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STATUS OF RIPARIAN ECOSYSTEMS IN THE UNITED STATES

by

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ABSTRACT

An attempt was made to review all available data on the extent and status of riparian ecosystems in the U.S.A. This report presents a synthesis of the findings, including some estimates of how much land was originally covered by woody riparian vegetation, and how much remains in that condition today. A synopsis of information is presented on the status of riparian ecosystems in each of 10 regions: California, Pacific Northwest, Rocky Mountain, Arid Southwest, Plains-Grasslands, Lake States, Corn Belt, Mississippi Delta, Northeast-Appalachian, and Southeast. Woody riparian plant communities once covered an estimated 75 to 100 million acres of land in the contiguous 48 states. Mankind has converted at least two-thirds of that nationwide acreage to other non-forest land uses and it is estimated that only 25 to 35 million acres of riparian plant communities remain in a near natural condition. Across the country, loss of riparian acreages is directly attributable to water resource development (especially channel modification), floodplain clearing for agriculture, and expansion of urban areas. In many states of the arid west, the midwest, and the lower Mississippi alluvial valley, riparian vegetation has been reduced in area by more than 80%. Riparian woodlands are one of this country's most heavily modified natural vegetation types.

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INTRODUCTION

Riparian ecosystems, as discussed herein, are those floodplain, bottomland, and streambank communities that occur along inland waterways of the United States. Riparian communities occur in transition zones between aquatic and upland ecosystems and are characterized by dominant vegetation types that are tolerant of, and adapted to, relatively high soil moisture content. Although these areas provide some outstanding values as natural resources (Brinson et al., 1981), man has dramatically reduced the quantity and quality of riparian ecosystems by intensively developing them for other uses. In many instances, development of riparian areas resulted in unnecessary losses of natural vegetation, to the detriment of fish and wildlife, recreation, water quality, wood production, and other natural values of riparian ecosystems.

In many areas of the country, extensive alteration of riparian vegetation has occurred but quantitative evidence of these changes has been unavailable. In the following discussion, we present some "ballpark" figures on the past and present status of riparian ecosystems based on information from Federal and State agencies and the literature. There have been no previous documentation of the total amount of land in the U.S.A. orginally covered by riparian ecosystems or the proportion of that area supporting natural riparian vegetation today. This may reflect man's failure to recognize and conserve the distinct and significant values of riparian ecosystems.

NATIONWIDE STATUS OF RIPARIAN ECOSYSTEMS

Riparian ecosystems occur entirely within the 100 year floodplains of streams and rivers, which comprise an estimated 121 million acres in the conterminous 48 states (Maddock, 1974). However, most riparian plant species require flooding more frequently than once in every hundred years. It is not surprising then, that the four predominant riparian forest types originally covered only about 67 million acres (Table 1). Most of the Nation's riparian forest acreage is directly associated with large, perennial, warmwater streams, such as the Atchafalaya, Brazos, Colorado, Columbia, Connecticut, Gila, Mississippi, Missouri, Rio Grande, Sacramento, Snake, and St. Lawrence Rivers. Adding to the latter figure the undetermined acreage of narrow streambank communities occurring along coldwater and intermittent streams, and other less abundant riparian vegetation types, the total area originally supporting riparian ecosystems was probably between 75 and 100 million acres, less than 5% of the U.S.A. land area.

Most of the original (potential) acreage of riparian ecosystems was occupied by stands of woody vegetation. However, only about 30% of the U.S.A. lands subject to flooding presently support woodlands (USDA Conservation Needs Inventory Committee, 1971; USDA Soil Conservation Service, unpubl.). As a result of clearing for urban or cultivated agricultural uses, the four predominant riparian forest types have been reduced to 23 million acres, a loss of 66% in area (Table 1). Estimates of existing riparian ecosystem acreage were available for at least a portion of 26 states, and account for over 26 million acres (Table 2). These data suggest that there are probably 25 to 35 million

acres of woody riparian vegetation in existence today. Although non-woody riparian communities are common in some parts of the country, no quantitative data on their status were found.

The extent of riparian ecosystem losses attributable to water resource developments is substantial. Stream channel modification, which has been a significant part of water resource development in the U.S.A. has been accompanied by large amounts of wetland drainage (often a project purpose) and vegetation clearing. Little (1973) estimated that mankind has been responsible for modification of at least 200,000 miles of waterways in the U.S.A. This represents a direct impact on at least 20% of the Nation's one million stream miles (Brinson et al., 1981). This estimate is in agreement with documentation from various states (Table 3). However, that amount of stream modification would equal over 50% of the total length of large warmwater streams, where channel alterations are most prevalent. Similarly, the U.S. Heritage Conservation and Recreation Service (pers. comm.) has determined that approximately 60% of the mileage of large streams and rivers in the U.S.A. were unsuitable for inclusion in the National Wild and Scenic Rivers System, because of water resource or other cultural developments within the riparian corridors. Large reservoirs (greater than 500 surface acres), which presently cover about 10 million acres (U.S. Fish and Wildlife Service, unpubl.), probably inundated at least 15,000 miles of streams, while the extent of smaller reservoirs on streams is virtually unknown. Losses in total area of riparian ecosystems may be greater than the actual extent of stream modification indicates, because the effects of channel work can extend far upstream.

Stream channel alterations by Federal agencies have affected riparian ecosystems along tens of thousands of stream miles nationwide. The U.S. Army Corps of Engineers assisted stream development projects covering over 11,000 miles between 1940 and 1971 (Little, 1973). The amount of SCS channel work constructed or under contract totalled nearly 11,000 miles by 1980, an average increase of approximately 300 miles per year since 1972 (Brinson et al., 1981). In projects administered by the Corps and SCS before 1971, approximately 35% (by mileage) was to have been carried out in Louisiana, Mississippi, and Arkansas, and an additional 35% in California, North Carolina, Texas, Florida, Georgia, Illinois, and Indiana (Little 1973). Water supply projects administered by the U.S.D.I. Bureau of Reclamation eliminated thousands of acres of riparian vegetation in the West, but the total extent has not been measured.

REGIONAL STATUS OF RIPARIAN ECOSYSTEMS

Although the acreage of riparian ecosystems has been reduced substantially in nearly every region of the country, losses at some locations far exceed the estimated national average. The decline of riparian communities has been most severe in the Mississippi Delta, Corn Belt, California, and the Arid Southwest. This decline is generally caused by demand for water and productive farmlands which riparian zones normally can provide. Specific causes of riparian ecosystem degradation are numerous, and vary in importance from one region to the next.

Following are 10 regional overviews presenting case histories illustrating the nature of riparian ecosystem losses. Although strict geographical boundaries are not implied, the following regions were identified to direct readers to geographically relevant information: California; Pacific Northwest; Rocky Mountain; Arid Southwest; Plains-Grasslands; Lake States; Corn Belt; Mississippi Delta; Northeast-Appalachian; and Southeast.

CALIFORNIA - Riparian ecosystems in California are under considerable pressure for alteration as a result of increased water supply needs for urbanization and agricultural expansion. Riparian forests along the Sacramento River were reduced from nearly 775,000 acres in the 1850's, to about 27,000 acres in 1952, and to 18,800 acres in 1972 (McGill, 1975). Native riparian vegetation along the river was further reduced to 17,850 acres by 1977, or about 2% of the original acreage. Most recent losses were caused by conversion of high terrace forest land to deciduous orchards (McGill, 1979). In the northern mountains, forestry activities constitute the greatest threat to riparian environments (Smith, 1977).

PACIFIC NORTHWEST - No studies were found documenting the extent of riparian habitat losses in this region, but logging, overgrazing, irrigation diversion, impoundments, and recreation developments have contributed to the degradation of many acres (Thomas et al., 1979).

ROCKY MOUNTAIN - In the Rocky Mountain states (Colorado, Idaho, Montana, Nevada, Utah, and Wyoming), mountain riparian areas have not changed as

distinctly as lowland floodplain areas; there has been some forest clearing and construction of dams, but vegetation along mountain streams generally has developed under near normal ecological processes (Horton, 1972). However, in arid lowland areas of this region, thousands of acres are dependent upon irrigation return flows (Chalk, 1979). Overgrazing is one of the most serious threats to riparian ecosystems, and stream alterations have affected as much as one third of the stream mileage in Montana (Peters and Alvord, 1964) and Idaho (Irizarry, 1969). In contrast, cottonwood communities along the lower South Platte River increased greatly in area during the century before the 1950's, as a result of water resource developments reducing "flashy" flows to more subdued seasonal fluctuations (Crouch, 1979).

ARID SOUTHWEST - Demands for water resource development (especially those which reduce streamflows and water tables) and overgrazing are widespread threats to riparian vegetation in the Arid Southwest (Arizona, Nevada, New Mexico). Also prevalent in this region is the practice of "phreatophyte control" - removal of riparian vegetation to reduce evapotranspirative loss of groundwater.

There is much evidence from Arizona that significant acreages of riparian vegetation have been destroyed. For example, about 9,300 acres of phreatophytes existed along a 46 mile reach of the upper Gila River in the 1940's (Gatewood et al., 1950). Sixteen percent had been cleared for farm use by 1958 (Horton, 1972), and another 13% was gone by 1967, leaving only 6,600 acres (Lacey et al., 1975). Similarly, by 1970, only 15% (16,000 acres) of the entire Gila River floodplain supported riparian vegetation, and nearly

two-thirds of this area was in saltcedar (Tamarix spp.) an exotic woody plant introduced in the mid-1800's (Haase, 1972). Saltcedar has probably spread into over 1,000,000 acres of riparian land in the Arid Southwest region (Robinson, 1967).

Riparian vegetation along the lower Colorado River is disappearing at an estimated rate of 3,000 acres per year (Anderson et al., 1978). Pure cottonwood communities have declined from 5,000 acres to 2,800 acres as a result of altered hydrologic regimes, impoundment, agricultural clearing, and invasion by saltcedar (Ohmart et al., 1977). Riparian vegetation along the San Pedro River in Arizona declined between 1935 and 1978 from 68,650 to 49,300 acres as a result of channel work, elimination of perennial streamflows (by irrigation diversion and groundwater pumping), and overgrazing (McNatt, 1978). Riparian communities along a 22 mile stretch of that river were reduced by nearly 50% (Lacey et al., 1975). Most of the loss was in cottonwood-willow stands, streambed thickets, and other wet habitats, while saltcedar and certain mesquite communities were increasing in area.

PLAINS-GRASSLANDS - A majority of the original forest acreage in this region has been destroyed by conversion to farmland and reservoir construction. Commercial forest area (of which 43% is elm-ash-cottonwood and 28% is oak-hickory) in several Northern Plains states (North Dakota, eastern South Dakota, Nebraska, and Kansas) declined 14% overall between 1952 and 1977, an average annual rate of 0.6%. This suggests that bottomland forests are subject to intensive development pressure in the Plains-Grasslands area (Spencer, 1979).

The relative lack of forest vegetation outside of floodplains and windbreaks makes this trend especially significant to the region's wildlife.

In Oklahoma, 29,000 acres of riparian forest along two streams experienced an 87% reduction in area between 1870 and 1969; about 81% was gone by 1937. These losses were largely attributable to impacts of channelization for flood control or agricultural development, or both (Barclay, 1980).

LAKE STATES - There are no documented estimates of acreage of riparian ecosystems in the Lake States region (Michigan, Minnesota, Wisconsin). U.S. Forest Service inventory data were not applicable because the riparian forest types also occur on many acres of nonriparian wetland. Nevertheless, it is likely that northern riparian communities are declining in abundance as a result of drainage (Prellwitz, 1976), forest clearing, and modification of streams for urban needs, such as flood control and navigation.

CORN BELT - Although the acreage of riparian ecosystems in this region (Iowa, Indiana, Illinois, northeast Missouri, and Ohio) is unknown, losses have probably been severe. At least one-third of the stream mileage in some Corn Belt States has been altered for drainage or irrigation of farmlands, or to accommodate urbanization (Table 3). Between 1879 and 1972, natural channel communities in the Missouri River were eliminated extensively as a result of streamchannel alterations; surface area of the river was reduced by 50% and area of unconnected islands was reduced by 98% (Funk and Robinson, 1974).

MISSISSIPPI DELTA - Unlike most other regions, riparian forest losses along the lower Mississippi River have been thoroughly documented (MacDonald et al., 1979a, 1979b). Most of the 24 million acre Mississippi alluvial plain supported riparian vegetation at one time. However, by 1937, bottomland hardwoods covered only 11.8 million acres, and by 1977 that acreage was further reduced to only 5.2 million acres. Cumulative losses between 1957 and 1977 ranged from 36 to 63% among the various States. The rate of clearing in this region averaged approximately 2% annually during that 20 year period.

Most riparian forest clearing in the lower Mississippi Valley results from conversion to agriculture, particularly for soybeans (MacDonald et al., 1979a; Sternitzke, 1976; Sternitzke and Christopher, 1970). Area of bottomland hardwoods in southeastern Missouri declined 96% between 1780 and 1975, primarily as a result of lumbering and drainage for agriculture (Korte and Frederickson, 1977), and was often facilitated by channelization (Fredrickson, 1979).

NORTHEAST-APPALACHIAN - Although this region exhibits considerable variation in climate and plant communities, there are similarities in topography, land use, and in the relative absence of information on the status of riparian vegetation. Due to man's early settlement of this region, riparian ecosystems have a long history of changing land uses. Nearly 80% by mileage of streamside vegetation in the Tennessee Valley Authority power region is regarded as poor quality habitat for wood ducks (Aix sponsa) because of habitat destruction, high human activity, or lack of large diameter trees (Tennessee Valley Authority, unpubl.). Estimating the total loss of riparian vegetation in the

Appalachians would be difficult because so much occurs as narrow streambank communities. In New England and other mountainous parts of this predominantly forested region, many streams have little associated riparian vegetation. In flat or rolling terrain, much riparian vegetation has been cleared for cultivated agriculture and pasture. The spread of urbanization in parts of this region, with demands for housing, recreation, and energy (e.g., hydroelectric power and firewood), will be a continuing force for development or modification of this region's riparian environments.

SOUTHEAST - In five southeastern states (Florida, Georgia, North Carolina, South Carolina, and Virginia), there are about 15.6 million acres of riparian bottomland hardwoods, of which about two-thirds is medium to fully stocked with desirable growing stock trees (O. G. Langdon et al., unpubl.). In contrast to the Mississippi Delta, the total acreage of bottomland forest-land in these southeastern states has remained fairly stable since 1940 (Cushwa et al., 1977; O. G. Langdon et al., unpubl.). Urbanization and water resource developments for water supply, recreation, energy, and transportation will require further use of remaining riparian ecosystems in the Southeast.

CONCLUSION

Existing inventories of floodplain area and stream length can be used to generally assess the status of riparian ecosystems in the U.S.A. Despite some discrepancies in definition and delineation of riparian ecosystems, these data provide much insight on the amount of riparian ecosystems that were originally

present nationwide, the quantity lost to other uses, and the nature of alterations. From the available information, some rudimentary estimates of the status of riparian ecosystems in the U.S.A. were derived.

Before European man's arrival to this country, there were probably 75 to 100 million acres of woody riparian vegetation in the 48 contiguous States. Based on available data, it appears that at least 70% of the original area of riparian ecosystems has been cleared in the U.S.A. Woody riparian communities now comprise between 25 and 35 million acres in the 48 States, or less than 2% of the U.S.A. land area. Riparian ecosystems cover such a small proportion of the landscape today because of their limited extent originally (except in the Southeast), and due to widespread floodplain alterations by man. The extent of these communities has been reduced by as much as 95% in some parts of the country. In addition to estimated quantitative losses of riparian ecosystems, the functional quality of many remaining areas is reduced through more subtle "chronic" impacts of man's activities in and adjacent to the riparian zone (e.g., stream alterations, pollution, grazing, and recreation). Numerical estimates of riparian ecosystem area fail to measure these less intensive disturbances.

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Table 1. Potential and present area of the four predominant riparian vegetation types in the United States (after Klopatek et al. 1979).

Vegetation type	Area (1000 ha) Potential	Present	% change
Elm-ash forest	2,239	279	-88
Northern floodplain forest	7,171	2,227	-69
Southern floodplain forest	17,744	6,645	-63
Mesquite bosque	71	63	-11
Total	27,225 (67 million acres)	9,214 (23 million acres)	-66

Table 2. Estimated acreage of riparian ecosystems in 26 states, or portions thereof (from Brinson et al., 1981).

State	Area (acres)
Alaska	29,725,000[a]
Arizona	279,600
Arkansas	1,015,000[a]
California	347,267
Colorado	60,394[a]
Idaho	56,609[a]
Kansas	512,500
Kentucky	34,000[a]
Louisiana	3,000,000[a]
Mississipi	3,600,000
Missouri	96,000[a]
Montana	126,554[a]
Nebraska	286,200
Nevada	90,000[a]
New Mexico	280,000
North Dakota	179,100
Oregon	175,775[a]
South Dakota	133,200[a]
Southeast (Florida, Georgia, North Carolina, South Carolina, Virginia)	15,600,000
Tennessee	130,000[a]
Utah	71,495[a]
Wyoming	45,642[a]
Total	55,844,366
Total	26,119,336 (without Alaska)

[a]Estimates were only available for portions of the State and should be considered an underestimate.

Table 3. Extent of stream alterations in 12 states.

State	Extent of alteration
Hawaii	Of 366 perennial streams in Hawaii, 15% have been channelized, totalling 94 miles (6% of the State total), and including 57% on the populous island of Oahu (Timbol and Maciolek, 1978).
Idaho	In a survey of 1,138 stream miles, 434 (38%) had been altered (Irizarry, 1969).
Illinois	An estimated one-third of the State's natural streams has been channelized (D. Rogers, Ill, Dept. of Conserv., pers. comm.).
Iowa	Total stream length in the State has been reduced at least 1,052 miles, and possibly as much as 3,000 miles (Bulkley et al., 1976).
Kentucky	In a survey of 218 miles, 89.5 (41%) had been recently altered (Russell, 1967).
Mississippi	About 2,400 miles (17%) of the streams in Mississippi have been altered (B. Freeman, Miss. Game & Fish Comm., pers. comm.).
Missouri	Across the State, 2,227 stream miles (4%) have been channelized, and at flood level an additional 2,920 miles (5%) are inundated by impoundments (O. Fajen, Mo. Dept. of Conserv., pers. comm.). One stretch of the Missouri River was shortened from 544 to 498 miles since 1870, a loss of 46 miles (8%) (Funk and Robinson, 1974).
Montana	Approximately one-third of stream mileage studied (250 of 768 miles) was altered from the natural condition. Total length had been reduced 68 miles (9%) by channelization (Peters and Alvord, 1964).
Nebraska	Total stream mileage has been reduced 833 miles (6%) by channelization (G. Zuerlein, Nebr. Game & Parks Comm., pers. comm.).
Ohio	An estimated 21,273 miles of streams (48% of the State total) have been altered (A. Spencer, Ohio Div. of Wildl., pers. comm.).
South Dakota	About 20% of the State stream mileage is altered, including impoundment of 80% (400 of 500 miles) of the Missouri River (R. Hanten, S.D. Dept. of Game, Fish and Parks, pers. comm.).
Tennessee River Basin	Over 3,500 miles (8%) of the total 42,000 stream miles are impounded at normal full pool level. An additional 1,100 miles (3%) have reservoir-regulated flows (Tennessee Valley Authority, unpubl.).

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