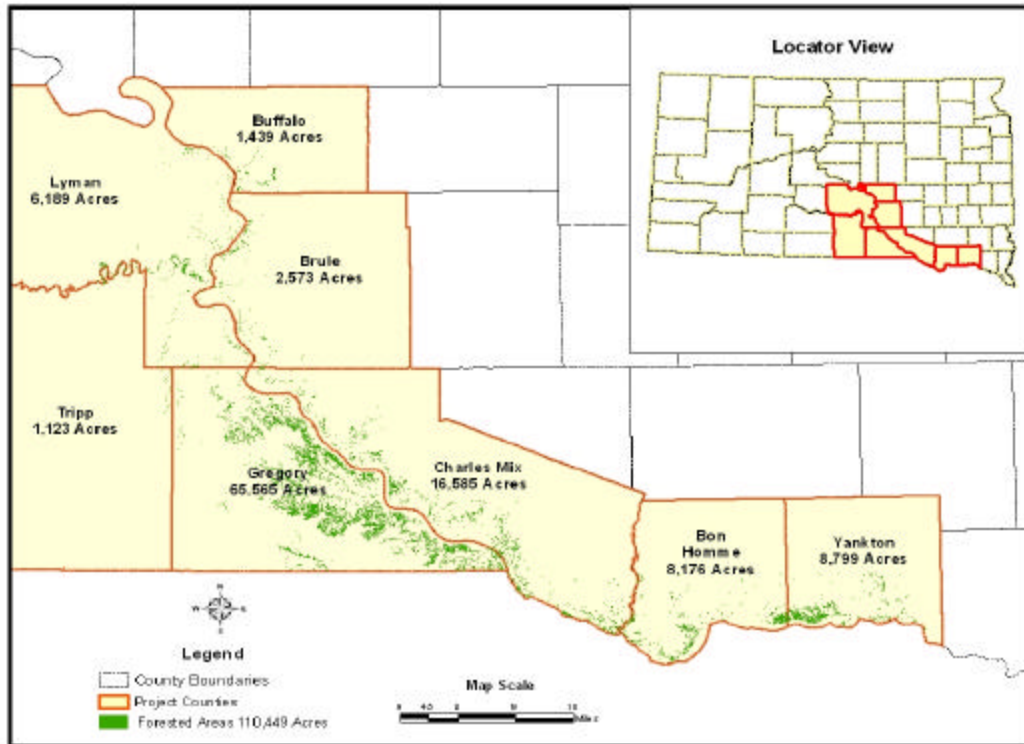
### **Pre-inventory Procedures:**

Forested areas inside the inventory area that were greater than 5 acres in size were outlined on aerial photographs of the counties. In order to verify the presence of forest resources and to determine the number of inventory points needed, 130 ground-check points were established on the aerial photographs. Once ground-checks were completed,

the outlined areas on the aerial photographs were digitized by the Division of Resource Conservation and Forestry for plot selection and acreage. The map in Figure 3 was generated using the digitized data and shows the areas covered by the inventory.

The inventory points were selected using a fixed grid overlay placed on the digitized maps and resulted in 440 possible inventory points. The 440 possible inventory points were supplemented by transects across the draws to validate the composition of the forest.

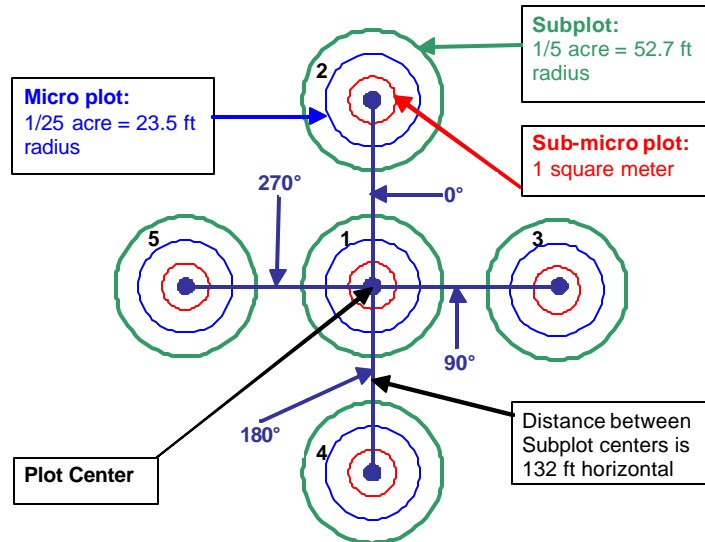
**FIGURE 3 - A composite of the digitized areas and acres in the 8 counties**



### **Inventory Procedures:**

Each inventory point was located using a compass and chain and a hand-held GPS unit was used to record the location of the inventory point center. Each inventory point consisted of five fixed radius plots. Each fixed radius plot contained three subdivisions; a 1/5 acre subplot for trees with a diameter breast height (dbh) of 8 inches or more, a 1/25 acre micro plot for trees with a dbh of 4-8 inches, and a 1/100 acre sub-micro plot for trees with a dbh of less than 4 inches (Figure 4). Transects were also run across the major draws and drainages. As the inventory progressed, the transects were discontinued based on the observed consistency of the forest composition. In addition, the 1/100 acre sub-micro plots were replaced with one square meter sub-micro plots.

**FIGURE 4 - Inventory point configuration.**



**Inventory Discussion:**

Data was collected from a total of 375 inventory points containing 1875 plots in the eight counties during the 2002 field season. Of the original 440 fixed inventory points planned, 10 percent were not sampled due to absentee landownership or being denied access to the property and 21 were not sampled because they did not have any forested areas or were now housing developments. A total of 94,583 trees and shrubs were recorded during the inventory. A list of species recorded during the inventory process is listed in Table 1.

**TABLE 1 - Tree and shrub species identified in the inventory.**

American Elm	Ironwood	White Poplar	Mulberry
American Basswood	Honeylocust	Wild Rose	Silver Maple
Boxelder	Siberian Elm	Snowberry	Willow
Bur Oak	Buckthorn	Ponderosa Pine	Sumac
Eastern Redcedar	Plum	Black Walnut	Catalpa
Eastern Cottonwood	Wild Grape	Russian-olive	Apple
Green Ash	Chokecherry	Hackberry	

The inventory results indicate that the naturally occurring forest resources are dominated by hardwoods. Hardwoods cover approximately 75% of the area inventoried. The lower side slopes and bottoms of draws, drainages, and the Missouri River flood plains are dominated by hardwoods. The lesser hardwood species and shrubs were typically found

along the edges of the major hardwood stands, on the uplands, and in openings within the stand.

There are very few Eastern redcedars found within these hardwood stands and regeneration occurs on a limited basis in small openings. Eastern redcedar appears to be more dominant along the upper side slopes between the hardwoods and the uplands. There are instances where the Eastern redcedars have moved onto the uplands and appear to be aggressively spreading out.

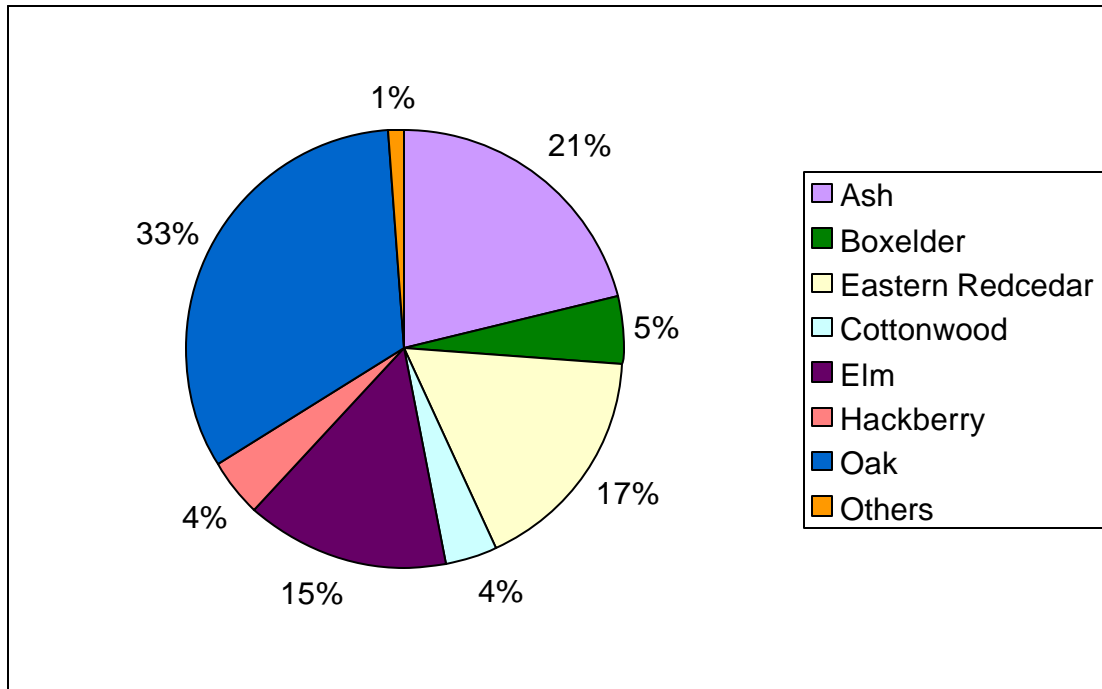
There was variability noted between the counties. The southern counties had a greater number of species and higher tree numbers than the northern counties. The variability of species and tree numbers with a dbh of 8 inches or greater is shown in Table 2.

The inventory crews noted that there appears to be little or no management of the forest resources at this time. The description of the naturally occurring forest resources in the eight county inventory area is general, and may vary greatly on any given tract of land. A landowner should have an inventory of their land done prior to undertaking any form of land or resource management.

**TABLE 2. Tally of tree species with a dbh of 8 inches or greater by county.**

	Bon Homme	Brule	Buffalo	Charles Mix	Gregory	Lyman	Tripp	Yankton	Total
Ash	78	41	125	311	2,877	210		137	3,779
Basswood	20				135			5	160
Boxelder	47	38	41	226	523	5	1	9	890
Catalpa				1					1
Cedar	385	70	9	387	2,002	65		185	3,103
Chokecherry					1				1
Cottonwood	100	1	1	102	178	88	78	95	643
Dogwood					9				9
Elm	356	1	4	317	1,781	42		236	2,737
Hackberry	90	1	16	80	515	9		62	773
Honeylocust	28				6			33	67
Ironwood					11				11
Mulberry	16				31			7	54
Oak	420	48	73	528	4,684		7	212	5,972
Ponderosa Pine								4	4
Silver Maple					5			41	46
White Poplar		8			3				11
Willow	6		1	40	32	12		2	93
Black Walnut	1							1	2
<b>Total</b>	1,547	208	270	1,992	12,793	431	86	1,029	18,356

**Figure 5 - Percent of trees 8 inches dbh or greater by species.**



## **REGENERATION**

Field data was collected for woody vegetation with a dbh of less than 4 inches and 4 to 7 inches, but was not analyzed in depth as part of this study. There are however several points that can be noted from the data.

Cottonwood regeneration is very limited and, at best, comprises 0 percent of the 0-3 inch and 4-7 inch dbh classes. This may be due to lack of conditions which cottonwood needs to regenerate.

Overall, there appear to be fewer trees, as a percentage, with a dbh less than 4 inches for all species listed in Figure 5, with the exception of elm and hackberry. This is also true, to a lesser degree, with all the hardwoods in the 4-7 inch dbh class. Eastern redcedar increases to 33 percent of the population in these diameter classes. This trend could be due to tree canopy closure and competition from other tree species and shrubs.

## **ESTIMATED VOLUME**

### **Estimated Volume Calculation Procedures:**

The field inventory data was entered into a database with the following information: point number, county, map name, map point number, legal description, GPS location, landowner name, species, tree count, tree height, and dbh. The database was sorted by tree species and dbh. Those entries with a dbh of 8 inches and greater were copied to a secondary database to be used in developing volume estimates.

The data base containing information on trees 8 inches dbh or greater was sorted by species, dbh, and tree height. Each species was tallied by dbh and average height. The volume for each tree species was calculated by dbh and tree height to find an estimated volume per acre which was expressed in cubic feet per acre, (cf/acre). The estimated volume was calculated using the "Volume Estimator Program" developed by the Forest Management Service Center, US Forest Service, Fort Collins, CO. The estimated volumes were calculated using the US Forest Service Region 2 equation numbers in the program to get cubic feet (cf). The total cubic foot volume (total cf) was calculated by multiplying the estimated cubic foot volume per tree by the tally for each given species, dbh, and average height. The total cubic foot volume value was then multiplied by 5 (plot size) and divided by 1875 (number of plots) to obtain the estimated cubic foot volume per acre (cf/acre).

The total volume for the project area was developed using a weighted ratio of total number of inventory points for a given species divided by the total number inventory points for the county.

### **Estimated Volume Discussion:**

Bur oak had the largest volume per acre with 101.30 cf/acre. Cottonwood had the second highest volume per acre with 94.58 cf/acre, but this may be misleading due to the species tally which was 4 to 10 times smaller than the tallies for bur oak, ash, Eastern redcedar, and elm. Table 3 below is a summary of estimated volumes by species for the project area.

The specific tables for each tree species are on file in the State Office of the Division of Resource Conservation and Forestry. They are available upon request. They are referenced as Appendix Tables 1 – 13 of the inventory report. In the near future, they will also be available on our website at: <http://www.state.sd.us/doa/forestry/publications>.

**TABLE 3 – Estimated Total Volumes by Species**

	<b>Cubic Feet</b>	<b>Total</b>
<b>Species</b>	<b>Per Acre</b>	<b>Cubic Feet</b>
ASH	78.3706936	<b>3,821,307</b>
BASSWOOD	4.5632	<b>8,736</b>
BLACK WALNUT	0.04133333	<b>7</b>
BOXELDER	17.2381333	<b>190,952</b>
CATALPA	0.01173333	<b>1</b>
EASTERN REDCEDAR	46.2090667	<b>1,967,442</b>
CHOKECHERRY	0.00373333	<b>0.2</b>
COTTONWOOD	94.576	<b>882,529</b>
DOGWOOD	0.15466667	<b>16</b>
ELM	62.1690667	<b>2,953,820</b>
HACKBERRY	16.2264	<b>237,040</b>
HONEYLOCUST	1.17466667	<b>1,698</b>
IRONWOOD	0.06	<b>9</b>
MULBERRY	2.25253333	<b>4,203</b>
OAK	101.296933	<b>3,798,765</b>
PONDEROSA PINE	0.0912	<b>18</b>
SILVER MAPLE	1.8032	<b>904</b>
WHITE POPLAR	1.78666667	<b>204</b>
WILLOW	3.48693333	<b>8,971</b>
<b>Total</b>		<b>13,876,622</b>

The estimated volume for all species for the 110,449 acres of the inventory project area is 13,876,622 cubic feet. Although reflected in the total volume, the species of catalpa, dogwood, ironwood, chokecherry, ponderosa pine, white poplar, black walnut, and silver maple should not be considered as species for the development of any markets because of their inconstant occurrence and low volumes.

### CONCLUSION

This was a limited inventory and this should be kept in mind when using the estimated volumes. More detailed work should be done at the county level. The volume estimates indicate that any potential for forest products manufacturing would be based primarily on utilization of hardwood species such as bur oak, elm and green ash. The utilization of Eastern redcedar would be secondary. Local landowners will have to have a long-term commitment to maintain, improve, and utilize their forest resources in order to make it practical for a company or cooperative to make the capital investment necessary to develop products or a manufacturing facility.

The inventory and estimated volumes both reflect the lack of forest management. The lack of management has resulted in lower volumes because of competition. There are also increases in less desirable species and encroachments into range and croplands by trees and shrubs. Ultimately, forest management planning would be beneficial to livestock and wildlife production, which should be viewed as an economic benefit by the landowners.



This study indicates that using prescribed fire to manage the spread of Eastern redcedar and other less desirable trees and shrubs would be very difficult to manage because of the terrain, limited accessibility, and other factors. Prescribed fire is likely to damage those tree species which the fire was intended to help. There are also potential liability concerns should a prescribed fire escape control and damage neighboring properties.

If a wildfire was to occur, there is the potential for environmental impacts due to the high clay contents of the soils and the steep slopes. These burned areas could become void of vegetation, could experience severe erosion which could deposit sediment and ash in the reservoirs, and could provide ideal conditions for a noxious weed infestation.

Finally, because of the diverse land ownership in the inventory area, it is essential that a common goal be established to manage the forest resources. To achieve this goal means landowners must work together.