1982

The floodplain vegetation of the Platte River: phytosociology, forest development, and seedling establishment

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THE FLOODPLAIN VEGETATION OF THE PLATTE RIVER: PHYTOSOCIOLOGY, FOREST DEVELOPMENT, AND SEEDLING ESTABLISHMENT

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The floodplain vegetation of the Platte River: Phytosociology, forest development, and seedling establishment

by

Paul Jon Currier

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GENERAL INTRODUCTION

This study is part of a U. S. Fish and Wildlife Service project to investigate the ecology and habitat requirements of sandhill cranes, whooping cranes, and other migratory birds along the Platte River in central and western Nebraska. About 200,000 sandhill cranes, congregate along the Platte River valley during their spring migration to breeding grounds in Canada and Alaska. At night, the cranes roost on submersed, unvegetated sandbars in the center of the river channel. During the last 40 or more years, there has been a serious degradation of these primary roost sites as a result of woody plant encroachment on many sandbars. A decline in peak and mean annual discharge levels in the river as a result of increased agricultural irrigation and the use of water for power generation, is thought to be primarily responsible for the encroachment of woody species.

Explanation of Dissertation Format

This dissertation has been written in three parts, representing three manuscripts to be submitted for publication. Part I is an inventory and classification of riparian plant communities along the Platte; Part II concerns an investigation of the effects of hydrological conditions on the germination, establishment, and mortality of *Populus* and *Salix*; and Part III is a description of the vegetation development scheme for the forest communities along the Platte. A summary of the entire dissertation (Parts I, II, and III) is provided after Part III.

PART I: CLASSIFICATION AND INVENTORY OF RIPARIAN COMMUNITIES

INTRODUCTION

This portion of the project was designed to provide baseline data about the riparian vegetation along 200 miles of the Platte and North Platte rivers between the east end of Lake McConaughy and Chapman, Nebraska (Figure 1). The specific study objectives were 1) to classify and describe the major riparian plant communities, 2) to provide an inventory of the vascular plants, 3) to document the current advancement of woody vegetation on sandbars at various locations along the river, and 4) to describe phytosociological and vegetational-environmental relationships present in the Platte River floodplain vegetation.

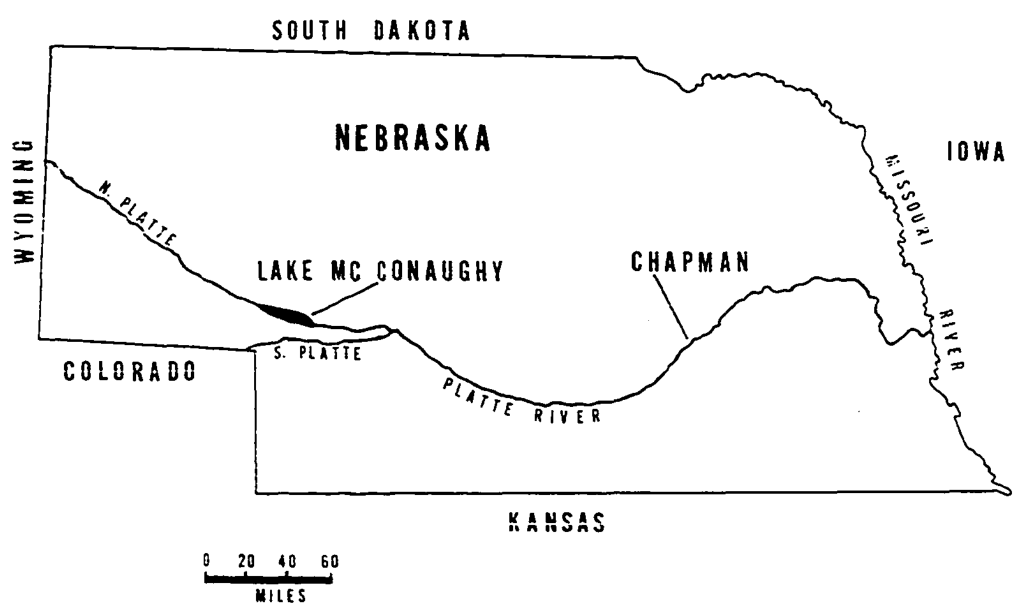


Figure 1. Location of study area between Lake McConaughy and Chapman in western and central Nebraska

History of Vegetation Studies

Early botanical studies along the Platte River floodplain (Webber 1890, Peterson 1912, Bates 1914, Winter 1936) were floristic in nature and generally emphasized prairie on upland sites (Sutherland 1974). Kellogg (1905), however, provided a quantitative but general description of forest communities along the Platte. Plant ecological investigations along the Platte were initiated by Pound and Clements in 1900, but these studies merely provided descriptions of the "Wet Meadow Formation", the "Sandbar Formation", and the "Wooded Island Formation". Ecological studies concerned with upland prairie (Hopkins 1951, Weaver and Bruner 1954), also provided brief descriptions of floodplain "lowland prairie".

A basic inventory of vascular plants present along the Platte was developed by Weaver (1965), Rothenberger (1973), and Sutherland (1974). Ecological studies by Bunde *et al*. (1975), Hadenfelt (1978), and Walters (1978) contributed to the inventory of vascular plants, but these studies did not emphasize classification of floodplain communities. The present study was designed to collect extensive quantitative data in order to develop a comprehensive classification of the floodplain vegetation along the Platte River.

DESCRIPTION OF THE STUDY AREA

Climate

The climate in central and western Nebraska is continental, with hot summers and cold winters. Annual precipitation ranges from 570 mm in the sub-humid Kearney/Grand Island area, to 450 mm in the semi-arid North Platte/Ogallala area (Stevens 1978). In addition, precipitation is highly seasonal, with 70% or more of the annual total precipitation occurring between May and September.

Soils

The major floodplain soils on the Platte and North Platte rivers are alluvial, and fall within the Leshara-Platte Soil Association in central Nebraska and within the McCook-Las Soil Association in western Nebraska (Elder 1969). A variety of loess-derived soils is found on the uplands surrounding the Platte River valley, while the terrace soils tend to be derived from a mixture of loess and alluvial materials. Detailed soil surveys are available from Keith (Layton and Buckhannan 1926), Lincoln (Goke et al. 1926), Dawson (Hayes et al. 1925), Gosper (Moran 1938), Phelps (Tillman and Hensel 1919), Kearney (Layton et al. 1927), Buffalo (Buller et al. 1974), Hall (Yost et al. 1962), Hamilton (Goke and Buckhannan 1927), and Merrick (Hayes et al. 1926) counties; however, only the Buffalo and Hall county surveys provide specific delineations and classifications of floodplain alluvial soils.

Hydrology

The Platte River is characterized by a wide, shallow channel with low banks and numerous vegetated and unvegetated sandbars and river islands. The channel of the North Platte River is generally narrower and deeper than that of the Platte and the banks are usually higher. In some areas (notably near Keystone and Sutherland), steep bluffs line the river channel. Stage levels in the Platte and North Platte rivers are quite variable, as a result of both seasonal climatic conditions and manipulation of water by man for irrigation and power generation. It is not uncommon for portions of the Platte, especially near Grand Island, to have no flow for several days to several weeks during the year (Williams 1978).

Kingsley Dam near Keystone, the Tri-County Diversion at the junction of the North and South Platte rivers, and the J-2 return flow at the Canaday Steam Power Plant near Overton are the major dams and diversions influencing water flows within the 200-mile area studied under the present investigation (Williams 1978). These water structures have affected the vegetation along the Platte and North Platte rivers in three ways: 1) drier communities have been created immediately below the Kingsley and Tri-County Diversion dams, 2) marsh, meadow, and forest communities with water-saturated soils have been produced immediately above the impoundment at the Tri-County Diversion, and 3) woody plant encroachment has apparently been hindered downstream from the J-2 return by diurnal fluctuations in stage levels related to the volume of water used by the Canaday Plant.

General Vegetation

In central and western Nebraska the Platte river floodplain is characterized by open-canopy, widely spaced Populus deltoides (cottonwood) forests with an understory of Juniperus virginiana (red cedar), Cornus drummondii (rough-leaf dogwood), and a variety of grasses and forbs. Eastern arboreal species such as Fraxinus pennsylvanica (green ash), Celtis occidentalis (hackberry), and Ulmus americanum (American elm), are common along the Platte in central Nebraska, but their numbers progressively decline toward the west. There is also a gradual thinning of the shrub understory in the floodplain forests toward the west. Along the river channel and on the numerous river islands, Salix rigida (diamond willow), Salix amgdaloides (peach-leaved willow), Salix exigua (coyote willow), and Amorpha fruticosa (indigo bush) are the dominant low-tree and shrub species. Recently exposed sandbars and mudflats are commonly dominated by Eragrostis pectinacea (lovegrass), Cyperus spp. (nutsedge), Echninochloa crus-galli (barnyard grass), and other annuals. On slightly more elevated mudflats, Xanthium strumarium (cocklebur), Melilotus albus (white sweet clover), and scattered seedlings and saplings of Salix spp. and Populus are the prominent species.

Although the vegetation along the Platte River floodplain is generally characterized by Populus forest, in several areas (i.e., Hershey, Overton, and scattered areas between Kearney and Grand Island) the forest is limited to a narrow strip along the riverbank, while the river channel itself is dominated by open, unvegetated sandbars and low shrub islands. These sandbars and islands are the areas used most heavily as primary roosts by sandhill cranes (Frith 1974). In many areas, extensive "wet meadow" grasslands dominate the river terraces adjacent to the narrow riverbank forests. Cranes utilize these wet meadows as secondary roosting or feeding sites (Frith 1974).

The floodplain vegetation of the Platte and North Platte rivers closely resembles that occurring along other rivers in the semi-arid plains, including the Republican River in southern Nebraska (Rand 1973), the Canadian River (Hefley 1937) and the South Canadian River (Ware and Penfound 1949) in central Oklahoma, and the Missouri River in southeastern South Dakota (Wilson 1970) and in North Dakota (Johnson et al. 1976). In general, Juniperus virginiana seems to be larger and more abundant along the Platte and North Platte rivers than along other rivers in the plains (Rand 1973). In addition, the upland-slope, forest communities along the Missouri River, characterized by Quercus macrocarpa (bur oak) (Johnson et al. 1976); and the raised-terrace, forest communities along the Canadian River, characterized by Quercus macrocarpa, Juglans nigra (black walnut) and Carya illinoensis (pecan) (Hefley 1937) are not present along the Platte and North Platte rivers in central and western Nebraska. Indeed, because the ancient river escarpment is located a mile or more on either side of the river channel, "true" upland riparian forests, in which the floodplain species give way to a slope forest characterized by upland species, simply does not exist along the Platte. In most cases, the floodplain forest is bounded by terraces dominated by grazed grasslands, hayfields, and cultivated fields. In the areas along the North Platte where there are steep bluffs (i.e., between Kingsley Dam and Keystone), the upland forest is basically a continuation of the floodplain forest in which scattered Juniperus is prominent in the overstory and Populus is no longer present. Because of their similarity with the floodplain forest, these bluff forests are likewise not considered "true" upland forests.

In many respects, the vegetational composition of the floodplains along the Platte and North Platte rivers also resembles the mudflat, shrub, and forest communities along more-eastern rivers studied by Shelford (1954), McVaugh (1957), Weaver (1960), Lindsey et al. (1961), and Robertson et al. (1978). The chief differences between the vegetation of these eastern rivers and the Platte and North Platte rivers are the greater diversity of arboreal species on the eastern floodplains (i.e., the presence of Platanus occidentalis, Gleditisia triacanthos, and Acer saccharinum), and the presence of "true" upland forest communities dominated by Oak-Hickory and Beech-Maple forests.

METHODS

Vegetation Survey

In 1978 and 1979, vegetation surveys were conducted along 44 north-south transect lines across the North Platte and Platte river channels in western and central Nebraska, between Lake McConaughy and Chapman. An additional 11 study sites, scattered throughout the study area, were also included in the survey. A stratified random design was used to determine the study site locations, with an emphasis towards sampling between Overton and Grand Island, the area most frequently used by sandhill cranes (Figure 2). The study area was divided initially into 406 one-half-mile segments, and numbered in sequence from east to west, beginning at Chapman (segment 1) and ending just east of Lake McConaughy (segment 406). The study sites were numbered to correspond with the one-half-mile segment in which each occurred. This numbering system was also used in the census of sandhill cranes during the spring of 1979 (Ferguson *et al*. 1980).

At each study site, percentage cover was estimated by cover class (Table 1) for all herbaceous, shrub, and arboreal species in 5-m x 20-m stands located at intervals of about 150-m along each transect line. Stands were located within areas of uniform vegetation type that were distinguished on aerial photographs. During the survey, 571 stands were sampled. Detailed locations of study sites and stands are provided in Appendix A.

Figure 2. Map of the Platte and North Platte rivers between Lake McConaughy and Chapman, Nebraska. The 44 transects (rectangles) and 11 other areas (squares) surveyed in 1978 and 1979 are indicated by the number of the one-half-mile segment in which they occurred

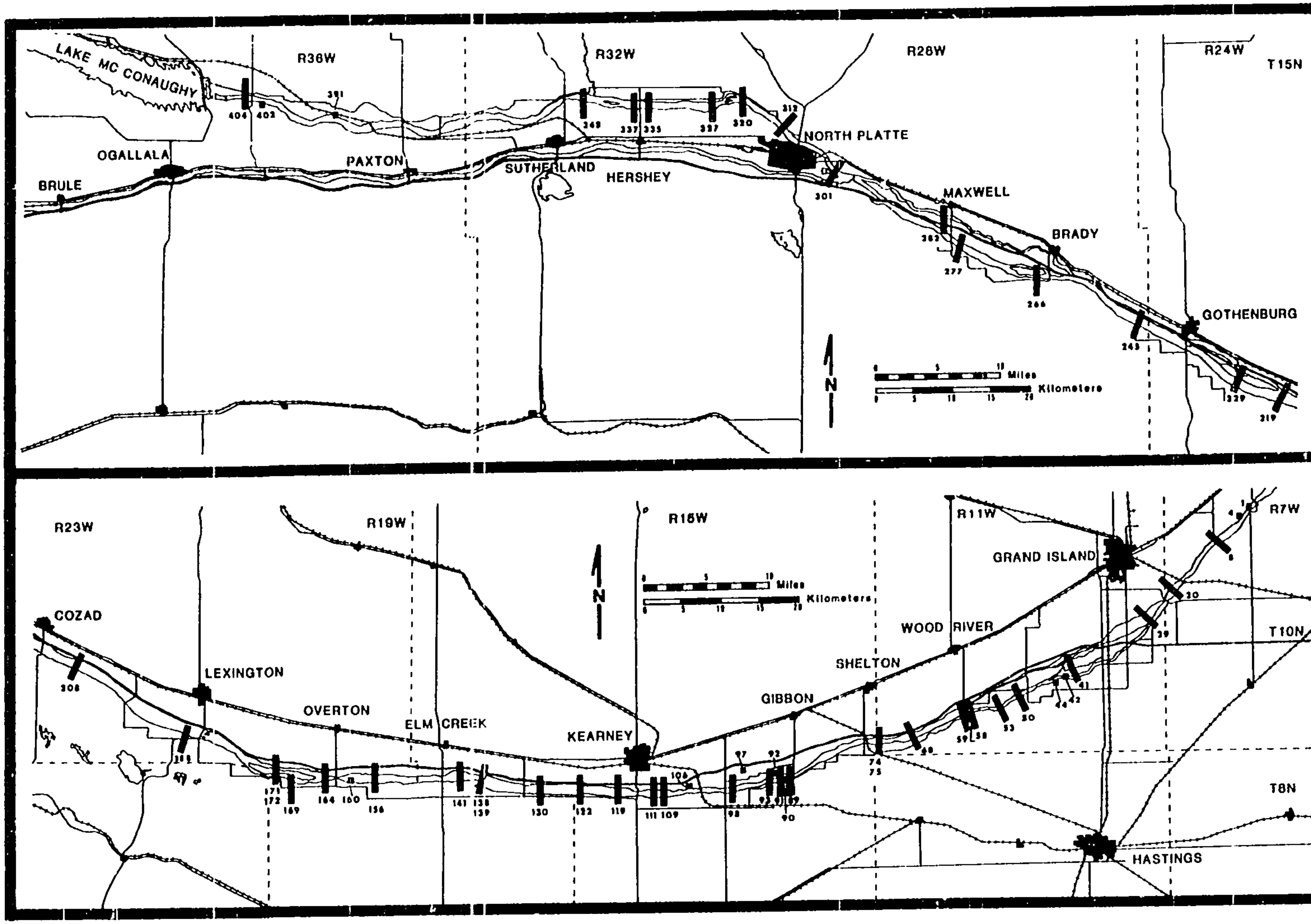

LAKE MC CONAUGHY
R36W
R32W
R28W
R24W
T15N
OGALLALA
BRULE
PAXTON
SUTHERLAND
HERSHEY
NORTH PLATTE
MAXWELL
BRADY
GOTHENBURG
N
Miles
Kilometers
R23W
R19W
R16W
R11W
R7W
COZAD
LEXINGTON
OVERTON
ELM CREEK
KEARNEY
GIBBON
SHELTON
WOOD RIVER
GRAND ISLAND
T10N
T8N
HASTINGS

Table 1. Percentage cover and cover class scheme used in the vegetation survey

Percentage Cover	Cover Class
< 1 %	1
1-10 %	2
11-25 %	3
26-50 %	4
51-75 %	5
76-90 %	6
91-100 %	7

A total of 636 voucher specimens was collected during the vegetation surveys in 1978 and 1979. These specimens have been deposited in the herbarium at Northern Prairie Wildlife Research Center in Jamestown, North Dakota. A complete list of voucher specimens is provided in Appendix B. Nomenclature follows the *Atlas of the Flora of the Great Plains* (Barkley 1977). Nomenclature follows Gleason and Cronquist (1963) for species not included in the *Atlas*. There are several problems with the nomenclature of *Populus* spp., *Juniperus* spp., and *Salix* spp. found along the Platte because of the overlapping distribution of eastern and western species and subspecies. Since differences in these species could not be detected in the field, the following nomenclature was adopted: *Populus deltoides* = *P. deltoides* + *P. sargentii*; *Juniperus virginiana* = *J. virginiana* + *J. scopulorum*; *Salix rigida* = *S. rigida* + *S. nigra* + *S. amygdaloides*; *Salix exigua* = *Salix exigua* + *S. interior*.

Vegetation Classification

The stands sampled in the vegetation survey were divided initially by height into mudflat (<1 m), meadow (1-2 m), shrub (2-4 m), and forest (>4 m) classifications. This primary classification was made to reduce the size of the entire data set and to insure separation of stands with highly similar composition, but highly dissimilar vegetation structure. Twinspan (Two Way Indicator Species Analysis) (Hill 1979), an eigenvector reciprocal averaging ordination technique, was used to make subsequent vegetation classfications.

Reciprocal averaging (RA) techniques produce a simultaneous optimal sequence (ordination) of both stands and species by weighting the species on an initial gradient, and then using the species weights (scores) to calculate stand scores (Hill 1973, Gauch et al. 1977). The stand scores are then used to calculate new species scores and, in turn, the new species scores are used to calculate new stand scores, and so on. With each cycle (iteration), the arrangement of stands and species approaches an optimal solution (i.e., the point where further iterations do not produce any further change in the sequence of either stands or species).

Twinspan is a refinement of an earlier indicator species analysis technique (Hill et al. 1975) designed to handle large data sets. The Twinspan program uses 3 RA ordinations to classify stands and species simultaneously. The primary ordination produces a crude dichotomy of the stands. The second ordination is a refinement of the first, based on the identification of differential species. The final ordination is based on the preferential or indicator species in the dichotomy. Repetition of this process results in a series of dichotomies in which the sample stands are separated at their center of gravity into progressively more similar (based on species composition) groups. Dichotomies made beyond the third level of divisions, however, are often no longer very ecologically meaningful. Therefore, an attempt was made to refine the classification by a further ordination of the groups of stands determined at the third level of divisions, using a 3-axis RA program (Hill 1973). In all but one case, these attempts failed to produce more ecologically meaningful separations of the stands.

The vegetation classification generated in this study is thus primarily based on species composition although the initial separation into mudflat, meadow, shrub, and forest classifications was based on height. An effort was made to relate the present classification of floodplain vegetation along the Platte River to the _Atlas of Platte River Vegetation_ (Pillmore _et al_. 1980) being prepared at Northern Prairie Wildlife Research Center. The vegetation classification in the _Atlas_ is based on the following height classes: herbaceous (<0.5 m), low shrub/herbaceous (0.5-2 m), shrub (2-4 m), tall shrub/woodland (4-8 m), and forest (>8 m). As such, the height classification in the _Atlas of Platte River Vegetation_ is not directly comparable with the mudflat, meadow, shrub, and forest classifications presented here.

RESULTS AND DISCUSSION

Species Inventory

A complete inventory of the species encountered along the Platte and North Platte rivers during the vegetation surveys is provided in Appendix B. Percentage cover and distributions of the major species (i.e., those which occurred with 20% or greater cover in at least one of the 571 survey stands) are provided in Appendix C. Stand data are presented in Appendix C according to mudflat, meadow, shrub, and forest classifications.

The diversity of arboreal and shrub species is relatively low. Of the 16 arboreal species encountered, only *Populus deltoides* (cottonwood), *Salix rigida* (diamond willow), *Juniperus virginiana* (red cedar), *Elaeagnus angustifolia* (Russian Olive), *Fraxinus pennsylvanica* (green ash), *Morus rubra* (red mulberry), *Ulmus rubra* (slippery elm), and *Ulmus americanum* (American elm) were found regularly in samples. Other arboreal species, including *Celtis occidentalis* (hackberry), *Catalpa speciosa* (catalpa), *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Juglans nigra* (black walnut), *Maclura pomifera* (osage orange), *Robinia pseudoacacia* (black locust), *Ulmus parvifolia* (Chinese elm), and *Ulmus pumila* (Siberian elm) were encountered in only a few stands throughout the entire vegetation survey.

The 15 shrubs recorded during the survey were more ubiquitous, but only *Cornus drummondii* (rough-leaf dogwood), *Salix exigua* (coyote willow), Amorpha fruticosa (indigo bush), Rosa woodsii (wild rose), and Zanthoxylum americanum (prickly ash) were common. Symphoricarpos spp. (snowberry), Cornus stolonifera (red-osier dogwood), Shepherdia argentea (buffalo berry), Rhus glabra (smooth sumac), Rhus aromatica (skunkbush), Prunus virginiana (choke cherry), Prunus americana (wild plum), and Tamarix ramosissima (salt cedar) were either quite rare or only locally abundant shrubs. The distribution of Tamarix along the Platte is of particular interest in light of its widespread colonization of floodplains along southwestern rivers. Along the Platte, Tamarix was encountered only near the river channel in scattered areas between Gothenburg and Kearney.

Most of the herbaceous species encountered during the vegetation survey are common grassland, woodland, and ruderal (weedy) species. Agrostis stolonifera (red top), and Poa pratensis (bluegrass) are probably the most widespread herbaceous species. These introduced grasses have aggressively invaded both native grasslands and forest communities. Wetland herbaceous species along the Platte tend to be rare or only locally abundant. Sisyrinchium angustifolium (blue-eyed grass). Hypoxis hirsuta (star grass), Juncus bufonius (toad rush), Ranunculus cymbalaria (shore buttercup), Triodanis perfoliata (Venus' looking glass), Veronica peregrina (purslane speedwell), and Ammania coccinea (tooth cup) are confined to small areas of wetland meadow and wetland shrub along the Platte; however, they are usually locally abundant. Rare wetland species include Hibiscus militaris (scarlet rose mallow), Sparganium eurycarpum (burreed), Ceratophyllum demersum (hornwort), Ranunculus longirostris (white water crowfoot), and Iris pseudacorus (yellow iris). A number of herbaceous species indigenous to drier habitats are also relatively rare along the Platte. These species include Onosmodium molle (false gromwell), Pycnanthemum virginianum (false dragonhead), Schrankia nutallii (sensitive briar), Schedonnardus paniculatus (tumble grass), and Verbena urticifolia (nettle-leaved vervain). Although there is a considerable number of rare species along the Platte, none appears to be endemic to western and central Nebraska. All species encountered during the vegetation survey are known to occur outside the study area.

Sutherland (1974) considered three of the species encountered during the vegetation survey, Orobanche ludoviciana (broomrape), Eustoma grandiflorum (prairie gentian), and Celastrus scandens (American bittersweet), as probably rare in the mid-state region of Nebraska. Apparently Eustoma grandiflorum and Orobanche ludoviciana are quite rare because they can only exist within a very narrow range of environmental conditions. Eustoma is restricted to heavily grazed pastures characterized by Lamo-type soils and the presence of Elaeagnus angustifolia. Orobanche was observed only on sandbars at the Audubon Bird Sanctuary (near site 90) where it was growing parasitically on Xanthium strumarium (cocklebur) rhizomes. For Orobanche to develop, a sequence of events in which sandbars are exposed and Xanthium becomes established, must coincide with the seed germination and early growth requirements of Orobanche. Although sandbars near the Audubon Bird Sanctuary were exposed and dominated by Xanthium in both 1978 and 1979, Orobanche developed only during the 1978 growing season when there was an earlier and longer exposure of the sandbars. Although Eustoma and Orobanche do seem to be quite rare, Celastrus is probably more widespread along the Platte than was previously thought (Sutherland 1974). During the vegetation survey, Celastrus was recorded growing on trees and shrubs at Mormon Island and Jeffreys Island, and as an important understory species in stands of Juniperus virginiana near Maxwell (site 277).

Vegetation Classification

Quantitative analyses of the percentage-cover data recorded during the vegetation survey (Appendix C) resulted in the vegetation classification scheme in Figure 3. The primary mudflat, meadow, shrub, and forest divisions were made on the basis of height. The 22 subsequent vegetation delineations were made using Twinspan, with an additional refinement of the shrub classification using a 3-axis reciprocal averaging technique.

The mudflat classification was divided into 2 vegetation types. The annual mudflat (AM) type is characterized by annual grasses and sedges, The perennial mudflat (PM) type is characterized by perennial grasses and sedges, and saplings of woody species.

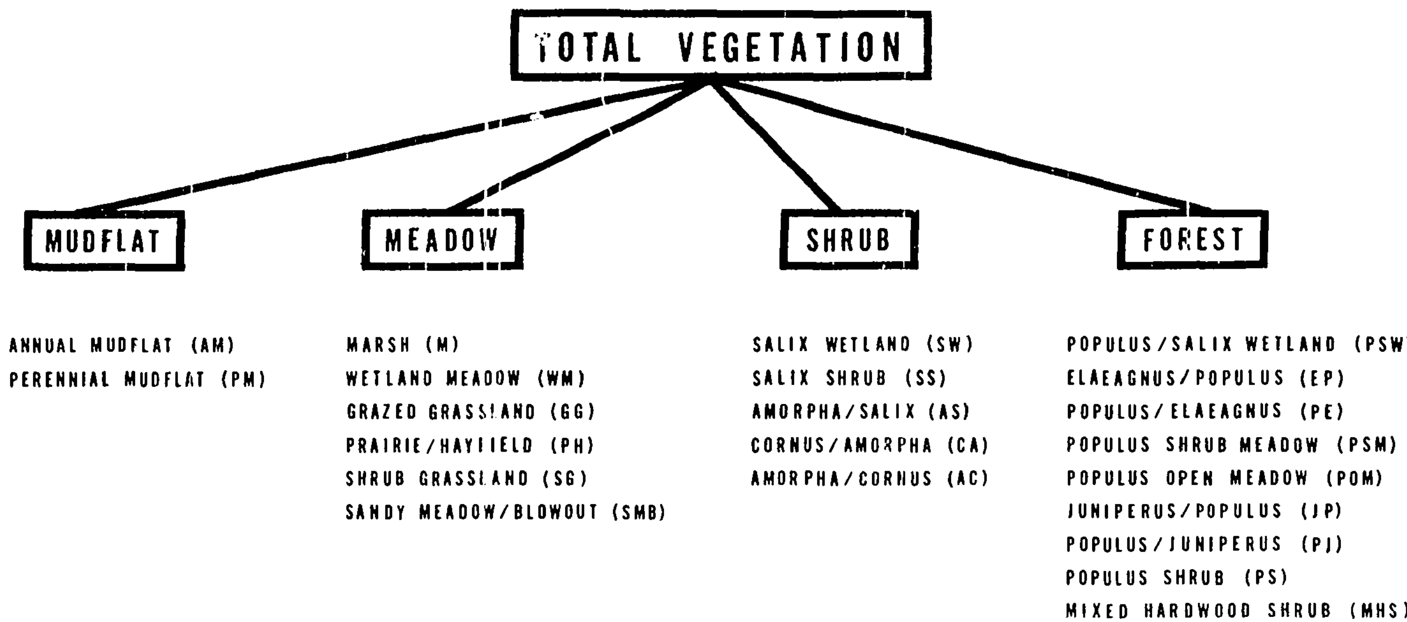


Figure 3. Classification scheme for the vegetation on the Platte River floodplain. Primary divisions (Mudflat, Meadow, Shrub, Forest) were determined by height. Subsequent divisions were developed from quantitative analyses of the the vegetation survey data

The meadow classification was divided into 6 vegetation types associated with wet (marsh, wetland meadow), moderately dry (grazed grassland, prairie/hayfield), or very dry (shrub grassland, sandy meadow/blowout) habitats. The marsh (M) and wetland meadow (WM) types are characterized by marsh emergents and sedges. Among the moderately dry communities, the grazed grassland (GG) type is characterized by introduced grasses and lowland prairie species, while the prairie/hayfield (PH) type is characterized by native upland prairie species. The very dry communities include shrub grasslands (SG) characterized by scattered shrubs with an understory of grasses and ruderal species, and sandy meadow/blowouts (SMB) characterized by open, sandy ground with scattered, ruderal species.

The shrub classification was divided into 5 vegetation types. The *Salix* wetland (SW), *Salix* shrub (SS), and *Amorpha*/*Salix* (AS) types are associated with lowlands and are characterized by *Salix exigua*. The *Cornus*/*Amorpha* (CA), and *Amorpha*/*Cornus* (AC) types are associated with upland sites and are characterized by *Amorpha fruticosa* and *Cornus drummondii*.

The forest classification was divided into 9 vegetation types. For the most part, these forest vegetation types are dominated by *Populus deltoides*, but are characterized by the arboreal, grassland, or shrub species present in the understory. Forest types characterized by arboreal species include the *Populus*/*Salix* wetland (PSW) type characterized by Salix exigua and Salix rigida, the Populus/Elaeagnus (PE) and Elaeagnus/Populus (EP) types characterized by Elaeagnus angustifolia and the Populus/Juniperus (PJ) and Juniperus/Populus (JP) types characterized by Juniperus virginiana. The Populus shrub meadow (PSM) and Populus open meadow (POM) types are characterized by grasslands species; while the Populus shrub (PS) and mixed-hardwood shrub (MHS) types are characterized by dense shrubs.

A complete classification of the vegetation survey stands within the 22 vegetation types outlined in Figure 3 is presented in Appendix D. No attempt was made to assess the abundance of the vegetation types within the entire study area because the vegetation along the Platte is too heterogeneous for accurate area measurements to be made from data gathered by the transect sampling technique employed during the study. An index of the relative abundance of each vegetation type is, however, provided by the number of stands of each type that were sampled during the study. A summary of the number of stands sampled within each vegetation type is provided in Table 7 on page 81 of this dissertation.

Descriptions of Mudflat Vegetation Types

Annual mudflat

The annual mudflat (AM) vegetation type develops on exposed mudflats close to the river channel. Technically, "mudflats" are uncommon along the Platte since the river bottom is predominately composed of sand. The term "mudflat" is used in the present context to include sandbars, sandflats, and mudflats. This terminology is preferred since mudflat implies that organic matter, silt, and viable seeds are probably present, while sandflat and sandbar tend to connote sterile, inorganic sediments.

Species which characterize the AM vegetation type, tend to be ephemeral, opportunistic annuals and biennials with the ability to colonize exposed mudflats rapidly. Eragrostis pectinacea (lovegrass), Cyperus spp. (nutsedge, including C. aristatus, C. erythrorhizos, and C. esculentes), and Xanthium strumarium are the dominant species on the annual mudflats (Table 2 and Figure 4). Average cover values for Eragrostis, Cyperus, and Xanthium are 21.5%, 18.0%, and 17.0%, respectively. Other important species found on annual mudflats include Echinochloa crusgalli (barnyard grass), and Sporobolus cryptandrus (sand dropseed) with average cover values of 8.1% and 5.7%, respectively.

The mudflats colonized by AM vegetation are used as primary roosting sites by sandhill cranes during their spring migration (Frith 1974). During the spring these mudflats are shallowly flooded, but by midsummer they are usually exposed as a result of a decline in river stage levels brought on by high rates of evapotranspiration, low precipitation, and demands for irrigation water. During the fall and winter, higher stage levels and more substantial scouring results

Table 2. Average percentage cover of the major species composing the annual mudflat (AM), and perennial mudflat (PM) vegetation types. Species with average cover values less than 2% have not been included. Indicator species are shown in parentheses

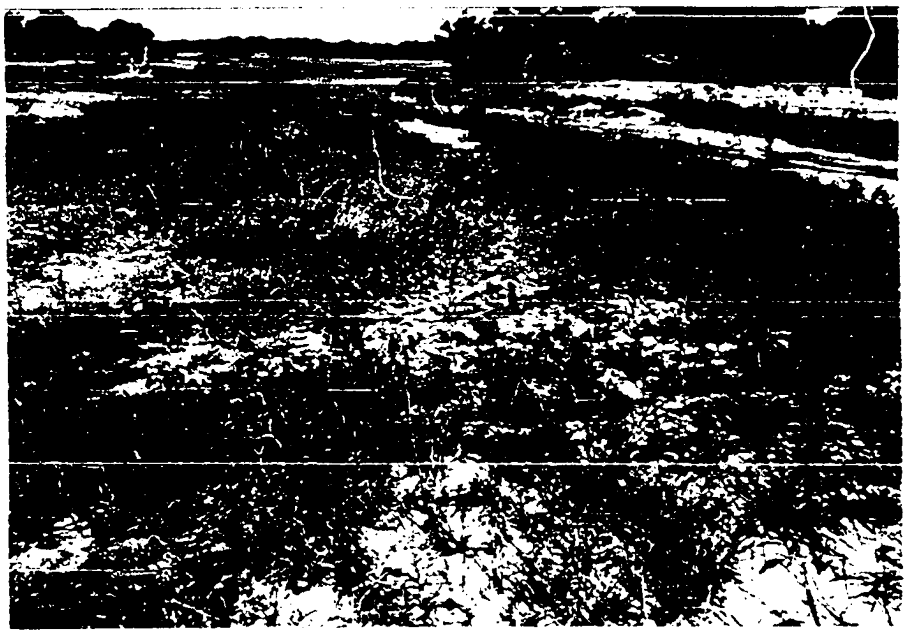
	AM	PM
Ambrosia artemisiifolia	-	5.5
Amorpha fruticosa	-	3.6
Cyperus spp.	(18.0)	-
Echinochloa crusgalli	8.1	-
Eleocharis palustris	-	(17.1)
Eragrostis pectinacea	(21.5)	-
Lythrum dacotanum	-	4.1
Melilotus albus	-	3.2
Polygonum lapathifolium	-	6.4
Polygonum persicaria	-	3.4
Populus deltoides	-	5.1
Salix exigua	3.9	(12.5)
Salix rigida	-	5.1
Scirpus americanus	-	(3.5)
Spartina pectinata	-	(4.1)
Sporobolus cryptandrus	5.7	-
Xanthium strumarium	17.0	14.8

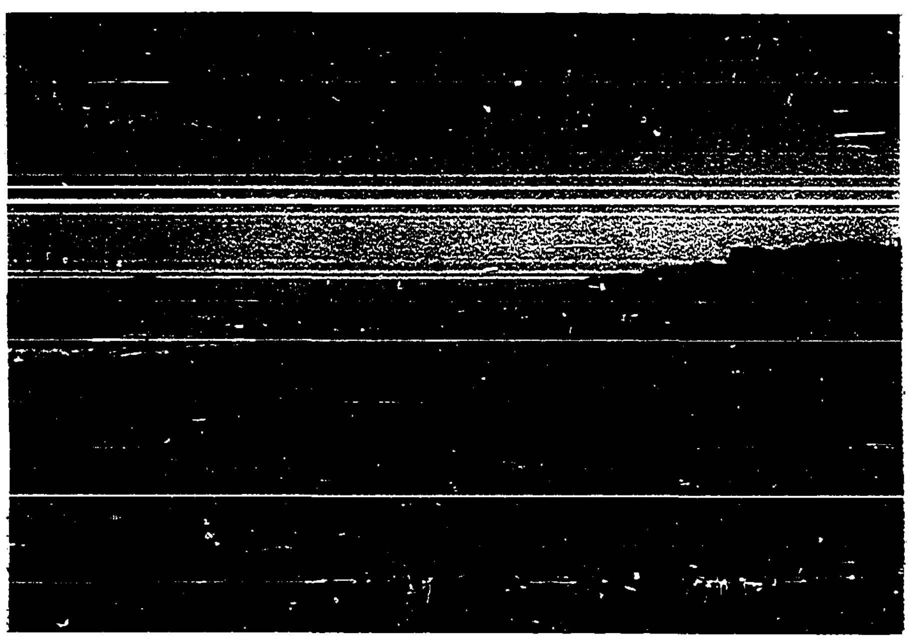
in the removal of most of the short-lived ephemeral species which characterize the AM vegetation. By the time the sandhill cranes arrive in the spring, the annual mudflats are normally barren of all vegetation.

Because the development of AM vegetation is vulnerable to changes in stage level, it is extremely difficult to assess the distribution of this vegetation type. Although the AM vegetation type occurs throughout the entire study area, its greatest potential concentration

Figure 4. Annual mudflat near Jeffreys Island (Overton) site 171-1. *Cyperus* spp., *Echinochloa crus-galli*, *Eragrostis pectinacea*, *Xanthium strumarium*, and other annuals are interspersed with open sand. (Photo by P.J. Currier 8-9-79)

Figure 5. Perennial mudflat near Jeffreys Island (Overton) site 172-2. Saplings of *Populus deltoides*, *Salix rigida*, and *Salix exigua* characterize this vegetation type. Other major species include *Eleocharis palustris*, *Ambrosia artemisiifolia*, *Xanthium strumarium*, *Polygonum* spp., and *Melilotus albus* (golden color in photo). (Photo by P.J. Currier 8-10-79)





(i.e., at low stage level) is between Alda Road (site 59) and Highway 2, just east of Grand Island (near site 20). This stretch of the Platte is one of the major roosting areas of the sandhill cranes.

Perennial mudflat

The perennial mudflat (PM) vegetation type develops on sandbars and mudflats elevated slightly above the annual mudflats. Perennial mudflats are subject to periodic flooding, but because of their slightly higher elevation they are normally exposed earlier and for a longer period of time than are annual mudflats. Once vegetation develops on the perennial mudflats, it is more difficult to remove than on annual mudflats, because the longer exposure insures more substantial growth, and the less frequent flooding reduces losses to scouring.

The PM vegetation type is characterized by woody saplings and perennial forbs and grasses (Table 2 and Figure 5). Although the average cover values of the major woody species on the perennial mudflats are quite modest (i.e., *Salix exigua*, 12.5%; *Salix rigida*, 5.1%; *Populus deltoides*, 5.1%; *Amorpha fruticosa*, 3.6%), collectively they have a cover value of 26%. *Eleocharis palustris* (spikerush), *Lythrum dacotanum* (loosestrife), *Spartina pectinata* (prairie cordgrass), and *Scirpus americanus* (American bulrush), the major perennial grasses and forbs in the PM vegetation type, have average cover values of 17.1%, 4.1%, 4.1%, and 3.5%, respectively. Although the PM vegetation type is characterized by perennials, several annual species including Xanthium strumarium, Polygonum lapathifolium (pale smartweed), Ambrosia artemisiifolia (ragweed), Polygonum persicaria (lady's thumb), and Melilotus albus (white sweet clover) are also important components of the vegetation with average cover values of 14.8%, 6.4%, 5.5%, 3.4%, and 3.2%, respectively.

Although PM vegetation was found throughout the study area, the greatest concentration occurred near the Audubon Bird Sanctuary between sites 98 and 75, and near Mormon Island between sites 59 and 20.

Descriptions of Meadow Vegetation Types

Marsh

The marsh (M) vegetation type is confined to areas of standing water behind dams and diversions and to isolated pools of water adjacent to the river channel. Scirpus acutus (hardstem bulrush), Scirpus americanus, and Typha latifolia (cattail) dominate the M vegetation type and have average cover values of 38.4%, 26.2%, and 23.3%, respectively (Table 3 and Figure 6). Other important species in the M vegetation type include Eleocharis palustris, Carex aquatilis (water sedge), Phyla lanceolata (frog fruit), and Salix exigua with average cover values of 10.7%, 7.4%, 4.0%, and 5.6%, respectively.

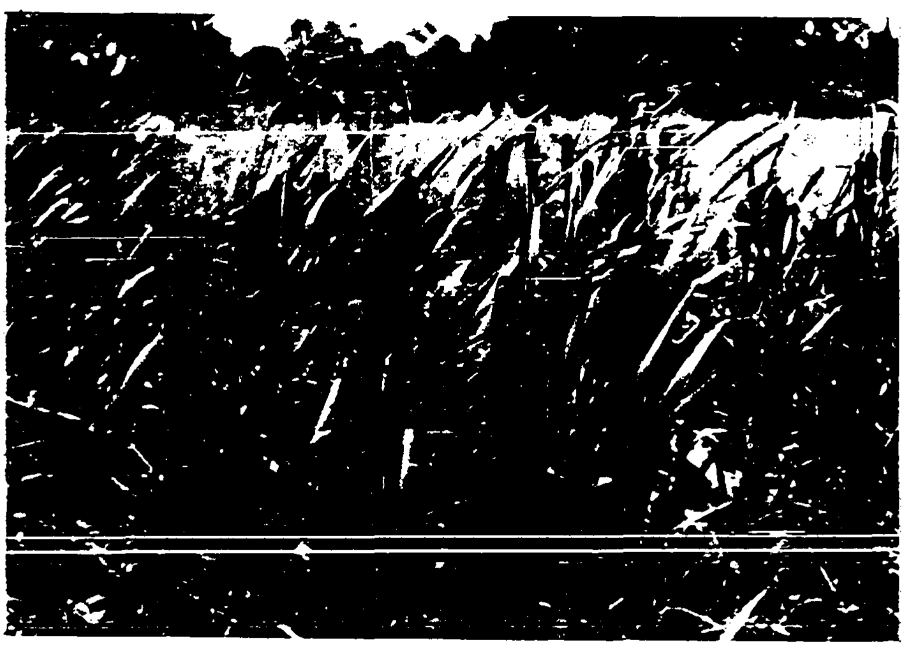
Marsh areas were encountered most frequently along the North Platte

Table 3. Average percentage cover of the major species composing the meadow vegetation types. Species with average cover values less than 2% have not been included. Indicator species are shown in parentheses. The meadow vegetation types are as follows: marsh (M), wetland meadow (WM), grazed grassland (GG), prairie/hayfield (PH), shrub grassland (SG), sandy meadow/blowout (SMB)

	M	WM	GG	PH	SH	SMB
Agropyron spp.	-	-	5.0	11.1	-	4.9
Agrostis stolonifera	-	-	8.0	-	-	-
Ambrosia artemisiifolia	-	(2.0)	(30.4)	8.6	31.3	15.5
Amorpha fruticosa	-	8.8	-	-	(7.0)	-
Andropogon gerardi	-	-	-	(17.3)	4.7	-
Andropogon scoparius	-	-	-	3.4	2.7	-
Bromus inermis	-	-	2.8	13.1	3.2	-
Bromus japonicus	-	-	3.4	12.6	14.3	14.6
Bromus tectorum	-	-	3.3	5.3	-	(32.1)
Carex aquatilis	7.4	-	-	-	-	-
Carex spp.	2.6	(13.4)	7.1	-	-	-
Desmanthus illinoensis	-	2.5	-	-	(6.0)	-
Distichlis spicata	-	-	4.2	5.3	-	-
Eleocharis palustris	10.7	14.5	(4.3)	-	-	-
Euphorbia maculata	-	-	-	-	-	2.9
Euphorbia marginata	-	-	-	-	-	2.1
Helianthus petiolaris	-	-	-	-	2.7	2.7
Hordeum jubatum	-	-	(5.0)	-	-	-
Lythrum dacotanum	-	5.9	-	-	-	-
Medicago lupulina	-	-	3.7	-	2.3	-
Melilotus albus	-	3.3	-	-	-	2.9
Panicum oligosanthes	-	-	-	-	2.7	-
Panicum virgatum	-	8.3	5.5	5.1	8.3	-
Phalaris arundinacea	-	7.1	-	-	-	-
Phyla lanceolata	4.0	8.9	-	-	-	-
Poa pratensis	-	-	16.4	10.7	12.3	7.7

Polygonum persicaria	-	5.7	-	-	-	-
Rosa woodsii	-	-	5.1	-	-	-
Salix exigua	5.6	9.3	-	-	-	-
Scirpus acutus	(38.4)	-	-	-	-	-
Scirpus americanus	26.2	26.1	(5.1)	-	-	-
Spartina pectinata	-	-	-	7.2	(9.9)	-
Sporobolus cryptandrus	-	-	-	(4.5)	-	(8.1)
Taraxacum officinale	-	-	3.5	-	-	-
Trifolium pratense	-	-	6.6	-	-	-
Typha latifolia	(23.3)	-	-	-	-	-
Verbascum thapsus	-	-	-	-	-	4.0
Verbena stricta	-	-	2.2	-	-	-
Vitis riparia	-	-	-	-	(2.0)	-

Figure 6. Marsh vegetation adjacent to the river channel at Bassway Strip State Wildlife Area (Gibbon) site 97. This vegetation type is dominated by Typha latifolia, Scirpus acutus, Scirpus americanus, Carex aquatilis, and Eleocharis palustris. (Photo by P.J. Currier 7-9-78)



River, especially in the backwaters of the Tri-County Diversion dam at the convergence of the North and South Platte rivers, just east of North Platte (site 301). Except for this extensive marsh complex, the M vegetation type is relatively rare along the Platte and North Platte rivers. Only 9 of the stands sampled in the vegetation survey were included in this vegetation type.

Wetland meadow

The wetland meadow (WM) vegetation type develops along moist, intermittently flooded river channels and other lowland areas in open grasslands and forests. The composition of the WM vegetation type is similar to the M vegetation type, except for the absence of *Scirpus acutus* and *Typha latifolia*, the dominant species in the M vegetation type. *Scirpus americanus*, *Carex* spp. (sedges), and *Eleocharis palustris* with average cover values of 26.1%, 13.4%, and 14.5%, respectively, are the species which characterize the WM vegetation type (Table 3). *Carex* spp. includes a number of species (e.g., *C. brevior*, *C. lanuginosa*, *C. blanda*, *C. meadii*, *C. stipata*, and *C. vulpinoidea*) which are generally common, but never individually dominant. *Phyla lanceolata*, *Panicum virgatum* (switchgrass), *Phalaris arundinacea* (reed canary grass), *Lythrum dacotanum*, and *Polygonum persicaria* are also important components of the WM vegetation type and have average cover values of 8.9%, 8.3%, 7.1%, 5.9%, and

5.7%, respectively. Scattered shrubs, especially Salix exigua and Amorpha fruticosa with average cover values of 9.3% and 8.8%, respectively, are locally abundant in some WM areas.

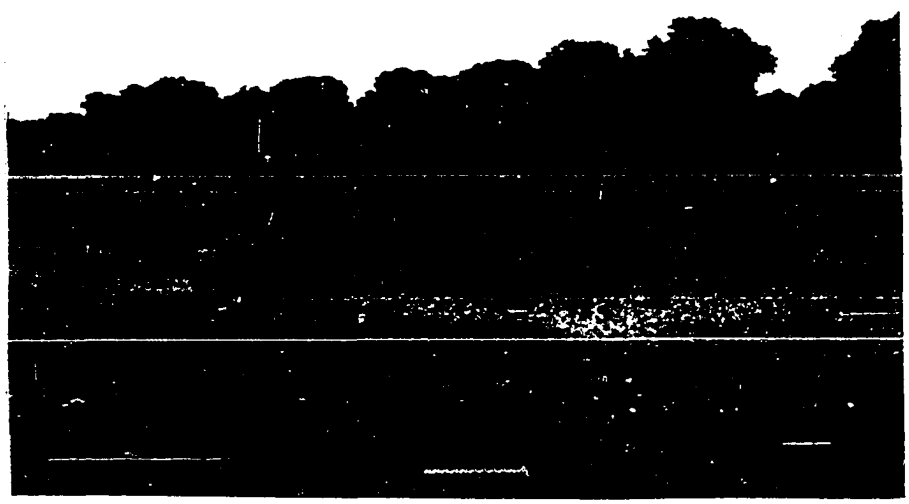
The wetland meadow vegetation type is distributed throughout the study area, but is particularly abundant towards the east (sites 98 to 29 where it is associated with grasslands on Fort Farm Island, Shoemaker Island, and Mormon Island. These grasslands generally consist of grazed pastures with "ribbons" of WM vegetation in lowland depressions which follow the natural drainage patterns.

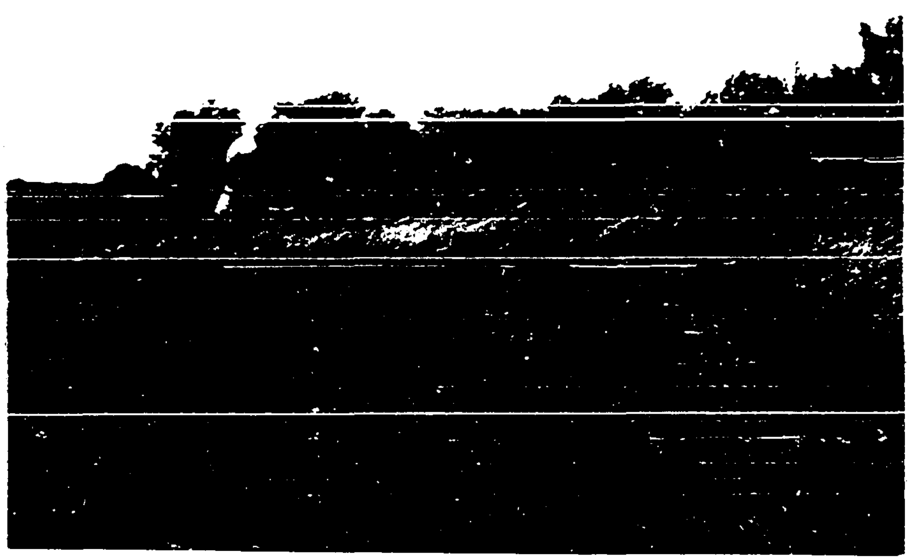
Grazed grasslands

The grazed grasslands (GG) vegetation type is characteristic of lowland grasslands composed of native and introduced grasses and ruderal species. These areas are generally grazed since most are near the river channel and are too wet to plow or cut for hay. Ambrosia artemisiifolia, Poa pratensis, Agrostis stolonifera, Carex spp., and Trifolium pratense (red clover) are the dominant species in the GG vegetation type and have average cover values of 30.4%, 16.4%, 8.0%, 7.1%, and 6.6%, respectively (Table 3 and Figure 7). Less-abundant grasses in the grazed grasslands include Panicum virgatum, Hordeum jubatum (foxtail barley), and Agropyron spp. (wheatgrass) with average cover values of 5.5%, 5.0%, and 5.0% respectively. Other important species in the GG vegetation type include

Figure 7. Grazed grassland at the western tip of Mormon Island near sites 41-2 and 41-3. This vegetation type is dominated by Ambrosia artemisiifolia, Poa pratensis, Carex spp., Agrostis stolonifera, and Trifolium pratense. Wetland meadow areas, dominated by Carex spp., Eleocharis palustris, and Scirpus americanus are often found in low lying areas. (Photo by P.J. Currier 6-10-79)

Figure 8. Prairie/hayfield at the Lillian Annette Rowe Audubon Bird Sanctuary (Gibbon) near site 90. Andropogon gerardi, Bromus inermis, Bromus japonicus, Poa pratensis, and Agropyron spp., are the dominant grasses, while Stipa comata, Sorghastrum avenaceum, Bouteloua spp., and Andropogon scoparius are less abundant, but quite important components of the prairie/hayfield vegetation type. (Photo by P.J. Currier 8-10-79)





Rosa woodsii, and Scirpus americanus, both with average cover values of 5.1%.

The grazed grassland vegetation type is generally synonymous with the "wetland meadow complex" of Frith (1974), used by sandhill cranes as secondary roosting or feeding sites. In the present classification, the drier, raised areas which constitute the bulk of the wetland complex are considered grazed grasslands, while the narrow "ribbons" of lowlands which follow the drainage patterns are considered wetland meadow (WM). As mentioned in the WM vegetation description, grazed grasslands are particularly abundant between sites 98 and 29 on Fort Farm Island, Shoemaker Island, and Mormon Island.

Prairie/hayfield

The prairie/hayfield (PH) vegetation type occurs on unplowed "upland" sites dominated by native prairie species. Although these sites are considered "upland" in comparison with other Platte River riparian habitats, they are lowland sites in comparison with the prairie dominated loess bluffs along the ancient river escarpment. For this reason, Hopkins (1951), Weaver and Bruner (1954), and Weaver (1965) classified the PH vegetation type as lowland prairie.

The PH vegetation type is dominated completely by native and introduced grasses. Andropogon gerardi (big blue stem) and Andropogon scoparius (little blue stem) are the native prairie species which characterize the PH vegetation type and have average cover values of 17.3% and 3.4%, respectively (Table 3 and Figure 8). Native species such as Stipa comata (needle and thread), Sorghastrum avenaceum (indian grass), Bouteloua hirsuta (hairy grama), and Bouteloua curtipendula (side oats grama) are also characteristic of the PH vegetation type, but are not very abundant (i.e., all have average cover values less than 2%). Other important grasses include, Bromus inermis (smooth brome), Bromus japonicus (Japanese brome), Agropyron spp., Poa pratensis, Spartina pectinata, Bromus tectorum (cheat grass), Distichlis spicata (salt grass), Panicum virgatum, and Sporobolus cryptandrus with average cover values of 13.1%, 12.6%, 11.1%, 10.7%, 7.2%, 5.3%, 5.3%, 5.1%, and 4.5%, respectively.

Remnants of native lowland prairie are scattered throughout the the study area, but are generally concentrated in the more arid western portion. Excellent examples of the PH vegetation type, however, are also present at the eastern end of the study area at the Audubon Bird Sanctuary (near site 90), on Shoemaker Island (near site 53), and on Mormon Island (site 41-4). Most PH sites are cut for hay annually.

Shrub grassland

The shrub grassland (SG) vegetation type occurs on dry upland sites in forest openings and in grasslands adjacent to forests. Scattered shrubs with an understory of grasses, forbs, and ruderal species characterize the SG vegetation type. *Ambrosia artemisiifolia*, *Bromus japonicus*, *Poa pratensis*, *Spartina pectinata*, and *Desmanthus illinoensis* (bundle-flower) are the dominant grasses and forbs, with average cover values of 31.3%, 14.3%, 12.3%, 9.9%, and 6.0%, respectively (Table 3). *Amorpha fruticosa* is the only important shrub in the SG vegetation type and has an average cover value of 7.0%. Shrub grasslands are scattered throughout the study area but are particularly common in forest openings between Elm Creek (site 141) and Alda (site 59).

Sandy meadow/blowout

The sandy meadow/blowout (SMB) vegetation type is characterized by dry, upland sites dominated by grasses and interspersed with open, sandy areas. SMB areas commonly develop on ridge tops of overgrazed PH-type and GG-type grasslands, but also occur as openings in floodplain forests where the alluvial sediments drain rapidly and the vegetation is relatively sparse.

Bromus tectorum, *Ambrosia artemisiifolia*, *Bromus japonicus*, *Sporobolus cryptandrus*, and *Poa pratensis* are the dominant species of the SMB vegetation type, having average cover values of 32.1%, 15.5%, 14.6%, 8.1%, and 7.7%, respectively. Other major species are Agropyron smithii, and Verbascum thapsus (miner's candle) with average cover values of 4.9%, and 4.0%, respectively. Euphorbia marginata (snow on the mountain), and Melilotus albus are locally abundant in some SMB areas, but they have average cover values of only 2.1% and 2.9%, respectively.

The SMB vegetation type is particularly common in the Jeffreys Island area (sites 171, 169, and 164) and in openings in the densely forested stretch of the Platte between Maxwell (site 282) and Odessa (site 122).

Descriptions of Shrub Vegetation Types

Salix wetland

The Salix wetland (SW) vegetation type is confined to low, wet areas along the river channel and is characterized by dense shrubs with a continuous understory of wetland species. Salix exigua, Amorpha fruticosa, and Salix rigida with average cover values of 51.5%, 12.8%, and 7.1%, respectively are the dominant shrubs in the SW vegetation type (Table 4). Cornus stolonifera is also characteristic of the SW vegetation type, but it is only locally abundant and has a relatively low average cover value of 3.7%.

Table 4. Average percentage cover of the major species composing the shrub vegetation types. Species with average cover values less than 2% have not been included. Indicator species are shown in parentheses. The shrub vegetation types are as follows: *Salix* wetland (SW), *Salix* shrub (SS), *Amorpha*/*Salix* (AS), *Cornus*/*Amorpha* (CA), *Amorpha*/*Cornus* (AC)

	SW	SS	AS	CA	AC
Agropyron spp.	-	-	-	-	3.3
Ambrosia artemisiifolia	-	9.8	(26.3)	8.0	8.9
Amorpha fruticosa	12.8	19.4	32.2	21.2	19.8
Apocynum sibiricum	-	-	2.6	-	-
Aster pilosus	-	5.4	-	-	-
Bromus japonicus	-	-	4.2	5.6	6.1
Bromus tectorum	-	-	-	(7.0)	-
Carex aquatilis	(9.8)	-	-	-	-
Carex spp.	-	-	-	-	(7.9)
Cornus drummondii	-	-	-	(31.5)	10.5
Cornus stolonifera	3.7	-	-	-	-
Desmanthus illinoensis	-	-	-	-	(3.1)
Eleocharis palustris	5.9	2.6	-	-	-
Helianthus petiolaris	-	(2.5)	-	-	-
Juniperus virginiana	-	-	-	-	5.0
Lycopus americanus	6.5	2.7	-	-	-
Melilotus albus	-	-	-	6.3	-
Panicum virgatum	-	-	-	-	(10.4)
Phyla lanceolata	-	7.5	-	-	-
Poa pratensis	-	-	-	(12.8)	-
Populus deltoides	-	(8.5)	-	8.7	-
Rhus radicans	-	-	-	-	6.6
Salix exigua	51.5	39.3	24.8	8.8	7.2
Salix rigida	7.1	6.6	-	-	3.1
Scirpus acutus	4.2	-	-	-	-

Solidago canadensis	5.6	3.4	4.2	-	-
Spartina pectinata	-	(7.2)	(11.7)	-	7.6
Verbascum thapsus	-	2.9	-	-	-
Vernonia fasciculata	(3.0)	-	-	-	-
Vitis riparia	(3.9)	-	-	-	-
Xanthium strumarium	-	3.2	-	-	-

Important understory species include Carex aquatilis, Lycopus americanus (American bugleweed), Eleocharis palustris, and Solidago canadensis (Canada goldenrod) and have average cover values of 9.8%, 6.5%, 5.9%, and 5.6%, respectively. The SW vegetation type seems to be fairly evenly distributed throughout the study area, but it is generally confined to areas adjacent to the river channel.

Salix shrub

The Salix shrub (SS) vegetation type is characterized by raised river islands dominated by dense shrubs and an open, sandy understory with scattered grasses, forbs, and ruderal species. The major shrubs and young trees in the SS vegetation type include Salix exigua, Amorpha fruticosa, Populus deltoides, and Salix rigida with average cover values of 39.3%, 19.4%, 8.5%, and 6.6%, respectively (Table 4 and Figure 9). The understory vegetation in the SS vegetation type resembles the vegetation of the PM type. Important understory species include Ambrosia artemisiifolia, Phyla lanceolata, Spartina pectinata, Aster pilosus (narrow-leaf aster), Solidago canadensis, and Xanthium strumarium and have average cover values of 9.8%, 7.5%, 7.2%, 5.4%, 3.4%, and 3.2%, respectively. The SS vegetation type tends to be concentrated on Platte River islands in the eastern portion of the study area (sites 172 to 1).

Figure 9. *Salix* shrub island near the Lillian Annette Rowe Audubon Bird Sanctuary site 92. *Salix exigua* is the dominant species in this vegetation type, but *Amorpha fruticosa*, *Populus deltoides*, *Ambrosia artemisiifolia*, *Phyla lanceolata*, and *Spartina pectinata* are also important components. (Photo by P.J. Currier 6-15-78)

Amorpha/Salix

The *Amorpha/Salix* (AS) vegetation type is very similar in structure and distribution to the SS vegetation type, but generally occupies slightly drier islands. In the AS vegetation type, *Amorpha fruticosa* is the dominant shrub, whereas in the SW and SS vegetation types, *Salix exigua* is the dominant (see Table 4). The understory in the AS vegetation type is also considerably less diverse than that in the SW and SS vegetation types. The dominant shrubs, *Amorpha fruticosa* and *Salix exigua* have average cover values of 32.2% and 24.8%, respectively (Table 4). Important understory species include *Ambrosia artemisiifolia*, *Spartina pectinata*, *Solidago canadensis*, and *Bromus japonicus* with average cover values of 26.3%, 11.7%, 4.2%, and 4.2%, respectively. As mentioned above, the distribution of the AS vegetation type is similar to that of the SS vegetation type and has its greatest concentration between site 172 and site 1.

Cornus/Amorpha

The *Cornus/Amorpha* (CA) vegetation type is characterized by dense shrubs growing primarily along the riverbanks of raised islands and tributary streams. Occasionally, the CA vegetation type develops in openings of *Populus*/shrub (PS) forests. In general, the CA vegetation type occupies drier sites than the SW, SS, or AS vegetation types and has a greater diversity and density of grasses in the understory. The dominant shrub and low tree species include Cornus drummondii, Amorpha fruticosa, Salix exigua, and Populus deltoides with average cover values of 31.5%, 21.2%, 8.8%, and 8.7%, respectively (Table 4). Important understory species include Poa pratensis, Ambrosia artemisiifolia, Bromus tectorum, Melilotus albus, and Bromus japonicus with average cover values of 12.8%, 8.0%, 7.0%, 6.3%, and 5.6%, respectively. As in the case of the SW, SS, and AS shrub vegetation types, the CA-type has its greatest concentration in the eastern portion of the study area between site 172 and site 1.

Amorpha/Cornus

The Amorpha/Cornus (AC) vegetation type is intermediate in structure, composition, and distribution between the CA and SG vegetation types (see Tables 3 and 4). The AC vegetation type is found commonly in forest openings and is characterized by dry, upland sites with scattered shrubs and an understory of grassland species. In general, the shrub overstory in the AC vegetation type is less dense than that in the CA vegetation type, but more dense and more diverse than that in the SG vegetation type. Grasses, on the other hand, are generally more sparse in the CA vegetation type and denser in the SG vegetation type than in the AC vegetation type.

The dominant shrubs in the AC vegetation type include Amorpha fruticosa, Cornus drummondii, and Salix exigua with average cover values of 19.8%, 10.5%, and 7.2%, respectively. Important understory grasses include Panicum virgatum, Spartina pectinata, and Bromus japonicus and have average cover values of 10.4%, 7.6%, and 6.1%, respectively. Other important understory species include Ambrosia artemisiifolia, Carex spp., and Rhus radicans (poison ivy) with average cover values of 8.9%, 7.9%, and 6.6%, respectively.

The AC vegetation type has a very scattered distribution throughout the study area, but is generally associated with forests or isolated woodlands.

Descriptions of Forest Vegetation Types

Populus/Salix wetland

The Populus/Salix wetland (PSW) is confined to intermittently flooded areas within abandoned river channels and adjacent to the main river channel. A dense arboreal overstory, scattered shrubs, and a nearly continuous ground cover of wetland species characterizes the PSW vegetation type. Young (30-40 years old) Populus deltoides is generally the dominant arboreal species, but large scattered trees of Salix rigida and Fraxinus pennsylvanica are also important components of the overstory vegetation. Populus, Salix rigida, and Fraxinus have average cover values of 27.6%, 13.4%, and 6.8%, respectively (Table 5). Important understory species include Carex aquatilis, Salix exigua, Phyla lanceolata, Ambrosia artemisiifolia, and Cornus drummondii with average cover values of 18.2%, 12.5%, 8.9%, 7.4%, and 5.6%, respectively. The PSW vegetation type tends to be distributed in the wetter floodplain forests on the North Platte River between sites 337 and 301 and in the area of rapidly developing forests along the Platte River between sites 141 and 58.

Elaeagnus/Populus

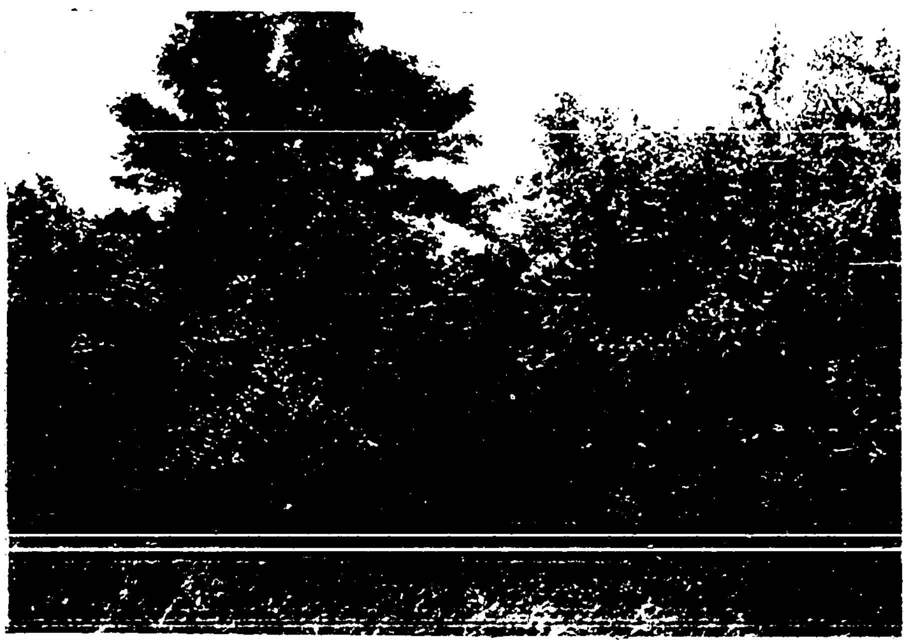
The Elaeagnus/Populus (EP) vegetation type is characterized by open, relatively young (less than 40 years old), lowland forests dominated by groves of Elaeagnus angustifolia with widely scattered individuals of Populus deltoides, and Salix rigida (Figure 10). Shrubs are almost completely absent from the understory of the EP vegetation type which is dominated by herbaceous grassland and wetland species. Populus, Elaeagnus, and Salix rigida, the dominant arboreal species, have average cover values of 21.4%, 12.3%, and 7.7%, respectively (Table 5). Occasionally, Juniperus virginiana is found associated with these dominant overstory species, but its average cover value is only 5.5%. The major understory species

Table 5. Average percentage cover of the major species composing the forest vegetation types. Species with average cover values less than 2% have not been included. Indicator species are shown in parentheses. The forest vegetation types are as follows: _Populus/Salix_ wetland (PSW), _Elaeagnus/Populus_ (EP), _Populus/Elaeagnus_ (PE), _Populus_ shrub meadow (PSM), _Populus_ open meadow (POM), _Juniperus/Populus_ (JP), _Populus/Juniperus_ (PJ), _Populus_ shrub (PS), mixed hardwood shrub (MHS)

	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
Agropyron spp.	-	(5.9)	-	-	-	-	-	-	-
Ambrosia artemisiifolia	7.4	16.0	26.1	17.0	12.8	7.6	3.9	-	-
Amorpha fruticosa	4.8	-	-	9.1	9.0	-	(4.0)	(4.3)	-
Apocynum sibiricum	-	-	-	-	-	-	(2.0)	-	-
Bromus japonicus	-	-	-	6.0	11.5	-	-	-	-
Bromus tectorum	-	-	-	3.8	6.3	6.9	-	3.7	-
Carex aquatilis	(18.2)	-	-	-	-	-	-	(11.7)	-
Carex spp.	4.9	14.0	7.6	-	-	-	-	-	-
Celastrus scandens	-	-	-	-	-	-	-	-	(3.5)
Celtis occidentalis	-	-	-	-	-	-	-	-	3.1
Cornus drummondii	5.6	-	5.3	(11.0)	-	23.6	27.2	24.6	43.9
Cornus stolonifera	2.1	-	-	-	-	-	2.0	2.0	-
Distichlis spicata	-	11.4	-	-	-	-	-	-	-
Elaeagnus angustifolia	-	12.3	24.5	-	-	-	6.2	2.2	-
Eleocharis palustris	4.7	-	-	-	-	-	-	-	-
Elymus canadensis	-	-	-	(4.2)	-	-	-	3.2	2.6
Fraxinus pennsylvanica	6.8	-	(7.2)	4.5	-	9.1	5.0	7.4	13.3
Helianthus petiolaris	-	-	-	-	(3.2)	-	-	-	-
Hordeum jubatum	-	-	2.6	-	-	-	-	-	-
Juniperus virginiana	-	5.5	-	3.4	-	(27.2)	10.2	-	(5.3)
Lythrum dacotanum	-	(5.9)	-	-	-	-	-	-	-
Medicago lupulina	-	-	3.0	2.2	-	3.3	3.5	-	-
Melilotus albus	-	-	-	4.6	-	-	3.3	-	-
Morus rubra	-	-	-	-	-	5.5	-	-	4.4
Panicum oligosanthes	-	-	3.2	-	-	-	-	-	-

Panicum virgatum	-	-	2.8	3.2	6.5		-	-	-
Parthenocissus vitacea	-	-	-	-	-	2.6	-	-	4.5
Phyla lanceolata	8.9	4.8	-	-	-	-	-	-	-
Physalis virginiana	-	-	-	2.4	-	-	-	-	-
Poa pratensis	-	20.1	22.7	(17.1)	-	24.5	24.5	10.2	4.0
Populus deltoides	27.6	21.4	38.2	33.7	35.0	21.3	(51.1)	30.9	26.9
Rhus glabra	-	-	-	-	-	-	-	-	2.6
Rhus radicans	-	-	-	2.5	-	6.6	16.4	19.5	21.6
Rosa woodsii	-	-	4.0	3.3	-	6.6	5.1	3.7	-
Salix exigua	(12.5)	-	-	-	-	-	-	6.7	-
Salix rigida	(13.4)	7.7	3.7	4.1	-	-	-	4.9	-
Sanicula canadensis	-	-	-	-	-	-	-	-	(4.2)
Scirpus americanus	3.9	4.9	-	-	-	-	-	-	-
Smilacina stellata	-	-	-	-	-	-	(3.0)	-	2.7
Solidago canadensis	2.7	-	-	-	-	-	-	8.7	3.8
Spartina pectinata	4.0	-	3.2	12.8	6.9	-	2.4	(3.3)	-
Sporobolus cryptandrus	-	-	-	2.3	12.8	3.6	-	-	-
Symphoricarpos orbiculatus	-	-	-	-	-	(7.6)	-	-	4.5
Taraxacum officinale	-	-	(4.0)	-	-	-	-	-	-
Ulmus americanum	-	-	-	-	-	4.5	-	5.0	-
Ulmus rubra	-	-	-	-	-	-	-	-	4.6
Vernonia fasciculata	-	2.7	-	-	-	-	-	-	-
Vitis riparia	4.1	-	3.1	(2.8)	-	-	(5.1)	5.2	4.4
Zanthoxylum americanum	-	-	-	-	-	5.4	-	-	3.1

Figure 10. *Elaeagnus/Populus* forest vegetation type near site 337-1 (Hershey). *Elaeagnus* and *Populus* are the dominant overstory species. Important understory species include *Ambrosia artemisiifolia*, *Carex* spp., *Distichlis spicata*, and *Poa pratensis*



include *Poa pratensis*, *Ambrosia artemisiifolia*, *Carex* spp., *Distichlis spicata*, *Agropyron* spp., *Lythrum dacotanum*, *Scirpus americanus*, and *Phyla lanceolata* with average cover values of 20.1%, 16.0%, 14.0%, 11.4%, 5.9%, 5.9%, 4.9%, and 4.8%, respectively.

The distribution of the EP vegetation type is generally confined to the North Platte River between sites 337 and 312. In addition, a few areas dominated by the EP vegetation type exist along the Platte River in the eastern portion of the study area near sites 139 (Elm Creek), 92 (Audubon Bird Sanctuary), and 89 (Gibbon Road).

Populus/Elaeagnus

The *Populus/Elaeagnus* vegetation type is similar in composition to the EP vegetation type, but is structurally different and tends to be located on drier, somewhat upland sites, rather than lowlands. An overstory of large *Populus deltoides* and a dense understory of *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, and *Salix rigida* characterize the PE vegetation type. *Populus*, *Elaeagnus*, *Fraxinus*, and *Salix rigida* have average cover values of 38.2%, 24.5%, 7.2%, and 3.7%, respectively (Table 5). Understory shrubs are infrequent in the PE vegetation type, but in a few locations (i.e., near Cozad site 219, and Overton site 156), *Cornus* *drummondii*, is an important component of the PE vegetation type. Its average cover value, however, is only 5.3%.

The PE vegetation type has a more widespread distribution than does the EP vegetation type, but its greatest concentration occurs along the North Platte River between sites 345 and 227.

Populus shrub meadow

The *Populus* shrub meadow (PSM) vegetation type is characterized by open-canopy *Populus deltoides* forest with a grassland understory and scattered, low shrubs. The understory vegetation in the PSM vegetation type resembles the SG vegetation type, but the PSM shrubs are generally denser and include *Cornus drummondii*. Often, the PSM vegetation type develops on overgrazed, upland forest sites. The common arboreal and shrub species include *Populus deltoides*, *Cornus drummondii*, *Amorpha fruticosa*, *Fraxinus pennsylvanica*, *Salix rigida*, and *Juniperus virginiana* with average cover values of 33.7%, 11.0%, 9.1%, 4.5%, 4.1%, and 3.4%, respectively. (Table 5). Important herbaceous understory species include *Poa pratensis*, *Ambrosia artemisiifolia*, *Spartina pectinata*, *Bromus japonicus*, *Melilotus albus*, and *Elymus canadensis* (Canada wild rye) with average cover values of 17.1%, 17.0%, 12.8%, 6.0%, 4.6%, and 4.2%, respectively. The PSM vegetation type is found throughout the study area, but tends to be concentrated between site 245 (Gothenburg) and site 111 (Kearney).

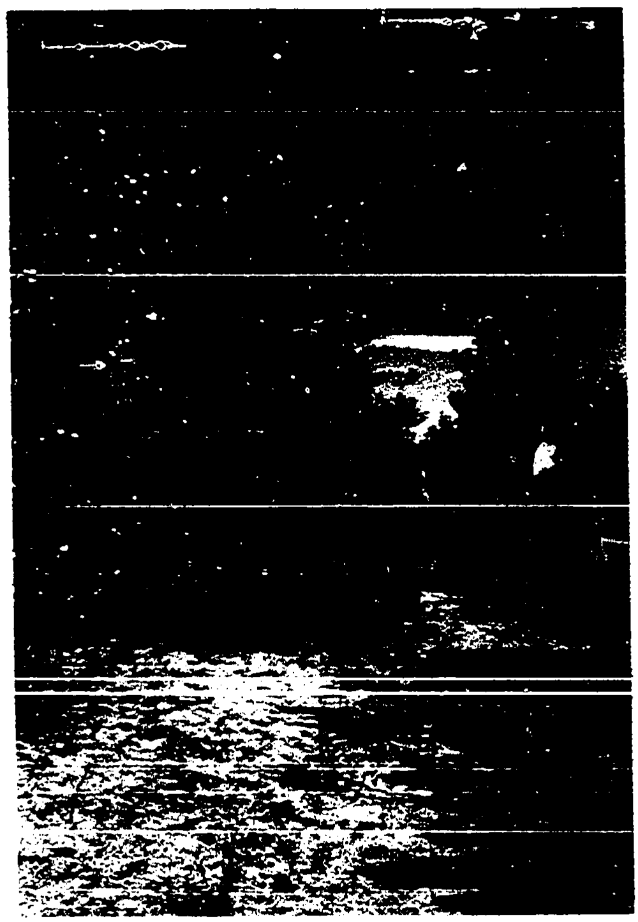
Populus open meadow

The *Populus* open meadow (POM) vegetation type is characterized by relatively young (less than 40 years old), open-canopy *Populus deltoides* forest with an understory of grasses and ruderal species interspersed with open, sandy areas (Figure 11). The POM vegetation occurs on well-drained, sandy soils and includes grazed, forested uplands and floodplain forests which receive deposits of alluvium (riverwash) during periodic floods.

Populus deltoides is the only important POM arboreal species and has an average cover value of 35.0% (Table 5). Shrubs are almost absent from the POM vegetation type, except for isolated stands of *Amorpha fruticosa*, which has an average cover value of 9.0%. The dominant grasses and forbs include *Sporobolus cryptandrus*, *Ambrosia artemisiifolia*, *Bromus japonicus*, *Spartina pectinata*, *Panicum virgatum*, and *Bromus tectorum* with average cover values of 12.8%, 12.8%, 11.5%, 6.9%, 6.5%, and 6.3%, respectively.

Hefley (1937) classified similar habitats along the "floodplain uplands" of the Canadian River in Oklahoma as "cottonwood parklands". Apparently, such "parklands" are much more widespread along the Canadian River than they are along the Platte, since only 20 of the

Figure 11. *Populus* open meadow vegetation at site 91-4 near the Lillian Annette Rowe Audubon Bird Sanctuary. Young *Populus* dominates the overstory, while *Ambrosia artemisiifolia*, *Bromus japonicus*, *Sporobolus cryptandrus*, *Panicum virgatum*, *Spartina pectinata*, *Bromus tectorum*, and *Amorpha fruticosa* dominate in the understory. (Photo by P.J. Currier 7-16-79)



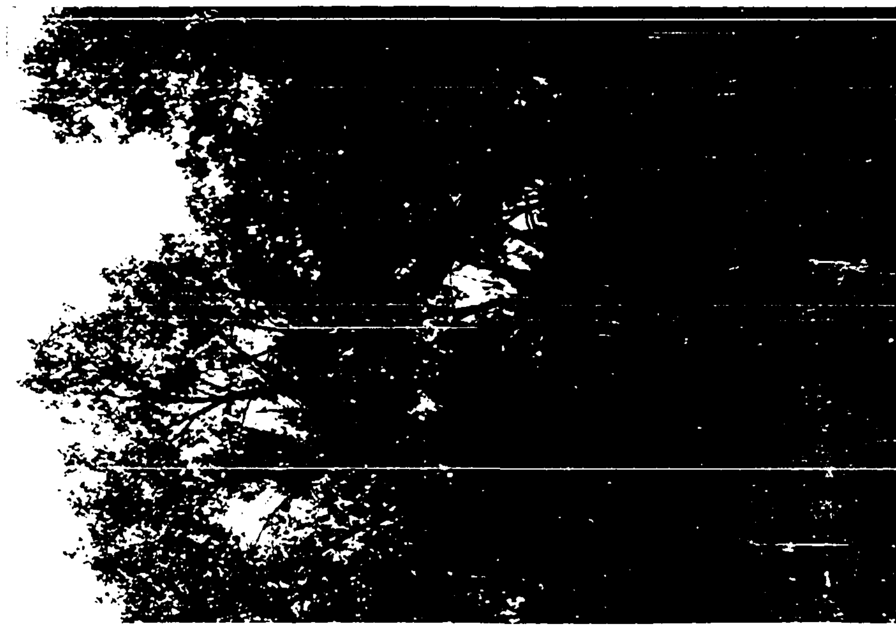
survey stands sampled in the present study were classified as POM. Along the Platte and North Platte, the POM vegetation type is particularly common near Keystone (sites 404 and 402) and in the Jeffreys Island area (sites 172 and 171).

Juniperus/Populus

The Juniperus/Populus (JP) vegetation type is characterized by dry, upland sites dominated by dense stands of Juniperus virginiana with scattered Populus deltoides in the overstory (Figure 12). The average cover values of Juniperus and Populus are 27.2%, and 21.3%, respectively (Table 5). Other arboreal species such as Fraxinus pennsylvanica, Morus rubra, and Ulmus americanum, are generally uncommon but do occur as seedlings and saplings in the forest understory. The average cover values of Fraxinus, Morus, and Ulmus are 9.1%, 5.5%, and 4.5%, respectively. In areas where Juniperus virginiana is very dense, there is almost no shrub understory. In other areas, Cornus drummondii, Symphoricarpos orbiculatus, Rosa woodsii, and Zanthoxylum americanum with average cover values of 23.6%, 7.6%, 6.6%, and 5.4%, respectively, form a dense understory. Important herbaceous species in the JP vegetation type include Poa pratensis, Ambrosia artemisiifolia, Bromus tectorum, and Rhus radicans and have average cover values of 24.5%, 7.6%, 6.9%, and 6.6%, respectively.

Figure 12. (Left Photo). _Juniperus/Populus_ vegetation near Maxwell site 277. _Juniperus virginiana_ is the dominant overstory species, but widely scattered _Populus_ contributes greatly to the overstory canopy. Understory species include _Poa pratensis_, _Cornus drummondii_, _Fraxinus pennsylvanica_, _Symphoricarpos orbiculatus_, and _Ambrosia artemisiifolia_. (Photo by P.J. Currier 7-24-79)

Figure 13. (Right Photo). _Populus/Juniperus_ vegetation near Brady at site 266-5. _Populus_ dominates the overstory while _Juniperus virginiana_, _Cornus drummondii_, _Poa pratensis_, and _Rhus radicans_ are the major species in the understory. (Photo by P.J. Currier 7-18-78)



The JP vegetation type is scattered throughout the study area but is particularly prominent at Maxwell, Overton, and Kearney (sites 277, 169, and 106).

Populus/Juniperus

The Populus/Juniperus (PJ) vegetation type also occurs on dry upland sites and is quite similar in composition to the JP vegetation type. In the PJ vegetation type, however, Populus deltoides is the dominant overstory species, while Juniperus virginiana and Cornus drummondii are prominent understory species (Figure 13). Populus, Juniperus, and Cornus have average cover values of 51.1%, 10.2%, and 27.2%, respectively (Table 5). Other woody species such as Elaeagnus angustifolia, Vitis riparia (wild grape), Rosa woodsii, Fraxinus pennsylvanica, and Amorpha fruticosa with average cover values of 6.2%, 5.1%, 5.1%, 5.0%, and 4.0%, respectively, also occur in the forest understory. The only major herbaceous species in the PJ vegetation type, Poa pratensis and Rhus radicans, have average cover values of 24.5%, and 16.4%, respectively. Other herbaceous species which characterize the PJ vegetation type include Ambrosia artemisiifolia, Medicago lupulina (hopseed), Melilotus albus, and Smilacina stellata (false soloman's seal), but they have average cover values of only 3.9%, 3.5%, 3.3%, and 3.0%, respectively.

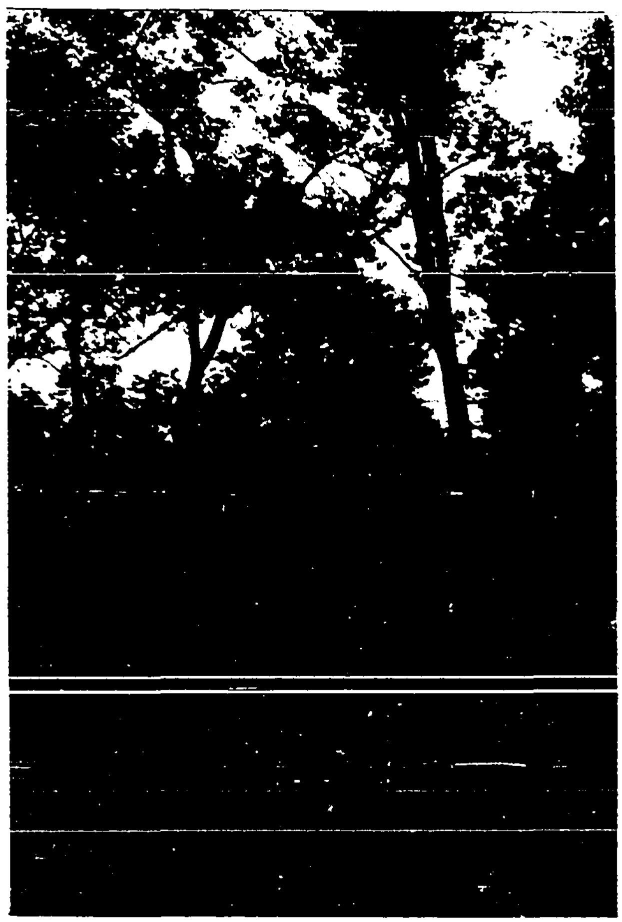
The PJ vegetation type is one of the most common forest types encountered in the vegetation survey (approximately 18% of all the forest stands). Although the PJ vegetation type is very widespread, it is especially common between Elm Creek (site 141) and Minden Road (site 97).

Populus/shrub

The Populus/shrub (PS) vegetation type is characterized by an overstory of Populus deltoides and a dense shrub understory (Figure 14). Although the PS vegetation type often occurs as a narrow strip of forest vegetation along the riverbank, it occurs in much larger floodplain forests as well. The Populus overstory and shrub understory of the PS vegetation type are similar to those in the PJ vegetation type, except that Juniperus virginiana is rare in the PS type.

Arboreal species in the PS vegetation type include Populus deltoides, Fraxinus pennsylvanica, Ulmus americanum, and Salix rigida with average cover values of 30.9%, 7.4%, 5.0%, and 4.9%, respectively. The shrub stratum is dominated by Cornus drummondii Salix exigua, and Amorpha fruticosa which have average cover values of 24.6%, 6.7%, and 4.3%, respectively. Important herbaceous species include Rhus radicans, Carex aquatilis, Poa pratensis, and Solidago canadensis with average cover values of 19.5%, 11.7%,

Figure 14. *Populus* shrub vegetation near site 156 (Overton). *Populus* dominates over dense *Cornus drummondii*, *Amorpha fruticosa*, and *Fraxinus pennsylvanica* shrub. Important herbaceous species include *Carex aquatilis*, *Poa pratensis*, *Rhus radicans*, and *Solidago canadensis*. (Photo by P.J. Currier 7-31-78)



10.2%, and 8.7%, respectively. The PS vegetation type is generally limited to the portion of the study area east of Overton (sites 169 to 1).

Mixed hardwood shrub

The mixed hardwood shrub (MHS) vegetation type commonly develops on raised river islands and other dry upland sites and is characterized by a forest overstory dominated by a variety of hardwood species and an understory of shrubs. Although Populus deltoides, with an average cover value of 26.9%, is the dominant overstory species, it is almost absent from some of the stands included in this vegetation type (e.g., stands 42-9 and 42-13)(see Table 5). Other important overstory arboreal species include Fraxinus pennsylvanica, Juniperus virginiana, Ulmus rubra, Morus rubra, and Celtis occidentalis with average cover values of 13.3%, 5.3%, 4.6%, 4.4%, and 3.1%, respectively. Cornus drummondii, Symphoricarpos orbiculatus, and Zanthoxylum americanum with average cover values of 43.9%, 4.5%, and 3.1%, respectively, are the dominant shrub species in the MHS vegetation type. The major herbaceous and ground cover species include Rhus radicans, Parthenocissus vitacea (virginia creeper), Vitis riparia, Sanicula canadensis (snakeroot), Poa pratensis, and Solidago canadensis with average cover values of 21.6%, 4.5%, 4.4%, 4.2%, 4.0%, and 3.8%, respectively.

The distribution of the MHS vegetation type is generally the same as the PS vegetation type and is limited to sites east of Overton (sites 169 to 1). This distribution pattern agrees with previous studies (Weaver 1965, Rand 1973, Sutherland 1974) that indicate that *Ulmus*, *Morus*, and *Celtis*, which characterize the MHS vegetation type, are more frequent towards the east on the floodplains of Nebraskan rivers.

Vegetation Characterization of River Segments

Although the vegetation along the Platte and North Platte rivers is quite heterogeneous within the 200-mile study area, general characterizations of the vegetation along particular river segments can be made. The following descriptions are based on the vegetation survey data and on interpretation of aerial photographs (1:24000) taken during October 1976.

Lake McConaughy to Sutherland

Between Lake McConaughy (site 406) and Sutherland (site 345) the North Platte River is characterized by *Populus* open meadow (POM) and *Populus/Juniperus* (PJ) forest vegetation. Near Keystone, however, much of this forest vegetation seems to be dying as a result of a rapid decline in the water table in recent years. Pastures on the river floodplain are heavily grazed and are generally dominated by sandy meadow/blowout (SMB) vegetation.

Less heavily grazed uplands adjacent to the floodplain are dominated by prairie/hayfield (PH) vegetation. Along this stretch of the North Platte the channel is rather narrow and shrub and mudflat communities are uncommon.

Sutherland to Hershey

Between Sutherland (site 345) and Hershey (site 335), the North Platte River is characterized by lowland grasslands and wetland forests. Populus/Elaeagnus (PE) and Elaeagnus/Populus (EP), the dominant forest vegetation types, are interspersed with grazed grassland (GG) and wetland meadow (WM) communities. In some areas, the river channel is quite broad and there are extensive mudflats and scattered shrubs.

Hershey to North Platte

Between Hershey (site 335) and North Platte (site 312), the North Platte River is bordered by floodplain forests on saturated soils. The dominant forest vegetation types, Populus/Salix wetland (PSW) and Elaeagnus/Populus (EP), are interspersed with intermittently flooded river channels dominated by marsh (M) and wetland meadow (WM) vegetation.

North Platte to Tri-County Diversion

A large impoundment created by the Tri-County Diversion dam at the confluence of the North and South Platte rivers, is the principal feature along this stretch of the river (sites 312 to 301). The impoundment is characterized by an extensive marsh (M) complex bordered by *Salix* wetlands (SW) and scattered islands dominated by *Populus*/*Salix* wetland (PSW) forests.

Tri-County Diversion to Gothenburg

Between the Tri-County Diversion dam (site 301) and Gothenburg (site 245) the Platte River is characterized by a relatively narrow channel and dry, upland forest communities. Dense *Populus*/*Juniperus* (PJ) and *Juniperus*/*Populus* (JP) are the dominant forest vegetation types. Forest openings are characterized by sandy meadow/blowout (SMB) vegetation, while upland grasslands are generally dominated by prairie/hayfield (PH) vegetation.

Gothenburg to Jeffreys Island

Between Gothenburg (site 245) and Jeffreys Island (site 172), the Platte is dominated by open-canopy *Populus* shrub meadow (PSM) forest. A variety of other forest vegetation types, including *Populus*/*Elaeagnus* (PE), *Populus*/*Juniperus* (PJ), and *Populus* open meadow (POM), are also prevalent. Forest openings are dominated by sandy meadow/blowout (SMB) vegetation, while grazed pastures near the floodplain forest are characterized by a mixture of grazed grassland (GG) and prairie/hayfield (PH) vegetation.

Jeffreys Island to Overton

Between Jeffreys Island (site 172) and Overton (site 160), the Platte is characterized by a heavily forested northern channel, a relatively open southern channel with extensive mudflats, and a central island area dominated by grasslands. The northern channel (North of Jeffreys Island) is characterized by open-canopy *Populus* open meadow (POM) and *Populus* shrub meadow (PSM) forest. In addition to open mudflats, *Salix* shrub and *Amorpha*/*Salix* shrub vegetation is prevalent along the southern channel (South of Jeffreys Island). Upland forest, characterized by dense *Juniperus*/*Populus* (JP) vegetation, dominates the raised riverbank along the southern edge of the south channel. Jeffreys Island itself (between the North and South channels), is dominated by sandy meadow/blowout (SMB) and shrub grassland (SG) vegetation.

Overton to Elm Creek

Between Overton (site 160) and Elm Creek (site 141) the Platte is characterized by very dense forest dominated by *Populus*/*Juniperus* (PJ), *Juniperus*/*Populus* (JP) and *Populus* shrub (PS) vegetation. In addition, *Populus*/*Elaeagnus* (PE) and *Populus* shrub meadow (PSM) vegetation types are locally prevalent.

Elm Creek to Kearney

Between Elm Creek (site 141) and Kearney (site 106) the Platte is generally characterized by relatively young (20-50 years old) open-canopy forests. *Populus/Juniperus* (PJ) is the dominant forest vegetation type, but *Populus* shrub meadow (PSM) and *Populus* open meadow (POM) are also fairly common. Shrub grassland (SG) vegetation commonly dominates in forest openings. The highly dissected river channel is characterized by *Salix* shrub (SS), *Amorpha/Salix* (AS), and *Cornus/Amorpha* (CA) shrub vegetation and widely scattered mudflats.

Kearney to Minden Road

The relatively small segment of the Platte between Kearney (site 106) and Minden Road (site 98) is characterized by raised uplands dominated by very dense *Juniperus/Populus* (JP) forest. Forest openings, which occur primarily along dry, abandoned river channels, are generally dominated by sandy meadow/blowout (SMB) vegetation. Grazed grassland (GG) and prairie/hayfield (PH) vegetation dominates on some of the larger river islands in this portion of the river.

Minden Road to Shelton

Between Minden Road (site 98) and Shelton (site 75) the north channel of the Platte is characterized by *Populus/Juniperus* (PJ) forest, while the south channel is characterized by extensive open mudflats and scattered island and shoreline shrubs. *Salix* shrub (SS) and *Amorpha/Salix* (AS) are the principal shrub vegetation types found along this stretch of the river. In some areas, river islands and narrow strips of shoreline forest are dominated by mixed hardwood shrub (MHS) vegetation.

Shelton to Wood River

Between Shelton (site 75) and Wood River (site 59) the Platte is characterized by forest vegetation and shoreline and island shrub communities. Older forests near the floodplain terraces, are generally dominated by *Populus* shrub (PS) vegetation. Forests located closer to the river channel are generally younger and tend to be dominated by *Populus/Salix* wetland (PSW) vegetation. *Salix* shrub (SS) vegetation is prominent along riverbanks and islands adjacent to the river channel. Much of the river channel is lined by narrow strips of forest vegetation dominated by mixed hardwood shrub (MHS) vegetation.

Wood River to Grand Island

Between Wood River (site 59) and Grand Island (site 20), the Platte is characterized by extensive, open mudflats with occasional islands dominated by *Salix* shrub (SS) and *Salix* wetland (SW) vegetation. Riverbank forests and isolated river islands are dominated by *Populus* shrub (PS) and mixed hardwood shrub (MHS) vegetation, but such forest communities are generally very sparse along this stretch of the river. In general, the uplands are characterized by extensive grasslands dominated by prairie/hayfield (PH), grazed grassland (GG), and wetland meadow (WM) vegetation.

Grand Island to site 8

Between Grand Island (site 20) and site 8 (Baim), the Platte is characterized by islands dominated by *Salix* shrub (SS), *Cornus/Amorpha* (CA), and *Amorpha/Cornus* (AC) vegetation. Although large areas of the river channel are dominated by mudflats, they are much less extensive than in the Wood River to Grand Island portion of the study area. The forests which occur along portions of the channel and on some river islands tend to be dominated by dense *Juniperus/Populus* (JP) and mixed hardwood shrub (MHS) vegetation.

Site 8 to Chapman

Between site 8 (Baim) and Chapman (site 1) the Platte is dominated by open mudflats and *Salix* shrub (SS) islands. Along the raised riverbank *Amorpha/Cornus* (AC) and *Salix* shrub (SS) vegetation is fairly common. Floodplain forests are dominated by *Populus/Juniperus* (PJ) vegetation, but narrow strips of *Populus/Salix* wetland (PSW) vegetation develop along intermittently flooded river channels which are interspersed throughout the *Populus/Juniperus* (PJ) forest vegetation.

Compositional vs Height Classifications

The present vegetation classification scheme, as mentioned above, is based almost exclusively on composition rather than structure or height of the vegetation. In general, the 22 vegetation types are directly comparable to one of the 5 height classes designated in the Atlas of Platte River Vegetation (Pillmore et al. 1980) (Table 6). Annual mudflats are comparable to class 1 (<0.5 m), while perennial mudflats fall within class 2 (0.5-2 m). The majority of the meadow vegetation types, including marsh, wetland meadow, prairie/hayfield, and shrub grassland fall within class 2 (0.5-2 m). The grazed grassland and sandy meadow/blowout vegetation types, however, fall within class 1 (<0.5 m), mainly as a consequence of grazing activity. In general, all the shrub vegetation types (i.e., *Salix* wetland, *Salix* shrub, *Amorpha*/*Salix*, *Cornus*/*Amorpha*, and *Amorpha*/*Cornus*) fall within class 3 (2-4 m). Occasionally, shrub vegetation falls within class 4 (4-8 m), but this is the exception rather than the rule. Forest vegetation types are divided between class 4 (4-8 m) and class 5 (>8 m). Forests dominated by young *Populus* (i.e., *Populus*/*Salix* wetland and *Populus* open meadow), or dense stands of *Elaeagnus* (i.e., *Elaeagnus*/*Populus*), or *Juniperus* (i.e., *Juniperus*/*Populus*) fall within class 4 (4-8 m). Older forests dominated by a *Populus* or mixed hardwood overstory (i.e., *Populus*/*Elaeagnus*, *Populus* shrub meadow, *Populus*/*Juniperus*,

Table 6. Comparison of compositional (present) and height (Pillmore *et al*. 1980) classifications of Platte River vegetation. Classes used in the height classification are as follows: (1) < 0.5 m, (2) 0.5-2 m, (3) 2-4 m, (4) 4-8 m, (5) > 8 m

Compositional	Height
MUDFLAT	
Annual Mudflat (AM)	Class 1 (herbaceous)
Perennial Mudflat (PM)	Class 2 (low shrub/herbaceous)
MEADOW	
Marsh (M)	Class 2 (low shrub/herbaceous)
Grazed Grassland (GG)	Class 1 (herbaceous)
Wetland Meadow (WM)	Class 2 (low shrub/herbaceous)
Prairie/Hayfield (PH)	Class 2 (low shrub/herbaceous)
Sandy Meadow/Blowout (SMB)	Class 1 (herbaceous)
Shrub Grassland (SG)	Class 2 (low shrub/herbaceous)
SHRUB	
Salix Wetland (SW)	Class 3 (shrub)
Salix Shrub (SS)	Class 3 (shrub)
Amorpha/*Salix* (AS)	Class 3 (shrub)
Cornus/*Amorpha* (CA)	Class 3 (shrub)
Amorpha/*Cornus* (AC)	Class 3 (shrub)
FOREST	
Populus/*Salix* Wetland (PSW)	Class 4 (tall shrub/woodland)
Elaeagnus/*Populus* (EP)	Class 4 (tall shrub/woodland)
Populus/*Elaeagnus* (PE)	Class 5 (forest)
Populus Open Meadow (POM)	Class 4 (tall shrub/woodland)
Populus Shrub Meadow (PSM)	Class 5 (forest)
Juniperus/*Populus* (JP)	Class 4 (tall shrub/woodland)
Populus/*Juniperus* (PJ)	Class 5 (forest)
Populus Shrub (PS)	Class 5 (forest)
Mixed Hardwood Shrub (MHS)	Class 5 (forest)

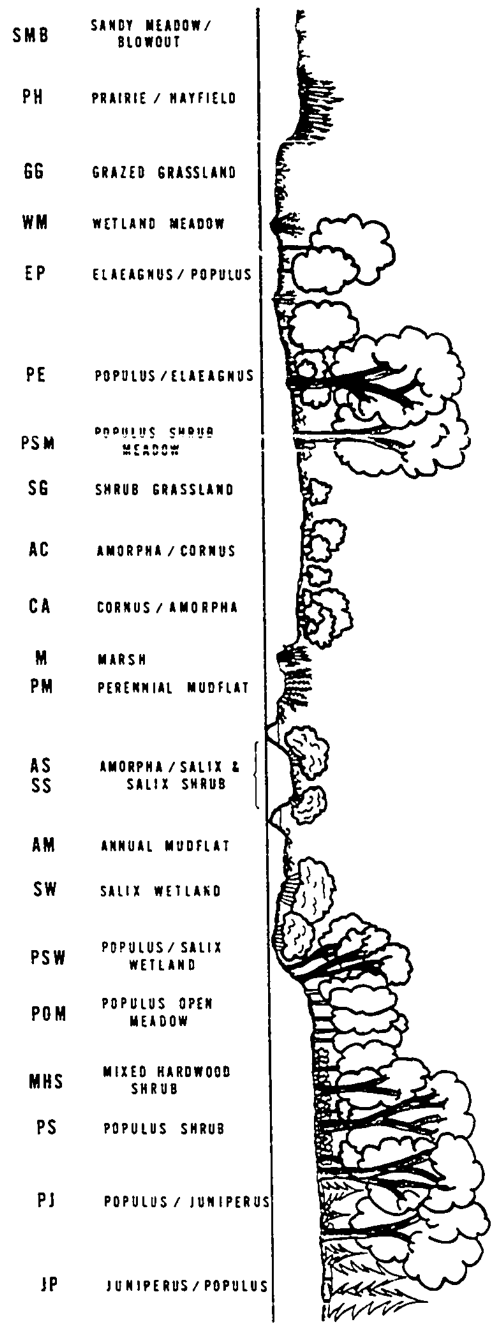
Populus shrub, and mixed hardwood shrub fall in class 5 (>8 m).

Vegetation Associations

A diagrammatic sketch of the 22 vegetation types and their approximate positions above the river channel and in relation to one another is shown in Figure 15. The horizontal axis is not drawn to scale, and in general is considerably condensed. It is highly unlikely that such a profile, including all 22 vegetation types, occurs anywhere along the Platte or North Platte rivers.

Vegetation types commonly found together in the field and those with similar species composition have been drawn close to one another in Figure 15. Such "associations" include mudflats (AM and PM), wetland shrubs (AS, SS, SW, and PSW), lowland grasslands (GG, WM, and EP), lowland forests (EP and PE), upland shrubs (SG, AC, and CA), upland grasslands (SMB and PH), and upland forests (MHS, PS, PJ, and JP). Rolling grassland complexes characterized by SMB and PH uplands and GG and WM lowlands occasionally dominate extensive areas along the Platte and are represented at the far left in the diagram (Figure 15). The Populus shrub meadow (PSM), marsh (M), and Populus open meadow (POM) vegetation types are commonly isolated from the other vegetation types. In the diagram, these vegetation types have been placed in positions which reflect their relationship to the channel. Thus, the vegetation adjacent to the

Figure 15. Diagrammatic sketch of the vegetation types on the Platte River floodplain. Each vegetation type has been drawn in its approximate relative position on the vertical profile


SMB SANDY MEADOW/ BLOWOUT
PH PRAIRIE / HAYFIELD
GG GRAZED GRASSLAND
WM WETLAND MEADOW
EP ELAEAGNUS / POPULUS
PE POPULUS / ELAEAGNUS
PSM POPULUS SHRUB MEADOW
SG SHRUB GRASSLAND
AC AMORPHA / CORNUS
CA CORNUS / AMORPHA
M MARSH
PM PERENNIAL MUDFLAT
AS SS AMORPHA / SALIX & SALIX SHRUB
AM ANNUAL MUDFLAT
SW SALIX WETLAND
PSW POPULUS / SALIX WETLAND
POM POPULUS OPEN MEADOW
MHS MIXED HARDWOOD SHRUB
PS POPULUS SHRUB
PJ POPULUS / JUNIPERUS
JP JUNIPERUS / POPULUS

PSM, M, and POM types may not actually represent realistic vegetation associations. In addition, the placement of the POM vegetation type is particularly difficult since it includes sites with similar species composition which are located on both dry upland sites and well-drained, intermittently flooded, riverwash areas.

SUMMARY

A summary of the major vegetation types, with brief descriptions of their general characteristics, is provided in Table 7. Some of the major types were determined by grouping vegetation types developed in the classification scheme. These groupings include lowland grassland (GG and WM), upland grassland (PH, SMB, and SG), wetland shrub (SW, SS, and AS), upland shrub (CA and AC), *Populus/ Elaeagnus* (EP and PE), *Populus* meadow (POM and PSM), *Populus/ Juniperus* (JP and PJ), and mixed hardwood shrub (PS and MHS). Although the 22 vegetation types determined in the classification scheme form distinct, describable vegetation units, they are probably more specific than is necessary for general habitat descriptions and many management objectives. The 12 major types listed in Table 7 are probably more useful in many applications.

Table 7. Summary of the vegetation types on the Platte River floodplain. The number of stands of each type sampled during the vegetation survey is provided at the right. Typical examples of each vegetation type are listed at the far right (refer to Appendix A for location of sample sites (first number) and stands (second number))

Type	General Description	Subtypes	Number Sampled	Example Sites
MUDFLAT				
Annual Mudflat	Recently exposed areas along the river channel colonized by Cyperus, Eragrostis, and other annuals.		16	122-02
Perennial Mudflat	Partially exposed areas near the river channel characterized by 1-2 M high Populus, Salix, and Amorpha saplings.		44	29-02
MEADOW				
Marsh	Typha and Scirpus acutus dominated communities in pools of standing water near river channels and in the backwaters of major dams and diversions.		9	301-03
Lowland Grassland	Grazed, intermittently wet meadows dominated by Ambrosia, Carex, Poa, and a variety of other grasses. Low lying areas are dominated by Scirpus, Eleocharis, and Phyla.	Grazed Grassland (GG) Wetland Meadow (WM)	20 15	41-02 92-1A
Upland Grassland	Dry Meadows characterized by Andropogon prairie, sandy areas dominated by Bromus tectorum, and grasslands with scattered Amorpha shrub.	Prairie/Hayfield (PH) Sandy Meadow/Blowout (SMB) Shrub Grassland (SG)	16 29 23	41-04 404-06 59-10
SHRUB				
Wetland Shrub	Riverbank and island shrub dominated by Salix exigua and Amorpha, with an understory of Carex, Scirpus, and Lycopus in intermittently flooded areas, and an understory of Solidago and Spartina on drier island sites.	Salix wetland (SW) Salix shrub (SS) Amorpha/Salix (AS)	14 41 30	301-01 92-03 50-01
Upland Shrub	Amorpha and Cornus drummondii dominated upland shrub areas in forest openings and along raised riverbanks. Ambrosia, Bromus japonicus and open ground are common in the understory.	Cornus/Amorpha (CA) Amorpha/Cornus (AC)	19 21	1-06 44-03

Table 7 (Continued)

Type	General Description	Subtypes	Number Sampled	Example Sites
FOREST				
Populus/Salix Wetland	Intermittently flooded forest dominated by Salix rigida, Populus, and Fraxinus, with an understory of Amorpha, Cornus, and Salix exigua shrub. Phyla and Carex are important herbaceous species.		34	219-14
Populus/Elaeagnus	Wet forest areas dominated by either dense Elaeagnus with an overstory of scattered Populus, or dense Populus with Elaeagnus in the understory. Ambrosia, Carex, and Poa are the dominant herbaceous species.	Elaeagnus/Populus (EP) Populus/Elaeagnus (PE)	18 22	337-01 335-10
Populus Meadow	Upland Populus forest with a grassland understory dominated by Panicum, Spartina, Poa, Sporobolus, Bromus, and scattered low Amorpha, Cornus, and Rosa shrub.	Populus Open Meadow (POM) Populus Shrub Meadow (PSM)	20 49	171-08 172-07
Populus/Juniperus	Dry upland forest dominated by either dense Juniperus with an overstory of scattered Populus, or dense Populus with Juniperus in the understory. Fraxinus (seedlings), Rosa, Rhus radicans, and Ambrosia are the dominant ground cover species.	Juniperus/Populus (JP) Populus/Juniperus (PJ)	24 48	106-06 266-05
Mixed Hardwood Shrub	Moderately dry forest dominated by Populus, with an understory of Fraxinus, Salix rigida, Morus, and Ulmus. Cornus drummondii, Amorpha, and Salix exigua are the dominant shrubs, while Solidago, Rhus radicans, Poa, and Elymus are the major herbaceous species.	Populus Shrub (PS) Mixed Hardwood Shrub (MHS)	28 31	89-01 42-13

LITERATURE CITED

Barkley, T. M. 1977. Atlas of the Flora of the Great Plains. Iowa State University Press, Ames, Iowa. 600 pp.

Bates, J. M. 1914. On the sedges of Nebraska. Univ. of Nebr. Studies 14:145-165.

Buller, L. L., R. S. Pollock, R. A. Boccheciamp, C. L. Hammond, and H. Hill. 1974. Soil Survey of Buffalo County, Nebraska. Conservation and Survey Division, Univ. of Nebraska, Lincoln, Nebraska. 86 pp.

Bunde, M., G. Deyle, J. Gray, T. Imel, M. Stines, T. Sweeney, and L. Weiss. 1975. The effects of the selective removal of cottonwood trees along the Platte River. Student Originated Studies Program, National Science Foundation, Department of Biology, Kearney State College, Kearney, Nebraska. 200 pp.

Elder, J. A. 1969. Soils of Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 60 pp.

Ferguson, E., C. Frith, and C. Faanes. 1980. Population estimates and distribution of Sandhill Cranes. Final Report, Platte River Ecology Study, Northern Prairie Wildlife Research Center, U.S. Fish and Wildlife Service. (unpublished).

Frith, C. R. 1974. The ecology of the Platte River as related to Sandhill Cranes and other waterfowl in south central Nebraska. Unpublished M.S. Thesis. Kearney State College, Kearney, Nebraska. 115 pp.

Gauch, H. G., R. H. Whittaker, and T. R. Wentworth. 1977. A comparative study of reciprocal averaging and other ordination techniques. J. Ecol. 65:157-174.

Gleason, H. A., and A. Cronquist. 1963. Manual of vascular plants of the northeastern United States and adjacent Canada. D. van Nostrand Company, Inc., Princeton, New Jersey. 810 pp.

Goke, A. W., E. A. Nieschmidt, and R. C. Roberts. 1926. Soil Survey of Lincoln County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 31 pp.

Goke, A. W., and W. H. Buckhannan. 1927. Soil Survey of Hamilton County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 26 pp.

Hadenfelt, B. 1978. Herbaceous vegetation study of Platte River islands. Student Originated Study Program, National Science Foundation, Department of Biology, Kearney State College, Kearney, Nebraska. 27 pp.

Hayes, F. A., G. E. Condra, and M. H. Layton. 1925. Soil Survey of Dawson County, Nebraska. Pages 391-436 in 1922 series. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska.

Hayes, F. A., A. F. Huddleston, M. H. Layton, G. E. Bates, and H. L. Bedell. 1926. Soil Survey of Merrick County, Nebraska. Pages 871-917 in 1922 series. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska.

Hefley, H. M. 1937. Ecological studies on the Canadian River floodplain in Cleveland County, Oklahoma. Ecol. Mono. 7:345-402.

Hill, M. O. 1973. Reciprocal averaging: An eigenvector method of ordination. J. Ecol. 61:237-249.

Hill, M. O. 1979. Twinspan (CEP-41) - A FORTRAN program for arranging multivariate data in an ordered 2-way table of classification of the individuals and attributes. Department of Ecology and Systematics, Cornell University, Ithaca, New York. 31 pp.

Hill, M. O., R. G. H. Brunce, and M. W. Shaw. 1975. Indicator species and analysis, a diverse polythetic method of classification, and its application to a survey of native pinewoods in Scotland. J. Ecol. 63:597-613.

Hopkins, H. H. 1951. Ecology of the native vegetation of the loess hills in central Nebraska. Ecol. Mono. 21:125-147.

Johnson, W. C., R. L. Burgess, and W. R. Keammerer. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. Ecol. Mono. 46:59-84.

Kellogg, R. S. 1905. Forest belts of western Kansas and Nebraska. USDA Forest Serv. Bull. No. 66. 44 pp.

Layton, M. H., and W. H. Buckhannan. 1926. Soil Survey of Keith County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 52 pp.

Layton, M. H., A. N. Huddleston, G. E. Condra, and F. A. Hayes. 1927. Soil Survey of Kearney County, Nebraska. Pages 441-482 in 1923 series. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska.

Lindsey, A. A., R. O. Petty, D. K. Sterling, and W. Van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe rivers. Ecol. Mono. 31:105-156.

McVaugh, R. 1957. Establishment of vegetation on sandflats along the Hudson River, New York. II. The Period 1945-1955. Ecology 38:23-29.

Moran, W. J. 1938. Soil Survey of Gosper County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 27 pp.

Peterson, N. F. 1912. Flora of Nebraska. 2nd edition. Published by the author, Plainview, Nebraska. 217 pp.

Pillmore, R., R. Kologiski, M. Meyer, and P. Currier. 1980. Atlas of the Platte River Vegetation. Northern Prairie Wildlife Research Center, U. S. Fish and Wildlife Service, Jamestown, North Dakota. (unpublished)

Pound, R., and F. E. Clements. 1900. The phytogeography of Nebraska. 2nd edition. Botanical Survey of Nebraska, Lincoln, Nebraska. 422 pp.

Rand, P. J. 1973. The woody phreatophyte communities of the Republican River valley in Nebraska. Final Report, Research contract, U. S. Bureau of Reclamation. Botany Department, Univ. of Nebraska, Lincoln, Nebraska. 110 pp.

Robertson, P. A., G. T. Weaver, and J. A. Cavanaugh. 1978. Vegetation and tree species patterns near the northern terminus of the southern floodplain forest. Ecol. Mono. 48:249-267.

Rothenberger, S. J. 1973. The herbaceous flora of Buffalo County, Nebraska. M.S. Manuscript. Kearney State College, Kearney, Nebraska.

Shelford, V. E. 1954. Some lower Mississippi valley floodplain biotic communities: their age and elevation. Ecology 35:126-142.

Stevens, W. R. 1978. Climates of the States - Nebraska. Pages 607-626 in J. A. Ruffner (ed.). Climates of the States. Gale Research Co., Detroit. 1185 pp.

Sutherland, D. M. 1974. Identification and evaluation of present vegetative resources - Nebraska Mid-State Region, Division Pick-Sloan Missouri Basin program and associated areas. Final Report prepared for U. S. Dept. Interior, Bureau of Reclamation, Grand Island, Nebraska. 102 pp.

Tillman, B. W., and B. F. Hensel. 1919. Soil Survey of Phelps County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 42 pp.

Walters, A. 1978. Riparian succession of the Platte River islands. Student Originated Study Program, National Science Foundation. Department of Biology, Kearney State College, Kearney, Nebraska. 9 pp.

Ware, G. H., and W. T. Penfound. 1949. The vegetation of the lower levels of the floodplain of the South Canadian River in central Oklahoma. Ecology 30:478-484.

Weaver, J. E. 1960. Floodplain vegetation of the central Missouri valley and contacts of woodland with prairie. Ecol. Mono. 30:37-64.

Weaver, J. E. 1965. Native vegetation of Nebraska. Univ. of Nebraska Press, Lincoln, Nebraska. 185 pp.

Weaver, J. E., and W. E. Bruner. 1954. Nature and place of transition from true prairie to mixed prairie. Ecology 35:117-126.

Webber, H. J. 1890. Catalogue of the flora of Nebraska. In C. E. Bessey, and H. J. Webber. Report of the Botanist on the grasses and forage plants and the catalogue of plants. State Journal Co., Lincoln, Nebraska. 162 pp.

Williams, G. P. 1978. The case of the shrinking channels - The North Platte and Platte rivers in Nebraska. Geological Survey Circular No. 781. 48 pp.

Wilson, R. E. 1970. Succession in stands of Populus deltoides along the Missouri River in southeastern South Dakota. Am. Midl. Nat. 83:330-342.

Winter, J. M. 1936. An analysis of the flowering plants of Nebraska. Unpublished manuscript. Botany Department, Univ. of Nebraska, Lincoln, Nebraska. 203 pp.

Yost, D. A., H. E. Paden, F. Matanzo, F. L. Bean, H. L. Hill, and R. A. Pollock. 1962. Soil Survey of Hall County, Nebraska. Univ. of Nebraska Conservation and Survey Division, Lincoln, Nebraska. 141 pp.

PART II: EFFECTS OF RIVERINE HYDROLOGY ON SEED GERMINATION, SEEDLING ESTABLISHMENT, AND SEEDLING MORTALITY OF *POPULUS DELTOIDES* AND *SALIX* SPP.

INTRODUCTION

This study is part of an investigation of the ecology and habitat requirements of sandhill cranes and other migratory birds in central and western Nebraska. An estimated 200,000 sandhill cranes use the Platte River valley as a staging area during spring migration to their breeding grounds in Canada and Alaska. At night, the cranes roost on shallowly flooded, unvegetated sandbars, mudflats, and islands in the middle of the river channel. During the past 40 years, declining stage levels in the Platte have exposed many sandbars, mudflats, and river islands and allowed Populus deltoides (cottonwood), Salix exigua (coyote willow), Salix rigida (diamond willow), Salix amygdaloides (peach-leaf willow), Amorpha fruticosa (indigo bush), Cornus drummondii (rough-leaf dogwood) and other woody species to invade many areas of the river channel and encroach upon the sandbar and island habitat utilized by the sandhill cranes (Frith 1974, Williams 1978). Because Populus and Salix spp. are the principal, as well as the pioneer woody species invading sandbars and mudflats, this study was designed to investigate their autecology and to document the environmental conditions under which Populus and Salix seed germination, seedling establishment, and seedling mortality occur.

The germination and seedling establishment requirements of Populus and Salix are quite similar, and have been reported frequently in the literature (Moss 1938, Kapustka 1972, McLeod and McPherson 1973). Under field conditions, germination and establishment of these species occurs only when seeds land on continuously moist, unvegetated substrates (Shull 1922, Moss 1938, McVaugh 1947, Dietz 1952, Everitt 1968, Wilson 1970, Kapustka 1972, McLeod and McPherson 1973). This moisture requirement is apparently linked to the delicate hairs on the hypocotyl which serve as the primary absorptive organs for the young seedling. If these hairs are allowed to dry-out, the seedling becomes desiccated and dies (Moss 1938). Light and temperature conditions are not nearly as critical for Populus and Salix germination. Kapustka (1972) reports that light apparently has no effect on Populus germination and that temperature is critical only above 40.5°C, when it becomes lethal to embryos and young seedlings. The optimal temperature range for Populus and Salix germination is approximately 25°C to 30°C (Kapustka 1972).

The seed viability period in Populus and Salix is extremely short. Although Populus has been estimated to remain viable for up to 7 weeks (Horton et al. 1960), most studies place its viability at 2-4 weeks (Moss 1938, Ware and Penfound 1949, Kapustka 1972). Salix reportedly has a seed viability period of only 1-3 weeks (Moss 1938, Ware and Penfound 1949, McLeod and McPherson 1973). By storing seeds at 10% relative humidity, Moss (1938) was able to extend the limited viability periods of Populus and Salix to 8-10 weeks.

Ripened seeds are released from Populus deltoides, Salix exigua, and Salix rigida during a relatively short 1- to 2- month period from mid-May to mid-July. Although the seed release period is relatively short, extremely large quantities of seed are produced by *Populus* and *Salix* trees. Kapustka (1972) estimates that a 15-cm DBH *Populus* tree releases 340,000 to 650,000 seeds annually. Most of these seeds are apparently viable; but because of their short viability and seed release periods and the limited availability of continuously moist, unvegetated substrates, only a few germinate and develop into seedlings.

Although the seed germination and seedling establishment requirements of *Populus* and *Salix* are well known, they have not been documented for populations along the Platte River in central and western Nebraska. In addition, little is known about the environmental conditions (i.e., hydrology, soil texture, and soil moisture) which characterize the habitats suitable for *Populus* and *Salix* seed germination and seedling establishment. This study was initiated to provide such autecological and environmental data for use in developing management plans to reduce the invasion of *Populus*, *Salix*, and other woody species on Platte River sandbars, mudflats, and islands, and preserve sandhill crane habitat.

METHODS

Study Sites

During the summer of 1979, 71 permanent 1- x 1-m quadrats were established at 20-m intervals along transect lines crossing the Platte River channel at Jeffrey Island, the Audubon Bird Sanctuary, and Mormon Island (Figure 1). Approximate locations of the permanent quadrats are indicated in Figure 2, which depicts profiles of the river bottom and adjacent uplands along each transect line. Although the river channel at all 3 sites is dominated by extensive, partially vegetated mudflats and river islands, the surrounding vegetation at each location is quite different. In general, forests characterize the Jeffrey site, bands of shoreline shrubs and forest characterize the Audubon site, and open-grazed meadows characterize the Mormon site.

Field Sampling

At weekly intervals, *Populus* and *Salix* seedling establishment, seedling mortality, soil moisture, and water depth were monitored in the 71 permanent quadrats. Although seedling and water regime monitoring continued until September 30, it was not possible to collect soil moisture data after August 27. Soil texture was determined by analyzing sediment samples collected from each quadrat at 2 different times during the study.

The soil moisture, water depth, and soil texture measurements were used to develop the 12 environmental parameters listed in Table 1.

Figure 1. Location of the Jeffrey Island, Audubon Bird Sanctuary, and Mormon Island sites where permanent quadrats were established during the summer of 1979. Inset map indicates the location of this segment of the Platte in Nebraska

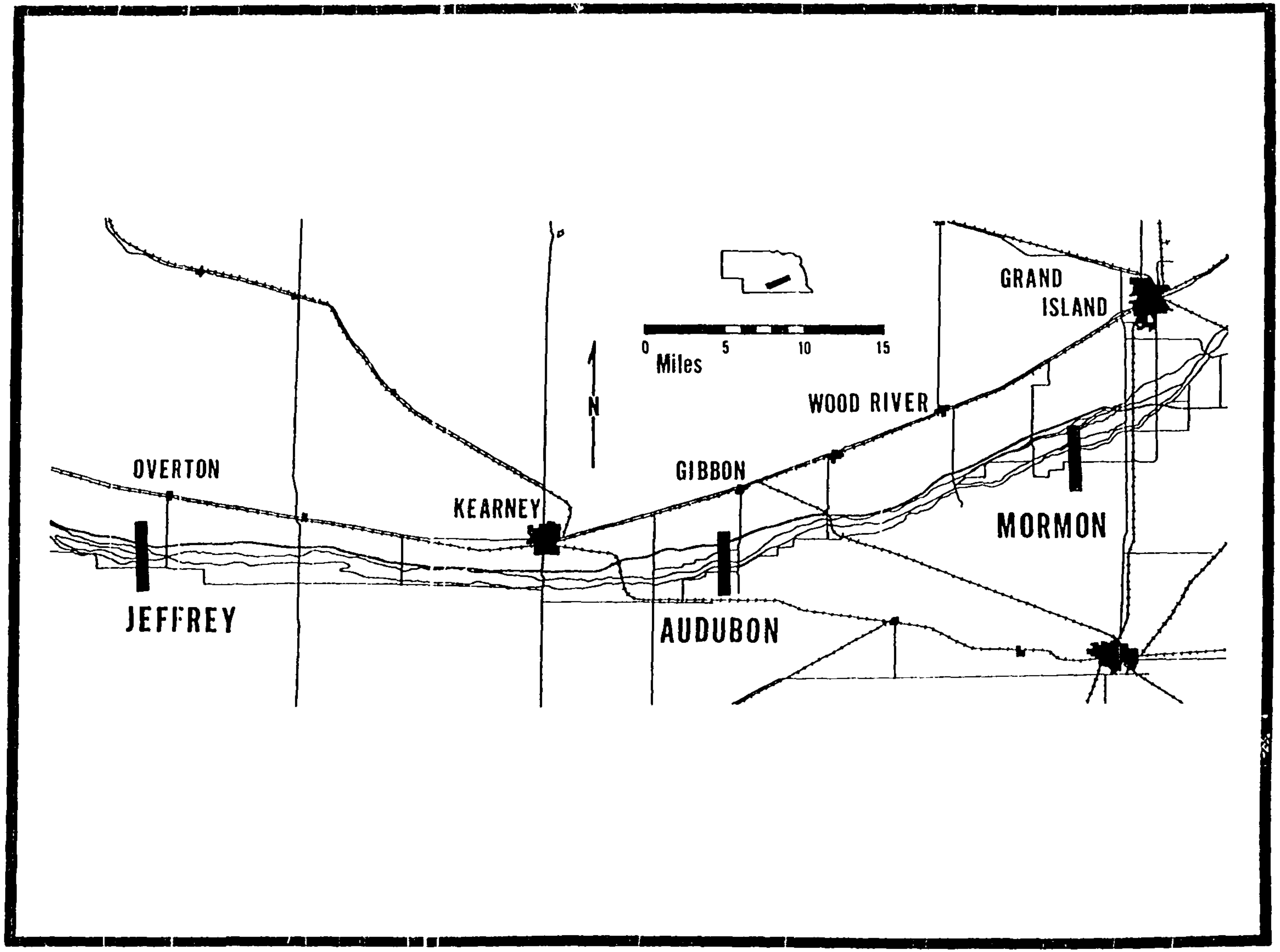
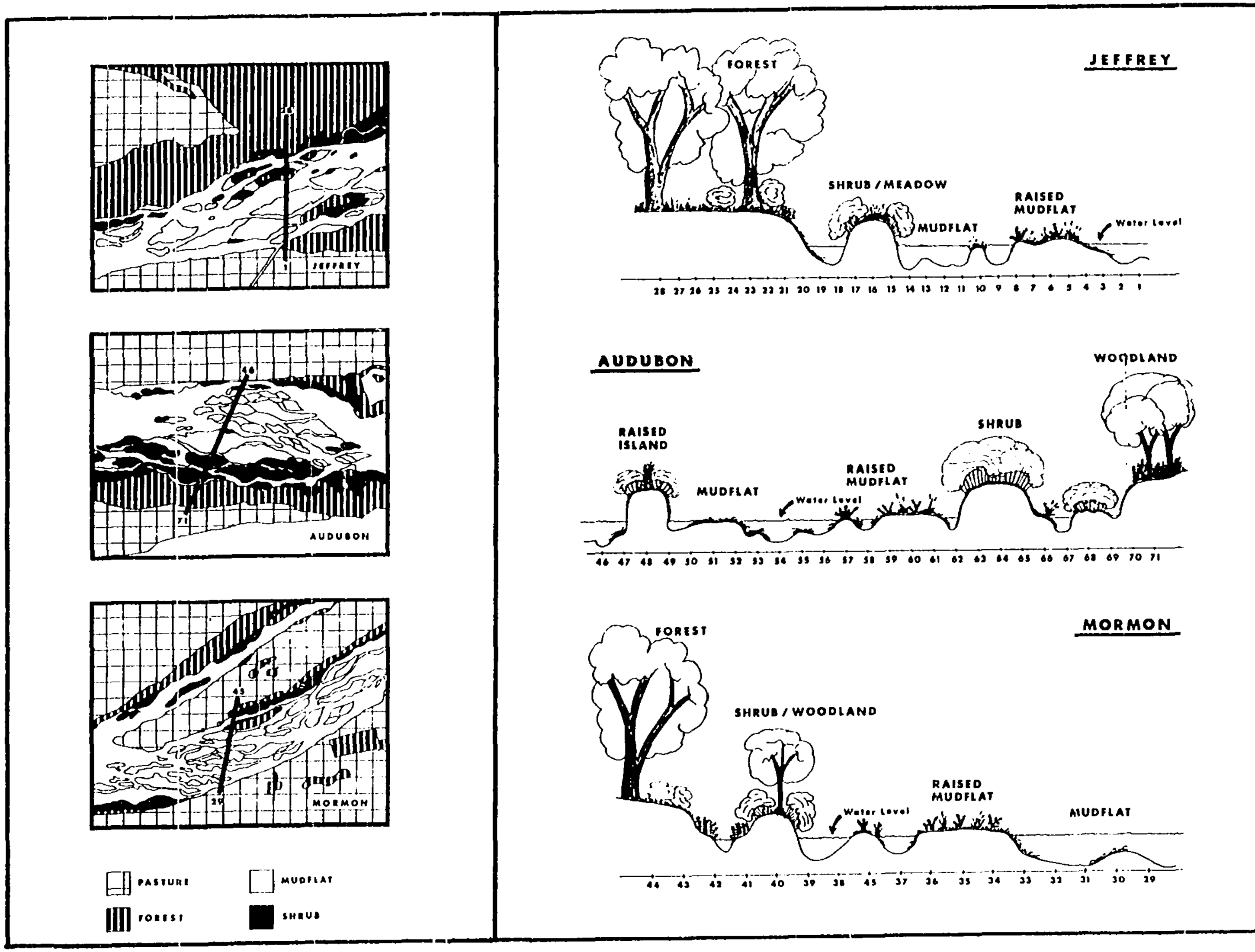

GRAND
ISLAND
0 5 10 15
Miles
N
WOOD RIVER
OVERTON
GIBBON
KEARNEY
MORMON
JEFFREY
AUDUBON

Figure 2. Characterization of the vegetation at the Jeffrey, Audubon, and Mormon sites is shown on the left. The profiles at the right depict the locations of the permanent quadrats in relation to the river channel and the surrounding uplands



JEFFREY
AUDUBON
MORMON
PASTURE
MUDFLAT
FOREST
SHRUB
FOREST
SHRUB / MEADOW
RAISED MUDFLAT
MUDFLAT
Water Level
28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
WOODLAND
RAISED ISLAND
MUDFLAT
Water Level
RAISED MUDFLAT
SHRUB
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71
FOREST
SHRUB / WOODLAND
RAISED MUDFLAT
Water Level
MUDFLAT
44 43 42 41 40 39 38 45 37 36 35 34 33 32 31 30 29

Table 1. Definitions of the 12 environmental parameters used to characterize the 71 permanent quadrats

Parameter	Definition
SOIL MOISTURE	
Average Soil Moisture (%)	Average weekly % soil moisture between 10 June and 27 August.
Critical Soil Moisture (%)	Average weekly % soil moisture between 16 July and 27 August.
Minimum Soil Moisture (%)	Minimum weekly % soil moisture between 10 June and 27 August.
SOIL TEXTURE	
Coarse Gravel (%)	% soil fraction > 4760 microns.
Gravel (%)	% soil fraction 2000-4760 microns.
Sand (%)	% soil fraction 250-2000 microns.
Fine Sand (%)	% soil fraction 105-250 microns.
Silt (%)	% soil fraction < 105 microns.
WATER REGIME	
Exposure (days)	Number of days (out of 77) of no flooding between 16 July and 30 September.
Average Depth (cm)	Average depth (cm) during flooding between 16 July and 30 September.
Total Maximum (cm)	Maximum water depth between 10 June and 30 September.
Critical Maximum (cm)	Maximum water depth between 16 July and 30 September.

Except for soil texture, these parameters were designed to reflect environmental conditions under the changing water regimes which occurred during the study. Between June 10 and July 16, stage levels in the Platte were very high ($\overline{X}$ = 2.71 ft.), leaving few mudflats exposed and virtually eliminating any possibility of woody seedling establishment. From July 16 until the end of September, stage levels were relatively low ($\overline{X}$ = 1.53 ft.), extensive mudflats were exposed, and conditions were generally more favorable for woody seedling establishment. The latter period is referred to as the critical establishment period, because all the new seedlings observed in the study established after July 16.

Soil moisture was determined as the difference between wet and oven-dry weight of sediment samples, and expressed as a percentage of the total wet weight. Average and minimum soil moisture were determined for the entire period (June 10 - August 27) for which soil moisture data were available. Critical soil moisture was calculated for the period between July 16 and August 27.

Soil texture was determined by sorting the sediment samples into coarse gravel (> 4760 μ), gravel (2000-4760 μ), sand (250-2000 μ), fine sand (105-250 μ), and silt (< 105 μ) fractions. Each soil fraction was weighed and expressed as a percentage of the total sample weight.

The water regime parameters were determined by extrapolating from the water depth data collected in each quadrat to the hourly river stage data recorded at the USGS gaging station near Overton. In this way, it was possible to approximate the elevation of each quadrat relative to stage level and generate continuous water depth data. Exposure (days) was determined by compiling the number of hours in which stage levels fell below the approximated elevation of each quadrat during the period between July 16 and September 30, when stage levels were relatively low and extensive mudflats were exposed. Relative stage levels were also used to calculate average and critical maximum water depths (cm) during the critical establishment period (July 16 - September 30), and to calculate total maximum water depth (cm), during the entire study period (June 10 - September 30).

Analysis of Field Data

The 71 permanent quadrats were grouped for data analysis. Seedling establishment and mortality data for Populus and Salix were also combined, because only a small number of seedlings was encountered during the study.

Stepwise multiple regression was used to investigate which environmental parameters or combinations of environmental parameters favored establishment, survival, and mortality of woody seedlings. Environmental parameters served as the independent variables and were added stepwise to the regression equation. Seedling parameters, including mature seedlings (at least 1 year old at initiation of the study), new seedlings, total (mature + new) seedlings, and seedling mortality served as the dependent variables.

A 3-axis reciprocal averaging (RA) ordination technique (Hill 1973) was also employed to investigate relationships between the seedling and environmental parameters. The RA technique produced a 2-dimensional ordination (Axis 1 vs Axis 3) of the 71 permanent quadrats, based on the 12 environmental parameters. The environmental parameter data were transformed by Log (x + 1) to insure that each parameter was weighted equally in the RA analysis. The 71 permanent quadrats were then separated into 5 types of sites based on their positions along a moisture gradient in the ordination and whether or not new seedlings had established in the quadrats during the study. The 5 types of sites included upland (U), raised mudflat (R), raised mudflat with new seedling establishment (RS), mudflat (M), and mudflat with new seedling establishment (MS). An unbalanced ANOVA procedure (Helwig and Council 1979), followed by Duncan's Multiple Range Test, were used to compare the means of the environmental and seedling parameters between the 5 types of sites.

Seed Viability

To complement the field observations, the period of viable *Populus* and *Salix* seed release along the Platte was documented and seed viability was experimentally tested under a variety of potential field conditions. Ripened *Populus* and *Salix* seeds were harvested periodically and tested for percentage viability by incubating 100 seeds on moist blotters for 2 weeks at a constant 25°C. To investigate the period of seed viability under conditions simulating upland (dry) and mudflat (wet) sites, viable Populus and Salix seeds were stored at a 20-30°C ambient temperature in cloth bags under dry and wet (totally submersed) treatments. Wet treatments were also conducted at a lower temperature regime (i.e., 10-15°C). On one set of Populus seeds the pappus of "cottony" hairs was removed before the seeds were stored. This was done to determine whether the pappus had a substantial affect upon the moisture-retaining capacity of seeds during the storage treatments. Seed viability was determined by subsampling 100 seeds from each treatment at 3, 7, 10, 14, 17, and 34 days after treatments began and incubating them in the manner described above.

RESULTS AND DISCUSSION

Seed Viability

Seed release

Populus began to release seeds as early as June 3 and continued until approximately July 26. The majority of Populus seeds, however, were released between June 5 and June 20. Seeds collected between June 7 and June 20 were nearly all viable. Because it was difficult to collect a large enough seed sample, viability of ripened Populus seeds was not investigated after June 20.

Salix began to release seeds somewhat later than Populus. The peak period of Salix seed release occurred between June 12 and July 20, but continued until July 30. Viability of seed being released from Salix rapidly decreased from 70-80% on June 12, to 60% one week later, and 0% by July 30. Even though Salix seed was released for nearly 2 months, viability of the seeds during the later part of the seed release period was quite low.

These periods of Populus and Salix seed release are similar to those recorded by Ware and Penfound (1949) along the South Canadian River in Oklahoma, and Kapustka (1972) along the Platte River in eastern Nebraska. In both of these studies, however, seed release began as early as May 15, 2 weeks earlier than in the present study. This variability probably reflects differential seed production and ripening as a result of localized climatic and growing conditions. Because of the small size and extremely large number of seeds produced by Populus and Salix, it is very difficult to assess the exact period when viable seed is released. At best, the present data and those reported in the literature (Ware and Penfound 1949, Kapustka 1972) indicate that Populus and Salix release virtually all their viable seed during the early summer months of May, June, and July.

Viability treatments

Seed viability curves for Populus and Salix under the experimental treatment regimes are provided in Figures 3 and 4, respectively. The curves represent total percentage germination over a 2-week period for seeds subsampled from each treatment at intervals of 3, 7, 10, 14, 17, and 34 days. Under all treatment regimes there was a rapid deterioration of seed viability with age. Salix seed remained viable for less than 2 weeks, while Populus seed retained its viability for nearly 3 weeks. These viability periods agree closely with those observed by Moss (1938), Ware and Penfound (1949), and Kapustka (1972).

Although between-treatment differences in seed viability were observed, they were generally small and are probably not statistically significant (see Figures 3 and 4). The largest differences were observed between the high-temperature (20-30°C) and low-temperature (10-15°C) wet treatments. The high-temperature wet treatments had initial (day 3) viabilities close to 100%; but because nearly all the seeds stored under this treatment had germinated by day 3, it was impossible to determine viability for longer periods of storage.

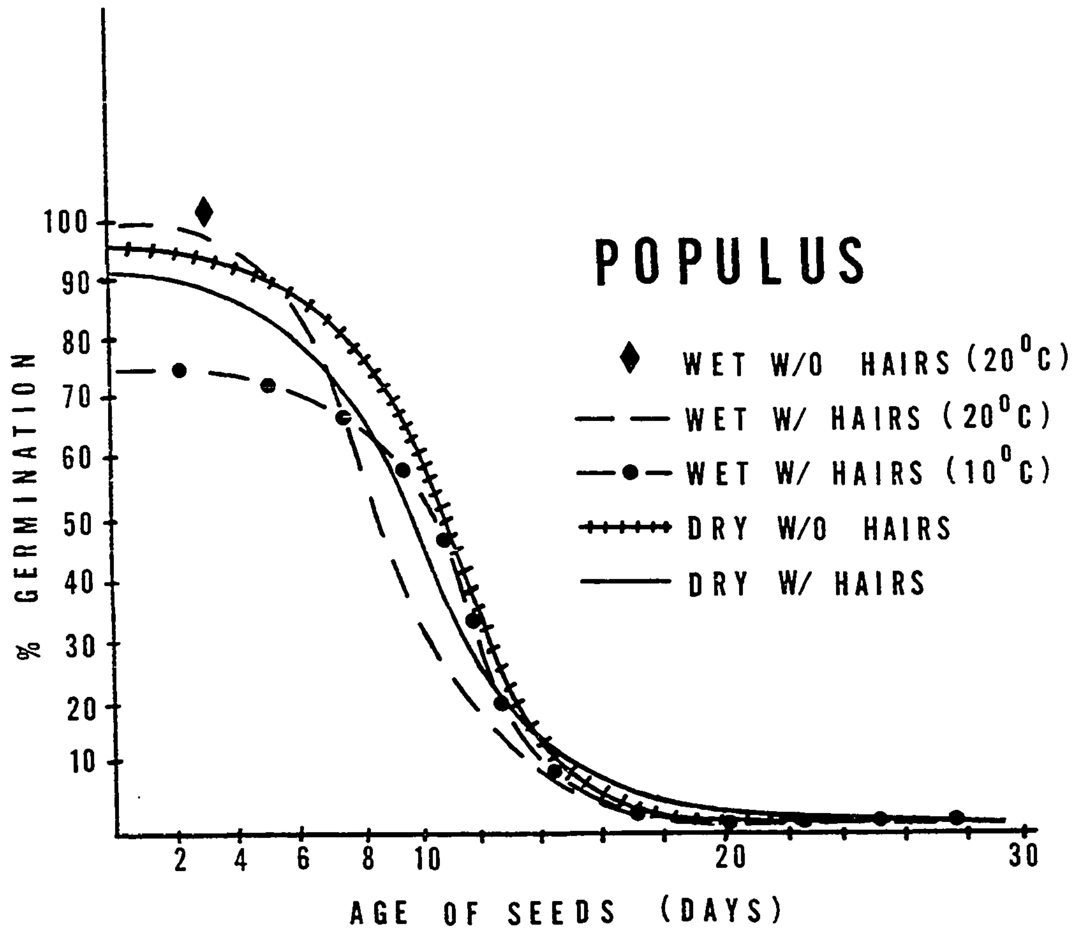


Figure 3. Seed viability curves for Populus under various experimental treatments. The curves represent total percentage germination over a 2-week period for seeds subsampled from each treatment at intervals of 3, 7, 10, 14, 17, and 34 days

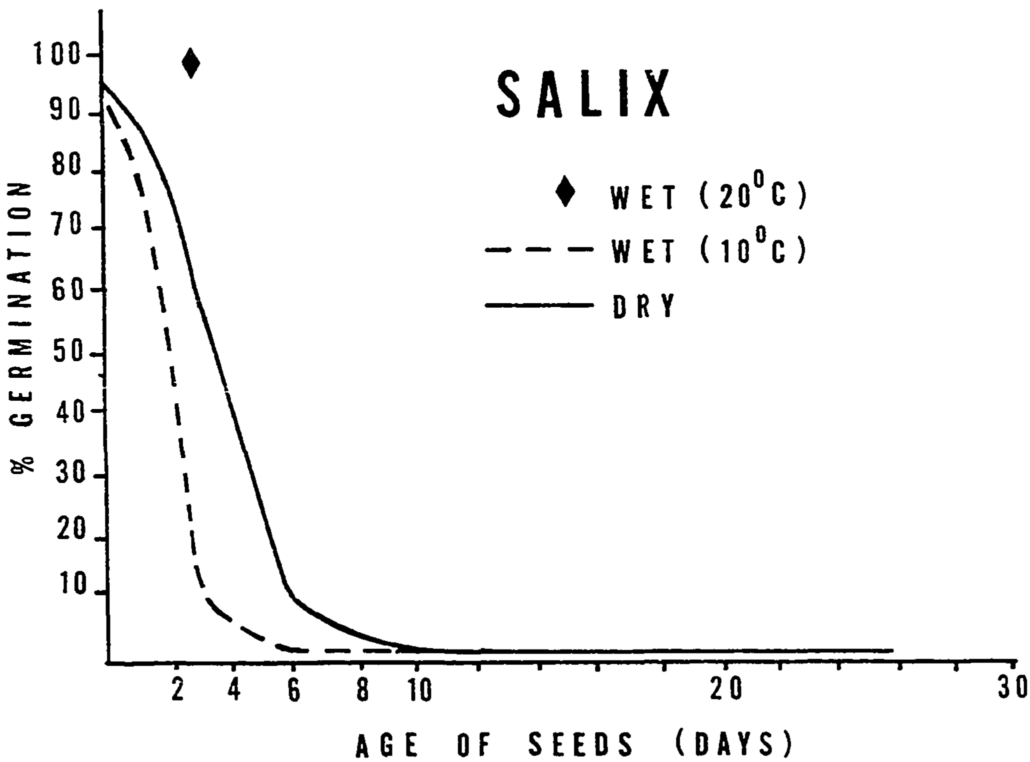


Figure 4. Seed viability curves for Salix under various experimental treatments. The curves represent total percentage germination over a 2-week period for seeds subsampled from each treatment at intervals of 3, 7, 10, 14, 17, and 34 days

Hosner (1957) observed a similar germination response after soaking seeds of Populus and Salix for 4 days in a container of water. The Populus treatment in which the seeds were stored with their pappus hairs, was the only high-temperature wet treatment in which the seeds did not all germinate within 3 days. Viability of seeds under this latter treatment, however, declined more rapidly than for all other Populus treatments (i.e., from 100% at day 3, to 80% at day 7, less than 10% at day 14, and 0% by day 17).

Wet treatments at the lower temperature regime (10-15°C) had much lower initial (day 3) viabilities for Populus (75%) and Salix (30%) than under the higher temperature regime. Because seeds stored under wet conditions at 10-15°C did not all germinate within 3 days, viability determinations could be conducted for a longer period of time than under the higher temperature regime. In general, these viability data indicate that the lower temperature regime slowed both the initial germination response and the decline in viability over time.

The seed viability curves for the dry treatments in both Populus and Salix are intermediate between those for the high and low temperature wet treatments. Although initial (day 3) viability for Salix under the dry treatment was nearly 95%, its viability dropped to less than 10% by day 7, and was only 0% by day 14. Populus viability declined less rapidly under the dry treatment regime, from an initial (day 3) 90-95%, to 80-90% at day 7, 17% at day 14, 3% at day 17, and 0% by day 34.

It was hypothesized that the storage of seeds in enclosed cloth bags with the pappus hairs intact, might increase the humidity in the seed environment. Under high humidity, seed longevity has been found to decrease (Moss 1938). Therefore, by removing the pappus hairs, it was hypothesized that seed longevity should be enhanced over treatments in which the pappus was not removed. There was, however, no apparent difference in the longevity of seeds under treatments with and without the pappus. Instead, there was a slight increase in the initial (3-day) viability of Populus seeds with the pappus removed. These data are inconclusive as to the effects of the pappus on Populus seed viability.

Field Sampling

Seedling monitoring

Combined seedling data for all species are presented in Table 2, for the 17 permanent quadrats in which seedlings were encountered. Although 307 mature seedlings (i.e., at least 1-year old at initiation of the study) were recorded, only 26 new seedlings established in the permanent quadrats. The mature seedlings were found on mudflats (quadrats 6, 8, 35, 41, 42, 45, 57, 60, 62), in upland shrubs (quadrats 63, 64, 68), and in upland woodlands (quadrats 40, 43); while new seedlings established only on mudflats (quadrats 3, 6, 8, 35, 41, 42, 53, 59, 60)(see profiles in Figure 2). Two-thirds of all the mature (223 of 307) and new (17 of 26) seedlings were found in quadrats 41 and 42, adjacent to a narrow river channel at the Mormon Island site. Most new seedling establishment occurred in quadrats where mature seedlings were already present.

Seedling mortality generally occurred on mudflats, between June 17

Table 2. Mature (initial) seedlings, seedling establishment, and seedling mortality in the 17 permanent quadrats in which seedlings were found

Quadrat/Location		Mature Seedlings	New Seedlings	Total Seedlings	Mortality	Survival
3	Jeffrey	0	1	1	0	1
6	Jeffrey	7	2	9	2	7
8	Jeffrey	18	1	19	4	15
35	Mormon	13	1	14	13	1
40	Mormon	3	0	3	0	3
41	Mormon	14	9	23	12	11
42	Mormon	209	8	217	93	124
43	Mormon	2	0	2	0	2
45	Mormon	6	0	6	3	3
53	Audubon	0	1	1	0	1
57	Audubon	12	0	12	4	8
59	Audubon	1	2	3	1	2
60	Audubon	1	1	2	0	2
62	Audubon	10	0	10	10	0
63	Audubon	4	0	4	0	4
64	Audubon	6	0	6	1	5
68	Audubon	1	0	1	0	1

and July 16, when river stage levels were high. All new seedlings established after stage levels declined in mid-July, and most survived until termination of the study on September 30.

Because a large volume of viable *Populus* and *Salix* seed is transported via the river, seedling establishment is probably never limited by seed availability. Mudflat availability, on the other hand, is undoubtedly very crucial to *Populus* and *Salix* seedling establishment. For example, even though the Jeffrey site was located closest to a *Populus* forest (see Figure 2) and thus within close proximity to a potentially large seed source, mudflats were uncommon and seedling establishment was the lowest of the 3 study locations (Table 2). At the Audubon and Mormon sites, forests were less abundant, but mudflats were more extensive and substantially greater seedling establishment occurred (Figure 2 Table 2).

Multiple regression analysis

The multiple regression analysis was designed to determine relationships between the seedling (dependent variables) and environmental (independent variables) parameters. New seedling establishment was the only dependent variable for which statistically significant (.05 level) relationships could be shown with the environmental parameters. The best model (Equation 1), where $\hat{Y}$ is the number of new seedlings, X_1

$$\hat{Y} = -\ 0.29793 + 0.01958X_1 - 0.01128X_2 + 0.03825X_3 \qquad (1)$$

is percentage fine sand, X_2 is percentage silt, and X_3 is critical percentage soil moisture, indicates a direct positive relationship between seedling establishment and percentage fine sand and percentage soil moisture during the critical establishment period and an inverse relationship between percentage silt and seedling establishment. Critical moisture is the most highly significant (F = 4.79, P = 0.0322) parameter in the model (Equation 1). Although this was the best regression model (Equation 1) found to predict seedling establishment, it does not include any of the water regime parameters investigated during the study.

When water regime parameters were added to the equation, the best regression model predicting seedling establishment was only significant at about the 10% level (P = 0.1015). The model (Equation 2) indicates

$$(2) \quad \hat{Y} = -\ 1.10301 + 0.00701X_1 + 0.02714X_2 + 0.03749X_3 + 0.00788X_4 + 0.03994X_5$$

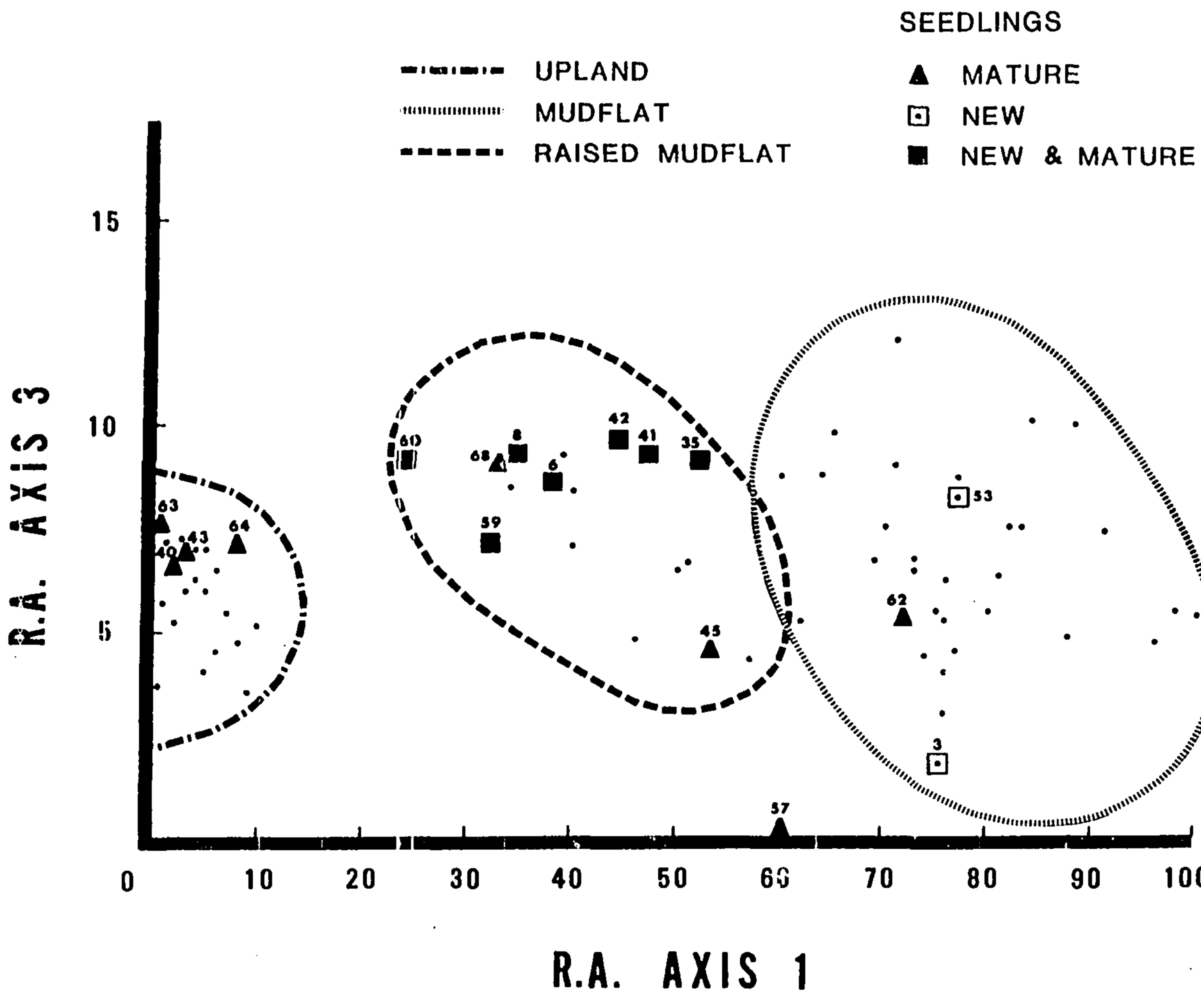
a direct positive relationship between seedling establishment ($\hat{Y}$) and percentage sand (X_1), percentage fine sand (X_2), critical percentage soil moisture (X_3), days of exposure (X_4), and average water depth (cm) during flooding (X_5). Again, as in the first model (Equation 1), percentage soil moisture during the critical establishment period was the most highly significant (F = 4.46, P = 0.0385) parameter in this model (Equation 2). Although the significance levels for these models are reasonable for biological data, the models themselves are based on the establishment of only 26 seedlings during only one growing season. Because of this small sample size and short sampling period, these regressions may not be entirely representative of conditions under which seedling establishment occurs along the Platte.

Reciprocal averaging analysis

While the regression analysis was used to model the environmental conditions under which seedling establishment took place, the reciprocal averaging technique was designed to identify groups of quadrats with similar environmental characteristics and then investigate the relationships between seedling and environmental parameters in each group. The reciprocal averaging ordination of the 71 permanent quadrats provided in Figure 5, is based on the 12 environmental parameters. The ordination represents an indirect moisture gradient from quadrats on dry uplands (left) to quadrats which were constantly flooded (right). Based on their positions in the ordination, the quadrats were divided into 3 broad habitat types: upland, raised mudflat, and mudflat. The uplands formed a very distinct group, but it was necessary to make a judgement distinction between raised mudflats and mudflats. Quadrat 57 was used to divide the groups; quadrats to the left were considered raised mudflats, quadrats to the right (including quadrat 57) were considered mudflats (see Figure 5).

Quadrats with new, mature, and both new and mature seedlings have been indicated in Figure 5. The distribution of seedlings along the

Figure 5. Reciprocal averaging (R.A.) ordination (Axis 1 vs Axis 3) of the 71 permanent quadrats as based on the 12 environmental parameters. The permanent quadrats are arranged in the ordination according to an indirect moisture gradient from upland to raised mudflats to mudflat sites. Quadrats with mature seedlings (i.e., at least one-year old at the initiation of the study), new seedlings, and both mature and new seedlings are indicated by symbols ▲, ⊡, and ■, respectively and by quadrat numbers


UPLAND
MUDFLAT
RAISED MUDFLAT
SEEDLINGS
MATURE
NEW
NEW & MATURE
R.A. AXIS 3
R.A. AXIS 1
0
10
20
30
40
50
60
70
80
90
100
5
10
15

moisture gradient confirms previous observations (Table 2, Figure 2) that mature seedlings were found on both upland and mudflat sites, but new seedlings established only on mudflats. The mature seedlings on the uplands probably established from resprouting of rootstocks or during periods of high water when these sites were inundated. The RA ordination also indicates that among the mudflat sites, the raised mudflats supported the greatest number of new seedlings.

The 71 permanent quadrats were grouped into 5 types of sites (Table 3), based on the 3 broad habitat types (i.e., upland, raised mudflat, mudflat) and the presence of new seedlings. From left to right in the ordination these 5 groups are: upland (U), raised mudflat (R), raised mudflat with new seedling establishment (RS), mudflat (M), and mudflat with new seedling establishment (MS).

Analysis of variance

Means for all the seedling and environmental parameters in each of the 5 types of sites are presented in Table 3. Analysis of variance indicated that there were significant differences (.05 level) in the means for all parameters between the 5 types of sites. Within each parameter, means underscored by the same letter are not significantly different (.05 level) from one another, as determined by Duncan's Multiple Range Test (Table 3).

Because the majority of seedling establishment and seedling mortality occurred at RS sites (Table 3), comparisons were made between the environmental conditions at these sites and those at all other sites. In many instances, the environmental conditions at the RS

Table 3. Means of the environmental and seedling parameters for quadrats included in the upland (U), raised mudflats (R), raised mudflat with new seedlings (RS), mudflat (M), and mudflat with new seedlings (MS) sites. Within each parameter, means with the same letter are not significantly different (.05 level)

Parameters	SITES U	R	RS	M	MS
SOIL MOISTURE					
Average (%)	21.8 a	22.9 a	28.4 a	12.3 b	10.0 b
Critical (%)	19.8 a	20.3 a	28.0 a	11.8 b	9.1 b
Minimum (%)	10.2 b	10.2 b	17.5 a	7.8 b	6.3 b
SOIL TEXTURE					
Coarse Gravel (%)	1.1 c	2.0 c	0.7 c	10.6 b	25.0 a
Gravel (%)	1.2 c	6.5 b	2.9 bc	15.3 a	16.5 a
Sand (%)	53.5 b	61.8 ab	62.6 ab	65.2 a	51.5 b
Fine Sand (%)	15.2 a	11.1 ab	14.6 a	4.4 b	5.9 ab

Silt (%)	29.0	18.7	19.1	4.5	1.0
	a	b	b	c	c
WATER REGIME					
Exposure (days)	77.0	75.5	74.2	33.6	49.7
	b	b	b	a	ab
Average depth (cm)	0.0	2.4	3.6	15.6	9.5
	c	c	bc	a	ab
Total maximum (cm)	0.0	30.7	26.1	73.5	86.0
	c	b	b	a	a
Critical maximum (cm)	0.0	3.2	5.3	36.5	39.0
	b	b	b	a	a
SEEDLINGS					
Mature (initial)	0.7	0.7	37.6	0.7	0.0
	b	b	a	b	b
New establishment	0.0	0.0	3.4	0.0	1.0
	b	b	a	b	b
Total (mature + new)	0.7	0.7	41.0	0.7	1.0
	b	b	a	b	b
Mortality	0.1	0.3	17.9	0.5	0.0
	b	b	a	b	b

sites did not significantly differ (.05 level) from those which characterized the U and R sites. For instance, average percentage soil moisture, critical percentage soil moisture, percentage coarse gravel, percentage sand, percentage fine sand, days of exposure, average water depth during flooding, and critical maximum water depth did not differ significantly among the RS, R, and U sites. Even though exposure (74.2 days), average water depth (3.6 cm), and critical maximum water depth (5.3 cm) at the RS sites did not significantly differ from the values for these parameters at the U (77.0 days, 0.0 cm, and 0.0 cm respectively) sites, they differed fundamentally because the U sites were never flooded. The values for total maximum water depth in the RS (26.1 cm) and R (30.7 cm) sites were substantially greater than in the U sites (0.0 cm). These differences between the U sites and the R and RS sites were statistically significant. The similarity of the water regime parameters for the R and RS sites was not surprising, since these sites are located at approximately the same elevation on the floodplain (raised mudflats) and were separated only on the basis of the presence of new seedlings.

Soil texture in the RS sites did not differ statistically from that in the R sites. The U sites, however, had a significantly greater percentage of silt (29.0%) than did either the R (18.7%) or RS (19.1%) sites. In addition, the percentage gravel in the R sites (6.5%) was significantly greater than that in the U sites (1.2%), but there was no significant difference between the percentage gravel in the RS sites

(2.9%) and that in either the R or the U sites.

All 3 soil moisture parameters were highest in the RS sites, intermediate in the R sites, and lowest in the U sites. Minimum percentage soil moisture, however, was the only soil moisture parameter which was significantly greater in the RS (17.5%) than in the R (10.2%) or U (10.2%) sites. Since soil moisture is critical for the survival of embryonic Populus and Salix seedlings (Moss 1938), this statistical difference in minimum percentage soil moisture is probably responsible for the statistically greater seedling establishment and numbers of mature seedlings found in the RS sites.

Although there were many similarities in the environmental characteristics of the RS, R, and U sites, there were major differences in the environmental characteristics of the RS and the M and MS sites. In general, the M and MS sites are characterized by shorter periods of substrate exposure, greater water depths, a greater percentage of coarse sediments, and a lower percentage soil moisture than are the RS sites.

Average, total maximum, and critical maximum water depths in the M sites (15.6 cm, 73.5 cm, and 36.5 cm respectively) were significantly greater than in the RS sites (3.6 cm, 26.1 cm, and 5.3 cm respectively). In the MS sites, total maximum and critical maximum water depths (86.0 cm, and 39.0 cm respectively) were also significantly greater than those in the RS sites. Average water depth, on the other hand, was greater in the MS sites (9.5 cm) than in the RS sites (3.6 cm), but the difference was not significant. Although exposure at the M and MS sites

(33.6 days and 49.7 days respectively) was much less frequent than at the RS sites (74.2 days), only the difference between the RS and the M sites was statistically significant.

Percentage sand and percentage fine sand were the only statistically similar soil texture parameters in the RS, M and MS sites. Percentage coarse gravel and percentage gravel in the M (10.6% and 15.3% respectively) and MS (25.0% and 16.5% respectively) sites were significantly greater than in the RS sites (0.7% and 2.9% respectively), while percentage silt in the M (4.5%) and MS (1.0%) sites was significantly less than that in the RS sites (19.1%).

Values for all the soil moisture parameters were significantly less in the M and MS sites than in the RS sites. In fact, the values for average, critical, and minimum soil moisture in the M (12.3%, 11.8%, and 7.8% respectively) and the MS (10.0%, 9.1%, and 6.3% respectively) sites were less than half the values for these parameters in the RS sites (28.4%, 28.0%, and 17.5% respectively). Undoubtedly, the relatively low percentage soil moisture values in the M and MS sites is a reflection of the high percentage coarse gravel and gravel at these sites and the relatively poor water-holding capacity of these sediments.

These comparisons between the RS and the U, R, M, and MS sites indicate that the relatively high percentage soil moisture, fine textured soils, long period of substrate exposure, and moderate water depth during flooding, make the RS sites particularly favorable for seed germination and seedling establishment. The number of mature seedlings in the RS sites was also significantly greater than in all other types of sites, suggesting that the RS sites have served as successful habitats for seed germination and establishment in the past. Although mature seedling mortality was significantly greater in the RS sites than elsewhere, this is most likely the result of larger seedling numbers in the RS sites rather than actual differences in mortality rates. The establishment of seedlings in the MS sites at 2 separate locations (quadrats 3 and 53) is more difficult to explain than is seedling establishment at the RS sites. Although the low percentage soil moisture; the coarse, porous sediments; and the relatively short exposure period at the MS sites are not particularly favorable conditions for seedling establishment, the greater water depth and more frequent flooding at these sites may compensate for the poor moisture-retaining capacity of the soils and provide an adequate moisture regime for seed germination and seedling establishment. The lack of mature seedlings and the relatively deep water regime at the MS sites suggest that although seedling establishment can occur, the probability of seedling survival is probably quite low.

Management Implications

The regression and reciprocal averaging analyses have quantitatively documented that seedling establishment of Populus and Salix occurs primarily on sites with high percentage soil moisture, fine textured soils (i.e., sand and fine sand), and an extensive substrate exposure during the time when viable seed is available. Seed germination and viability studies indicate that viable seeds are released from mid-May to mid-July, but that Populus seeds remain viable for only 3 weeks and Salix seeds remain vaible for less than 2 weeks. Under these circumstances, viable seed should be available only during the seed-release period (mid-May to mid-July) and perhaps for a month or so following the seed-release period (i.e., until the end of August). For seed germination and seedling establishment to occur, mudflats with high percentage soil moisture must be exposed for at least 1-2 weeks during this short, mid-May to August viability period.

Once seedlings establish, major floods and scouring action are probably necessary to remove them. Field observations by Shull (1944) and Dietz (1952) indicated that Populus and Salix seedlings and saplings were quite resistant to the effects of flooding. Hosner (1958) demonstrated experimentally that 3-inch (7.6-cm) seedlings of Populus could survive 16 days of inundation, but that recovery was very slow. Salix seedlings under the same treatment were able to survive 32 days and recovered very rapidly. Flooding experiments conducted with Platte River seedlings (Currier, unpublished) indicate that somewhat taller (15-cm) Populus seedlings were able to survive 30 days of inundation and recovered completely following the experiments. The 15-cm height seedlings were chosen for the latter study because they were representative of seedlings that established on Platte River mudflats in July and

August of 1978, when the substrate was exposed for 4-5 weeks during the seed viability period. A similar, but later exposure of the substrate occurred in August and September 1979. If this water regime is typical of most years along the Platte, seedlings establishing in mid-summer would probably have ample opportunity to develop to a height of 15 cm or more. Manipulation of river stage levels during the fall, winter, or spring when demands on river water for irrigation are minimal, would undoubtedly remove some of the seedlings that established during the previous summer, but this technique would probably not be very effective at removing seedlings with a stature of 15 cm or more.

An alternative approach to the control of woody invasion on the Platte would be to prevent seed germination and seedling establishment altogether. This could be accomplished either by raising river stage levels during the seed viability period (mid-May to August), so that mudflats would never be exposed, or allowing the channel to completely dry-out, creating a sub-optimal moisture regime for seedling establishment. During the present study, seedling establishment occurred primarily on raised mudflats which, on the average, were exposed at stage levels (relative to the Overton gaging station) less than 2.3 ± 0.3 feet (0.70 ± 0.09 meters). Stage levels averaged 2.7 feet (0.83 meters) during the early portion of the summer (June 10 to July 16) and thus were adequate to prevent seedling establishment. From July 16 to September 30, however, stage levels averaged only 1.53 feet (0.47 meters) and a substantial number of mudflats were exposed and seedling establishment occurred. Mean stage levels would have to be kept above 2.6 feet (0.79 meters) during May, June, July, and August when viable Populus and Salix seeds are present along the Platte, to successfully eliminate seedling establishment. The manipulation of the Platte to produce such a water regime (i.e., nearly double the stage levels which occur normally in July and August) is not very feasible since there is probably not enough water in the Platte to sustain a stage level of 2.6 feet (0.79 meters) and still meet the high demands for irrigation water during June, July, and August.

A complete drawdown during the viability period is also probably not a very feasible technique for controlling woody seedling establishment. Such a water manipulation could have detrimental effects on wildlife along the Platte and probably would not be aesthetically pleasing to the local property owners. In addition, there is even some doubt that a complete drawdown could be implemented, since there would be no way to keep rainfall and surface runoff from entering the Platte River channel.

Alternatively, it might be possible to reduce seedling establishment by altering flow patterns in the river to increase the percentage of gravel and coarse gravel in the substrate. Although seedling establishment is apparently hindered on coarse-textured substrates such as those found in the mudflat sites 3 and 53, the presence of new seedlings at these sites indicates that such substrate manipulations may not be entirely effective in inhibiting seedling establishment.

Soil moisture, rather than soil texture is undoubtedly much more limiting to the establishment of *Populus* and *Salix* seedlings.

Chemical and mechanical techniques for the removal of seedlings are probably the most feasible means of controlling woody invasion on Platte River sandbars and mudflats. These management techniques, however, are both costly and labor intensive and would have to be used repeatedly to insure successful control of woody encroachment ment. The effectiveness of specific chemical and mechanical techniques must be evaluated before full-scale management recommendations can be made.

This study deals solely with the autecology of *Populus* and *Salix* and the investigation of management techniques to control their establishment on the Platte River floodplain. There is no assurance that management techniques which inhibit *Populus* and *Salix* establishment will also control the encroachment of other woody species such as *Amorpha fruticosa*, *Cornus stolonifera*, *Cornus drummondii*, *Fraxinus pennsylvanica*, and *Ulmus americana*. Because little is known about the germination and establishment requirements of these latter species, their autecology must be investigated before a definitive management plan to inhibit woody encroachment can be developed.

SUMMARY

1. Viable seed was released from *Populus* and *Salix* trees from early June to mid-July.

2. Seed viability under both wet and dry storage treatments declined rapidly with age. *Populus* viability lasted nearly 3 weeks, but *Salix* remained viable for less than 2 weeks.

3. The 26 seedlings which established during the study developed primarily on raised mudflats in quadrats in which mature seedlings were already present.

4. Multiple regression analysis indicated a direct relationship between seedling establishment and percentage fine sand and critical soil moisture and an inverse relationship between seedling establishment and percentage silt.

5. When water regime parameters were included in the regression equation a direct relationship was found between seedling establishment and percentage sand, percentage fine sand, critical percentage soil moisture, days of substrate exposure, and average water depth during flooding.

6. The 71 permanent quadrats were divided among upland (U), raised mudflat (R), raised mudflat with new seedlings (RS), mudflat (M), and mudflat with new seedlings (MS) types of sites, based on their positions along a moisture gradient in the reciprocal averaging ordination and on the presence of new seedlings.

7. Analysis of variance indicated that the means for all the environmental and seedling parameters, except percentage sand, were significantly different (.05 level) among the 5 types of sites.
8. Statistical comparisons (ANOVA followed by Duncan's Multiple Range Test) between the RS sites where the majority of new and mature seedlings were found and all other sites, indicated that high percentage soil moisture, fine textured soils, moderate water depth during flooding, and relatively long period of substrate exposure in the RS sites are the environmental parameters favoring seed germination and seedling establishment.
9. Mechanical or chemical techniques are probably the most feasible means for removing woody plants which establish along the Platte, since fall, winter, and spring flooding may not be effective against 15-cm or taller seedlings, and mid-summer flooding and drawdown techniques to inhibit seed germination and seedling establishment would conflict with demands for irrigation water and could be detrimental to some wildlife species.
10. Because the seedling establishment requirements of *Amorpha*, *Cornus*, *Fraxinus*, *Ulmus*, and other woody species which invade the Platte River floodplain are virtually unknown, their autecology must be investigated before a definitive management plan to inhibit woody encroachment can be developed.

LITERATURE CITED

Dietz, R. A. 1952. Evolution of a gravel bar. Annals Missouri Bot. Gard. 39:249-254.

Everitt, B. L. 1968. Use of the cottonwood in an investigation of the recent history of a floodplain. Am. J. Sci. 266:417-439.

Frith, C. R. 1974. The ecology of the Platte River as related to sandhill cranes and other waterfowl in south central Nebraska. Unpublished M.S. Thesis. Kearney State College, Kearney, Nebraska. 115 pp.

Helwig, J. T., and K. A. Council. 1979. The SAS user's guide. SAS Institute Inc., Raleigh, North Carolina. 495 pp.

Hill, M. O. 1973. Reciprocal averaging: An eigenvector method of ordination. J. Ecol. 61:237-249.

Horton, J. S., F. C. Mounts, J. M. Kraft. 1960. Seed germination and seedling establishment of phreatophyte species. USDA Forest Service, Rocky Mountain Forest and Range Expt. Stat, Station Paper No. 48. 26 pp.

Hosner, J. F. 1957. Effects of water upon the seed germination of bottomland trees. For. Sci. 3:67-70.

Hosner, J. F. 1958. The effects of complete inundation upon seedlings of six bottomland tree species. Ecology 39:371-373.

Kapustka, L. A. 1972. Germination and establishment of <u>Populus deltoides</u> in eastern Nebraska. Unpublished M.S. Thesis. Univ. of Nebraska, Lincoln, Nebraska. 72 pp.

McLeod, K. W., and J. K. McPherson. 1973. Factors limiting the distribution of <u>Salix nigra</u>. Bull. Torr. Bot. Club. 100:102-110.

McVaugh, R. 1947. Establishment of vegetation on sandflats along the Hudson River, New York. Ecology 28:189-194.

Moss, E. H. 1938. Longevity of seed and establishment of seedlings in species of <u>Populus</u>. Bot. Gaz. 99:529-542.

Shull, C. A. 1922. The formation of a new island in the Mississippi River. Ecology 3:202-206.

Shull, C. A. 1944. Observations of general vegetational changes on a river island in the Mississippi River. Am. Midl. Nat. 32:771-776.

Ware, G. H., and W. T. Penfound. 1949. The vegetation of the lower levels of the floodplain of the South Canadian River in central Oklahoma. Ecology 30:478-484.

Williams, G. P. 1978. The case of the shrinking channels - The North Platte and Platte Rivers in Nebraska. Geological Survey Circular No. 781. 48 pp.

Wilson, R. E. 1970. Succession in stands of Populus deltoides along the Missouri River in southeastern South Dakota. Am. Midl. Nat. 83:330-342.

PART III. ORIGIN AND VEGETATION DEVELOPMENT OF PLATTE RIVER FOREST COMMUNITIES

INTRODUCTION

Since 1909, climatic conditions in central and western Nebraska have remained fairly uniform, but peak and mean annual discharge in the North Platte and Platte rivers has decreased quite significantly (Williams 1978). In many cases, the decline in peak and mean annual discharge corresponds with the development of dams and reservoirs in Wyoming (Pathfinder 1909, Guernsey 1927, Alcova 1938, Seminoe 1939, Glendo 1957) and in Nebraska (McConaughy 1941). These reductions in annual discharge have decreased scouring and shifting of the streambed alluvium and have allowed extensive forest development on the bottomlands of the North Platte and Platte rivers during the past 40 or more years (Frith 1974).

Forest development on the river floodplain has resulted in the deterioration of sandhill crane habitat (Frith 1974). Each spring 200,000 sandhill cranes pass through the Platte River valley in central and western Nebraska en route to their breeding grounds in Canada and Alaska. At night, the cranes roost on shallowly flooded unvegetated sandbars and mudflats in the middle of the river channel. Expansion of woody vegetation on these sandbars and mudflats has caused a serious degredation of the sandhill crane habitat along the Platte and has tended to concentrate the crane population into progressively smaller segments of the river channel.

This study was initiated to investigate the origin and development of woody vegetation on the Platte River floodplain and to provide information useful in developing management plans to arrest further woody plant encroachment. Specifically, the study objectives were: 1) to document the age structure and period of forest development on the floodplain; 2) to investigate the effects of hydrological conditions on the radial growth of Populus, Salix, and Juniperus; 3) to examine soil-vegetation relationships to establish the site preferences of the major arboreal species; and 4) to devise an idealized vegetation development scheme based on contemporary plant communities, the age structure of the forests, and the site preferences of the major arboreal species.

History of Forest Development

Until 12,000 years ago, boreal spruce forests extended from the eastern United States to the foothills of the Rocky Mountains, dominating the vegetation of the Great Plains (Wright 1970). During post-Wisconsin times, a climatic warming trend resulted in the demise of this boreal forest. In the eastern United States, deciduous forests became the dominant vegetation, while treeless grasslands developed on the western plains. A variety of factors, including unhindered prairie fires and an arid climate have been proposed to explain why there has not been widespread invasion of forest species into the Great Plains during post-glacial times (Borchert 1950, Bryson 1966, Wells 1970). Although arboreal species have generally been unsuccessful invaders on upland prairie sites, they have apparently been able to migrate westward along the major river courses in the plains (Bessey 1899, Kellogg 1905, Gleason 1922).

Along the Platte River, initial (pre-1909) forest advancement was confined, for the most part, to a narrow strip along the river channel, because the shifting streambed and uncontrolled flooding inhibited the invasion of forest species on the wide alluvial bottomland (Kellogg 1905, Gleason 1922). Kellogg (1905) noted that over long stretches of the Platte, timber growth was either "wholly absent" or consisted of only scattered Populus deltoides (cottonwood), Salix rigida (diamond willow), and Salix amygdaloides (peach-leaf willow). Juniperus virginiana (red cedar) was present in localized areas along the Platte, but this species was most abundant along bluffs in western Nebraska. Kellogg (1905) suggested that Juniperus migrated towards the east from the foothills of the Rockies at the same time that deciduous species were migrating westward. Ulmus americana (American elm), Fraxinus pennsylvanica (green ash), Celtis occidentalis (hackberry), and Acer negundo (boxelder) were also present in the advancing eastern forests, but these latter species were generally only minor components of the forest vegetation (Kellogg 1905, Rand 1973).

The decline in river stage levels after 1909 allowed forests to develop on the broad alluvial bottomlands, as well as along the riverbank. Although the advancing forests provided a sufficient seed source for the establishment of the dominant arboreal (Populus, Salix, Juniperus, Acer, Ulmus, Celtis, Fraxinus) and shrub (Salix exigua (coyote willow), Cornus drummondii (rough-leaf dogwood), Amorpha fruticosa (indigo bush), Cornus stolonifera (red-osier dogwood)) species, the planting of shelterbelts also provided abundant local sources of seed from a variety of introduced arboreal species. The Timber Culture Act of 1873 encouraged the planting of such shelterbelts. Homesteaders who planted ten or more acres of shelterbelt trees were entitled to an additional free section of land (Albertson and Weaver 1945).

Populus and Juniperus were the major arboreal species planted in shelterbelts, but virtually all the arboreal species which have become established on the Platte River floodplain, including Elaeagnus angustifolia (Russian olive), Fraxinus, Ulmus americana, Ulmus rubra (slippery elm), Morus rubra (red mulberry), Acer negundo, Acer saccharinum (silver maple), Celtis, Ulmus parvifolia (Chinese elm), and Ulmus pumila (Siberian elm) have also been planted in shelterbelts (Albertson and Weaver 1945, Read 1958). Celtis, Populus, Fraxinus, Acer, and Ulmus have airborne seeds which could easily have been blown to the river floodplain from shelterbelts. Birds have probably been responsible for the transport of seeds from Juniperus, Elaeagnus, and Morus (Kellogg 1905, Albertson and Weaver 1945, McVaugh 1957).

METHODS

In 1978 and 1979 vegetation surveys were conducted along 44 North-South transect lines across the North Platte and Platte rivers between Lake McConaughy and Chapman, Nebraska (see Part I). An inventory of all the herbaceous, shrub, and arboreal species was conducted by estimating cover for all species in 571 stands (5 m x 20 m) located at intervals of 150 m along the transect lines. The study area was divided initially into 406 one-half mile segments and numbered in sequence from East to West, beginning at Chapman (segment 1) and ending just east of Lake McConaughy (segment 406)(see Part I, Figure 2).

Most forest stands on the floodplain seemed to be of a uniform age class, suggesting that widespread forest development occurred following a change in hydrological conditions. Increment tree cores were taken from trees located along the vegetation survey transects to determine when widespread forest establishment occurred and to correlate the time of establishment with hydrological events. *Populus* trees were cored most frequently (260 trees), but 71 *Juniperus*, 17 *Salix*, and individual trees of *Celtis*, *Catalpa*, and *Elaeagnus* were also cored. Trees representative of the uniform age class in each forest stand were selected for coring. The oldest trees were not cored because they occurred primarily as isolated trees on raised islands or along the riverbank, and most likely established under a different set of hydrological conditions than the uniform age class forests. Increment tree cores were mounted on wooden moldings, sanded, and aged by counting annual rings.

Comparisons of radial growth in _Populus_ were made between a period when mean annual discharge in the Platte was relatively high (1920-29) and a period when mean annual discharge was relatively low (1930-39). In addition, comparisons in radial growth were made for _Populus_, _Salix_, and _Juniperus_ between the 1967-70 period when mean annual discharge was relatively low, and the 1971-74 period when mean annual discharge was relatively high. Comparisons were made by measuring the total radial growth (mm) in each of the time periods and using a t-test to identify significant differences in growth rates. In each case, radial growth in the later period was corrected for the inherent decline in radial growth due to senescence. These corrected radial growth measurements were used in the t-test analysis. Radial growth was adjusted for senescence following the technique described by Johnson _et al._ (1976), in which linear regression equations were computed for growth vs tree age midpoints (i.e., age during 1925 and 1935 in the 1920-29/1930-39 comparison, and age in 1968 and in 1972 for the 1967-70/1971-74 comparisons). In each comparison, regression equations were determined for each species during both the early and late time periods. The equation with the greater slope was used to adjust growth rates. This procedure probably more than compensated for the loss in radial growth due to senescence.

Soils from 37 locations throughout the study area were classified following Elder (1969). The soils were sampled in areas that represented the major forest, lowland meadow, upland meadow, shrub, and mudflat vegetation types along the Platte River floodplain. Vegetation and soil types were compared to investigate trends in the site preferences of the major arboreal species.

RESULTS AND DISCUSSION

Vegetation Survey

The vegetation inventory and classification was discussed in detail in Part I. Twelve major vegetation types were distinguished along the Platte and North Platte rivers. Herbaceous communities included annual and perennial mudflats, lowland grasslands, upland grasslands, and marshes. Shrub communities consisted of wetland shrubs along the river channel (dominated by Salix exigua and Amorpha fruticosa) and upland shrubs in forest openings (dominated by Cornus drummondii and Amorpha). Forest communities included Populus-Salix wetlands, Populus-Elaeagnus, Populus-meadow, Populus-Juniperus, and mixed hardwood shrub vegetation types. The predominant forest vegetation along the Platte consisted of Populus with an understory of Juniperus and Cornus. In some areas, Elaeagnus and Juniperus formed dense, nearly monospecific stands. In other areas, intensive grazing and constant alluvial overwash have resulted in Populus forests with an understory of meadow species. In a few areas, where Populus is not present, Celtis, Fraxinus, Ulmus americana, and Morus dominate the forest canopy.

Precipitation and Discharge

Mean annual discharge (m^3/sec) (after Williams 1978) and deviations from long-term average annual precipitation (mm) (U.S. climatological data) are presented for the North Platte River in Figure 1 and for the Platte River in Figure 2. Maximum (peak) annual discharge, number of days of no flow, and additional precipitation data are provided in Appendix E.

In the western, more arid Hershey/North Platte area, average annual precipitation was only 514 mm, while in the Kearney/Overton area, average annual precipitation was 624 mm. During the 1910-1979 period, there was no discernible long-term change in the precipitation patterns for western (North Platte) and central (Kearney) Nebraska. As Williams (1978) noted, long-term changes in hydrology of the North Platte and Platte rivers are therefore not the result of fluctuations in climate, but rather the result of water level manipulation by man.

On the average, mean discharge in the North Platte River (42.63 $\pm$ 33.7 m^3/sec) was considerably less than in the Platte River (56.28 $\pm$ 37.9 m^3/sec) between 1910 and 1977. In both rivers, peak and mean annual discharge have declined since 1909, although the most substantial declines have occurred since 1930 (Figures 1 and 2). Average pre-1930 mean discharge levels at North Platte (86.0 $\pm$ 25.9 m^3/sec) and Overton (107.1 $\pm$ 32.5 m^3/sec) were nearly 3 times the average post-1930 mean discharge levels at these locations (24.6 $\pm$ 14.8 m^3/sec, and 40.1 $\pm$ 21.3 m^3/sec respectively). During the post-1930 period, discharge was relatively uniform, except in 1971, 1973, and 1974,

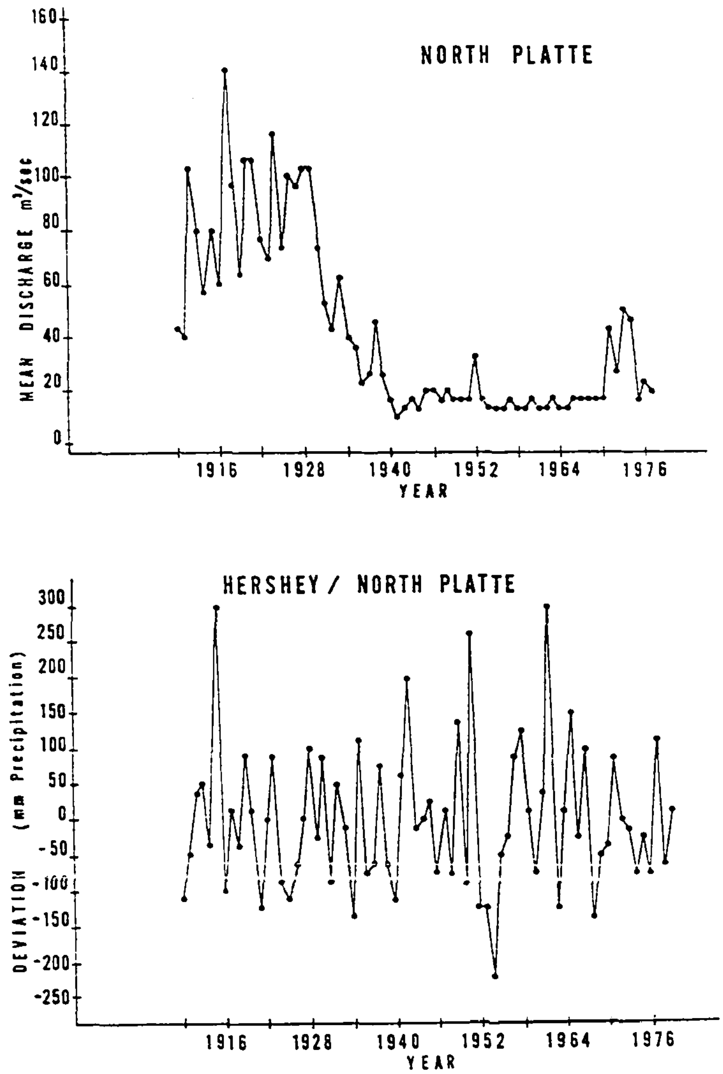


Figure 1. Mean annual discharge (after Williams 1978) and deviations from long term average annual precipitation along the North Platte River (North Platte station) in western Nebraska since 1910

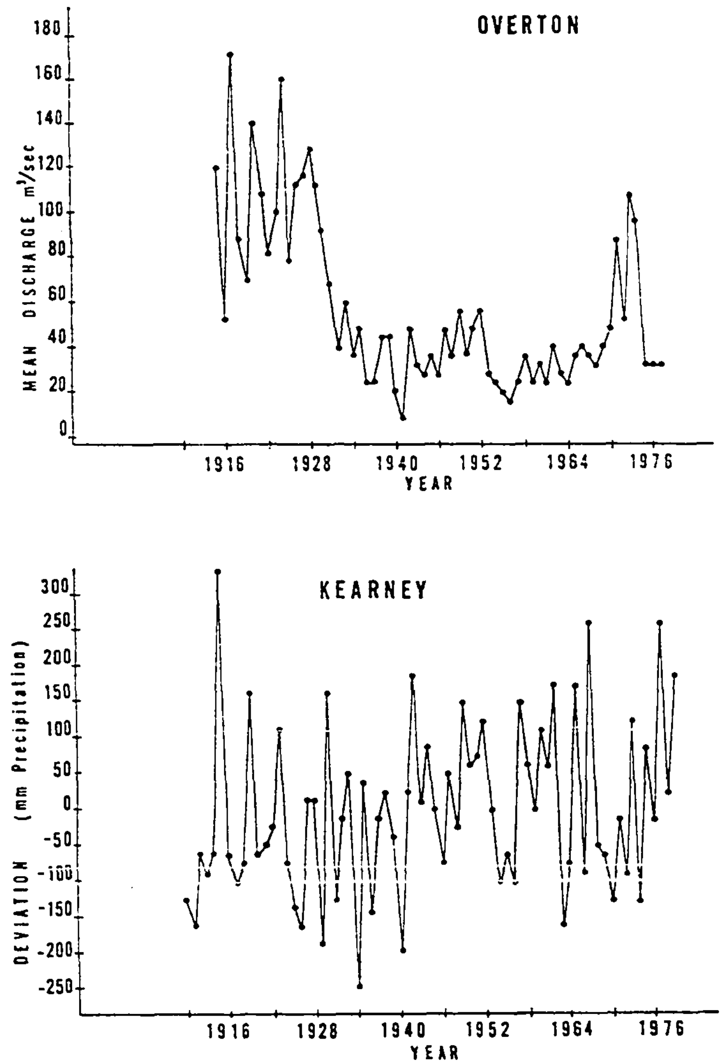


Figure 2. Mean annual discharge (after Williams 1978) and deviations from long term average annual precipitation along the Platte River (Overton station) in central Nebraska since 1910

when there were major increases in both peak and mean annual discharge as a result of unusually large inflows into the North Platte and Platte from snowmelt in the Rocky Mountains (Williams 1978).

Forest Age

The average and earliest ages of Populus, Juniperus, Salix, and other minor species were determined by counting annual growth rings on increment cores taken from trees growing along the 44 transect lines sampled during the vegetation survey (Table 1). Complete age and DBH (diameter at breast height) data for all the trees cored during the study are presented in Appendix F. Because of the high frequency of "false" annual rings in Populus and Salix and the difficulties in discerning initial growth rings in all species, these age estimates are probably only within ± 5 years of the actual dates of establishment (R. Q. Landers, personal communication).

False annual rings occur when there are wide fluctuations in the water regime during a single growing season. For example, a tree may begin to lay down an annual ring in early spring when the water regime is quite adequate, but during late spring, growth may cease entirely if the moisture regime becomes suboptimal. If an adequate water regime develops again, growth may resume until the end of the growing season. Because growth rings are formed by the changes in wood density as tree growth slows (late wood), stops, and then resumes (spring wood), the fluctuating water sequence described

Table 1. Average and earliest years of establishment of *Populus*, *Juniperus*, *Salix*, and other trees along the Platte River, as determined by increment tree cores. Tree age (relative to 1979) is provided in parentheses following each year

LOCATION		POPULUS				JUNIPERUS				SALIX				OTHER			
		AVERAGE		EARLIEST		AVERAGE		EARLIEST		AVERAGE		EARLIEST		AVERAGE		EARLIEST	
Feltz	402-01	1945	(34)	1940	(39)	1954	(25)	1941	(38)	--	--	--	--	--	--	--	--
Feltz	402-02	1929	(50)	1923	(56)	--	--	--	--	--	--	--	--	--	--	--	--
Buckhorn	391-03	1941	(38)	1939	(40)	1966	(13)	1963	(16)	1954	(25)	1954	(25)	--	--	--	--
Boyle	337-01	1937	(42)	1934	(45)	--	--	--	--	1934	(45)	1934	(45)	--	--	--	--
Boyle	337-03	1937	(42)	1930	(49)	--	--	--	--	1934	(45)	1934	(45)	1952	(27)	1952	(27)[a]
Summers	335-11	1919	(60)	1918	(61)	--	--	--	--	--	--	--	--	--	--	--	--
Star	327-10	1939	(40)	1933	(46)	--	--	--	--	1952	(27)	1952	(27)	--	--	--	--
Applegate	320-02	1930	(49)	1923	(56)	--	--	--	--	--	--	--	--	--	--	--	--
Applegate	320-04	1944	(35)	1940	(39)	--	--	--	--	1948	(31)	1944	(35)	--	--	--	--
Cofer	312-13	1944	(35)	1921	(58)	--	--	--	--	--	--	--	--	--	--	--	--
Golden	301-05	1952	(27)	1951	(28)	--	--	--	--	1951	(28)	1951	(28)	--	--	--	--
Golden	301-06	1967	(12)	1967	(12)	--	--	--	--	--	--	--	--	--	--	--	--
Maxwell	282-05	1949	(30)	1948	(31)	1963	(16)	1963	(16)	--	--	--	--	--	--	--	--
Maxwell	282-02	--	--	--	--	1942	(37)	1942	(37)	1959	(20)	1959	(20)	--	--	--	--
Martin	277-06	1915	(64)	1900	(79)	1938	(41)	1924	(55)	--	--	--	--	--	--	--	--
Brady	266-03	1936	(43)	1927	(52)	1956	(23)	1949	(30)	--	--	--	--	--	--	--	--
Brady	266-05	1906	(73)	1894	(85)	1931	(48)	1926	(53)	--	--	--	--	--	--	--	--
Gothenburg	245-06	1942	(37)	1935	(44)	1952	(27)	1940	(39)	1943	(36)	1943	(36)	--	--	--	--
Koch	229-05	1936	(43)	1929	(50)	1952	(27)	1940	(39)	1926	(53)	1926	(53)	--	--	--	--
Cozad	219-13	1937	(42)	1932	(47)	1950	(29)	1944	(35)	--	--	--	--	--	--	--	--
Darr	208-03	1943	(36)	1924	(55)	1938	(41)	1938	(41)	--	--	--	--	--	--	--	--
Darr	208-09	1951	(28)	1949	(30)	--	--	--	--	--	--	--	--	--	--	--	--
Lexington	188-01	1949	(30)	1945	(34)	--	--	--	--	--	--	--	--	--	--	--	--
Lexington	188-06	1939	(40)	1936	(43)	--	--	--	--	--	--	--	--	--	--	--	--
Jeffrey	172-06	1908	(71)	1907	(72)	--	--	--	--	--	--	--	--	--	--	--	--
Jeffrey	172-05	1956	(23)	1956	(23)	--	--	--	--	--	--	--	--	--	--	--	--
Jeffrey	171-07	1940	(39)	1934	(45)	--	--	--	--	--	--	--	--	--	--	--	--
Jeffrey	166-05	1948	(31)	1929	(50)	--	--	--	--	--	--	--	--	--	--	--	--

Peterson	160-02	1942	(37)	1928	(51)	--	--	--	--	--	--	--	--	--	--	--	--
Peterson	158-04	1934	(45)	1917	(62)	--	--	--	--	--	--	--	--	--	--	--	--
Peterson	156-05	1913	(66)	1903	(76)	1953	(26)	1940	(39)	1925	(54)	1919	(60)	--	--	--	--
Peterson	156-08	1941	(38)	1933	(46)	1962	(17)	1962	(17)	1916	(63)	1916	(63)	--	--	--	--
Mc Cormick	139-02	--	--	--	--	1937	(42)	1936	(43)	--	--	--	--	--	--	--	--
Mc Cormick	139-05	1955	(24)	1952	(27)	1958	(21)	1958	(21)	--	--	--	--	--	--	--	--
Odessa	122-07	1954	(25)	1943	(36)	1968	(11)	1966	(13)	--	--	--	--	--	--	--	--
Odessa	122-11	1944	(35)	1942	(37)	1957	(22)	1956	(23)	--	--	--	--	--	--	--	--
Volentine	119-06	1955	(24)	1951	(28)	--	--	--	--	--	--	--	--	--	--	--	--
Volentine	119-16	1936	(43)	1934	(45)	1960	(19)	1959	(20)	--	--	--	--	--	--	--	--
Johnson	111-09	--	--	--	--	1949	(30)	1949	(30)	--	--	--	--	--	--	--	--
Kahle	109-05	1962	(17)	1961	(18)	--	--	--	--	--	--	--	--	--	--	--	--
Kahle	109-06	1943	(36)	1929	(50)	1960	(19)	1957	(22)	--	--	--	--	--	--	--	--
Camp	106-06	1887	(92)	1881	(98)	1922	(57)	1916	(63)	--	--	--	--	--	--	--	--
Bassway	97-02	1930	(49)	1929	(50)	1957	(22)	1951	(28)	--	--	--	--	--	--	--	--
Bassway	97-03	1945	(34)	1945	(34)	--	--	--	--	--	--	--	--	--	--	--	--
Bassway	97-05	1916	(63)	1915	(64)	1960	(19)	1957	(22)	--	--	--	--	--	--	--	--
Audubon	92-02	1916	(63)	1914	(65)	--	--	--	--	--	--	--	--	--	--	--	--
Audubon	92-03	1969	(10)	1969	(10)	--	--	--	--	--	--	--	--	--	--	--	--
Audubon	91-15	1943	(36)	1937	(42)	--	--	--	--	1927	(52)	1927	(52)	--	--	--	--
Woodman	75-11	1947	(32)	1938	(41)	--	--	--	--	--	--	--	--	--	--	--	--
Woodman	75-15	1960	(19)	1960	(19)	--	--	--	--	--	--	--	--	--	--	--	--
Short	68-04	1921	(58)	1919	(60)	1949	(30)	1949	(30)	--	--	--	--	--	--	--	--
Short	68-12	1960	(19)	1960	(19)	1963	(16)	1963	(16)	--	--	--	--	--	--	--	--
Mormon	44-04	1936	(43)	1936	(43)	--	--	--	--	--	--	--	--	--	--	--	--
Mormon	44-06	1903	(76)	1890	(89)	1955	(24)	1955	(24)	--	--	--	--	--	--	--	--
Mormon	42-13	--	--	--	--	1956	(23)	1943	(36)	1934	(45)	1934	(45)	1950	(29)	1950	(29)[b]
Mormon	42-11	1961	(18)	1961	(18)	1962	(17)	1962	(17)	1940	(39)	1940	(39)	--	--	--	--
Baim	8-09	1951	(28)	1943	(36)	--	--	--	--	--	--	--	--	--	--	--	--
Boerson	4-01	1936	(43)	1931	(48)	1952	(27)	1952	(27)	--	--	--	--	1940	(39)	1940	(39)[c]
Boerson	4-03	1957	(22)	1957	(22)	1965	(14)	1965	(14)	1960	(19)	1960	(19)	--	--	--	--
Boerson	4-01	1918	(61)	1918	(61)	--	--	--	--	--	--	--	--	--	--	--	--
Chapman	1-04	1954	(25)	1954	(25)	1960	(19)	1957	(22)	--	--	--	--	--	--	--	--

[a] <u>Elaeagnus</u>

[b] <u>Celtis</u>

[c] <u>Catalpa</u>

above could result in the production of two rings during one growing season. False annual rings may not be very frequent in Platte River Populus and Salix trees, however, since the water table is relatively high on the floodplain, and there is probably adequate soil moisture throughout the entire growing season.

The oldest trees encountered during the survey were Populus trees that established in 1900, 1894, 1881, and 1890 near Maxwell (site 277-6), Brady (site 266-5) Kearney (site 106-6), and Mormon Island (site 44-6) respectively. The oldest Salix and Juniperus trees (established in 1916) were located at sites 156-8 (Peterson) and site 106-6 (Kearney).

Although these earliest dates of establishment provide information about the pre-1909 advancement of woody species along the Platte, the average dates of establishment are more indicative of the period when most of the forests developed. The average age of trees is shown in relation to the study sites (i.e., site 1, Chapman; site 406, Lake McConaughy) in Figure 3. Trees that established along the Platte during the relatively high mean annual discharge period before 1930 were generally found on upland sites or along the original (1890s) river shoreline (Figures 1, 2, and 3). These upland sites have been circled in Figure 3. The only bottom-

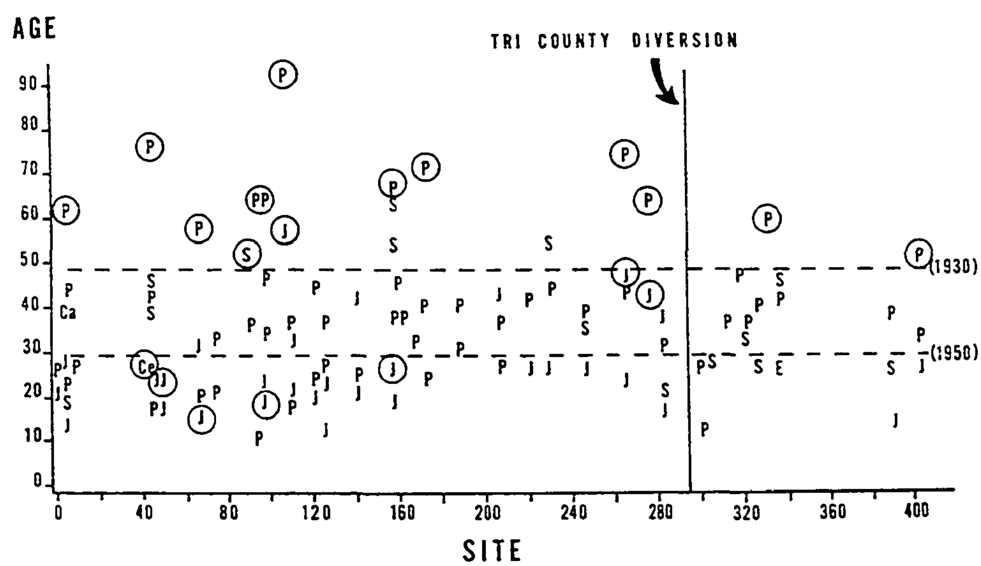


Figure 3. Average age of Populus (P), Juniperus (J), Salix (S), Catalpa (Ca), Celtis (Ce), and Elaeagnus (E), trees in relation to site. Circled letters indicate sites on uplands or along the original (1890s) shoreline

land trees that developed prior to 1930 were groves of Salix rigida trees along the major river channels at sites 229-5, 156-5, and 156-8. On many of the upland sites, Juniperus has developed in the understory since 1930.

Most trees on the alluvial bottomlands were established between 1930 and 1950, immediately following the major decline in peak and mean annual discharge on the North Platte and Platte rivers (Figures 1, 2, and 3). Since 1950, forest development in floodplain areas west of Overton has been limited primarily to the establishment of understory Juniperus, Salix, and Elaeagnus. In floodplain areas east of Overton, Juniperus, Salix, Celtis, and Catalpa have developed in the understory since 1950, but new Populus and Salix forest establishment has also occurred in these areas.

Populus and Salix have generally been the pioneer arboreal species at all locations. On the average these species have established 19 to 21 years before Juniperus (Table 1 and Figure 3). Catalpa speciosa, on the other hand, established only 4 years after Populus at site 4-1, near Chapman, while Elaeagnus established approximately 15 years after Populus at site 337-3 near Hershey. Although this age estimate for Elaeagnus is based on only one tree core, its date of establishment (i.e., 1952) coincides with observations made by local landowners (Mrs. Summers and J. Boyle, R.R. 1

Hershey, personal communication) that most of the *Elaeagnus* establishment near Hershey occurred in the late 1940s and early 1950s.

Hydrology and Radial Growth

Populus was the only arboreal species for which there was a large enough sample of trees growing prior to 1930, to allow comparisons between pre-1930 growth when mean annual discharge was relatively high ($\overline{X} = 95.6 \pm 15.9$ m^3/sec on the North Platte, $\overline{X} = 112.5 \pm 25.1$ m^3/sec on the Platte) and post-1930 growth when mean annual discharge was substantially lower ($\overline{X} = 43.9 \pm 17.0$ m^3/sec on the North Platte, $\overline{X} = 47.2 \pm 21.3$ m^3/sec on the Platte)(Figures 1 and 2). Total incremental growth of *Populus* in the 1920-29 period averaged 53.18 mm and declined to 46.09 mm (adjusted for senescence) during the 1930-39 period, but the difference was not statistically significant at the 5% level (Table 2).

The effects of the more recent increase in mean annual discharge during 1971, 1973, and 1974 on radial growth were also investigated by comparing total incremental growth of *Pcpulus*, *Salix*, and *Juniperus* during 1967-70, with total incremental growth of these species during 1971-74 (Table 3). Mean annual discharge was only 17.25 m^3/sec on the North Platte River and 38.0 m^3/sec on the Platte River during the pre-1970 period, but mean annual discharge was

Table 2. Comparison of radial growth (mm) in <u>Populus</u> during a period of high mean annual discharge (1920-29) and a period of low mean annual discharge (1930-39). The regression equation was used to adjust the 1930-39 radial growth to compensate for the decline in radial growth due to senescence. A t-test was conducted to test the difference in radial growth during the 2 periods (adjusted 1930-39 values were used tin the calculations)

SPECIES/SITE	RADIAL GROWTH 1920-29 $\bar{X}$	RADIAL GROWTH 1930-39 $\bar{X}$	REGRESSION EQUATION (GROWTH [Y] VS. TREE AGE [X])	ADJUSTED 1930-39 RADIAL GROWTH $\bar{X}$	T-VALUES
<u>Populus</u>					
Total (22)	53.18	37.00	$Y = -1.47X + 78.6$	46.09	-1.99

Table 3. Comparison of radial growth (mm) in *Populus*, *Juniperus*, and *Salix* during a period of low mean annual discharge (1967-70) and a period of high mean annual discharge (1971-74). Regression equations used to adjust 1971-74 radial growth values for the effects of senescence are provided. Radial growth in the 2 periods was compared with t-tests, using adjusted 1971-74 radial growth values. Comparisons were also made between upland and bottomland sites

SPECIES/SITE	RADIAL GROWTH 1967-70 $\bar{X}$	RADIAL GROWTH 1971-74 $\bar{X}$	REGRESSION EQUATION (GROWTH [Y] VS. TREE AGE [X])	ADJUSTED 1971-74 RADIAL GROWTH $\bar{X}$	T-VALUES
Populus					
Upland (33)	10.00	9.09		9.34	-1.41
Bottomland (164)	15.68	15.80	Y = -0.3953X + 26.3	16.43	1.35
Total (197)	14.73	14.68		15.24	1.09
Juniperus					
Upland (28)	14.68	12.79		13.29	-2.43 ($P<0.05$)
Bottomland (38)	16.47	14.79	Y = -0.2847X + 21.2	15.50	-1.60
Total (66)	15.71	13.94		14.56	-2.71 ($P<0.01$)
Salix					
Bottomland (13)	13.15	17.46	Y = -0.4052X + 30.1	17.92	4.03 ($P<0.005$)
Total (16)	13.25	16.44		16.94	3.23 ($P<0.01$)

41.25 m^3/sec and 86.25 m^3/sec on the North Platte and Platte rivers respectively during the post-1970 (1971-74) period. Although mean water discharge in 1972 was not unusually high, this year was included in the total 1971-74 incremental growth to increase the size of the increment, and thus reduce measurement errors. Because trees on uplands and bottomlands could exhibit differential growth responses to changes in hydrology, t-tests were conducted for each species as a group (total) and independently for trees on upland sites and trees on bottomland sites. Only comparisons for total and bottomland Salix trees were conducted, since only 3 increment cores were taken in upland trees of this species.

Radial growth in Populus declined on upland sites (10.00 mm to 9.34 mm), but increased on bottomland sites (15.68 mm to 16.43 mm), and increased overall (total) (14.73 mm to 15.24 mm) between the pre-1970 and post-1970 periods. These changes were neither large nor statistically significant (.05 level). Radial growth in Juniperus, on the other hand, declined significantly (.05 level) on uplands (14.68 mm to 13.29 mm), on bottomlands (16.47 mm to 15.50 mm), and overall (15.71 mm to 14.56 mm) from the pre-1970 to the post-1970 period. In contrast, radial growth in Salix was significantly greater (.01 level) during the post-1970 period on both bottomlands (13.15 mm to 17.92 mm) and overall (13.25 mm to 16.94 mm). These data indicate that while there was no significant change in the growth of *Populus* with changes in hydrology, *Juniperus* growth was inhibited and *Salix* growth was promoted during periods of high mean discharge.

Johnson *et al*. (1976) observed that radial growth of *Populus* on the Missouri River floodplain also did not differ significantly during high and low discharge periods. These investigators found, however, that *Fraxinus pennsylvanica*, *Ulmus americana*, and *Acer negundo* radial growth was statistically greater during a period of high water discharge, just as in the case of *Salix* along the Platte. Because *Fraxinus*, *Ulmus*, *Acer*, and *Salix* generally establish in and seem to be better adapted to substantially wetter areas of the floodplain than is *Juniperus*, it is reasonable to expect that they would respond positively to such a change in hydrology. *Salix* trees are thought to be especially tolerant of high water regimes because they can develop adventitious roots to absorb water when their original root systems can no longer function under flooded (anaerobic) conditions (Hosner and Boyce 1962). Climatic factors, including rainfall and temperature, could partially explain the changes in radial growth observed in this study. But, since floodplain trees receive nearly continuous moisture from ground water and periodic flooding, climate probably plays a relatively minor role in their radial growth (Johnson *et al*. 1976).

Vegetation-Soil Relationships

A comparison of vegetation and soil types at selected sites along the North Platte and Platte rivers is presented in Table 4. In general, the grassland areas sampled along the Platte were characterized by

Table 4. The relationship between vegetation and soils at selected sites along the North Platte and Platte rivers. The dominant vegetation, soil type, pH, and the surface and subsurface soil texture at each location is provided

LOCATION		VEGETATION	SURFACE PH	SURFACE TEXTURE	SUBSOIL TEXTURE	SOIL TYPE
Keystone	404-02	Populus/ Juniperus	7.6	Silty Loam	Sand/Gravel	Platte
Boyle	337-01	Elaeagnus/ Populus	8.2	Loam/Sandy	Sandy Loam	Mc Grew
Boyle	337-1A	Scirpus/ Eleocharis	7.5	Loam	Sand/Gravel	Platte
Boyle	337-03	Elaeagnus/ Populus	7.6	Sandy Loam	Loam/Clay Loam	Las
Applegate	320-04	Populus/ Sedge	8.0	Loam	Sand/Gravel	Platte
Applegate	320-06	Typha/ Scirpus	5.5	Loam	Sand/Gravel	Platte
Maxwell	280-00	Bromus/Poa	6.6	Loam	Sand/Gravel	Platte
Maxwell	219-00	Juniperus/ Populus	7.1	Silty Loam	Very Fine	Haverson
Cozad	219-08	Populus/ Juniperus	7.5	Silty Loam	Silty Loam	Leshara
Cozad	219-10	Populus (Dead)	7.1	Sandy Loam	Sandy Loam	Cass
Cozad	219-14	Salix Rigida	7.7	Loamy Sand	Fine Sand/	Boel/River
Lexington	188-01	Populus (Open)	7.4	Loamy Sand	Loam Sand	Inavale

Table 4 (Continued)

LOCATION		VEGETATION	SURFACE PH	SURFACE TEXTURE	SUBSOIL TEXTURE	SOIL TYPE
Jeffrey	172-07	Populus (Open)	6.9	Sand	Course Sand	River Overwash
Jeffrey	165-00	Populus/ Cornus	5.8	Sandy Loam	Silt Loam/ Sandy Loam	Darr
Overton	163-00	Anpopogon (Hayfield)	7.5	Silt Loam	Silt Loam	Leshara
Overton	163-00	Agrostis/ Elaeagnus	7.7	Silty Clay Loam	Silty Clay Loam	Lamo
Odessa	122-05	Populus Juniperus	5.8	Sandy Loam	Fine Sand	Boel
Odessa	122-11	Populus/ Juniperus	5.5	Sandy Loam	Sandy Loam	Darr
Camp	106-06	Bromus/Poa	6.4	Sandy Loam	Sand/Gravel	Platte
Camp	106-06	Juniperus/ Populus	7.0	Silt Loam	Silt Loam	Leshara
Bassway	97-02	Populus/ Juniperus	6.6	Silt Loam	Silty Clay Loam	Grigston
Audubon	92-01	Elaeagnus/ Poa	8.0	Silty Clay Loam	Silty Clay Loam	Lamo
Audubon	92-1A	Carex (Marsh)	6.0	Silty Clay Loam	Silty Clay Loam	Lamo
Audubon	91-01	Populus/ Cornus	7.3	Loam	Course Gravel/Sand	Platte
Audubon	91-03	Salix Exigua	6.4	Sandy Loam	Find Sand	Boel

Table 4 (Continued)

LOCATION		VEGETATION	SURFACE PH	SURFACE TEXTURE	SUBSOIL TEXTURE	SOIL TYPE
Audubon	91-06	*Xanthium* (Sandflat)	7.3	Sand	Sand/Gravel	Sandy Alluvial
Audubon	90-05	*Andropogon* (Prairie)	6.9	Silt Loam	Silt Loam	Hobbs
Gibbon	89-00	*Elaeagnus*/ *Poa*	6.9	Silty Clay Loam	Sandy Silt Clay Loam	Lamo
Woodman	75-02	*Populus*/ *Cornus*	7.3	Silt Loam	Silt Loam	Leshara
Woodman	75-15	*Populus* (Young)	5.9	Sandy Loam	Fine Sand	Boel
Shoemaker	54-00	*Andropogon* (Hayfield)	8.1	Silt Loam	Silt Loam	Grigston
Shoemaker	50-00	*Agrostis* (Grazed)	7.1	Silt Loam	Silt Loam	Leshara
Mormon	41-01	*Bromus* (Hayfield)	7.9	Silt Loam	Silt Loam	Leshara
Mormon	41-02	*Agrostis* (Grazed)	6.6	Sandy Loam	Sandy Loam	Wann
Chapman	1-00	*Salix Exigua*	7.6	Loamy Sand (Lt. Color)	Loamy Sand	Inavale
Chapman	1-03	*Salix Rigida*	7.0	Sandy Loam	Sandy Loam	Alda
Chapman	1-04	*Populus*/ *Juniperus*	5.5	Sandy Loam	Sandy Loam	Cass

well-developed lowland prairie soil types (Leshara, Grigston, Hobbs) dominated by silty loam. Except for the poorly drained sandy loam soils (Wann) on Mormon Island, these grassland soils were moderately well-drained. Forest soils, in contrast, were generally very well drained on both uplands and bottomlands. *Elaeagnus* was the only woodland type found on poorly drained soils.

Elaeagnus establishment is generally associated with intensively grazed wetland meadows characterized by intermittent flooding and Lamo and Las soils. In most cases, these grasslands in which *Elaeagnus* establishes become progressively elevated and drier with time as a result of overbank deposition, degredation of the river channel, and declines in river stage levels. The oldest *Elaeagnus* stands observed during the study (site 337-1), for instance, were found on well-drained McGrew soils, on which *Elaeagnus* is apparently no longer able to establish.

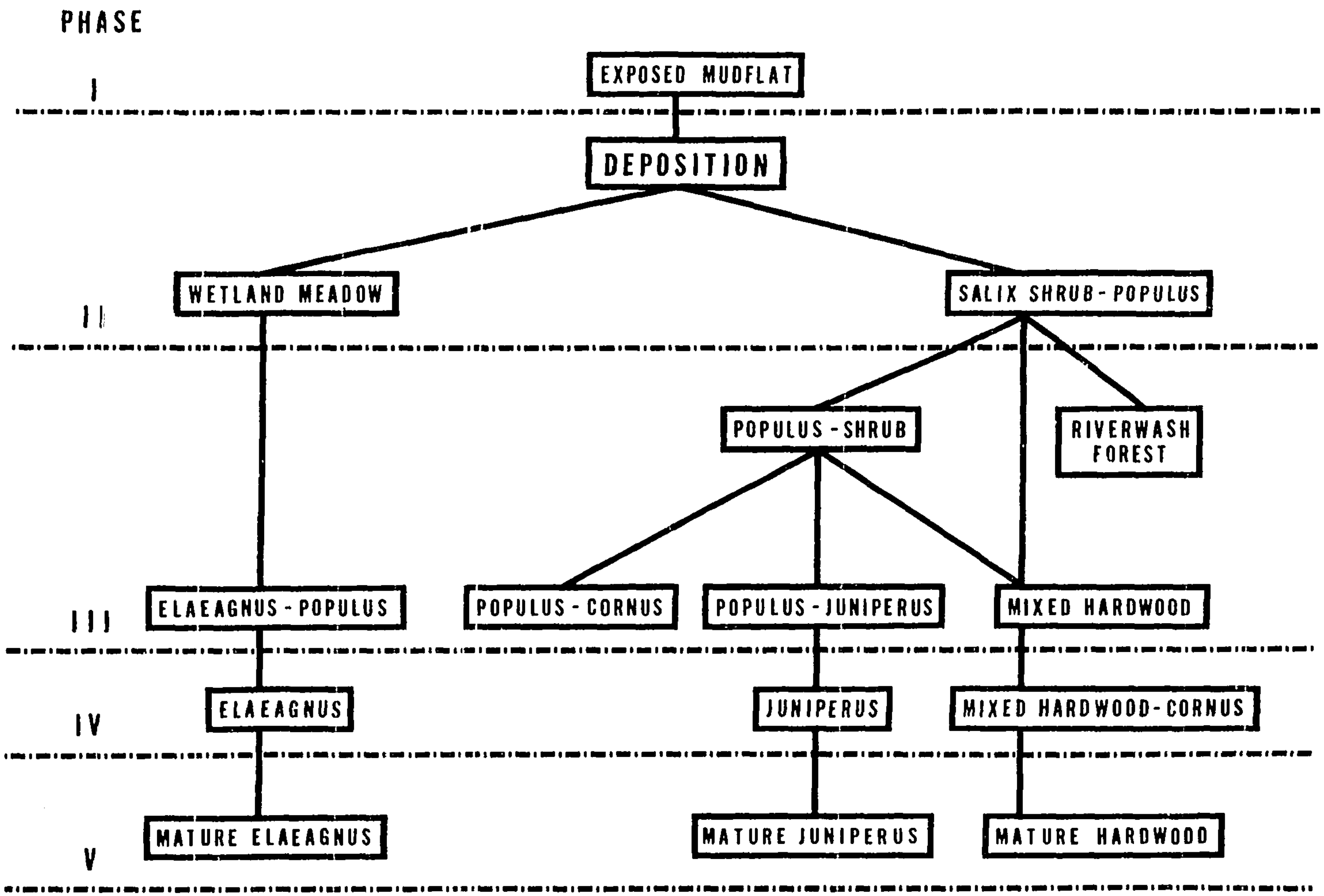
Populus forests were found on a variety of soil types, ranging from riverwash alluvium to silty loam and clay loam. Young *Populus* and *Salix* trees were found primarily on undeveloped soils (Platte and Boel) near the river channel. This indicates that establishment of these species is probably confined to recently exposed, unvegetated alluvium. Subsequent soil development after establishment of *Populus* and *Salix* may take a number of routes, depending upon the local environmental conditions. The poorly drained Lamo soils were the only soils on which *Populus* was generally not very abundant.

Juniperus was generally encountered on upland, well-drained soils dominated by silty loam (Leshara, Grigston, Haverson) and sandy loam (Darr and Cass). *Juniperus* was not found on the course-textured Platte or Boel soil types in any location except Keystone (site 404-2). At the Keystone site, however, it is suspected that *Juniperus* originally developed on more highly developed upland soils that have subsequently been buried under layers of alluvial overwash. *Juniperus* tends to establish after the development of fine textured soils, although a relatively dry moisture regime is probably a more important factor in *Juniperus* establishment than is soil texture.

Vegetation Development Scheme

The following idealized vegetation development scheme was based on the contemporary inventory of plant communities (Part I), the age structure of the forest stands, and vegetation-soil relationships. The schematic diagram in Figure 5 illustrates the major steps in the vegetation development sequence which has arbitrarily been divided into 5 phases. The first three phases deal with sandbar and river island vegetation development, *per se*, while the final 2 phases are concerned with the vegetation dynamics in advanced stages of forest development. The vegetation sequence described in the final 2 phases is entirely hypothetical, since these stages in forest development have not yet been reached anywhere within the study area.

Figure 5. Idealized vegetation development scheme for the forest communities along the Platte and North Platte rivers in central and western Nebraska


PHASE
I
II
III
IV
V
EXPOSED MUDFLAT
DEPOSITION
WETLAND MEADOW
SALIX SHRUB-POPULUS
POPULUS-SHRUB
RIVERWASH FOREST
ELAEAGNUS-POPULUS
POPULUS-CORNUS
POPULUS-JUNIPERUS
MIXED HARDWOOD
ELAEAGNUS
JUNIPERUS
MIXED HARDWOOD-CORNUS
MATURE ELAEAGNUS
MATURE JUNIPERUS
MATURE HARDWOOD

At the left in Figure 5 is an outline of Elaeagnus development along the Platte. As mentioned in the discussion of soils, Elaeagnus establishment is generally confined to grassland sites where saturated soils are present and intensive grazing reduces competition from herbaceous species. Scattered Populus trees are found in most Elaeagnus stands, but in some areas Populus may dominate the forest canopy while Elaeagnus establishes in the forest understory. At the right in Figure 5, the vegetation development sequence from alluvial sandbars and river islands to mature forest communities is illustrated.

Mudflat phase (phase I)

During the initial phase of vegetation development, exposed mudflats are colonized rapidly by annual species such as Eragrostis pectinacea (lovegrass), Cyperus spp. (nutsedge), and Echinochloa crus-galli (barnyard grass). Herbaceous perennial and biennial species such as Eleocharis palustris (spikerush), Scirpus americanus (American bulrush), Xanthium strumarium (cocklebur), Lythrum dacotanum (loosestrife), Spartina pectinata (prairie cordgrass), and Melilotus albus (white sweet clover) also develop at this time, but their numbers are usually small, since their life history strategies are not geared for short-term, high-volume seed production and, as such, they are not generally rapid colonizers. Seedlings of woody species, including

Populus, Salix exigua, Salix rigida (diamond willow), Salix amygdaloides (peach-leaf willow), and occasionally Ulmus americana, and Fraxinus also establish during this phase of vegetation development. Hosner and Minckler (1963) and Noble (1979) observed Ulmus, Fraxinus, Acer negundo, and Acer saccharinum seedlings, as well as seedlings of Populus and Salix during the initial phases of vegetation development. All these woody species have airborne seeds that could have been easily blown to the river bottomlands. But, the majority of woody seedlings probably develop from seeds which have been carried in the river and become stranded on mudflats when river stage levels decline.

Moss (1938), Wilson (1970), Kapustka (1972), McLeod and McPherson (1973), and data from the present investigation (see Part II), indicate that Populus and Salix can establish only on unvegetated, continuously moist substrates. This requirement is apparently associated with the development of the embryonic seedling, which absorbs water primarily through the delicate hairs located on the hypocotyl. If these hairs are allowed to dry-out, the seedling becomes dessiccated and dies. Because of this moisture requirement, Populus and Salix germination and establishment is virtually confined to the earliest phase in the vegetation sequence. Moisture conditions in later vegetation phases are generally inadequate for establishment.

It is difficult to assess how long this phase of vegetation development persists. In many situations, flooding and scouring action remove the phase I vegetation and cause a reversion back to exposed mudflats. In other situations, the phase I vegetation may persist for 1 to 5 years. During this 5 year period, annual species decline in importance, while perennials mature to a stage where major flooding and scouring would be necessary to remove them.

Shrub phase (phase II)

Sandbars and mudflats which become stabilized by vegetation during phase I, become elevated in relation to the river channel. This is caused by alluvial deposition on the sandbar itself; alluvial degredation of the river channel; or a decline in average, river stage levels. This elevational change allows perennial species to establish more substantially and enables them to resist removal by flooding and scouring action. Everitt (1968), Hefley (1937), McVaugh (1957), and Nickel (1978) indicated that overbank deposition is the primary factor involved in this elevational change. Nickel (1978), for example, found twigs, seeds, and organic matter (indicative of surface sediments) buried under several layers of alluvium in soil profiles taken on Platte River islands in central Nebraska.

Although species composition in phase I and II is often very similar, herbaceous species tend to dominate in phase I; while perennial, arboreal, and shrub species dominate in phase II. In situations where soils remain saturated and deposits of organic matter begin to accumulate, wetland meadows (Figure 5), dominated by herbaceous species and scattered woody saplings become established. In other areas, shrub vegetation dominated by Salix exigua, Amorpha fruticosa, Cornus stolonifera, and Cornus drummondii (Figure 5, Salix shrub-Populus) is prominent at this phase. Of these shrub species, only Salix exigua was found in phase I. The delayed development of Amorpha and Cornus is probably the result of both a limited seed source and the presence of environmental conditions that do not favor establishment of these species during phase I.

Investigations of seedbanks from phase I mudflats along the Platte River (Currier, unpublished) indicate that although viable Amorpha seeds were present in the substrate, there was no evidence that Cornus seeds were present. Amorpha produces tiny indehiscent fruits which are transported via the river to mudflat sites, while Cornus seeds develop inside fleshy fruits and are distributed primarily by birds. Although Amorpha seeds floating in the river should have nearly the same chance of landing on phase I as on phase II mudflats, germination and establishment of this species is apparently confined to the drier, slightly more elevated phase II mudflats. Cornus seeds, on the other hand, may be carried preferentially to phase II mudflats by birds responding to the taller more substantial vegetation. In any case, conditions for Amorpha and Cornus establishment seem to be most ideal along the edge of phase II mudflats, where the substrate is continually moist and large numbers of wind-row seeds are deposited as river stage levels decline.

Arboreal species such as Fraxinus, Ulmus, and Celtis may establish occasionally during this vegetation phase, but Shull (1944), Rand (1973), and Johnson et al. (1976) indicate that these species require a higher nutrient status than do Populus and Salix and may be confined to areas where seeds are deposited in alluvial organic material. Weaver (1960) indicated that most floodplain soils are low in nitrogen and organic matter, but usually have adequate supplies of other macro-nutrients. Fraxinus, Ulmus, Celtis, and other hardwood species may require a higher nitrogen content in the soil before they can establish. Since inputs of organic matter and soil nutrients through overbank deposition and litter accumulation should increase with forest age, establishment of these species should be favored at later phases in the vegetation development sequence.

Phase II vegetation development occurs during the period from 5 to 20 years after initial vegetation establishment. During this 15-year span, shrub vegetation establishes, expands, matures, and then begins to decline in importance. Salix exigua, the pioneer shrub species along the Platte, apparently matures and degenerates after 15 to 20 years, although the longevity of this species has been estimated at 25-35 years in some situations (Wilson 1970, Noble 1979).

Young forest phase (phase III)

Vegetation development during this phase can follow a number of routes, depending on local environmental conditions. Although *Populus* develops as the dominant overstory in most locations, *Celtis*, *Fraxinus*, *Ulmus*, *Juniperus*, or *Elaeagnus* may become the dominant arboreal species. The forest sites in phase III are generally much drier than phase I and II mudflats, as a result of continued overbank deposition and degredation of the river channel. *Salix exigua*, *Amorpha*, and *Cornus stolonifera* are probably unable to reproduce under these drier conditions and stands of these species begin to thin as individuals reach maturity and die (Figure 5, *Populus*-shrub). The present distribution of *Cornus drummondii* along the Platte suggests, however, that this species is able to establish under drier conditions than those supporting *Amorpha*, *Salix exigua*, and *Cornus stolonifera* and in many cases may replace these later species (Figure 5, *Populus*-*Cornus*).

In forests with intermittent flooding, and saturated soils, *Elaeagnus* often establishes in the understory (Figure 5, *Elaeagnus*-*Populus*), while *Juniperus* tends to establish in the understory on drier sites (Figure 5, *Populus*-*Juniperus*). These species develop late in the vegetation development sequence from seeds dispersed by birds which roost on young *Populus* and other arboreal species. Windborne seeds of Celtis, Fraxinus, and Ulmus also may germinate and establish late in the vegetation sequence (Figure 5, mixed hardwood), because of their requirement for higher nutrient substrates (Shull 1944, Rand 1973, Johnson et al. 1976).

In some areas, there is no arboreal or shrub development in the forest understory, and an open meadow vegetation develops beneath the Populus canopy (Figure 5, riverwash forest). Such open forests may be the result of intensive grazing, poor initial establishment of shrubs, or the removal of understory vegetation by constant deposits of alluvial riverwash. Forests developing on the bottomlands north of Jeffreys Island (site 171-7) are representative of such alluvial riverwash sites.

Phase III vegetation develops during the period from 20 to 50 years after initial vegetation establishment. Near the end of this phase, Populus and arboreal species of Salix have matured, and other arboreal species in the understory are replacing them as the dominants.

Populus maturity phase (phase IV)

The low moisture content of the surface sediments of most mature floodplain forests prevents regeneration of Populus and Salix. As a consequence, stands of Elaeagnus, Juniperus, or mixed hardwood species (Fraxinus, Ulmus, Morus) will most likely replace Populus and Salix.

As _Elaeagnus_ and _Juniperus_ begin to dominate the forest vegetation, a closed canopy develops, and the understory shrubs, dominated by _Cornus drummondii_ begin to thin and die. In the more open-canopy mixed hardwood forests, however, _Cornus drummondii_ will continue to establish and will most likely become the dominant understory shrub (Figure 5, mixed hardwood-_Cornus_).

At the present time, only a few areas along the Platte have reached this phase of vegetation development. These areas include the _Juniperus-Populus_ forests near Kearney (site 106) and Maxwell (site 277). Because few of the overstory trees have actually died at these sites, they are considered to be at the initial stages of Phase IV. Shelford (1954), Read (1958), and Everitt (1968) have estimated the life span of _Populus_ at anywhere from 30 to 75 years, while increment cores from the present study indicate that trees near Kearney are nearly 100 years old (relative to 1979) (see Table 1). Because of this variability in estimates of the life span of _Populus_, it is difficult to predict how long this phase of vegetation development is likely to persist, although in most cases, phase IV should exist between 50 and 100 years.

Maturity of understory species (phase V)

Vegetation development in phase V is hypothetical since there are no areas along the Platte where the forest vegetation is known to be more than 100 years old. When Elaeagnus, Juniperus, Fraxinus, Ulmus, Celtis, and Morus become the dominant arboreal species, they will probably be able to regenerate themselves and continue to dominate the forest vegetation. Hosner and Minckler (1963) have suggested that Fraxinus, Ulmus, Acer negundo, and Acer saccharinum would regenerate indefinitely along rivers in Southern Illinois, while Rand (1973) hypothesized a similar perpetuation of Fraxinus, Ulmus americana, Ulmus rubra, and Acer negundo along the Republican River in south-central Nebraska. Only in situations where there are substantial changes in the conditions for germination and establishment would major shifts be expected in the species dominating particular sites. Such changes could occur in woodlands dominated by Elaeagnus, since this species generally establishes in lowland sites while most of the mature Elaeagnus stands are located on relatively dry upland sites.

Clementsian vs Gleasonian Vegetation Development

Hefley (1937), Shull (1922), Lee (1945), Shelford (1954), Weaver (1960), Lindsey et al. (1961), Everitt (1968), Wilson (1970), Bunde et al. (1975), Aronson and Ellis (1979) and others have interpreted the development of woody floodplain vegetation as uni-directional, Clementsian succession (i.e., in the sense of Cowles 1899, Clements 1916, Weaver and Clements 1937) in which a succession of species leads to a climatic or edaphic climax. Generally these Clementsian succession schemes represent a replacement sequence in which succeeding species are envisioned as altering their local environment for the benefit of subsequent species. The most frequently described floodplain vegetation sequence consists of the following stages: 1) pioneer grasses and forbs, 2) replacement by Salix exigua, which holds the soil and allows Populus and arboreal Salix to establish, 3) Populus forest domination with understory seedlings and saplings of Ulmus americana, Acer negundo, Morus rubra, Acer saccharinum, Ulmus rubra, and Fraxinus pennsylvanica, 4) Populus maturity and death with subsequent dominance by Fraxinus, Celtis, Acer, Ulmus, and Morus, and 5) establishment of a Quercus-Fraxinus-Ulmus (bur oak-ash-elm) climax forest vegetation type.

This classical succession model has two major flaws. First, the model fails to recognize that many of the "climax" species are present from the initial stages of vegetation development in seedling or propagule form. Second, the model predicts vegetation development towards one homogeneous climax forest type (Quercus-Fraxinus-Ulmus) under all sets of environmental conditions. Egler (1954) and Drury and Nisbet (1971, 1973) have challenged classical succession schemes on the grounds that many of the propagules for species which dominate in later stages of the vegetation sequence are present from the initial stages of the vegetation development. In these cases, the vegetation change represents sequential dominance of a variety of extant species, rather than an actual replacement sequence. Changes in dominance are a function of differential growth rates. Indeed, Hefley (1937) and Lindsey _et al_. (1961), who described the vegetation sequence on floodplains in terms of classical succession, recognized that the vegetation development process represented a "transfer" of dominance. These authors suggested, however, that subsequent vegetation development would lead to a homogeneous regional climax vegetation type.

Noble and Slatyer (1977) indicated that in Clementsian succession, the process represents effective altruism in which the succeeding species prepare the way for their replacements. From an evolutionary perspective, such altruism makes little sense in terms of the perpetuation of a species. Gleasonian succession (i.e., Gleason 1917, 1927) provides a much more reasonable approach to vegetation development because, unlike Clementsian succession, it is not inherently directional, has no fixed endpoint, and makes no distinction between seral and climax communities. Gleasonian succession as defined by van der Valk (1980) occurs whenever a new species establishes, a species dies, or both events occur simultaneously. The Gleasonian approach to vegetation development thus allows for fluctuating or variable environmental conditions in the determination of the vegetation sequence. The idealized vegetation development scheme presented in Figure 5 and described in the preceding section of this paper represents a Gleasonian interpretation of the forest development along the Platte River. The idealized vegetation scheme in Figure 5 is inherently directional in terms of the age structure of the forest communities, however, perturbations at any phase in the sequence could cause a reversion to earlier phases or to a different community type under a particular set of environmental conditions.

One of the problems in developing a vegetational sequence for the woody vegetation along the Platte is that the environmental and hydrological conditions under which many of the contemporary forest communities developed (i.e., 30 to 50 years ago) are very different from those under which the present sandbar and river island vegetation is developing. Since we are uncertain about the exact environmental conditions during the past 50 years, and about those in the near future, it is difficult to assess "the" vegetational sequence which is likely to occur. Because the environment is continually fluctuating, it would seem most reasonable, especially from a management viewpoint, to base predictions of vegetation development on the response of individual species to specific environmental perturbations. Such a technique has been pioneered by Noble and Slatyer (1977) in a Mediterranean ecosystem and has been adapted by van der Valk (1980) to explain the dynamics of prairie glacial marshes. In both cases, the "vital attributes" of individual species in the ecosystem were used to predict a vegetation sequence under a variety of hypothetical environmental regimes (disturbance schemes) in which climatic and edaphic conditions remained relatively constant.

The vital attributes are based on 3 key life history characters, and include: 1) dispersal and longevity of propagules (i.e., seeds, turions, rhizomes), 2) germination and establishment requirements, and 3) potential length of the life span. Although information on the vital attributes of Populus and Salix, the most widespread woody species along the Platte, is available (see Part II); little is known about the germination, establishment, or longevity of Amorpha, Cornus, Juniperus, Fraxinus, Ulmus, Morus, or Celtis, the other major woody invaders on sandbars and river islands. Before a definitive vegetation development sequence can be developed for Platte River forest communities, more information is needed about the autecology of these latter species. Furthermore, without a definitive vegetation development scheme, it is nearly impossible to develop functional management plans to inhibit further encroachment of woody plants on sandbars and islands along the Platte.

SUMMARY

Most of the Populus, Salix, and Juniperus trees on the North Platte and Platte river floodplains have established since 1930, during a period when mean annual water discharge was nearly 70% lower than in the period between 1910 and 1930. Trees which established before 1930 were generally found on raised river islands, uplands, or along the shoreline. In a few areas, Salix rigida trees developed before 1930 on bottomlands adjacent to the major river channels.

Radial growth in Populus was not significantly different during periods of high (1920-29, 1971-74) and periods of relatively low 1930-39, 1967-70) mean annual discharge. Radial growth in Salix, however, was significantly greater (.01 level) and radial growth in Juniperus was significantly less (.05 level) during the high mean annual discharge period in 1971-74, compared to radial growth of these species in the 1967-70 period.

Populus and Salix were found on a variety of soils ranging from coarse sand to silty loam. Elaeagnus was generally confined to poorly drained soils and Juniperus was primarily associated with sandy to silty loam soils.

An idealized vegetation development scheme for the forest communities along the Platte and North Platte rivers was based on the inventory of plant communities (Part I), the germination and establishment requirements of Populus and Salix (Part II), and the age structure and site preferences of the major forest species (Part III).

LITERATURE CITED

Albertson, F. W., and J. E. Weaver. 1945. Injury and death or recovery of trees in prairie climate. Ecol. Mono. 15:393-433.

Aronson, J. G., and S. L. Ellis. 1979. Monitoring, maintenance, rehabilitation, and enhancement of critical whooping crane habitat, Platte River, Nebraska. Pages 168-180 in Mitigation Symposium, Ft. Collins, Colorado, 1979. USDA Rocky Mt. For. Range Exp. Sta., Gen. Tech. Rpt. RM-65.

Bessey, C. E. 1899. Are the trees advancing or retreating upon the Nebraska plains? Science 10:768-770.

Borchert, J. R. 1950. The climate of the central North American grassland. Ann. Assoc. Amer. Geogr. 40:1-39.

Bryson, R. A. 1966. Air masses, streamlines, and the boreal forest. Geogr. Bull. 8:228-269.

Bunde, M., G. Deyle, J. Gray, T. Imel, M. Stines, T. Sweeney, and L. Weiss. 1975. The effects of the selective removal of cottonwood trees along the Platte River. Student Originated Studies Program, National Science Foundation. Dept. Biology, Kearney State College, Kearney, Nebraska. 200 pp.

Clements, F. E. 1916. Plant succession: an analysis of the development of vegetation. Carnegie Inst. Washington Pub. No. 242. 512 pp.

Cowles, H. C. 1899. The ecological relations of the vegetation on the sand dunes of Lake Michigan. Bot. Gaz. 27:95-117, 167-202, 281-308, 361-391.

Egler, F. E. 1954. Vegetation science concepts: 1. Initial floristic composition, a factor in old field vegetation development. Vegetatio 4:412-417.

Elder, J. A. 1969. Soils of Nebraska. Univ. of Nebraska Conservation and Survey Div., Lincoln, Nebraska. 60 pp.

Everitt, B. L. 1968. Use of cottonwood in an investigation of the recent history of a floodplain. Am. J. Sci. 266:417-439.

Drury, W. H., and I. C. T. Nisbet. 1971. Interrelations between developmental models in geomorphology, plant ecology, and animal ecology. General Systems 16:57-68.

Drury, W. H., and I. C. T. Nisbet. 1973. Succession. J. Arnold Arboretum 54:331-368.

Frith, C. R. 1974. The ecology of the Platte River as related to Sandhill Cranes and other waterfowl in south central Nebraska. Unpublished M.S. Thesis. Kearney State College, Kearney, Nebraska. 115 pp.

Gleason, H. A. 1917. The structure and development of the plant association. Bull. Torr. Bot. Club 44:463-481.

Gleason, H. A. 1922. The vegetational history of the Middle West. Annals Assoc. Amer. Geogr. 12:39-85.

Gleason, H. A. 1927. Further views on the succession concept. Ecology 8:299-326.

Hefley, H. M. 1937. Ecological studies on the Canadian River floodplain in Cleveland County, Oklahoma. Ecol. Mono. 7:345-402.

Hosner, J. F., and S. G. Boyce. 1962. Tolerance to water saturated soil of various bottomland hardwoods. For. Sci. 8:180-186.

Hosner, J. F. , and L. S. Minckler. 1963. Bottomland hardwood forests of southern Illinois — Regeneration and succession. Ecology 44:29-41.

Johnson, W. C., R. L. Burgess, and W. R. Keammerer. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. Ecol. Mono. 46:59-84.

Kapustka, L. A. 1972. Germination and establishment of Populus deltoides in eastern Nebraska. Unpublished M.S. Thesis. Univ. of Nebraska, Lincoln, Nebraska. 72 pp.

Kellogg, R. S. 1905. Forest belts of western Kansas and Nebraska. USDA Forest Ser. Bull. No. 66. 44 pp.

Lee, M. B. 1945. An ecological study of the floodplain forest along the White River system in Indiana. Butler Univ. Stds. 7:155-165.

Lindsey, A. A., R. O. Petty, D. K. Sterling, and W. van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe rivers. Ecol. Mono. 31:105-156.

McLeod, K. W., and J. K. McPherson. 1973. Factors limiting the distribution of Salix nigra. Bull. Torr. Bot. Club 100:102-110.

McVaugh, R. 1957. Establishment of vegetation on sandflats along the Hudson River, New York. II. The period 1945-55. Ecology 38:23-29.

Moss, E. H. 1938. Longevity of seed and establishment of seedlings in species of Populus. Bot. Gaz. 99:529-542.

Noble, M. 1979. The origin of Populus deltoides and Salix interior zones on point bars along the Minnesota River. Am. Midl. Nat. 102:59-67.

Noble, I. R., and R. O. Slatyer. 1977. Post-fire succession of plants in Mediterranean ecosystems. Pages 27-36 in H. A. Mooney, and C. E. Conrad, eds. Symposium on the environmental consequences of fire and fuel management in Mediterranean ecosystems. USDA Forest Ser. Gen. Tech. Rpt. WO-3. 498 pp.

Nickel, J. 1978. Origin and plant succession of Platte River Islands: Soil analysis and interpretation. Student Originated Stud. Program, National Science Foundation. Dept. Biology, Kearney State College, Kearney, Nebraska. 20 pp.

Rand, P. J. 1973. The woody phreatophyte communities of the Republican River Valley in Nebraska. Final Report, Research contract, Bureau of Reclamation. Botany Department, Univ. of Nebraska, Lincoln, Nebraska. 110 pp.

Read, R. A. 1958. Trees for Nebraska windbreaks. Nebr. Farmer 100(7):42.

Shelford, V. E. 1954. Some lower Mississippi Valley floodplain biotic communities: Their age and elevation. Ecology 35:126-142.

Shull, C. A. 1922. The formation of a new island in the Mississippi River. Ecology 3:202-206.

Shull, C. A. 1944. Observations of general vegetational changes on a river island in the Mississippi River. Am. Midl. Nat. 32:771-776.

van der Valk, A. G. 1980. Succession in wetlands: A Gleasonian approach. Ecology (in press).

Weaver, J. E., and F. E. Clements. 1937. Plant Ecology. McGraw-Hill, New York. 520 pp.

Weaver, J. E. 1960. Floodplain vegetation of the central Missouri valley and contacts of woodland with prairie. Ecol. Mono. 30:37-64.

Wells, P. V. 1970. Vegetational history of the Great Plains. Pages 185-202 *in* W. Dort, and J. K. Jones, eds. Pleistocene and recent environments of the central Great Plains. U. of Kansas Press, Lawrence, Kansas.

Williams, G. P. 1978. The case of the shrinking channels - The North Platte and Platte Rivers in Nebraska. Geological Survey of Circular No. 781. 48 pp.

Wilson, R. E. 1970. Succession in stands of *Populus deltoides* along the Missouri River in southeastern South Dakota. Am. Midl. Nat. 83:330-342.

Wright, H. E. 1970. Vegetational history of the central Great Plains. Pages 157-172 *in* W. Dort and J. Knox, eds. Pleistocene and recent environments of the central Great Plains. U. of Kansas Press, Lawrence, Kansas.

GENERAL SUMMARY

An inventory of the vegetation along 200 miles of the North Platte and Platte rivers in Nebraska was conducted. Twenty-two vegetation types were identified through the use of Twinspan, a computerized reciprocal averaging ordination technique.

Increment tree cores revealed that most of the trees on the Platte river floodplain established since 1930, following a 70% decline in mean annual discharge levels in the river. Populus incremental growth did not differ significantly during periods of high and low mean annual discharge. Salix, however, grew significantly more and Juniperus grew significantly less during periods of high mean discharge.

Populus and Salix were found on a variety of soils ranging from coarse sand to silty loam. Elaeagnus angustifolia was generally confined to poorly drained, silty clay soils, while Juniperus was found primarily on well drained sandy to silty soils. Seedling establishment of Populus and Salix is limited to the period from mid-May to the end of August as a result of the short seed-release (May-July) and seed-viability (2-3 weeks) periods of these species. Before widespread seedling establishment can occur, mudflats with fine textured soils, high soil moisture, and a long substrate exposure period are needed.

The germination and establishment requirements of Populus and Salix, the age structure and site preferences of the major arboreal species, and the vegetation survey data were used to develop an idealized vegetation progression scheme for forest communities along the Platte.

ACKNOWLEDGMENTS

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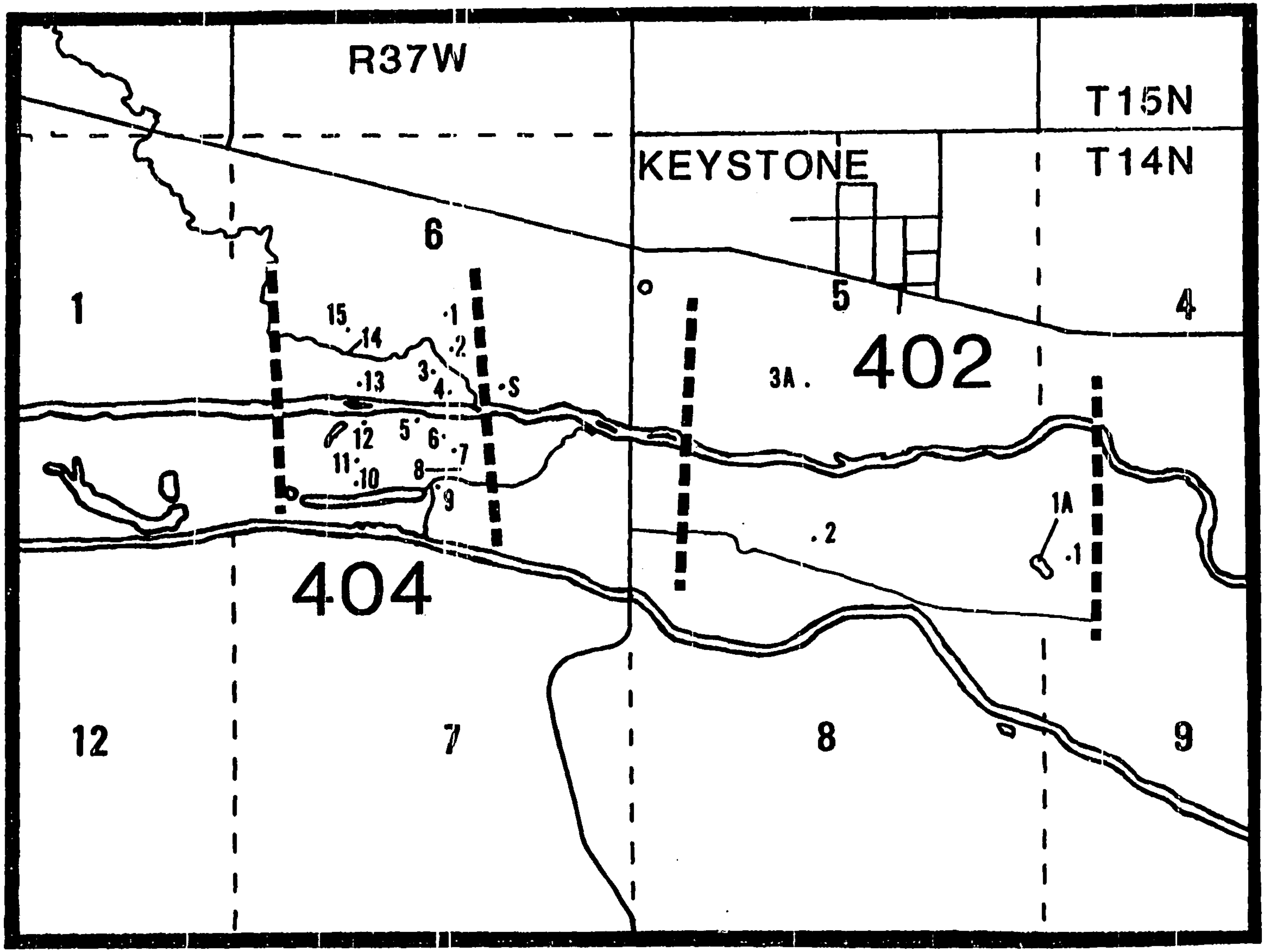
APPENDIX A: MAPS OF STUDY SITES



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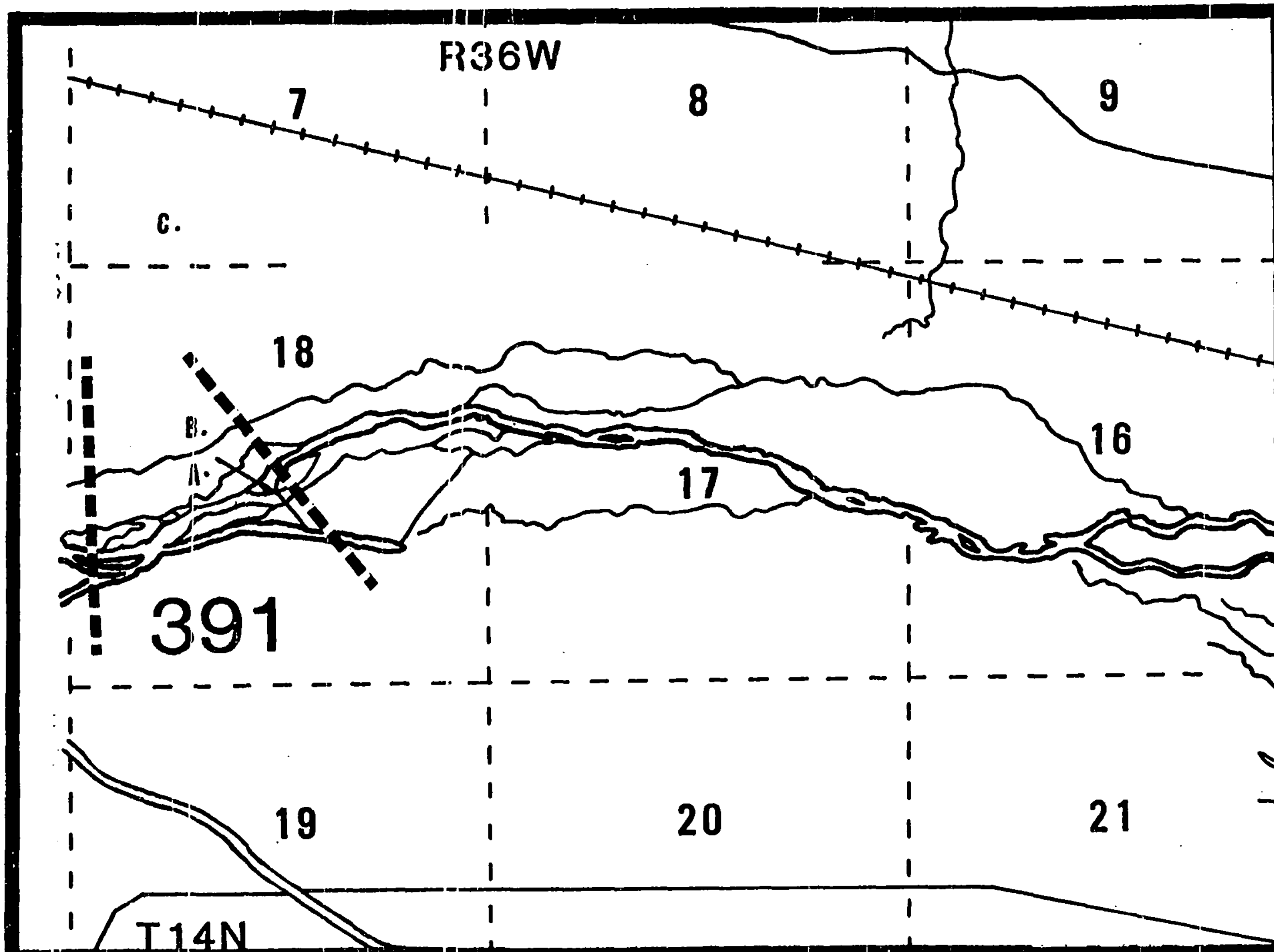
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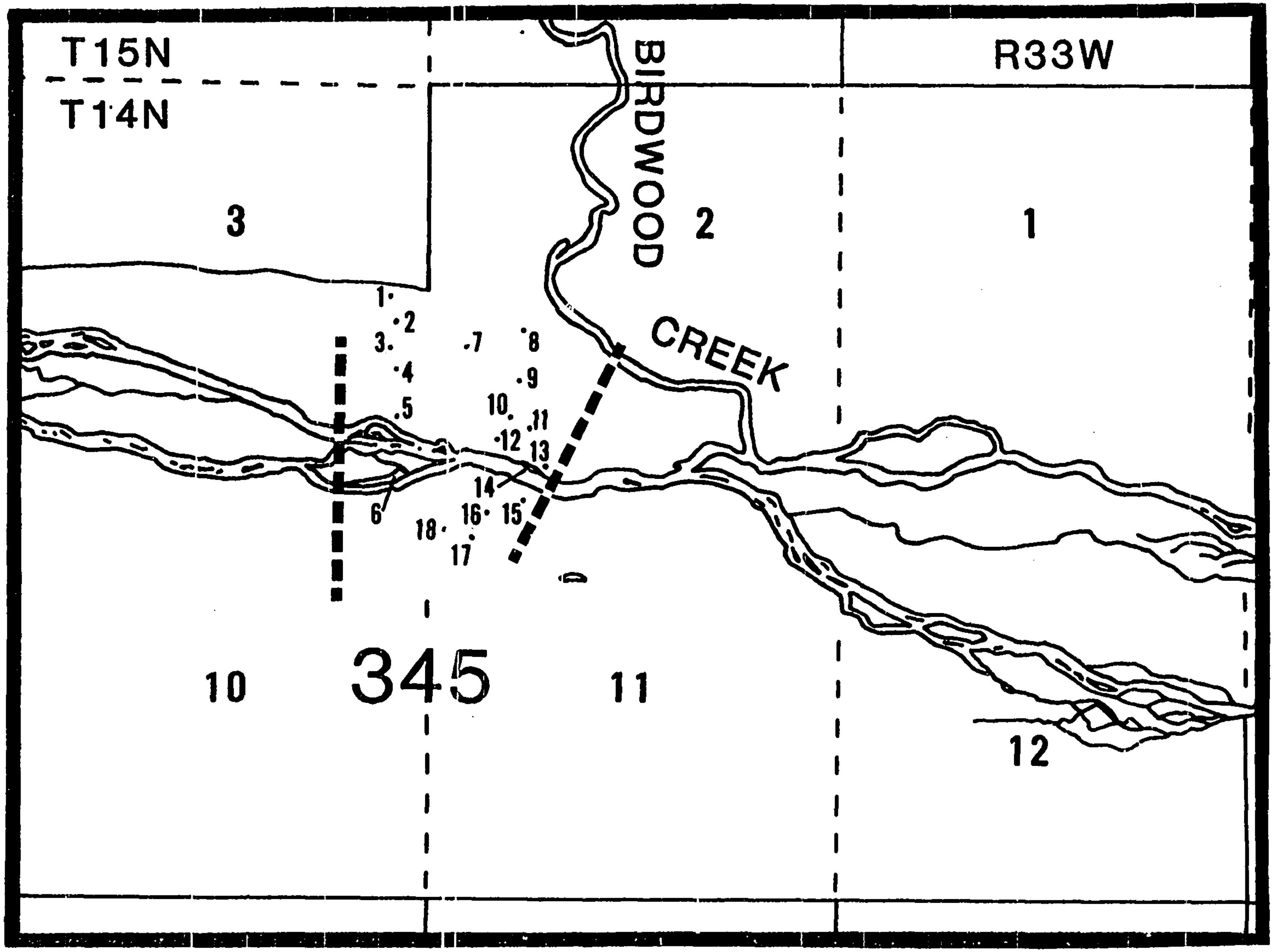
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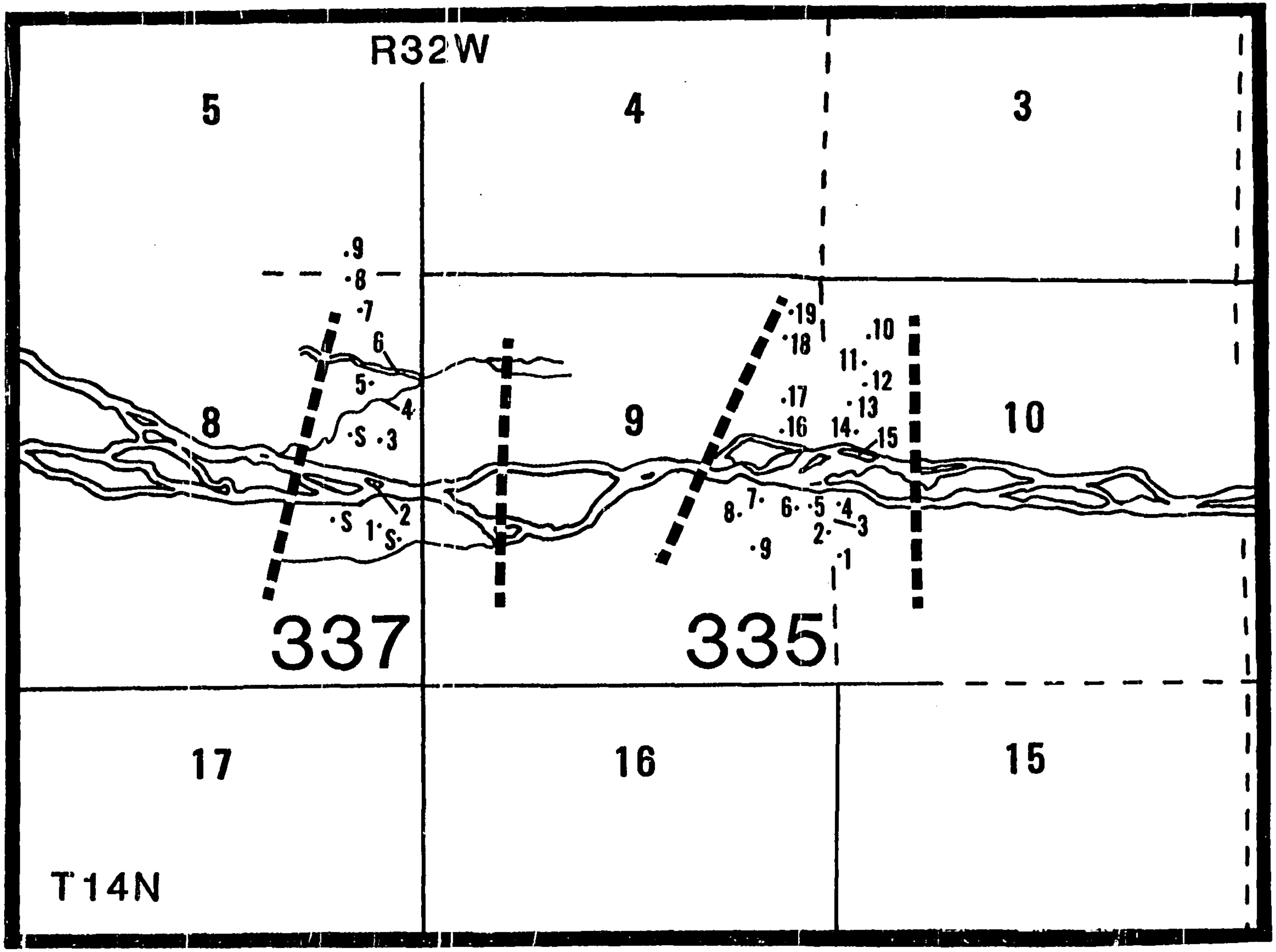
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335
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2
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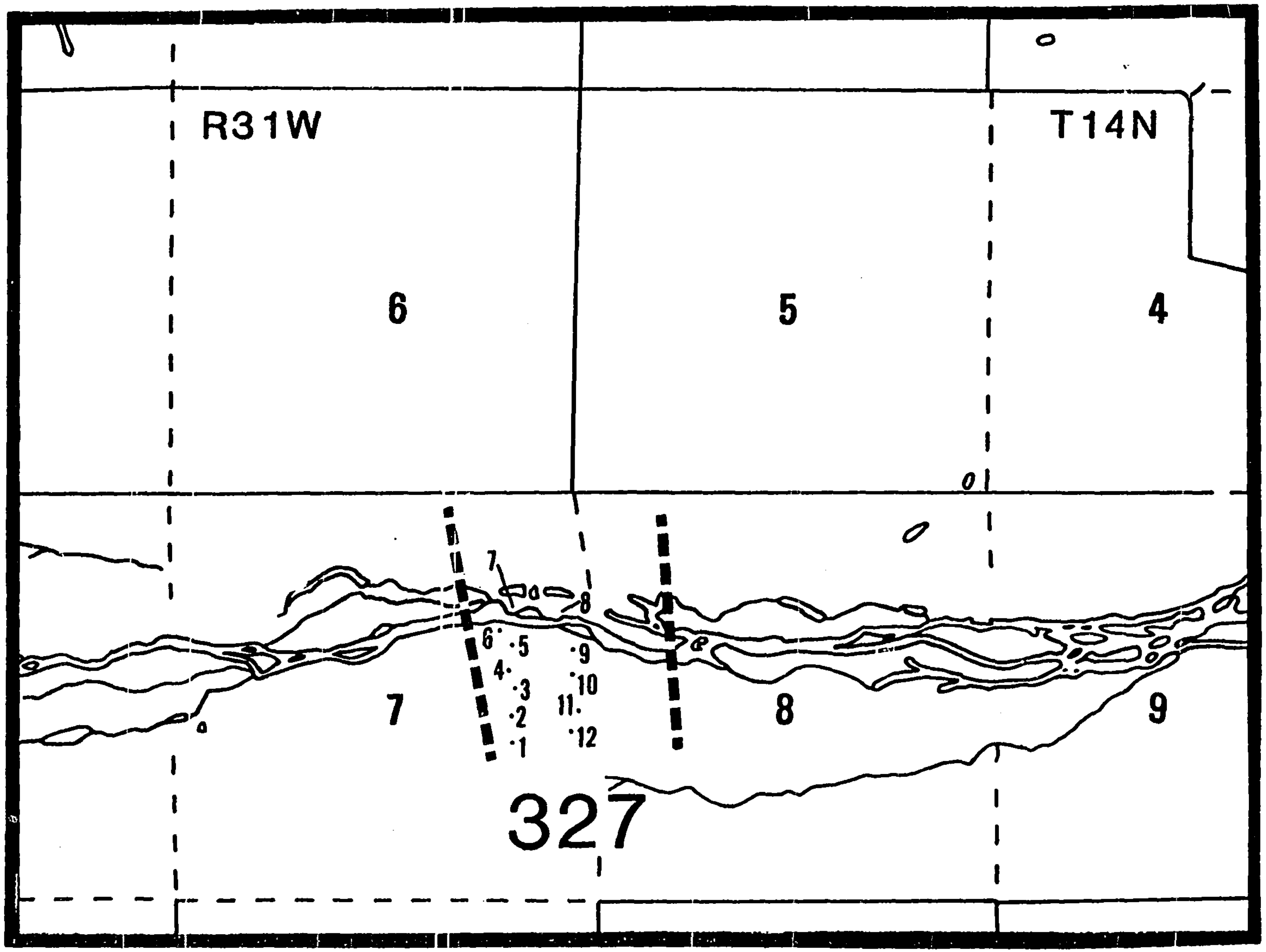
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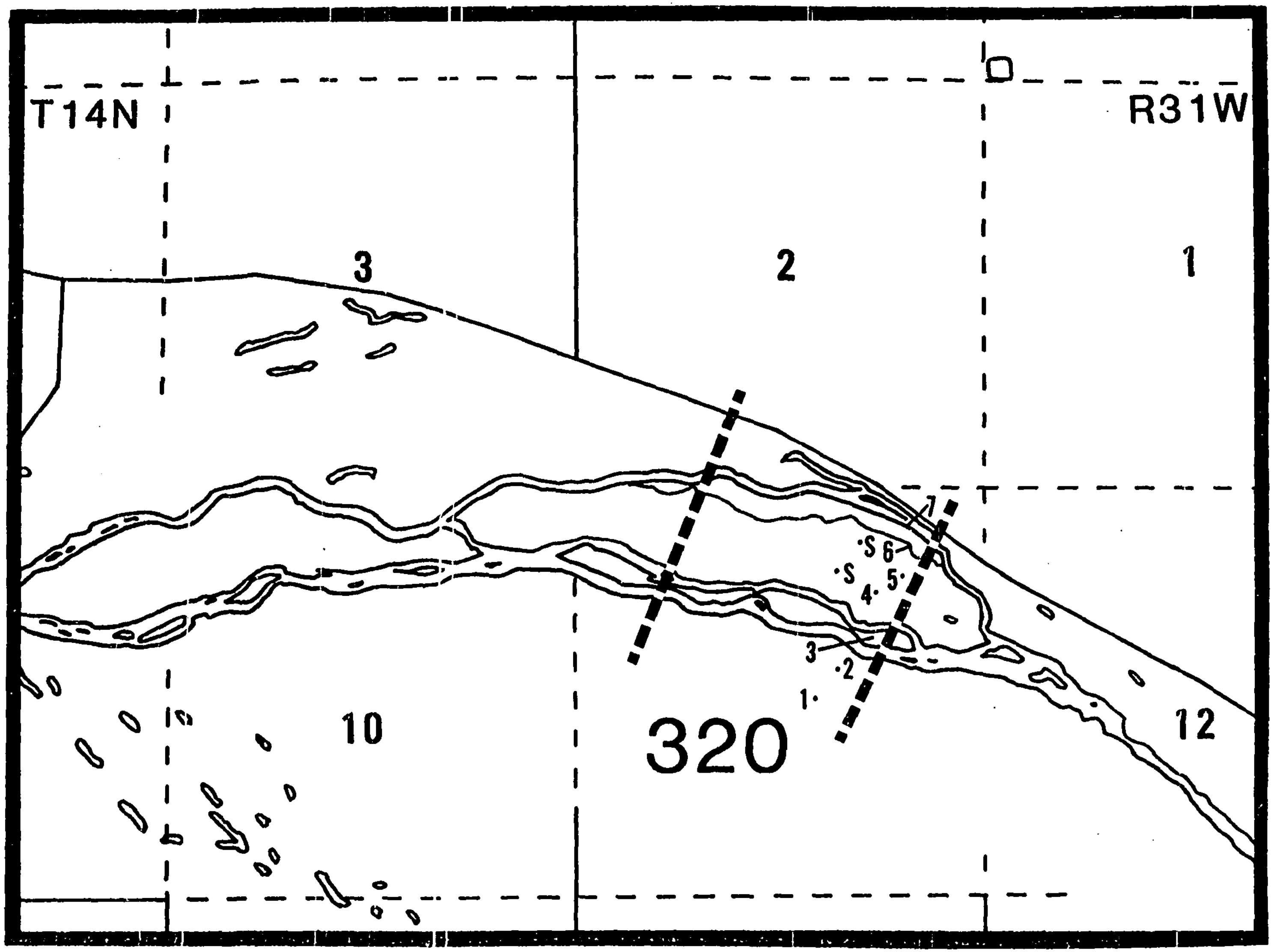
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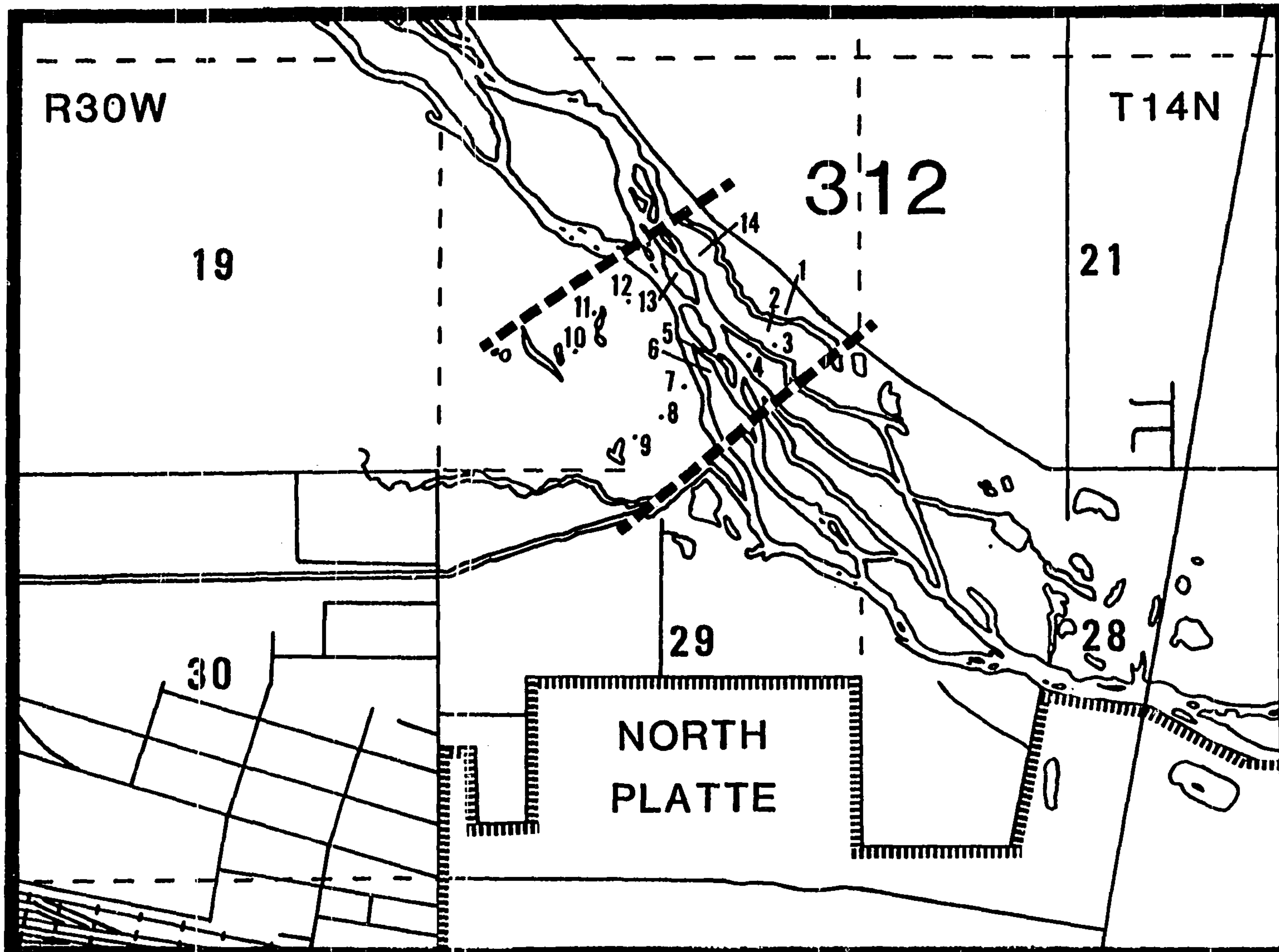
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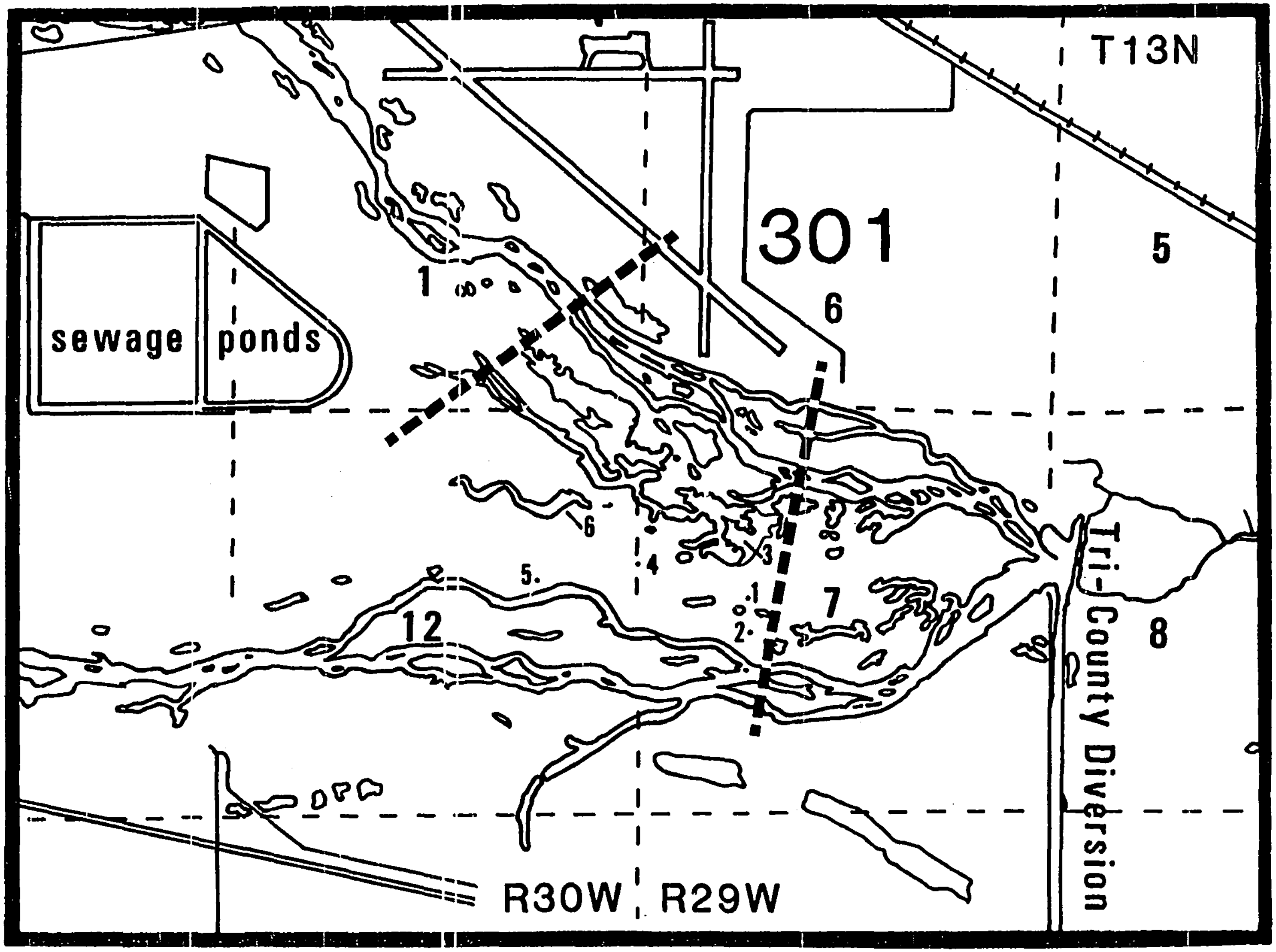
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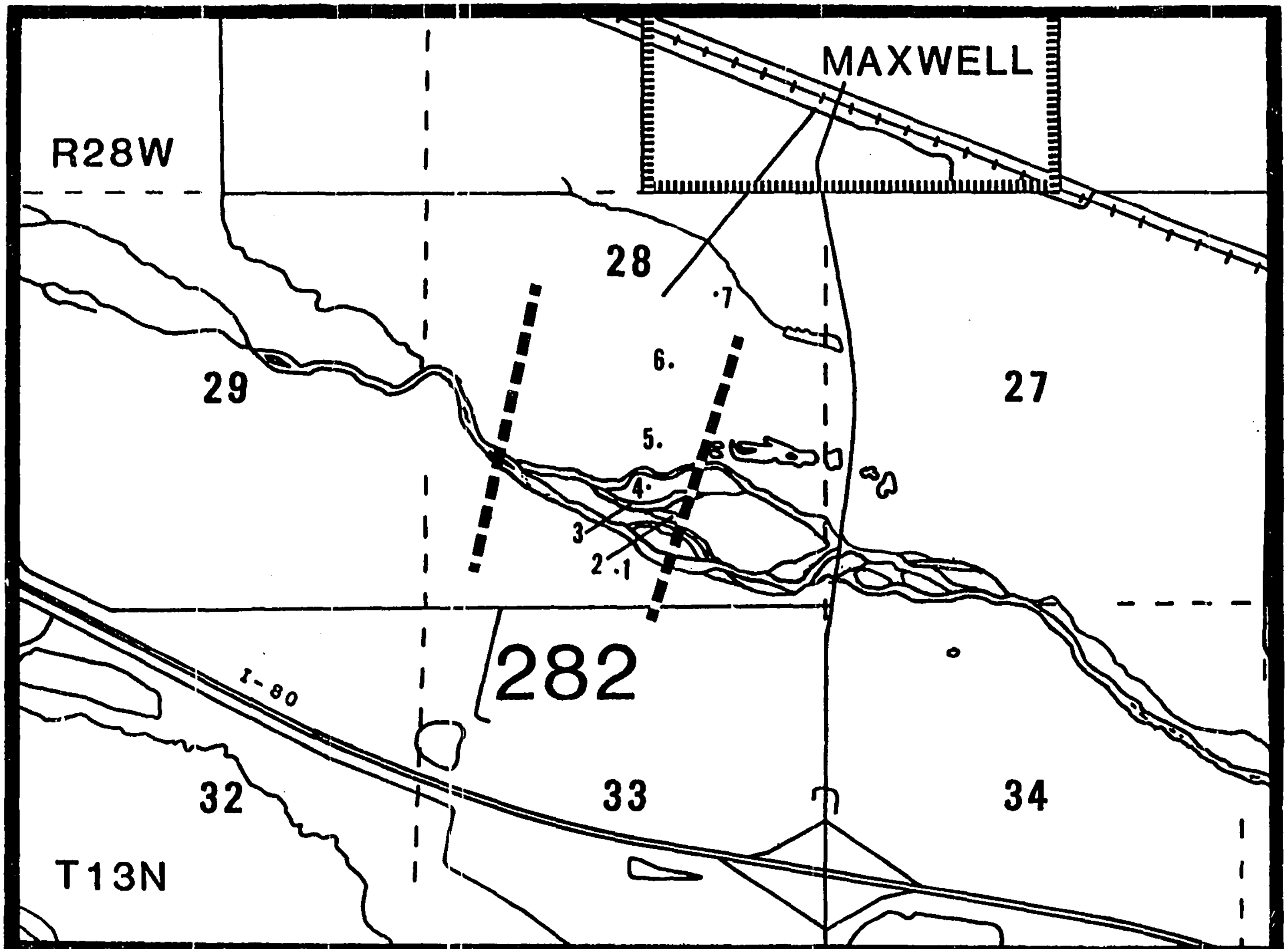
R30W
R29W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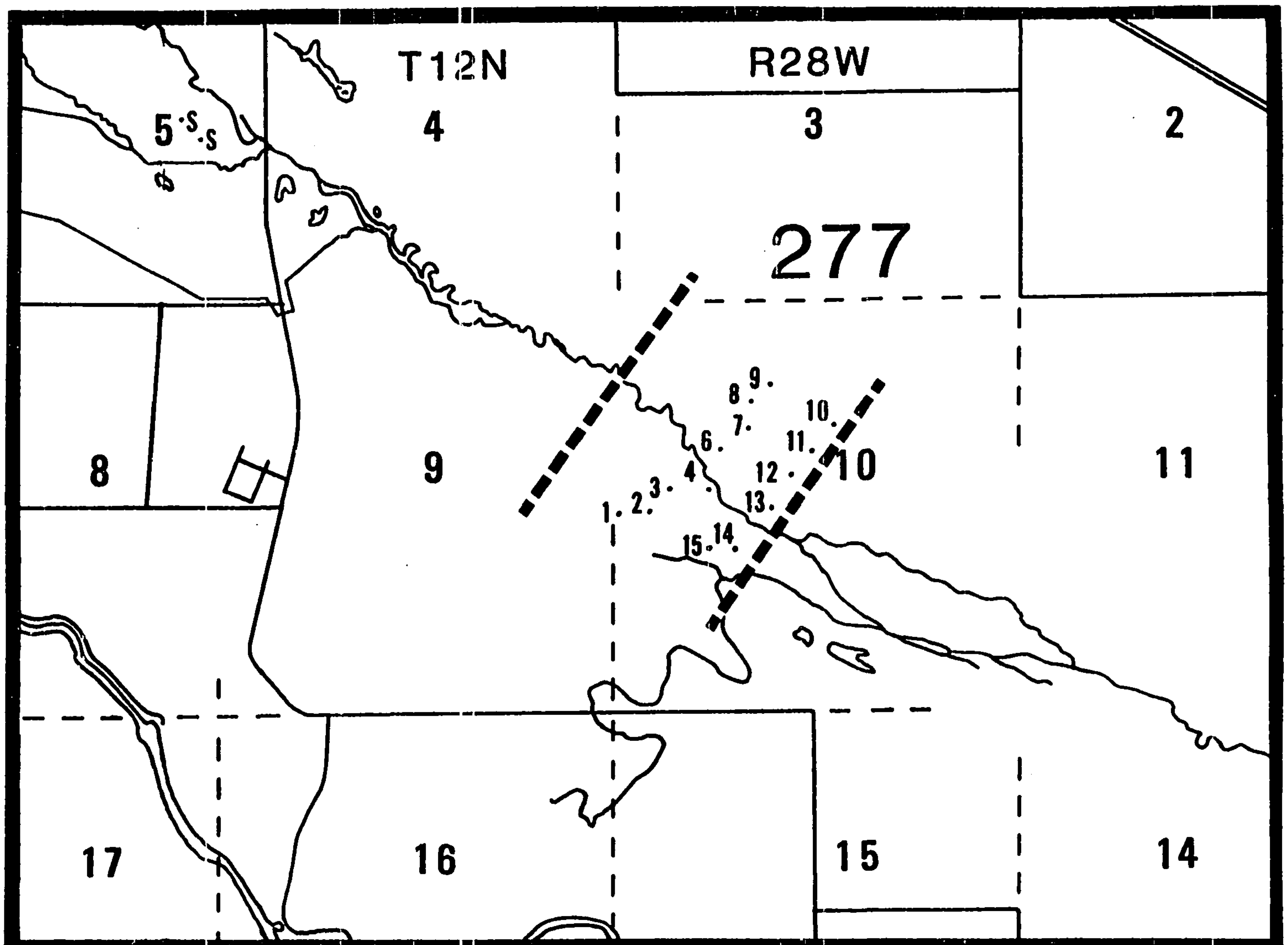
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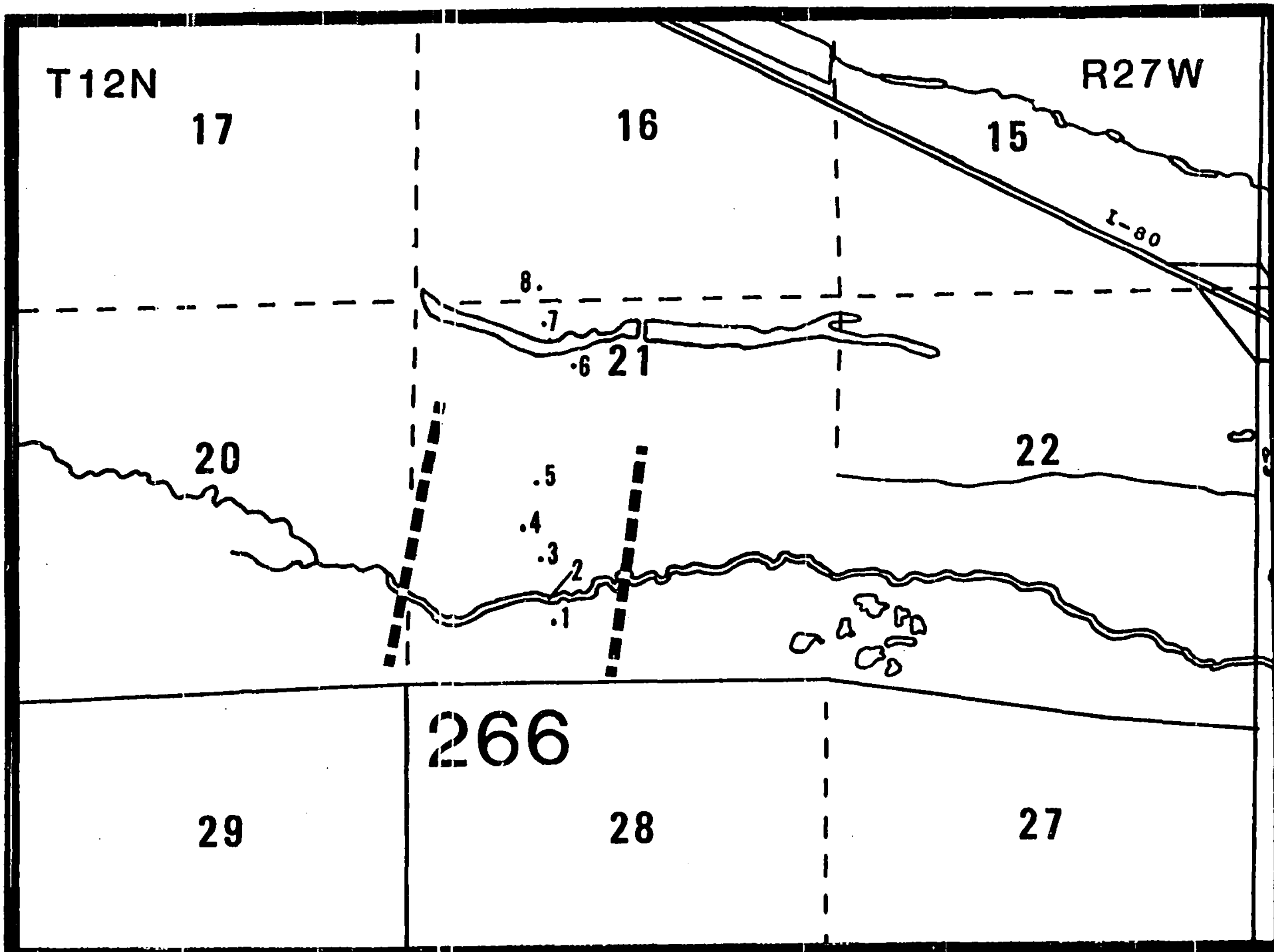
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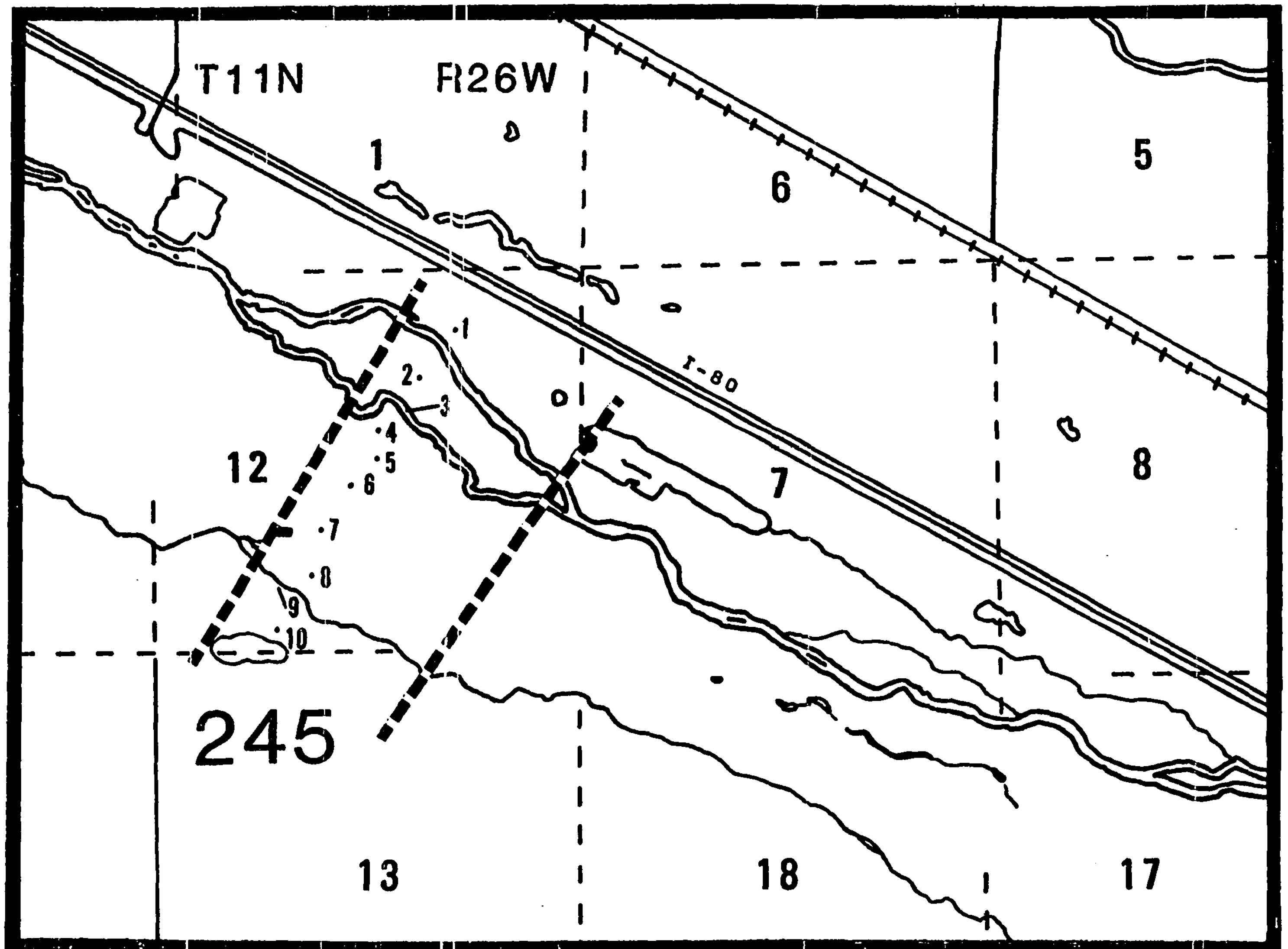
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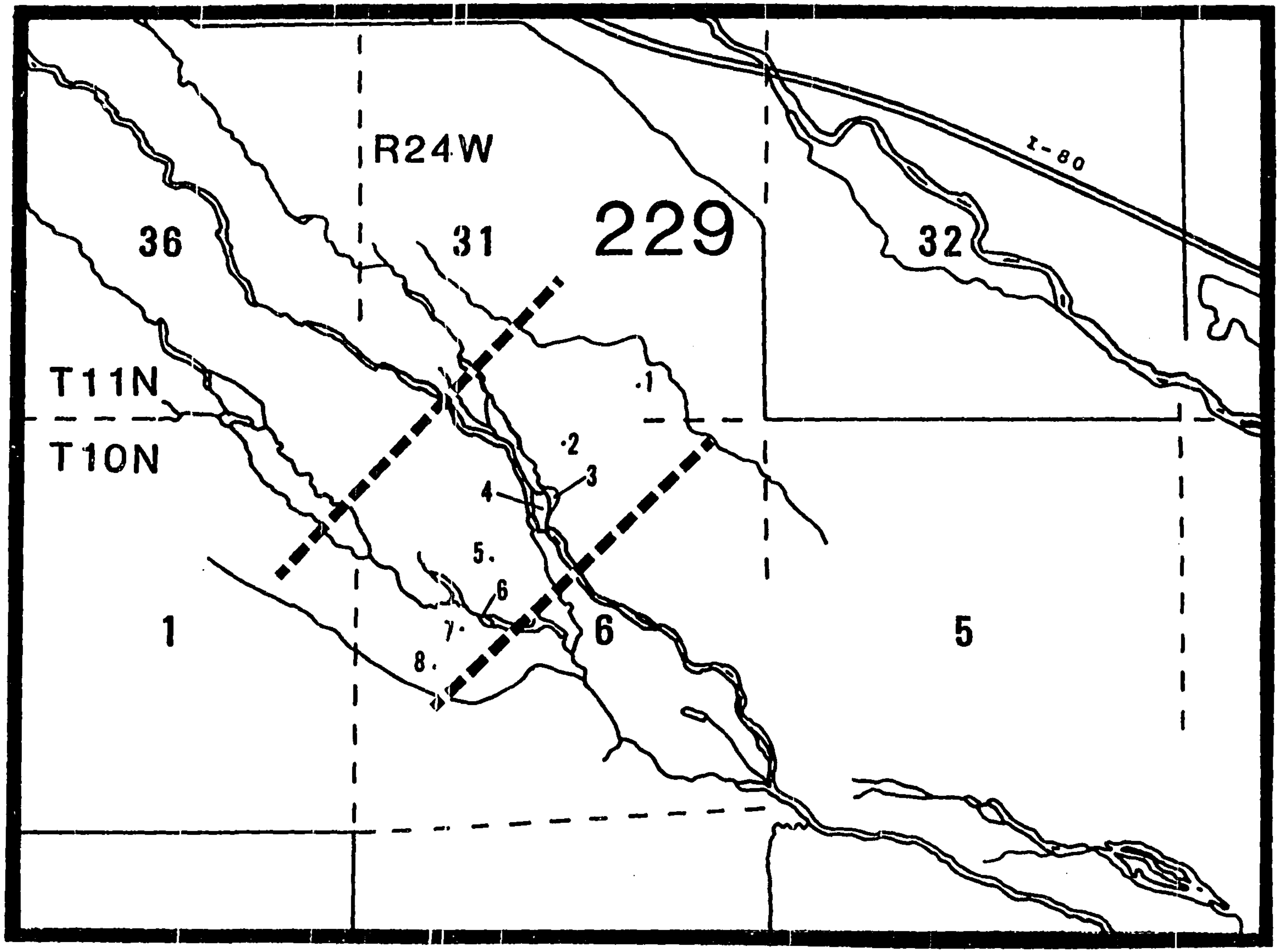
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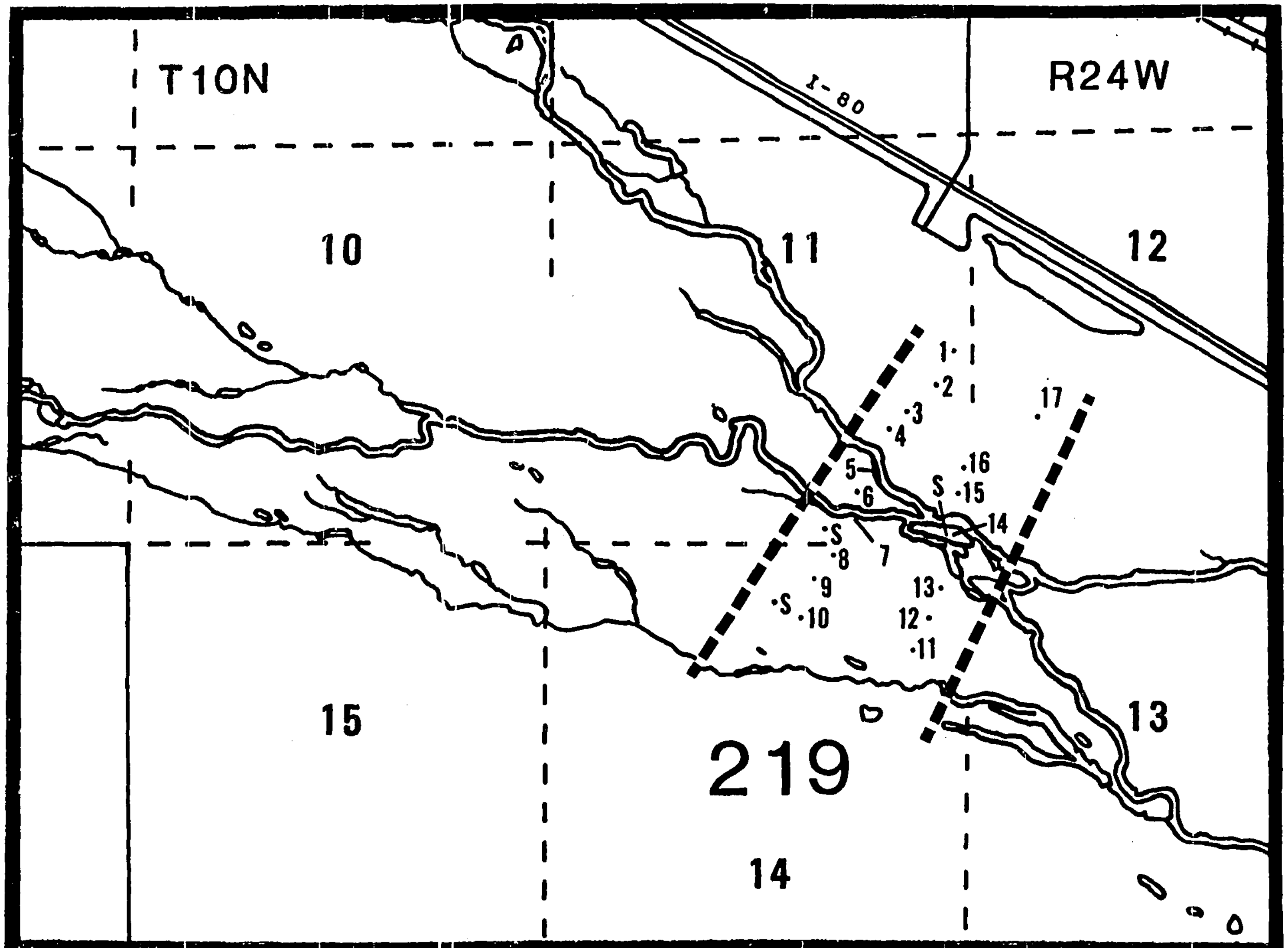
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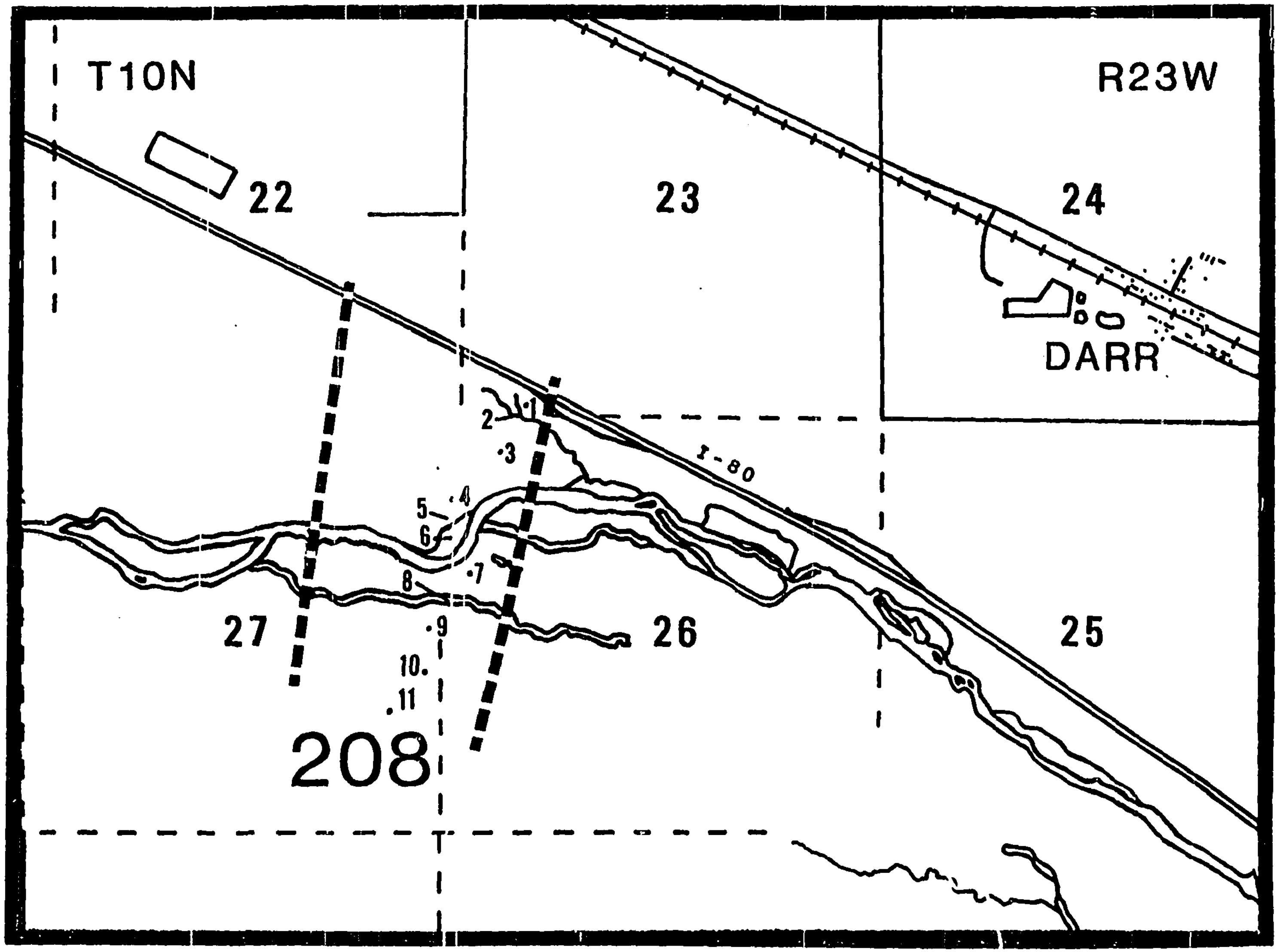
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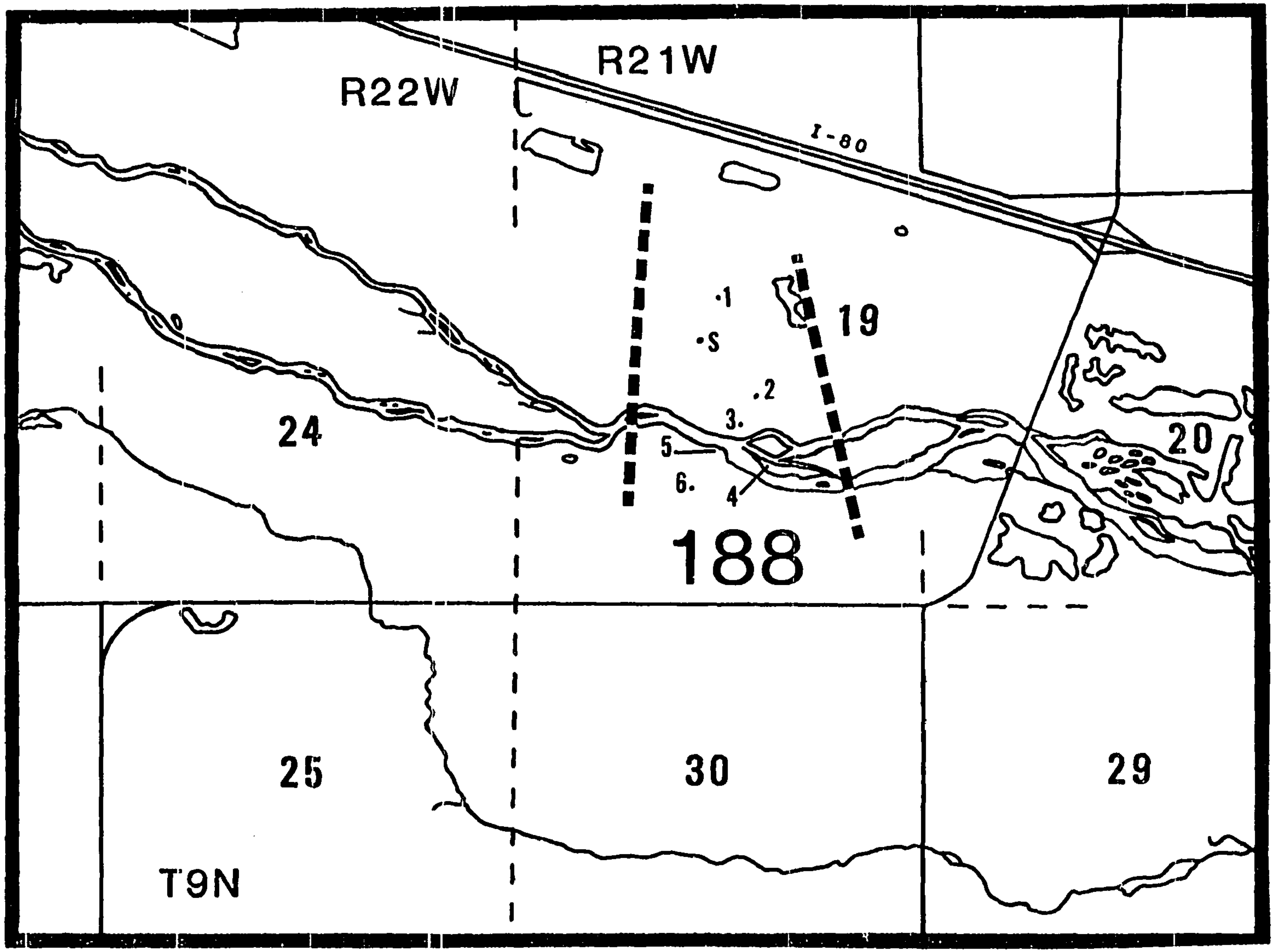
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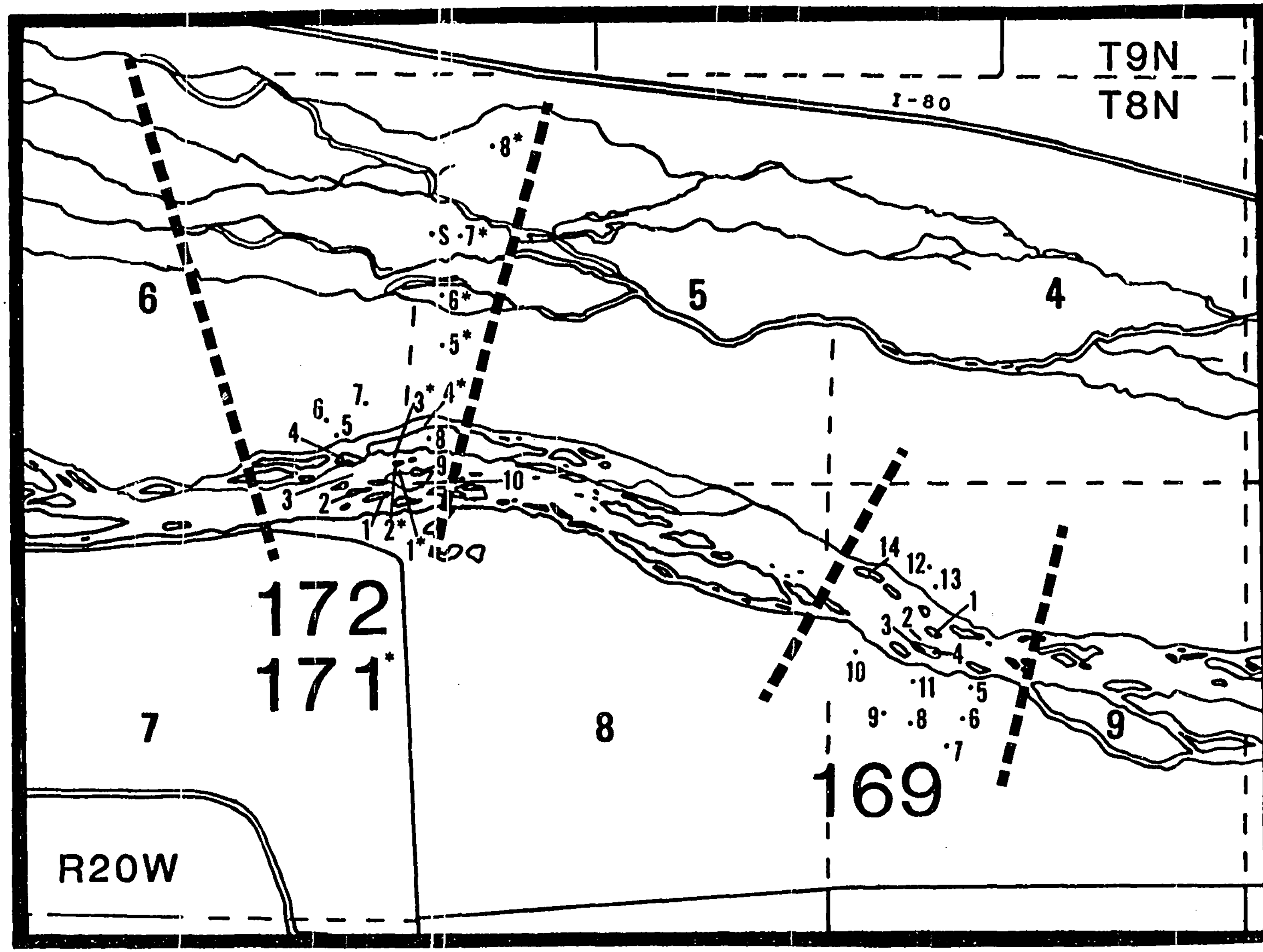
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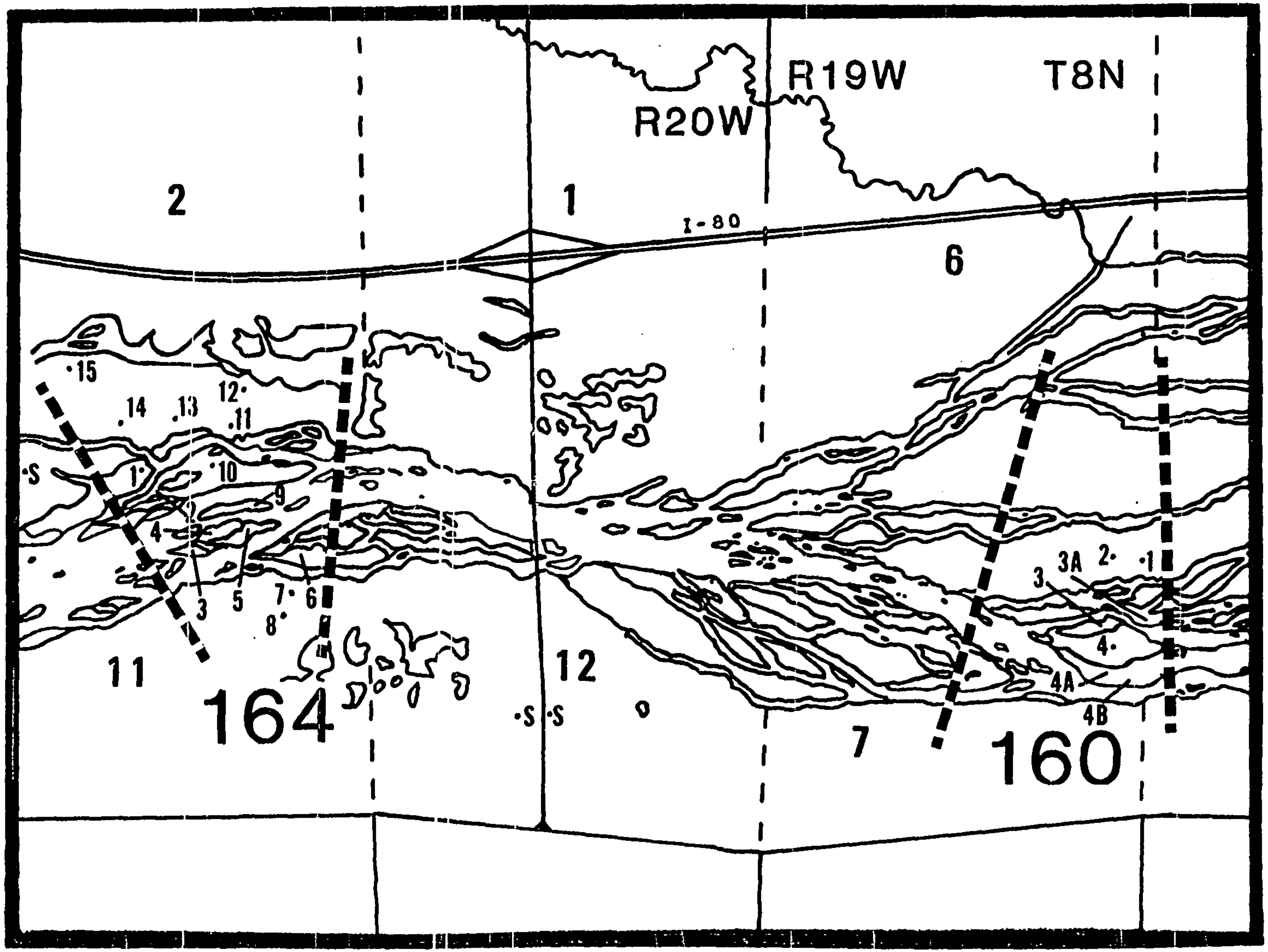
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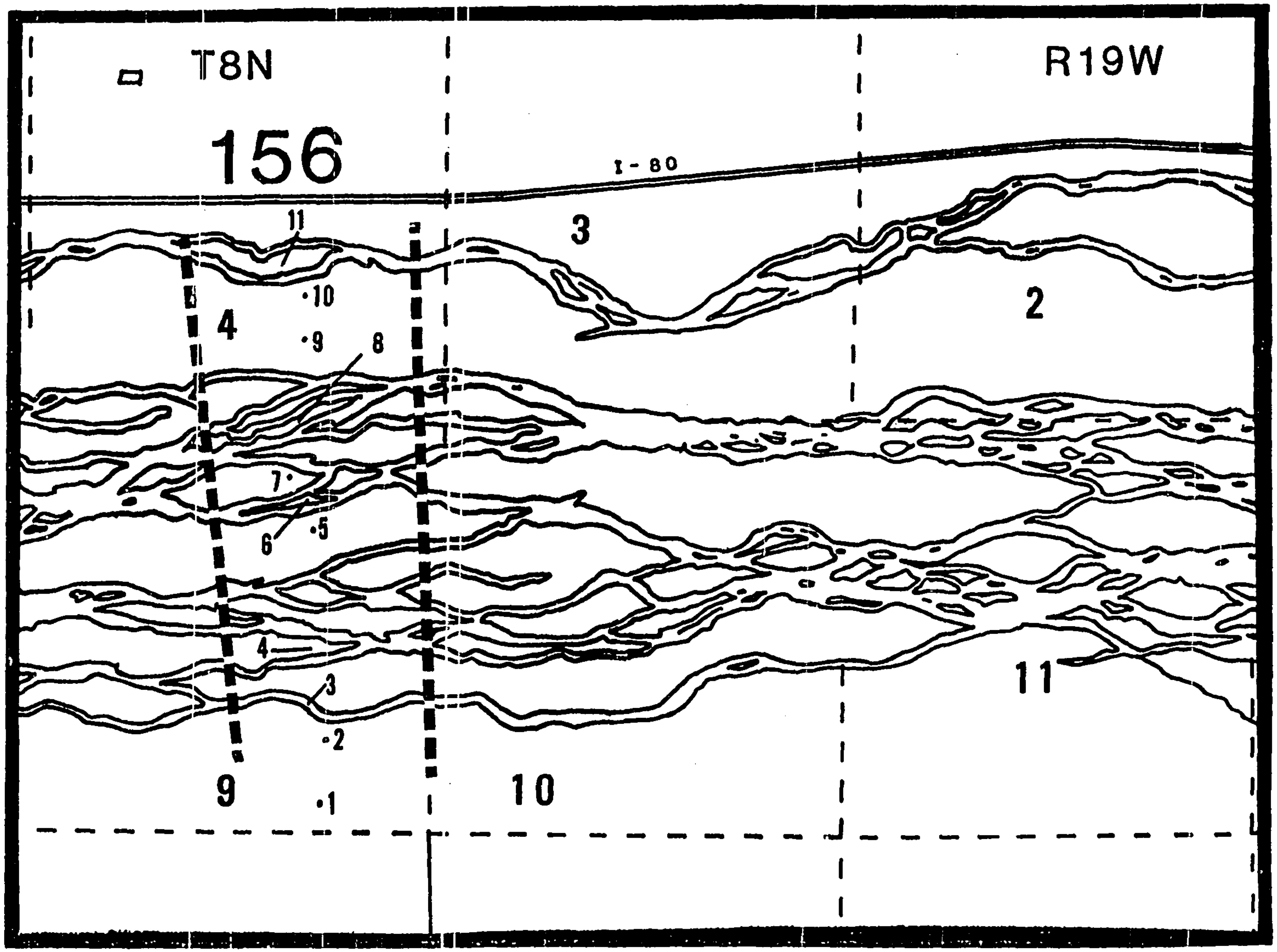
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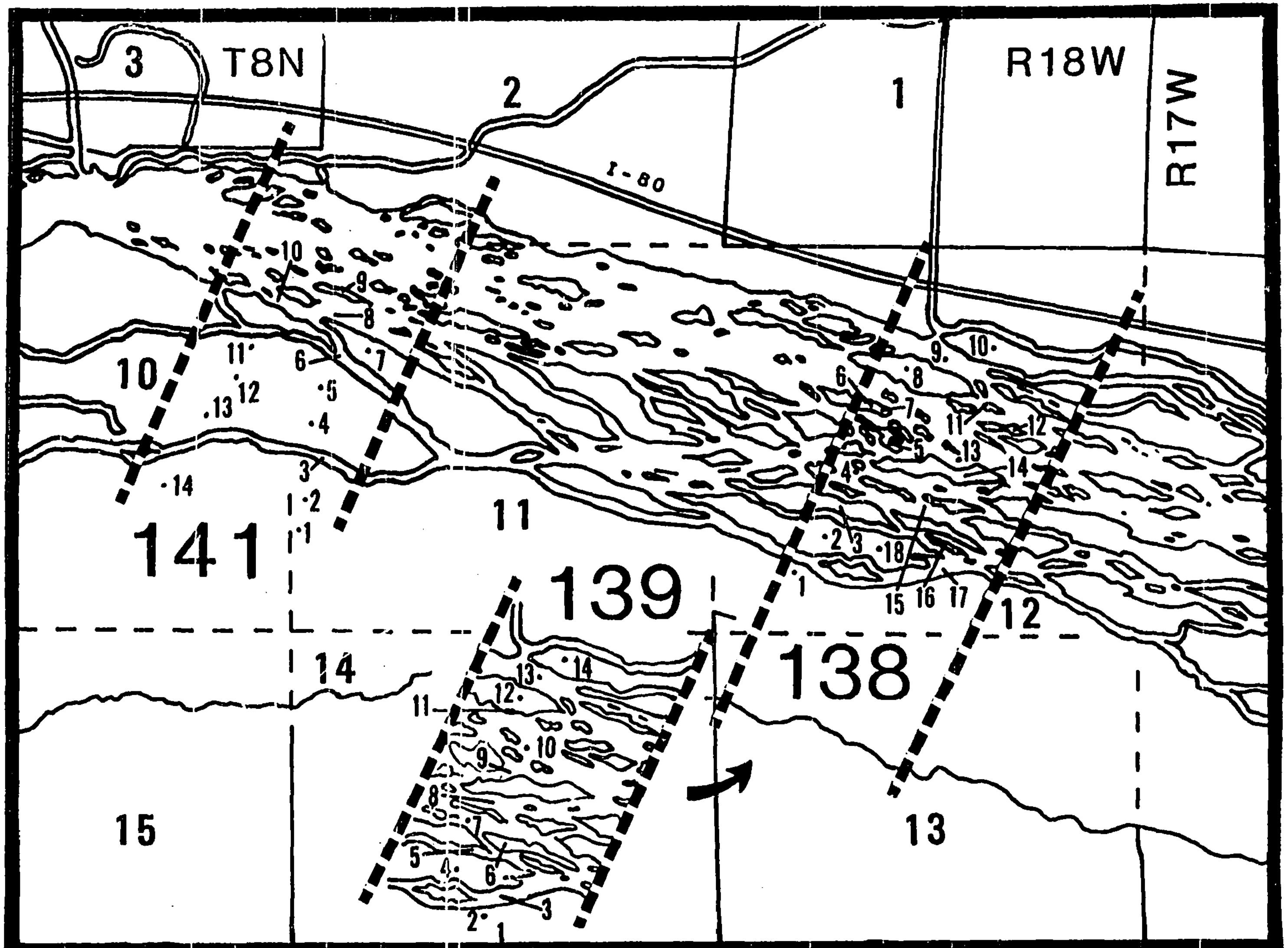
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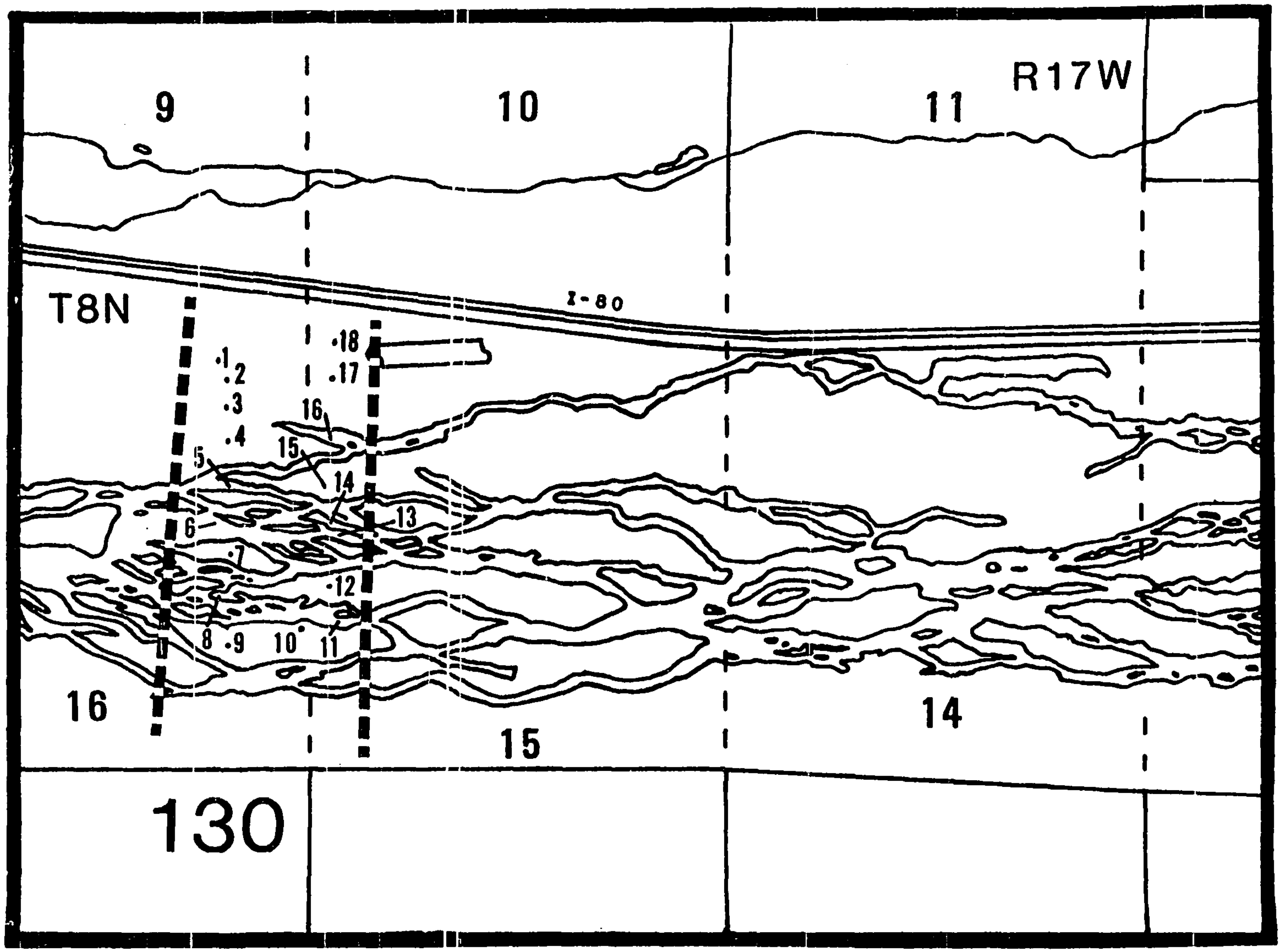
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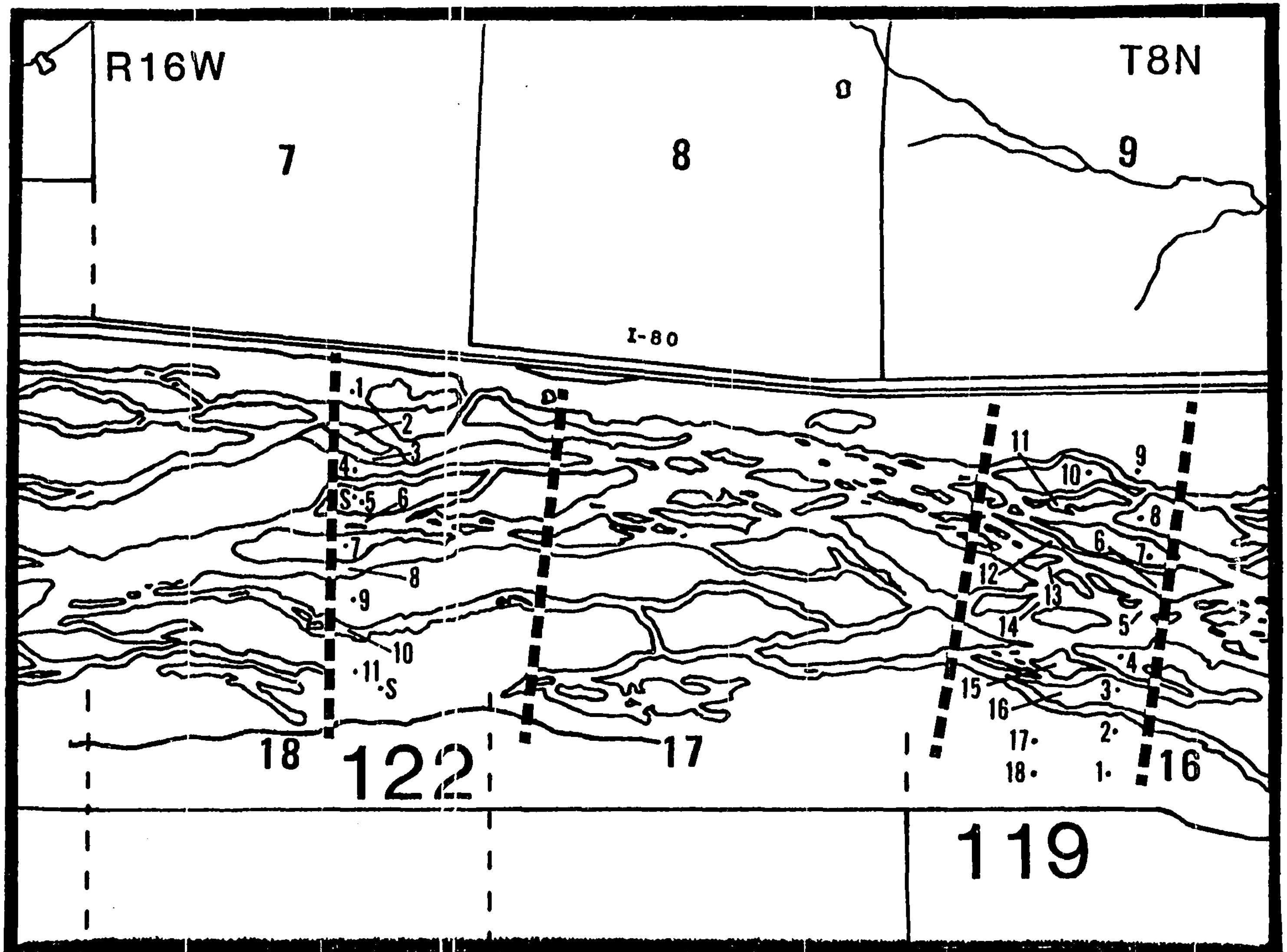
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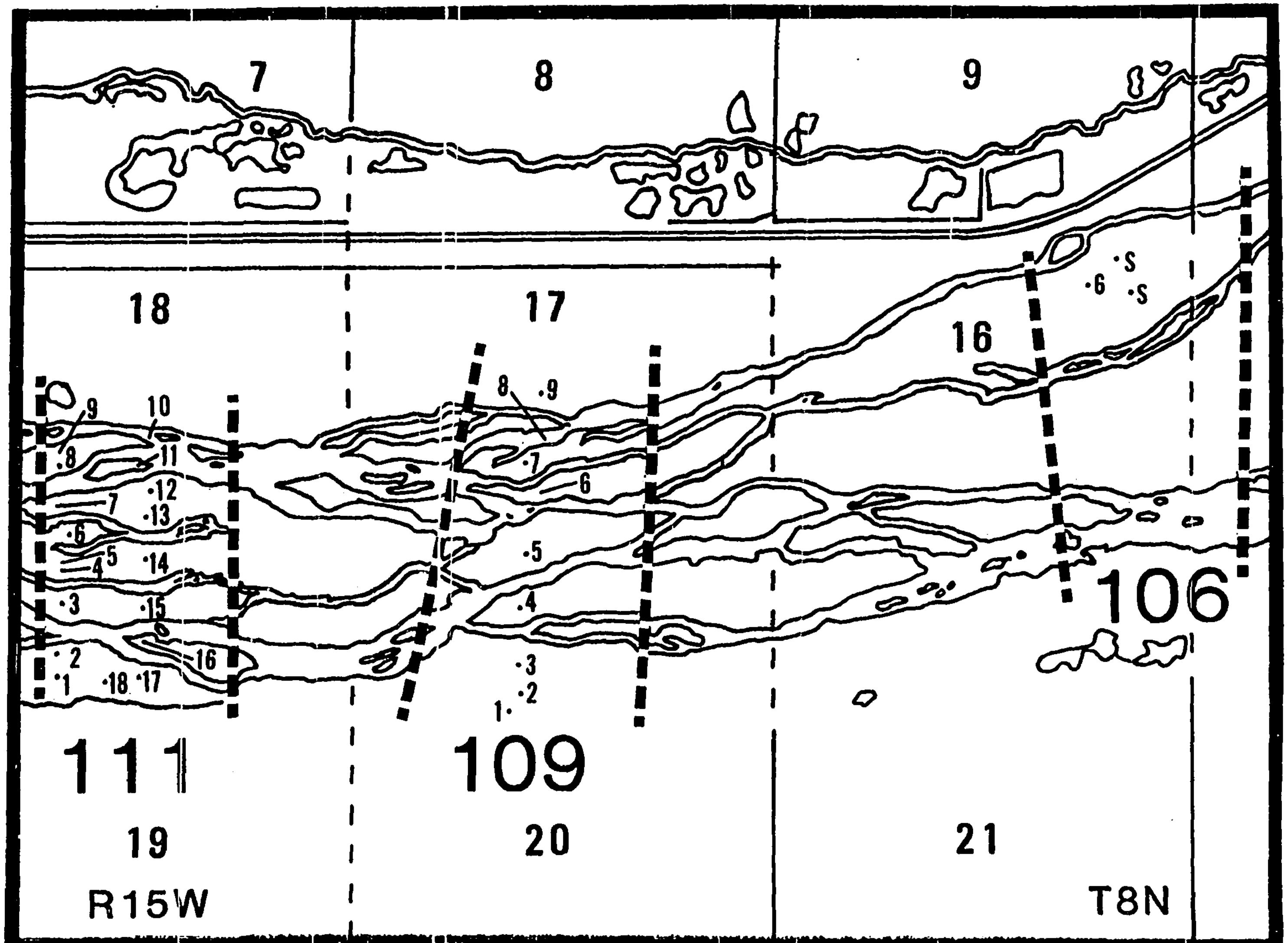
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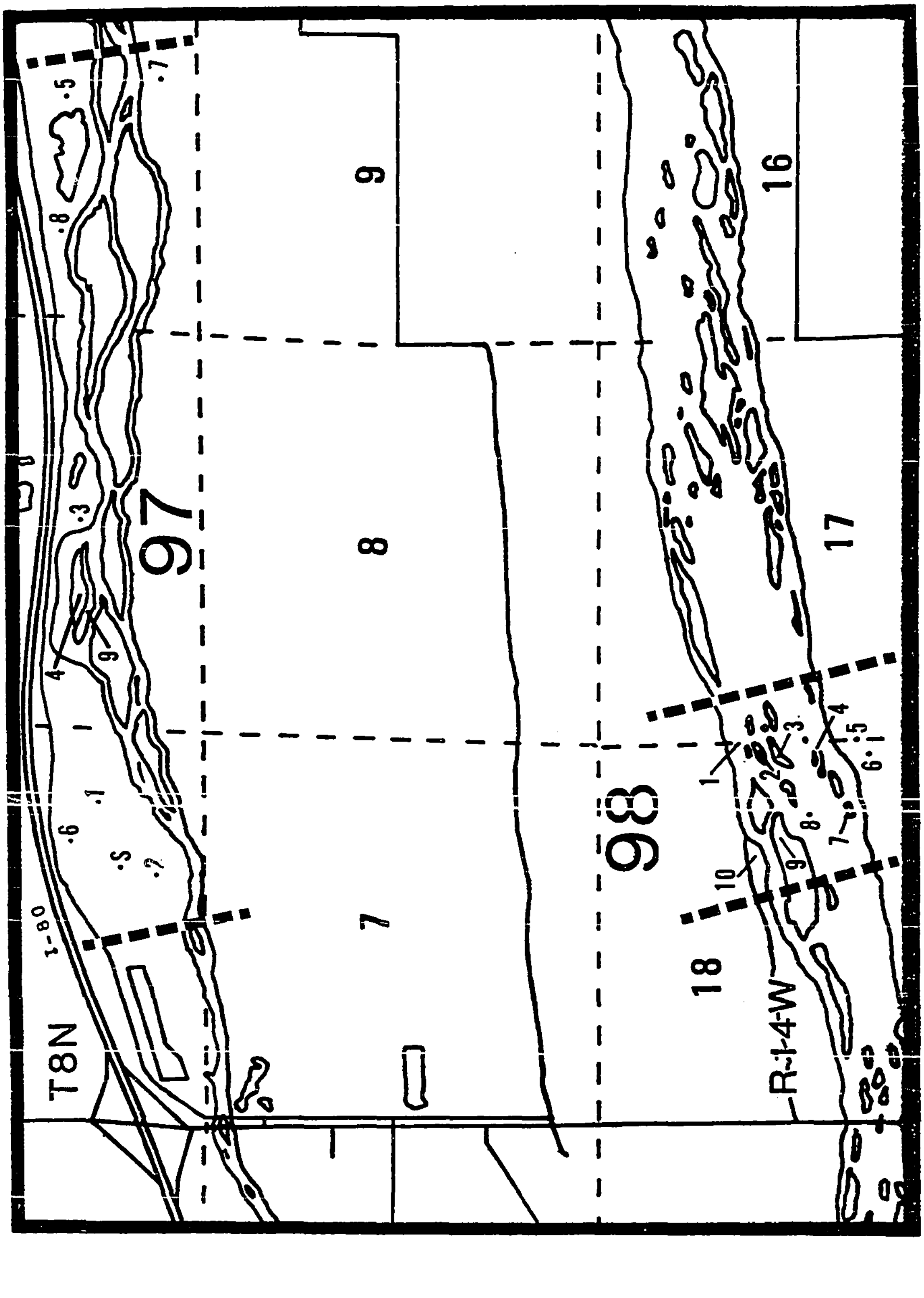
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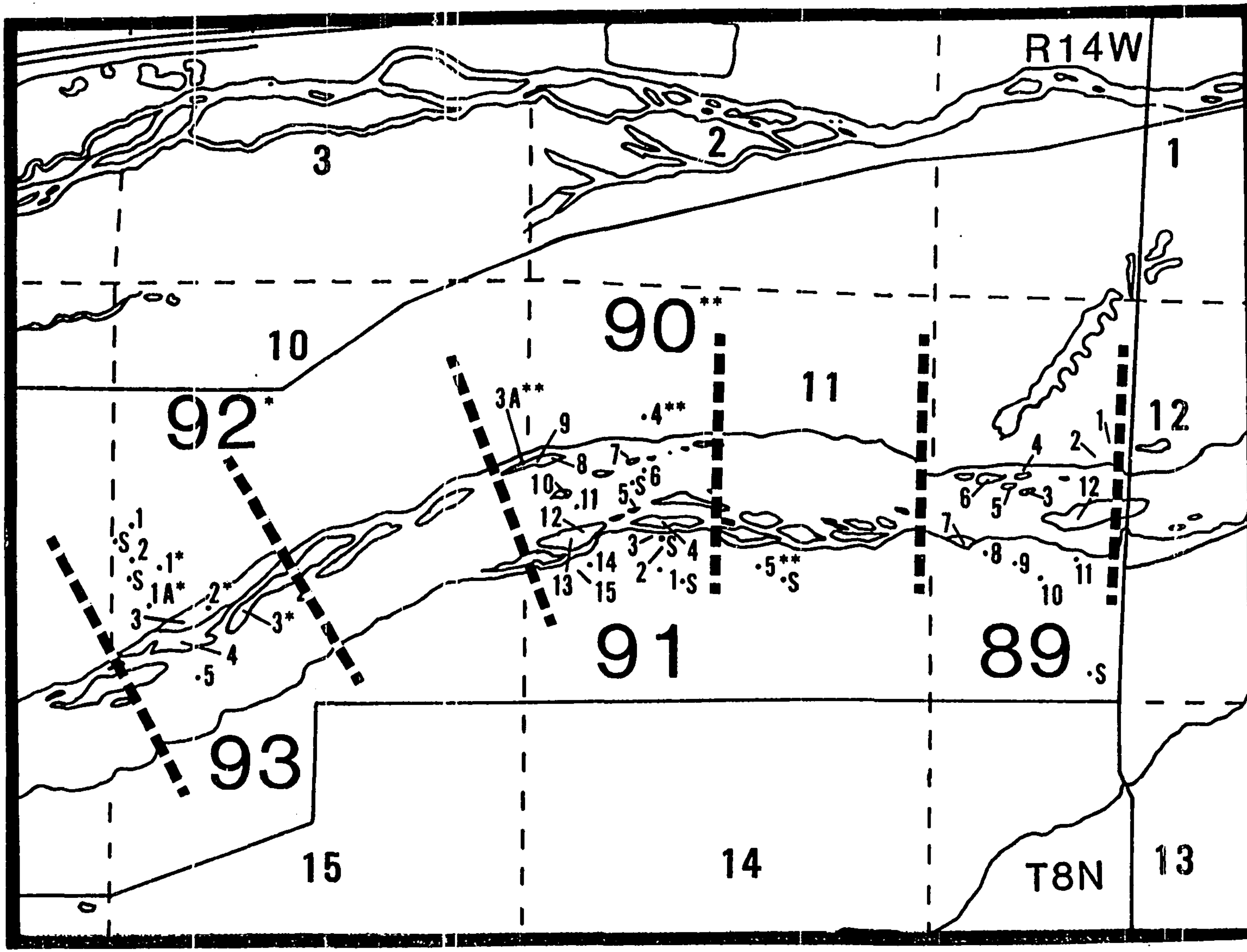
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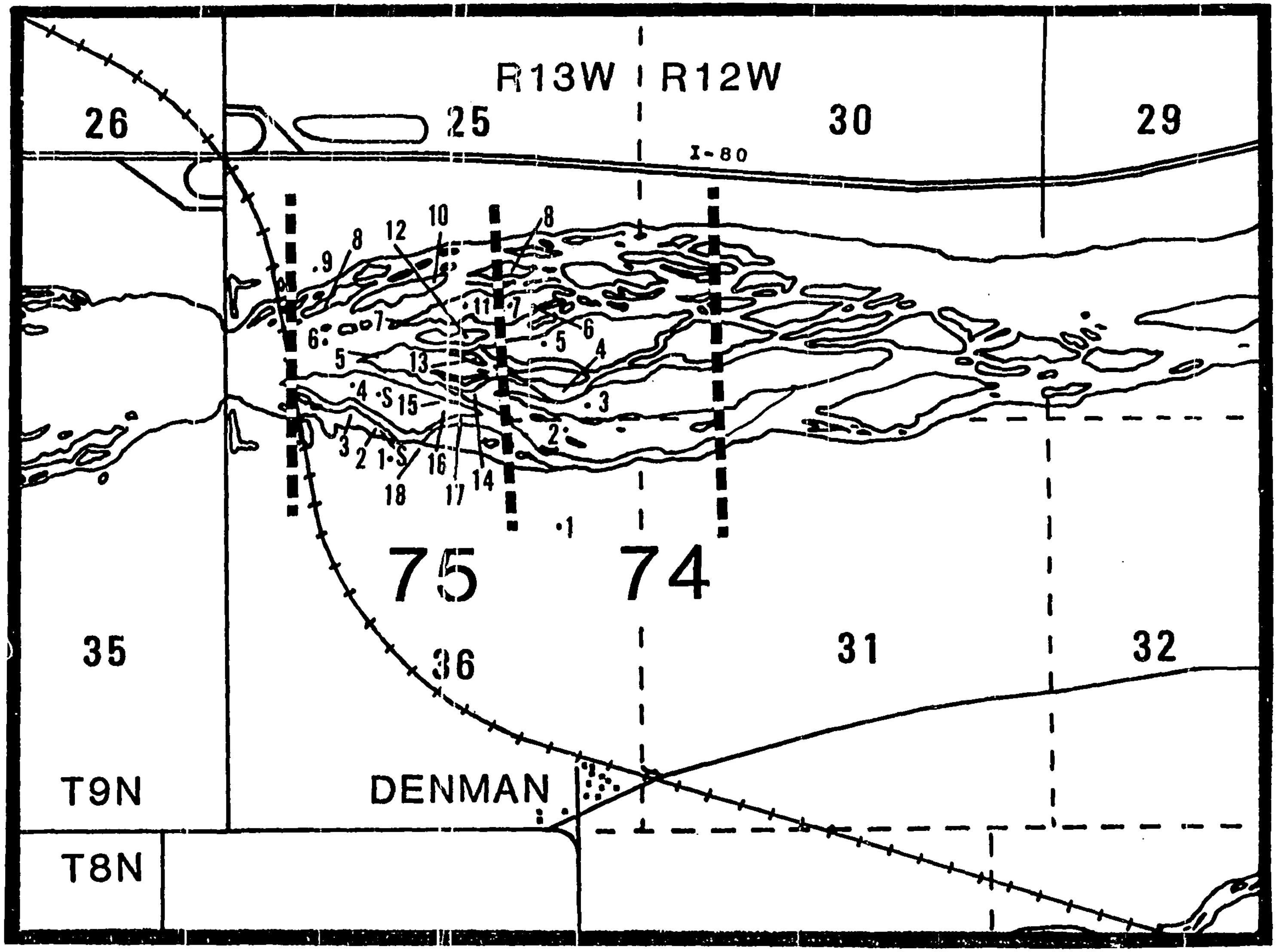
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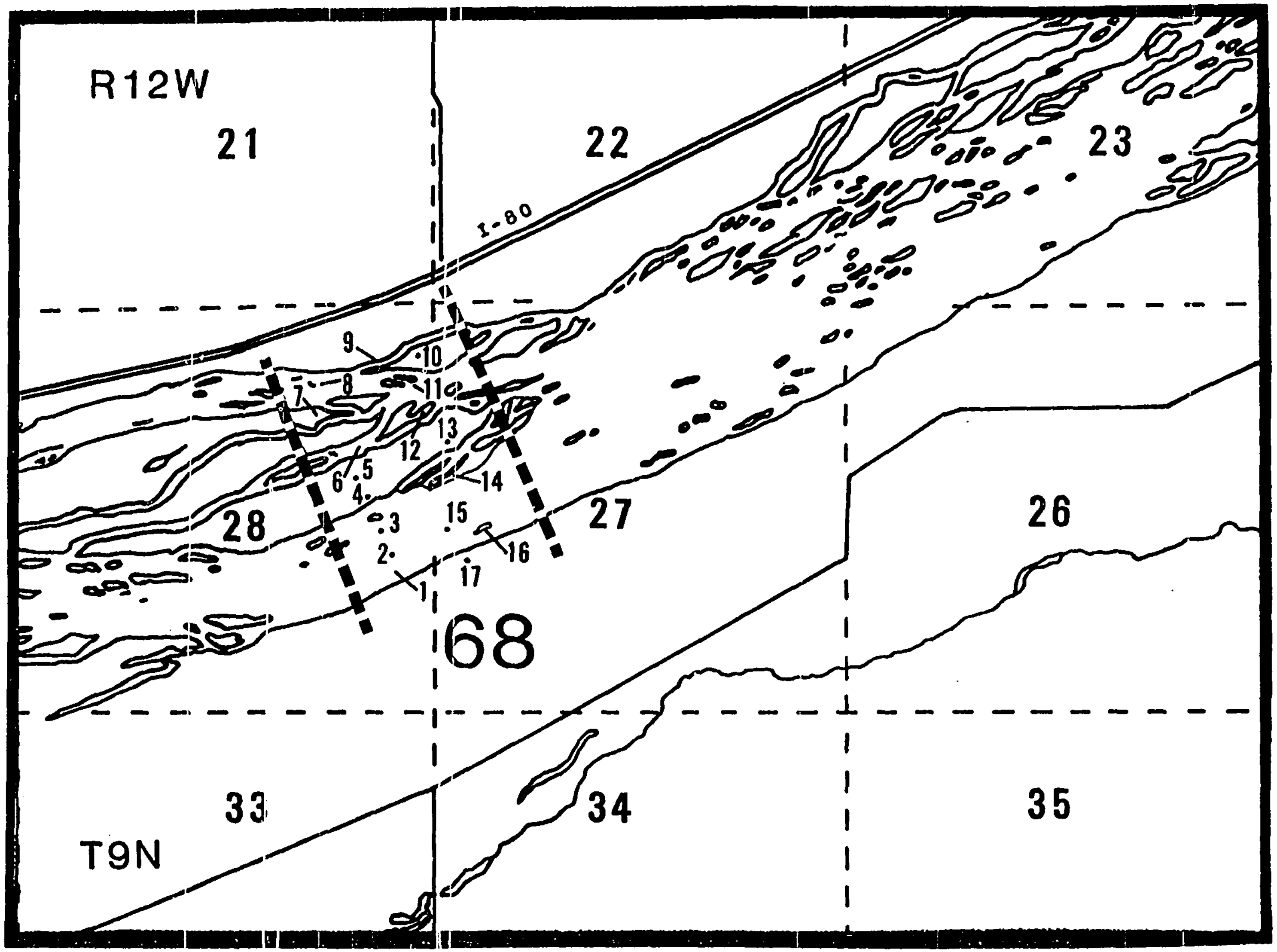

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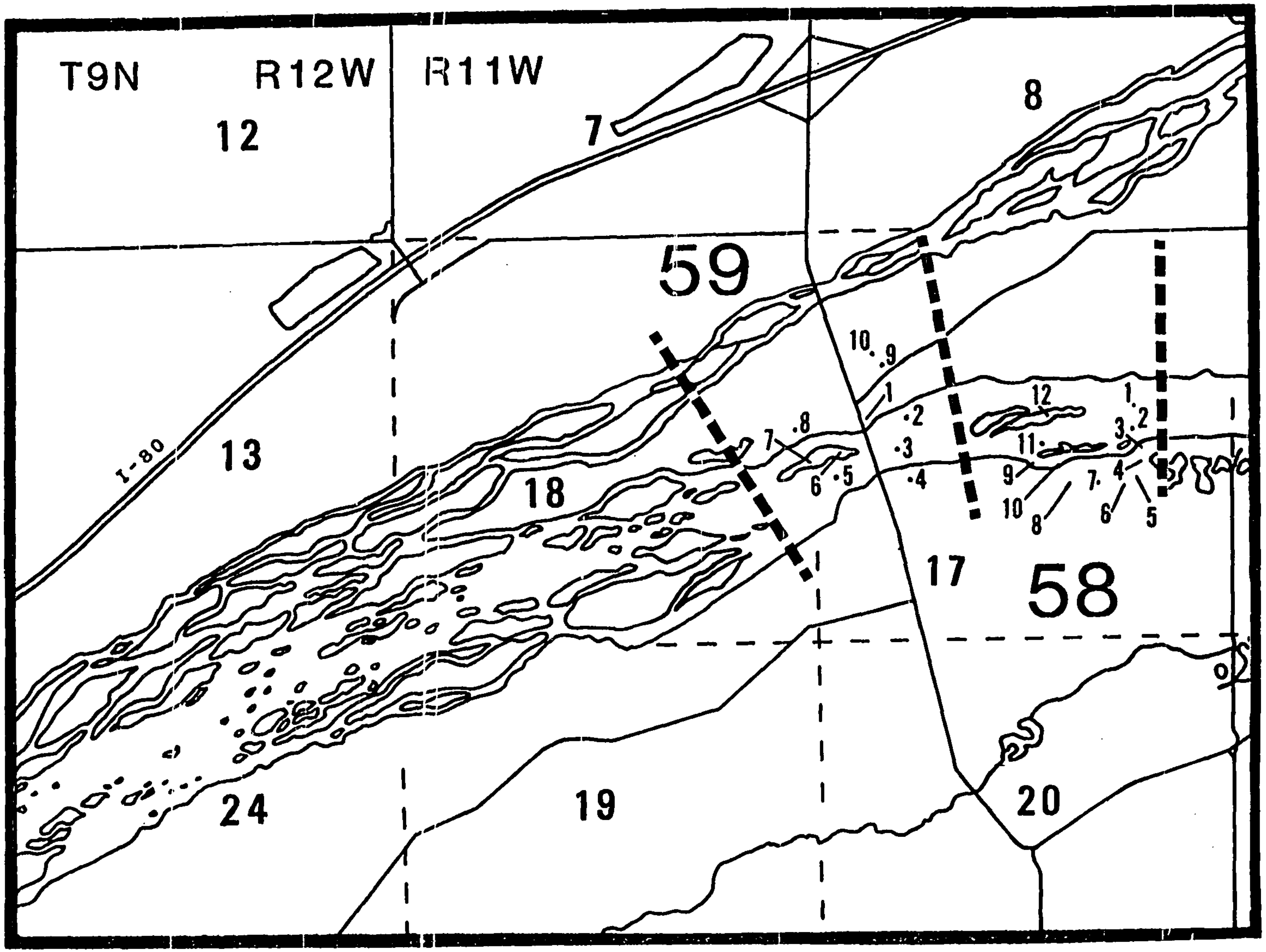
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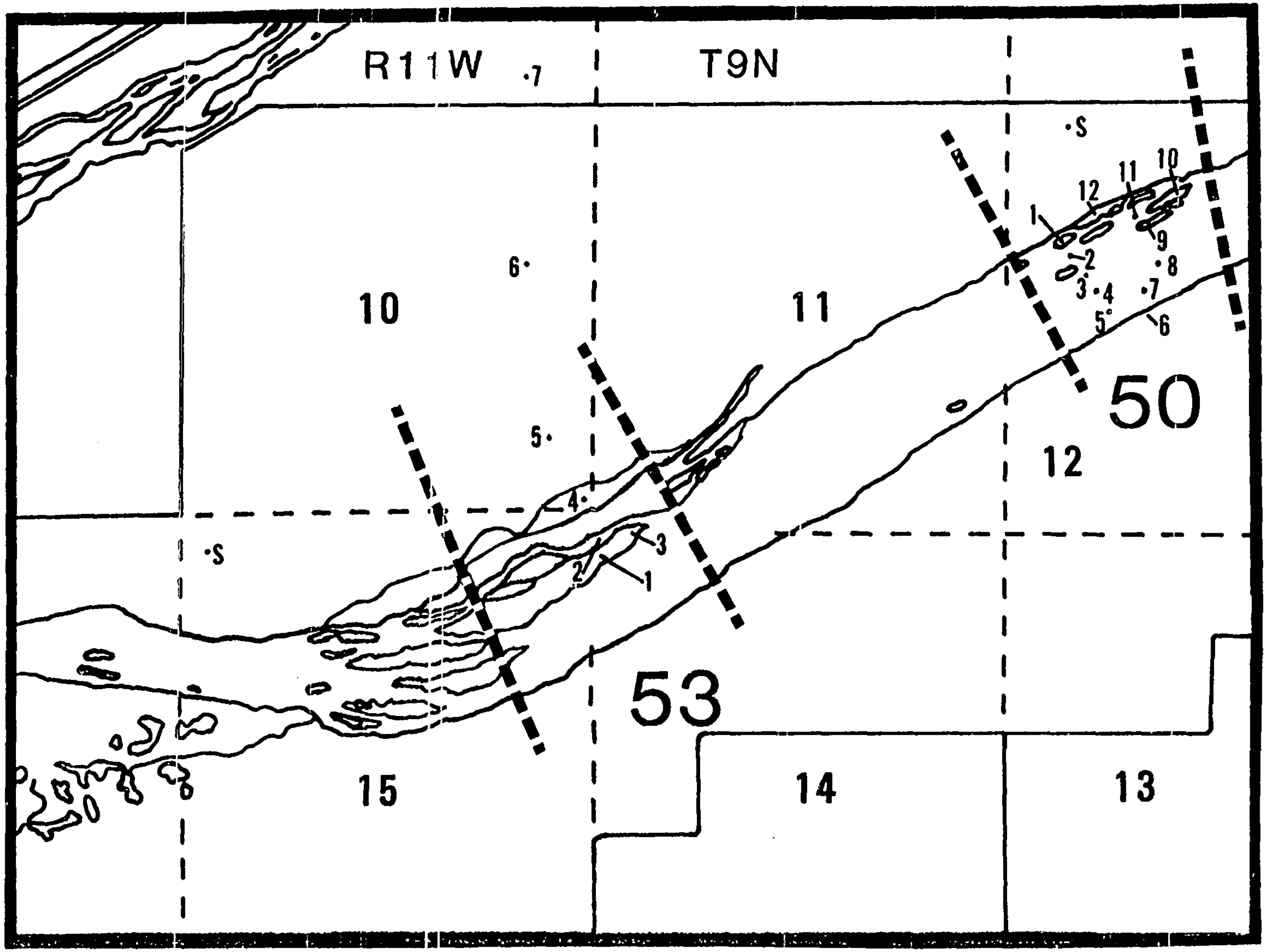
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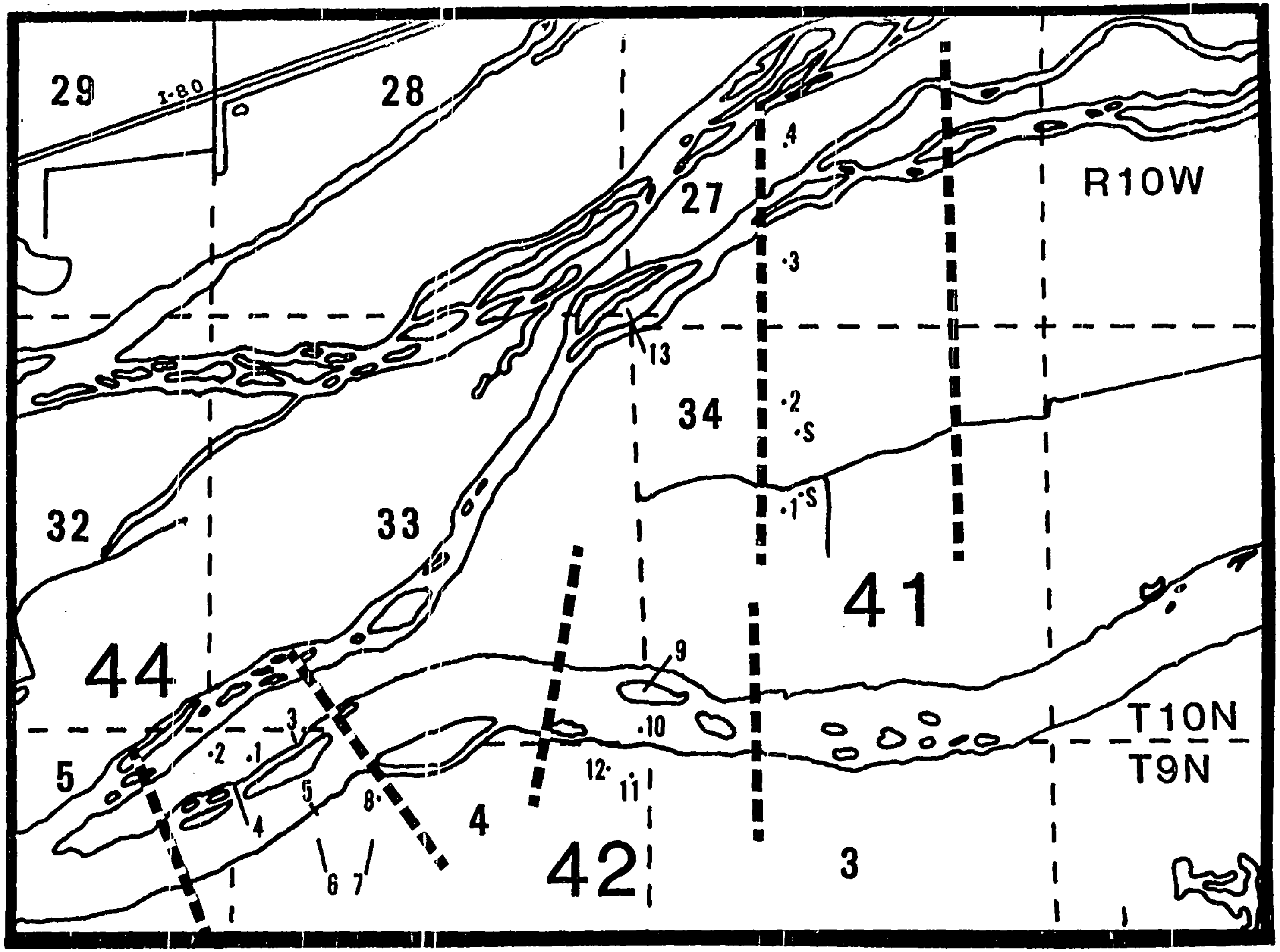

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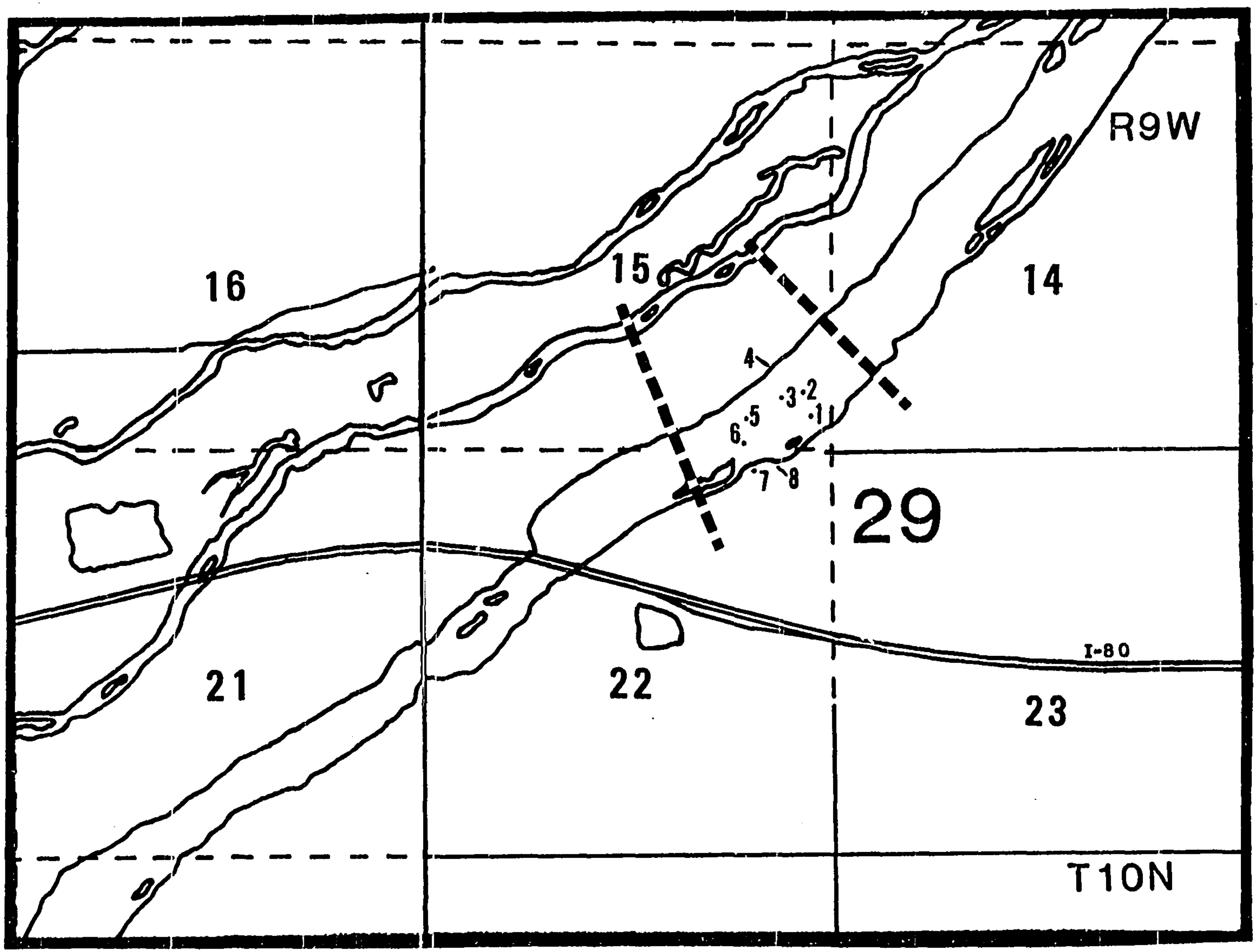

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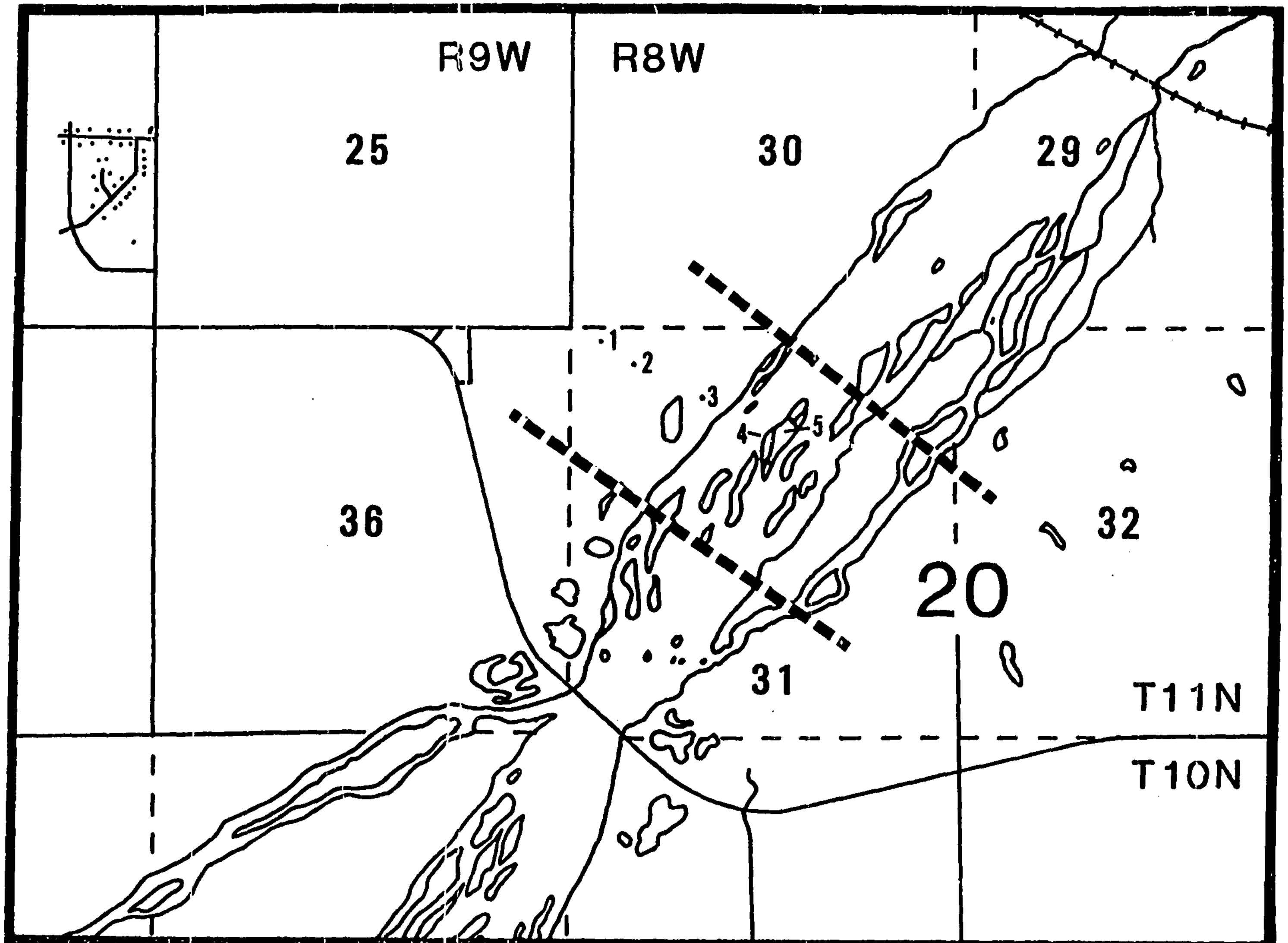
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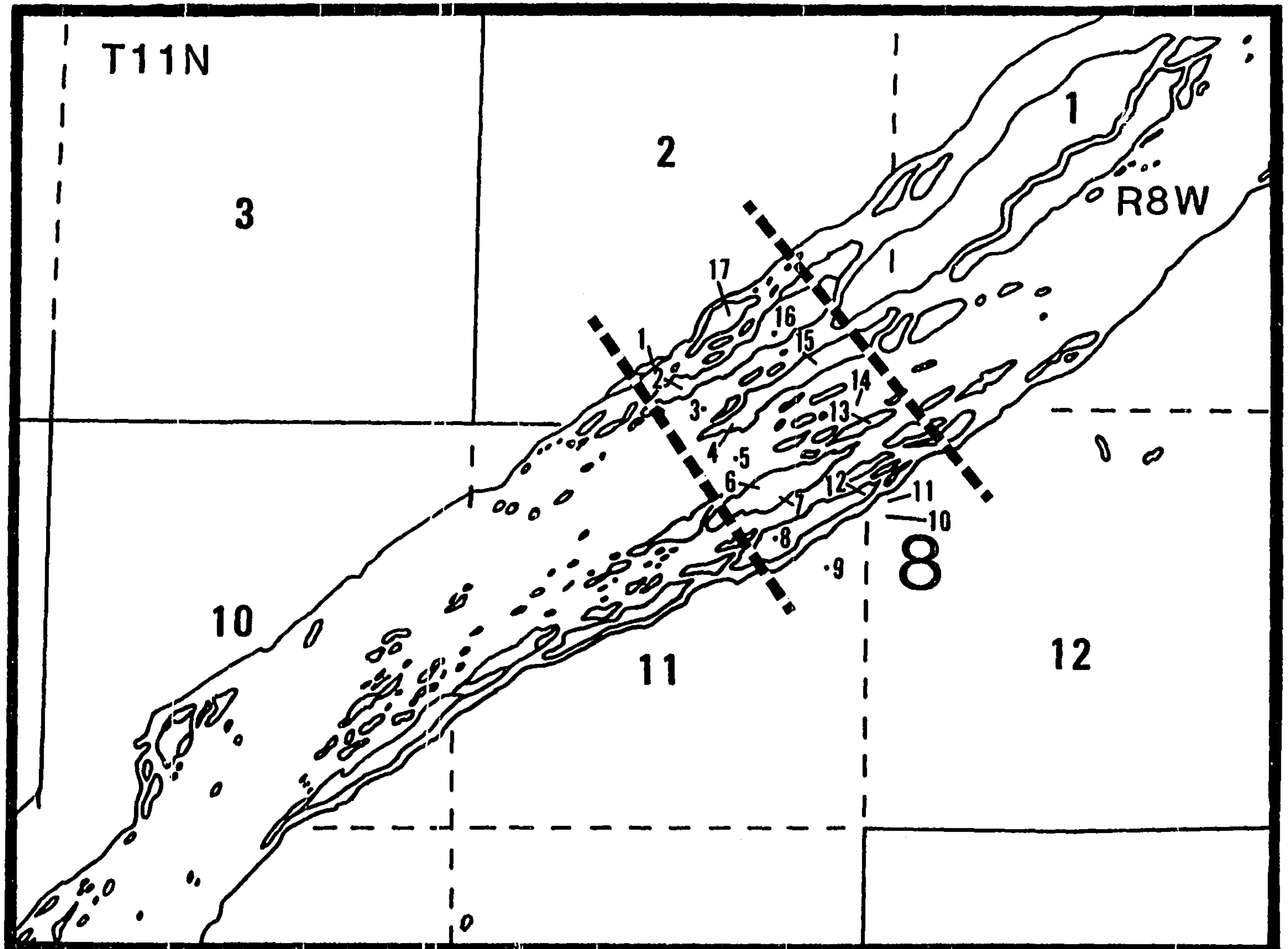
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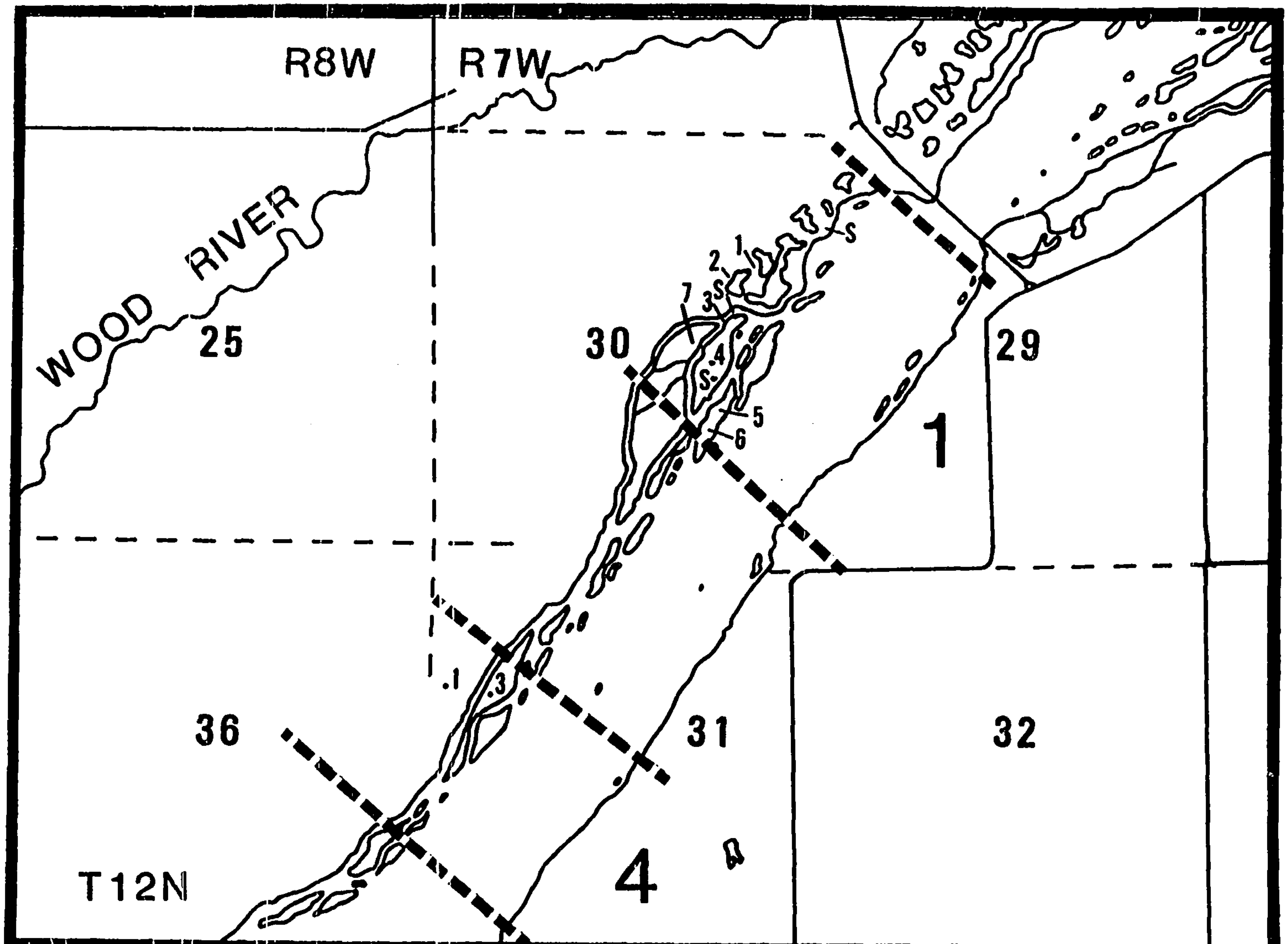
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32
4
T12N

APPENDIX B: SPECIES LIST

TABLE B1. LIST OF SPECIES ENCOUNTERED AND VOUCHER SPECIMENS COLLECTED DURING THE PLATTE RIVER VEGETATION SURVEY

SPECIES	VOUCHER SPECIMEN NUMBER
ABRONIA FRAGRANS NUTT.	1734
ACER NEGUNDO L.	832 1635
ACER SACCHARINUM L.	1368
ACHILLEA MILLEFOLIUM L.	725 763 1664
AGALINIS TENUIFOLIA (VAHL) RAF.	1540
AGRIMONIA GRYPOSEPALA WALLR.	1117
AGROPYRON CANINUM (L.) BEAUV.	801 1488
AGROPYRON CRISTATUM (L.) GAERTN.	853 1270
AGROPYRON SPP.	
AGROSTIS STOLONIFERA L.	1528
ALISMA PLANTAGO-AQUATICA L.	1095
ALLIUM CANADENSE L.	759 1519
ALOPECURUS CAROLINIANUS WALT.	1750 1903
AMARANTHUS RUDIS SAUER	1772
AMBROSIA ARTEMISIIFOLIA L.	1296 1766
AMBROSIA PSILOSTACHYA DC.	1759 1760
AMBROSIA TRIFIDA L.	1763 1764
AMMANNIA COCCINEA ROTTB.	821
AMORPHA CANESCENS PURSH	1588 1599
AMORPHA FRUTICOSA L.	747 1125 1441 1442 1568
ANDROPOGON GERARDI VITMAN	1274
ANDROPOGON HALLII HACK.	1613 1614
ANDROPOGON SCOPARIUS MICHX.	1022 1617
ANEMONE CANADENSIS L.	762 1452
APIOS AMERICANA MEDIC.	1548 1622
APOCYNUM SIBIRICUM JACQ.	755 856 911 1492 1518 1531
ARCTIUM MINUS SCHKUHR	1165
ARISTIDA LONGESPICA POIR.	1625
ARISTIDA LONGISETA STEUD.	798 1339 1484
ARTEMISIA CAMPESTRIS L.	1580
ARTEMISIA FILIFOLIA TORR.	1586
ARTEMISIA FRIGIDA WILLD.	1582
ARTEMISIA LUDOVICIANA NUTT.	1591 1702 1749
ASCLEPIAS INCARNATA L.	809 1698
ASCLEPIAS PUMILA (GRAY) VAIL	838 941
ASCLEPIAS SPECIOSA TORR.	
ASCLEPIAS SYRIACA L.	1380
ASCLEPIAS VERTICILLATA L.	1355 1611
ASPARAGUS OFFICINALIS L.	1429 1844
ASTER PILOSUS WILLD.	
ASTER SIMPLEX WILLD.	1542
ASTRAGALUS BISULCATUS (HOOK.) GRAY	1748
ASTRAGULUS CRASSICARPUS NUTT.	1503
ASTRAGALUS RACEMOSUS PURSH	1740
ATRIPLEX PATULA L.	1672
BIDENS CERNUA L.	1300 1541
BIDENS FRONDOSA L.	1910
BOEHMERIA CYLINDRICA (L.) SW.	1084 1758
BOUTELOUA CURTIPENDULA (MICHX.) TORR.	1104 1578 1632
BOUTELOUA GRACILIS (H.B.K.) GRIFFITHS	1287
BROMUS INERMIS LEYSS.	831 1728
BOUTELOUA HIRSUTA LAG.	1567 1610

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
BROMUS JAPONICUS THUNB.	1021 1391
BROMUS TECTORUM L.	707 765 1853 1854
CALAMAGROSTIS INEXPANSA GRAY	949 1753
CALAMOVILFA LONGIFOLIA (HOOK.) SCRIBN.	1630 1744
CALLIRHOE ALCAEOIDES (MICHX.) GRAY	731 732 1379
CALLIRHOE INVOLUCRATA (T.&G.) GRAY	703 724 1135 1384 1511
CALYLOPHUS HARTWEGII (BENTH.) RAVEN	1730
CALYLOPHUS SERRULATUS (NUTT.) RAVEN	1729
CANNABIS SATIVA L.	1089
CAPSELLA BURSA-PASTORIS (L.) MEDIC.	1419
CARDARIA DRABA (L.) DESV.	1421
CARDUUS NUTANS L.	
CAREX AQUATILIS WAHL.	1334 1950 1851 1914 1916
CAREX ATHERODES SPRENG.	1337 1913
CAREX BLANCA DEW.	1460
CAREX BREVIOR (DEW.) MACK.	1917 1918 1919 1920
CAREX LANUGINOSA MICHX.	1921 730
CAREX MEADII DEW.	1922 1923
CAREX STIPATA MUHL.	1336 1924
CAREX TENERA DEW.	1352 1925
CAREX VULPINOIDEA MICHX.	1926 1927
CATALPA SPECIOSA WARDER	749 885
CELASTRUS SCANDENS L.	1422
CELTIS OCCIDENTALIS L.	1075 1463
CENCHRUS LONGISPINUS (HACK.) FERN.	1202
CERASTIUM BRACHYPODUM (ENGELM.) ROBINS.	1445
CERATOPHYLLUM DEMERSUM L.	
CHENOPODIUM ALBUM L.	1053
CHENOPODIUM GLAUCUM L.	1115 1500
CHLORIS VERTICILLATA NUTT.	
CHRYSANTHEMUM LEUCANTHEMUM L.	728 746 770 1517
CHRYSOPSIS VILLOSA (PURSH) NUTT.	1547 1667
CICHORIUM INTYBUS L.	1040
CIRSIUM FLODMANI (RYDB.) ARTHUR	1912
CIRSIUM PLATTENSE (RYDB.) FERN.	1501
CIRSIUM UNDULATUM (NUTT.) SPRENG.	1650
CIRSIUM SPP.	
CLEOME SERRULATA PURSH	1078 1607
CONVOLVULUS ARVENSIS L.	950 1395 1537 1666
CONYZA CANADENSIS (L.) CRONQ.	1032 1282 1761
COREOPSIS TINCTORIA NUTT.	
CORNUS DRUMMONDII C. A. MEYER	914 1498
CORNUS STOLONIFERA MICHX.	774 1333 1478 1872 1873
CORONILLA VARIA L.	874
CREPIS RUNCINATA (JAMES) T.&G.	1455 1661
CROTON TEXENSIS (KLOTZSCH) MUELL. ARG.	1344 1668
CUSCUTA GLOMERATA CHOISY	1297
CYCLOLOMA ATRIPLICIFOLIUM (SPRENG.) COULT.	1641
CYPERUS ARISTATUS ROTTB.	788 871
CYPERUS ERYTHRORHIZOS MUHL.	824 1928 1929 1930
CYPERUS ESCULENTUS L.	834 1901 1906
DACTYLIS GLOMERATA L.	930 988

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
DAUCUS CAROTA L.	1904
DESCURAINIA PINNATA (WALT.) BRITT.	1852
DESCURAINIA SOPHIA (L.) WEBB	1646
DESMANTHUS ILLINOENSIS (MICHX.) MACM.	816 1552 1554
DESMODIUM CANADENSE (L.) DC.	1579
DESMODIUM GLUTINOSUM (MUHL.) WOOD	1071 1072
DISTICHLIS SPICATA (L.) GREENE	1096 1373 1480
DYSSODIA PAPPOSA (VENT.) HITCHC.	1909
ECHINOCHLOA CRUSGALLI (L.) BEAUV.	869 1278
ECHINOCHLOA MURICATA (BEAUV.) FERN.	953
ECHINOCYSTIS LOBATA (MICHX.) T.&G.	1561
ELAEAGNUS ANGUSTIFOLIA L.	916 1436 1437
ELEOCHARIS PALUSTRIS (L.) R.&S.	897
ELYMUS CANADENSIS L.	1271 1693
ELYMUS VIRGINICUS L.	823 1283 1644
EQUISETUM HYEMALE L.	1332 1902
EQUISETUM LAEVIGATUM A. BR.	725
ERAGROSTIS CILIANENSIS (ALL.) E. MOSHER	1624
ERAGROSTIS PECTINACEA (MICHX.) NEES	855 946
ERIGERON PHILADELPHICUS L.	733
ERIGERON STRIGOSUS MUHL.	1525
EUPHORBIA MACULATA L.	948 1638
EUPHORBIA MARGINATA PURSH	1087 1263 1695
EUPHORBIA MISSURICA RAF.	1593
EUPHORBIA PODPERAE CROIZAT	1458
EUSTOMA GRANDIFLORUM (RAF.) SHINNERS	1039 1091 1555
FESTUCA OCTOFLORA WALT.	847 1015 1127 1466
FRAGARIA VIRGINIANA DUCHN.	1847
FRAXINUS PENNSYLVANICA MARSH.	1062 1063 1427
FROELICHIA GRACILIS (HOOK.) MOQ.	1768
GALIUM APARINE L.	1471 1875 1876 1877
GALIUM CIRCAEZANS MICHX.	782 920
GAURA COCCINEA PURSH	1739
GAURA PARVIFLORA DOUGL.	1042 1108
GEUM CANADENSE JACQ.	815 923
GEUM VERNUM (RAF.) T.&G.	1366
GLYCYRRHIZA LEPIDOTA PURSH	1281 1388 1674 1725
GRINDELIA SQUARROSA (PURSH) DUN.	1049 1050 1545 1757
HACKELIA VIRGINIANA (L.) I. M. JOHNST.	1704
HAPLOPAPPUS SPINULOSUS (PURSH) DC.	1592
HEDEOMA HISPIDA PURSH	846 1652
HELENIUM AUTUMNALE L.	1908
HELIANTHUS ANNUUS L.	1767
HELIANTHUS GROSSESERRATUS MARTENS	
HELIANTHUS PETIOLARIS NUTT.	837 1025 1506
HELIANTHUS TUBEROSUS L.	
HELIOPSIS HELIANTHOIDES (L.) SWEET.	1708
HIBISCUS MILITARIS CAV.	1706
HIBISCUS TRIONUM L.	1669
HORDEUM JUBATUM L.	713 974
HORDEUM PUSILLUM NUTT.	840 1465
HORDEUM VULGARE L.	1328

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
HYPOXIS HIRSUTA (L.) COV.	1133 1415 1865
IMPATIENS BIFLORA WALT.	
IPOMOEA LEPTOPHYLLA TORR.	1611
IPOMOEA PANDURATA (L.) MEY.	1514
IRIS PSEUDACORUS L.	1346 1401
IVA XANTHIFOLIA NUTT.	
JUGLANS NIGRA L.	1719
GALIUM TRIFLORUM MICHX.	
JUNCUS BALTICUS WILLD.	738 1092 1312 1863
JUNCUS BUFONIUS L.	908 1138 1411
JUNCUS DUDLEYI WEIG.	1094
JUNCUS TORREYI COV.	1690 1743
JUNIPERUS SCOPULORUM SARG.	1360
JUNIPERUS VIRGINIANA L.	1874 1878 1879
KOCHIA SCOPARIA (L.) SCHRAD.	1288
KOELERIA PYRAMIDATA (LAM.) BEAUV.	1754
LACTUCA SERRIOLA L.	1765 1911
LAPPULA ECHINATA GILIB.	1532
LEERSIA ORYZOIDES (L.) SW.	
LEMNA MINOR L.	1687
LEPIDIUM DENSIFLORUM SCHRAD.	902 999 1153
LEPTOCHLOA FASCICULARIS (LAM.) GRAY	1752 1905
LIATRIS GLABRATA RYDB.	1609
LIATRIS PYCNOSTACHYA MICHX.	1619 1620
LITHOSPERMUM CANESCENS (MICHX.) LEHM.	1018
LITHOSPERMUM INCISUM LEHM.	1017 1417 1864
LOBELIA SIPHILITICA L.	1546
LOBELIA SPICATA LAM.	1549 1726
LOTUS CORNICULATUS L.	706 1008
LOTUS PURSHIANUS CLEM. & CLEM.	1707
LUPINUS PUSILLUS PURSH	1742
LYCOPUS AMERICANUS MUHL.	1164 1700
LYCOPUS ASPER GREENE	1107 1701
LYGODESMIA JUNCEA (PURSH) HOOK.	1566
LYSIMACHIA CILIATA L.	1206
LYSIMACHIA THYRSIFLORA L.	717 1142 1499
LYTHRUM DACOTANUM NIEUW.	839 1513 1731
LYTHRUM SALICARIA L.	1258
MACLURA POMIFERA (RAF.) SCHNEID.	1213
MATRICARIA MATRICARIOIDES (LESS.) PORTER	
MEDICAGO LUPULINA L.	1147 1423 1524
MEDICAGO SATIVA L.	1013 1324
MELILOTUS ALBUS DESR.	786 1012 1326
MELILOTUS OFFICINALIS (L.) LAM.	767 1322
MENTHA ARVENSIS L.	968
MENTZELIA DECAPETALA (PURSH) URBAN & GILG	1048 1577 1596
MIMULUS GLABRATUS H.B.K.	1409
MIRABILIS HIRSUTA (PURSH) MACM.	1602
MIRABILIS NYCTAGINEA (MICHX.) MACM.	1141
MOLLUGO VERTICILLATA L.	1629
MONARDA FISTULOSA L.	1120
MORUS RUBRA L.	1439

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
MUHLENBERGIA ASPERIFOLIA (NEES & MEYEN) PARODI	943 1264
NEPETA CATARIA L.	859 873 1359
OENOTHERA BIENNIS L.	1727
OENOTHERA LACINIATA HILL	1683
OENOTHERA RHOMBIPETALA NUTT.	805 863 1723
OENOTHERA SPECIOSA NUTT.	741 1522
ONOSMODIUM MOLLE MICHX.	1657 1658
OPUNTIA MACRORHIZA ENGELM.	1403
OPUNTIA POLYACANTHA HAW.	854
OROBANCHE FASCICULATA NUTT.	1530
OROBANCHE LUDOVICIANA NUTT.	1054
OXALIS SPP.	
OXYTROPIS SPLENDENS DOUGL.	1502
PANICUM CAPILLARE L.	1292 1573 1670
PANICUM LANUGINOSUM ELL.	1931 1932 1933 1934 1935
PANICUM OLIGOSANTHES SCHULT.	1936 1937 1938 1939 1940 1941
PANICUM VIRGATUM L.	947 1031 1169 1612
PARIETARIA PENSYLVANICA MUHL.	1098 1315 1684
PARTHENOCISSUS VITACEA (KNERR) HITCHC.	1074 1677
PASPALUM SETACEUM MICHX.	842 951
PENSTEMON ALBIDUS NUTT.	1321
PENSTEMON GRANDIFLORUS NUTT.	1473
PENTHORUM SEDOIDES L.	1568
PETALOSTEMON CANDIDUM (WILLD.) MICHX.	828 1597 1696
PETALOSTEMON PURPUREUM (VENT.) RYDB.	944 1399 1558
PETALOSTEMON VILLOSUM NUTT.	864 934
PHALARIS ARUNDINACEA L.	857 906 1330
PHLEUM PRATENSE L.	1016
PHLOX OVATA L.	1453
PHRAGMITES AUSTRALIS (CAV.) TRIN.	
PHRYMA LEPTOSTACHYA L.	1103 1689
PHYLA LANCEOLATA (MICHX.) GREENE	820 849 888
PHYSALIS HETEROPHYLLA NEES	1196
PHYSALIS VIRGINIANA MILL.	1390
PHYSOSTEGIA VIRGINIANA (L.) BENTH.	1383
PLANTAGO PATAGONICA JACQ.	710 1014 1126 1306 1354
PLANTAGO RUGELII DCNE.	
POA PRATENSIS L.	1840 1841
POLYGONATUM BIFLORUM (WALT.) ELL.	1487
POLYGONUM ARENASTRUM JORD. EX BOR.	1682
POLYGONUM COCCINEUM MUHL.	1745 1773
POLYGONUM LAPATHIFOLIUM L.	1163
POLYGONUM PERSICARIA L.	778 945 1295 1722 1774
POLYGONUM SCANDENS L.	
POLYPOGON MONSPELIENSIS (L.) DESF.	883 1110 1686
POPULUS DELTOIDES MARSH.	1057 1109 1839 1855 1856 1857
PORTULACA OLERACEA L.	
POTENTILLA ANSERINA L.	
POTENTILLA PARADOXA NUTT.	1659 1732
POTENTILLA RECTA L.	1055
POTENTILLA RIVALIS NUTT.	
PRUNELLA VULGARIS L.	1085 1102 1152 1340

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
PRUNUS AMERICANA MARSH.	1705
PRUNUS VIRGINIANA L.	1449 1845 1846 1866 1867
PSORALEA ARGOPHYLLA PURSH	1106
PYCNANTHEMUM VIRGINIANUM (L.) DURAND & JACKS	1721
RANUNCULUS ABORTIVUS L.	1447
RANUNCULUS CYMBALARIA PURSH	748 1150 1653
RANUNCULUS LONGIROSTRIS GODR.	1859 1860 1861
RANUNCULUS MACOUNII BRITT.	1660
RANUNCULUS RHOMBOIDEUS GOLDIE	751
RATIBIDA COLUMNIFERA (NUTT.) WOOT. & STANDL.	889 1392
RHAMNUS CATHARTICUS L.	1338
RHUS AROMATICA AIT.	1044 1273 1408 1507 1585
RHUS GLABRA L.	829 937
RIBES AUREUM PURSH	1590
ROBINIA PSEUDOACACIA L.	1162 1414
RORIPPA PALUSTRIS (L.) BESS.	791 1397 1699
ROSA WOODSII LINDL.	1136 1146 1424
RUBUS OCCIDENTALIS L.	
RUDBECKIA HIRTA L.	761 1024 1376
RUMEX ALTISSIMUS WOOD	1381
RUMEX CRISPUS L.	
RUMEX MARITIMUS L.	1060 1276
RUMEX VENOSUS PURSH	1510
SAGITTARIA LATIFOLIA WILLD.	867 1643
SALIX EXIGUA NUTT.	753 754 960
SALIX RIGIDA MUHL.	1842 1843 1900
SALSOLA IBERICA SENNEN & PAU	1029 1289 1678
SAMBUCUS CANADENSIS L.	940 1527
SANICULA CANADENSIS L.	1077 1639
SCHEDONNARDUS PANICULATUS (NUTT.) TREL.	1363
SCHRANKIA NUTTALLII (DC.) STANDL.	1564 1565
SCIRPUS ACUTUS MUHL.	
SCIRPUS AMERICANUS PERS.	
SCIRPUS ATROVIRENS WILLD.	1575
SCIRPUS FLUVIATILIS (TORR.) GRAY	771 1001 1431
SCIRPUS VALIDUS VAHL	899 942 1428
SCUTELLARIA GALERICULATA L.	1348
SCUTELLARIA LATERIFLORA L.	1066 1067 1716
SECALE CEREALE L.	760
SENECIO PLATTENSIS NUTT.	1504
SETARIA VIRIDIS (L.) BEAUV.	1703
SHEPHERDIA ARGENTEA (PURSH) NUTT.	901 1045 1688
SISYRINCHIUM ANGUSTIFOLIUM MILLER	734 991
SIUM SAUVE WALT.	
SMILACINA STELLATA (L.) DESF.	737 739 1433
SMILAX HISPIDA MUHL.	1293
SOLANUM AMERICANUM MILL.	1692
SOLANUM CAROLINENSE L.	1378
SOLANUM ROSTRATUM DUN.	879 1691
SOLANUM TRIFLORUM NUTT.	1733
SOLIDAGO CANADENSIS L.	1168 1275 1943 1944 1945
SOLIDAGO GRAMINIFOLIA (L.) SALISB.	1303

TABLE B1 (CONTINUED)

SPECIES	VOUCHER SPECIMEN NUMBER
SOLIDAGO RIGIDA L.	1269
SORGHASTRUM AVENACEUM (MICHX.) NASH	1569 1570 1623
SPARGANIUM EURYCARPUM ENGELM.	1009
SPARTINA PECTINATA LINK	882 1515
SPHAERALCEA COCCINEA (PURSH) RYDB.	1736
SPHENOPHOLIS OBTUSATA (MICHX.) SCRIBN.	785 1341 1551 1634 1741
SPOROBOLUS CRYPTANDRUS (TORR.) GRAY	
STACHYS PALUSTRIS L.	844
STACHYS TENUIFOLIA WILLD.	1294
STIPA COMATA TRIN. & RUPR.	1020
SUAEDA DEPRESSA (PURSH) WATS.	
SYMPHORICARPOS OCCIDENTALIS HOOK.	1681
SYMPHORICARPOS ORBICULATUS MOENCH	794 1118
TAMARIX RAMOSISSIMA LEDEB.	795
TARAXACUM OFFICINALE WEBER	1849
TEUCRIM CANADENSE L.	952 1280
THALICTRUM DASYCARPUM FISCH. & LALL.	1317
THELESPERMA FILIFOLIUM (HOOK.) GRAY	1529
THLASPI ARVENSE L.	744 1000 1155 1416
TOXICODENDRON RADICANS (L.) O. KTZE.	
TRADESCANTIA BRACTEATA SMALL	729 756 757
TRAGOPOGON DUBIUS SCOP.	1149
TRIBULUS TERRESTRIS L.	933
TRIFOLIUM HYBRIDUM L.	735
TRIFOLIUM PRATENSE L.	736 1114
TRIGLOCHIN MARITIMUM L.	1122 1418
TRIODANIS PERFOLIATA (L.) NIEUW.	894 1004 1154
TYPHA ANGUSTIFOLIA L.	512
TYPHA LATIFOLIA L.	813 1059
ULMUS AMERICANUM L.	783 1070
ULMUS PARVIFOLIA JACQ.	797
ULMUS PUMILA L.	1266 1836 1837 1838
ULMUS RUBRA MUHL.	1061 1868 1869
VERBASCUM THAPSUS L.	
VERBENA BRACTEATA LAG. & RODR.	1342 1536 1654
VERBENA HASTATA L.	818 1560
VERBENA STRICTA VENT.	931 1159 1313 1557
VERBENA URTICIFOLIA L.	1712
VERBESINA VIRGINICA L.	
VERNONIA FASCICULATA MICHX.	1046 1083 1618 1697
VERONICA ANAGALLIS-AQUATICA L.	1006 1140 1665
VERONICA PEREGRINA L.	896 1438
VIOLA MISSOURIENSIS GREENE	1848
VITIS RIPARIA MICHX.	1137 1459 1870 1871
XANTHIUM STRUMARIUM L.	
YUCCA GLAUCA NUTT.	
ZANTHOXYLUM AMERICANUM MILL.	925 1069 1489 1715

APPENDIX C: PERCENTAGE COVER DATA

TABLE C1. KEY TO THE SPECIES ABBREVIATIONS USED IN THE PLATTE RIVER VEGETATION SURVEY DATA TABLES C2 THROUGH C27

ACNE	= ACER NEGUNDO
AGRO	= AGROPYRON SPP.
AGST	= AGROSTIS STOLONIFERA
AMAR	= AMBROSIA ARTEMISIIFOLIA
AMPS	= AMBROSIA PSILOSTACHYA
AMTR	= AMBROSIA TRIFIDA
AMFR	= AMORPHA FRUTICOSA
ANGE	= ANDROPOGON GERARDI
ANSC	= ANDROPOGON SCOPARIUS
APIO	= APIOS AMERICANA
APSB	= APOCYNUM SIBIRICUM
ARCA	= ARTEMISIA CAMPESTRIS
ASIN	= ASCLEPIAS INCARNATA
ASVE	= ASCLEPIAS VERTICILLATA
ASPI	= ASTER PILOSUS
BICE	= BIDENS CERNUA
BIFR	= BIDENS FRONDOSA
BOCY	= BOEHMERIA CYLINDRICA
BRIN	= BROMUS INERMIS
BRJA	= BROMUS JAPONICUS
BRTE	= BROMUS TECTORUM
CAIN	= CALAMAGROSTIS INEXPANSA
CALO	= CALAMOVILFA LONGIFOLIA
CASA	= CANNABIS SATIVA
CAAQ	= CAREX AQUATILIS
CASP	= CAREX SPP.
CESC	= CELASTRUS SCANDENS
CEOC	= CELTIS OCCIDENTALIS
CHAL	= CHENOPODIUM ALBUM
CISP	= CIRSIUM SPP.
COCA	= CONYZA CANADENSIS
CODR	= CORNUS DRUMMONDII
COST	= CORNUS STOLONIFERA
CRTE	= CROTON TEXENSIS
CYSP	= CYPERUS SPP.
DESO	= DESCURAINIA SOPHIA
DEIL	= DESMANTHUS ILLINOENSIS
DISP	= DISTICHLIS SPICATA
ECCR	= ECHINOCHLOA CRUSGALLI
ELAN	= ELAEAGNUS ANGUSTIFOLIA
ELPA	= ELEOCHARIS PALUSTRIS
ELCA	= ELYMUS CANADENSIS
EQSP	= EQUISETUM SPP.
ERPE	= ERAGROSTIS PECTINACEA
ERST	= ERIGERON STRIGOSUS
EUMA	= EUPHORBIA MACULATA
EUMR	= EUPHORBIA MARGINATA
FRPE	= FRAXINUS PENNSYLVANICA
GAAP	= GALIUM APARINE
GACI	= GALIUM CIRCAEZANS
GECA	= GEUM CANADENSE
GLLE	= GLYCYRRHIZA LEPIDOTA
HEAN	= HELIANTHUS ANNUUS
HEPE	= HELIANTHUS PETIOLARIS
HEHE	= HELIOPSIS HELIANTHOIDES
HOJU	= HORDEUM JUBATUM
IMBI	= IMPATIENS BIFLORA
IPPA	= IPOMOEA PANDURATA
IVXA	= IVA XANTHIFOLIA
JUNI	= JUGLANS NIGRA
JUTO	= JUNCUS TORREYI
JUVI	= JUNIPERUS VIRGINIANA

TABLE C1 (CONTINUED)

KOSC = KOCHIA SCOPARIA
LASE = LACTUCA SERRIOLA
LAEC = LAPPULA ECHINATA
LEOR = LEERSIA ORYZOIDES
LEDE = LEPIDIUM DENSIFLORUM
LYAM = LYCOPUS AMERICANUS
LYAS = LYCOPUS ASPER
LYDA = LYTHRUM DACOTANUM
MELU = MEDICAGO LUPULINA
MEAL = MELILOTUS ALBUS
MEAR = MENTHA ARVENSIS
MEDE = MENTZELIA DECAPETALA
MORU = MORUS RUBRA
MOFI = MONARDA FISTULOSA
NECA = NEPETA CATARIA
OEBI = OENOTHERA BIENNIS
PACA = PANICUM CAPILLARE
PAOL = PANICUM OLIGOSANTHES
PAVI = PANICUM VIRGATUM
PAVT = PARTHENOCISSUS VITACEA
PHAR = PHALARIS ARUNDINACEA
PHLA = PHYLA LANCEOLATA
PHVI = PHYSOSTEGIA VIRGINIANA
POPR = POA PRATENSIS
POLA = POLYGONUM LAPATHIFOLIUM
POPE = POLYGONUM PERSICARIA
PODE = POPULUS DELTOIDES
RHAR = RHUS AROMATICA
RHGL = RHUS GLABRA
RHRA = RHUS RADICANS (TOXICODENDRON)
ROWO = ROSA WOODSII
RUSP = RUBUS SPP.
RUCR = RUMEX CRISPUS
SAEX = SALIX EXIGUA
SARI = SALIX RIGIDA
SACA = SANICULA CANADENSIS
SCAC = SCIRPUS ACUTUS
SCAM = SCIRPUS AMERICANUS
SCFL = SCIRPUS FLUVIATILIS
SHAR = SHEPHERDIA ARGENTEA
SMST = SMILACINA STELLATA
SOCA = SOLIDAGO CANADENSIS
SPPE = SPARTINA PECTINATA
SPOB = SPHENOPHOLIS OBTUSATA
SPCR = SPOROBOLUS CRYPTANDRUS
SYOR = SYMPHORICARPOS ORBICULATUS
TAOF = TARAXACUM OFFICINALE
TRPR = TRIFOLIUM PRATENSE
TYLA = TYPHA LATIFOLIA
ULAM = ULMUS AMERICANUM
ULPA = ULMUS PARVIFOLIA
ULRU = ULMUS RUBRA
VETH = VERBASCUM THAPSUS
VEHA = VERBENA HASTATA
VEST = VERBENA STRICTA
VEFA = VERNONIA FASCICULATA
VEAA = VERONICA ANAGALLIS-AQUATICA
VIRI = VITIS RIPARIA
XAST = XANTHIUM STRUMARIUM
ZAAM = ZANTHOXYLUM AMERICANUM

TABLE C2. PERCENTAGE COVER MUDFLAT VEGETATION DATA FROM SITES 8 TO 91 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	8	8	20	29	29	29	42	50	50	50	50	50	53	58	59	59	59	68	74	75	90	91	91
PLOT	03	05	04	01	02	05	10	02	03	04	05	07	02	11	02	03	05	01	04	06	3A	06	08
SPECIES																							
AGST															5								
AMAR	1		5	1		5	63			5		1	1		18				18				5
AMTR										1												5	1
AMFR	1	1	1	1	5			1	1	38	1	5	1		1	1	5	1		1	18	1	5
APSB								1															1
ARCA																							
ASIN		1		1	1	1	1	1		1		5			1		1					1	1
ASPI				5	18	5					1	18			5	1	18			1		5	5
BICE	5			1		5		18	5	5	5	18						1		1		18	
BIFR	5	1	5	5	5	18		5		1		1		1			5	1		1	5	18	
BRJA															1								
BRTE																							
CAIN				1			1																
CASP																						5	
CESC																							5
CHAL																					1		
CISP																			18				
COCA			18										18								5		
CODR																							
CYSP	18								1					18				38		18	38		
DESO																							
DEIL															1								
DISP																							
ECCR	5	5		1	1	1		1	5	5	5			5		5		5		5		1	
ELAN																							
ELPA	5			38	18		5	38	18	18	18	18	5	5				1	1	18		5	18
ELCA														5	18								
ERPE			5																		63		
ERST			1																				
EUMA																							
EUMR																							
GAAP																			5				
HEAN				18																	5	5	
HEPE			5							1					18		18				5		5
HOJU				5	18		18						1				1					1	1

TABLE C2 (CONTINUED)

SITE	8	8	20	29	29	29	42	50	50	50	50	50	53	58	59	59	59	68	74	75	90	91	91
PLOT	03	05	04	01	02	05	10	02	03	04	05	07	02	11	02	03	05	01	04	06	3A	06	08
SPECIES																							
JUTO	1	1	1	5	1	1		5	1	1	5	1		5	1		1			5		1	5
LASE																					1		
LEOR						5	5	1	5		5	5										1	
LEDE																							
LYAM	5			5	5	1	5			5	5		63	5					1				
LYAS				1	1	1		1		5		5					18	1		5			
LYDA							5	1		1	1	1								1			1
MEAL			18				5														5		
MEAR					5	1					1						18		18				
OEBI																		1			5		
PAVI																							
PHLA							18					5	5							5			5
PHVI										5							1			1	5		1
POPR																							
POLA	1	83		18	1		5	5		5		1		38	1	18	18	5		38	5	5	5
POPE	5	5	1	5	38	38	5	1	5		1			1		1	1	5		1		5	5
PODE	5			1	5		38	5	18			5		38	1	1	5	18		5			1
RUCR	1	1		5	5	1	1	1			1	1		5	38		5	1		5		1	5
SAEX	38	1			18	38	5	38	18	5	1	63		18		1	18	38	5	5	5		5
SARI	5			1	5		18	5	5	18	1	5		18		18	5	1		5			1
SCAC		1		1	1	1	5	5	5	1	1			5		1	1	1		1			
SCAM	5			1	1	5	5	18	5	5	5		1	5		1		1	1	5		1	5
SCFL	1	1			1	1	1	5	1			1				1	1	1				1	1
SOCA										5					5								
SPPE	5	5	1	5	5	1	5	5		1	1			5	1	5	1	5	1	5	5	18	5
SPOB							1						1										
SPCR																							
TYLA				5	1	5	5	1									1	1		1	1		1
VETH																							
VEHA										1													1
VEST																			5				
VEFA			5							1											5		1
VEAA			1						5											1			
XAST	83	63	18	18	18	18	18	18	1	5	18	5	1	38	5	38		38	5	18	63	18	5

TABLE C3. PERCENTAGE COVER MUDFLAT VEGETATION DATA FROM SITES 91 TO 169 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT / SPECIES	91-11	91-12	93-05	97-04	98-01	98-07	98-08	109-05	109-08	111-10	119-14	122-02	122-03	122-06	122-08	122-10	138-13	139-07	156-03	160-04	160-4A	160-4B	169-02
AGST																							
AMAR	5	1		38		38	5	1		5	5	5	18				5						5
AMTR			1							1													
AMFR	38		5		5	38	5			1			5										
APSB																							
ARCA																							5
ASIN		1			1		1						1										
ASPI					1		5																
BICE		1		18	18		38			5	5		5		1				1				
BIFR	1		5							18	38												
BRJA				1																			
BRTE																							5
CAIN											1												1
CASP			18									18											
CESC																							
CHAL																		1					
CISP																							
CCCA	5			1		5							18								5		
CODR			5																				
CYSP				18				18				18		5	18			38	5		5	5	
DESO																							
DEIL	5			1	1																	1	
DISP																							
ECCR	1	5	1						5	1	1	1		5	5			5	5		5	18	
ELAN																							
ELPA	5			5	18		18	63		1	5		18				38		38				5
ELCA	1					5																	
ERPE		1	1							18		5		5	38	5			5		18	63	
ERST																							
EUMA	1									1									5				
EUMR																							
GAAP																							
HEAN						18																	
HEPE	5				18			1															1
HOJU		1			1	1	1			5	1						5		5				5

TABLE C3 (CONTINUED)

SITE	91	91	93	97	98	98	98	109	109	111	119	122	122	122	122	122	138	139	156	160	160	160	169
PLOT	11	12	05	04	01	07	08	05	08	10	14	02	03	06	08	10	13	07	03	04	4A	4B	02
SPECIES																							
JUTO		1		1	1		1	18		1	1	5	1			1				1			
LASE	1		1																		1		
LEOR	1			1	5														1				
LEDE	1					1				5		1											
LYAM			1				1																
LYAS	1	1			1																		
LYDA				18	1		1						63							38	18		
MEAL	1			38		1				1						1				1	18	5	38
MEAR					5																		
OEBI	1									5										1	1		
PAVI		5			1							1		1									1
PHLA				5	5		18			1	5	1	18				38		5				
PHVI						5																	
POPR																							5
POLA	5	18		5	5		1				1										1	5	
POPE	1		5					5	5	18	1	5		1	1	5			1		1	1	
PODE		5		5		5	18			5	1	5	18	5	5	5	1	5	5	18	5	1	18
RUCR		18			1		1	1		5	5	1		5			1			1			1
SAEX	5	18	18	38	5					18	18		18						38	63	5	1	1
SARI	5	1			5	5	1			18							1						5
SCAC	1			5	1								5										1
SCAM	5	1		5	1	1		5			5		5				5						5
SCFL	1			1						5	1		5		5		1						
SOCA	5						1																1
SPPE	18	5		1	18	5	18				1		5				18		1				1
SPOB				1		1				1			18						1				
SPCR				1								5		18	18	38							
TYLA			1	5						1			1			5	1						1
VETH																							1
VEHA				1																1	1		
VEST																							
VEFA			18	18																			
VEAA				1				18		18		1			1	1					5		
XAST	1	38	18	1	5		5	38	1	38	38	18				38	63		18		18	5	1

TABLE C4. PERCENTAGE COVER MUDFLAT VEGETATION DATA FROM SITES 171 TO 404 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	171-01	171-02	171-03	172-02	172-08	188-05	208-05	208-06	229-03	245-03	245-09	266-02	320-07	335-15	337-02	404-05
SPECIES																
AGST																
AMAR	1						5	18								
AMTR				1							18					
AMFR																
APSB											5					
ARCA	5	18		1												
ASIN																
ASPI																
BICE							5									
BIFR							18									
BRJA	5									5						
BRTE	5															18
CAIN												1				
CASP													63			
CESC																
CHAL	1															1
CISP																
COCA			1				5	5		1				1	1	1
CODR																
CYSP	5	5				5		1	38			38				
DESO																5
DEIL																
DISP										18						
ECCR	5			18	1	18	1	1	18			5				
ELAN													5			
ELPA				5	83		38					18	18	18	18	
ELCA					1											
ERPE	5			38				18	38			5			5	
ERST			5													
EUMA	1							18								5
EUMR											5					
GAAP																
HEAN																
HEPE				5												
HOJU														18	18	1

TABLE C4 (CONTINUED)

SITE	171	171	171	172	172	188	208	208	229	245	245	266	320	335	337	404
PLOT	01	02	03	02	08	05	05	06	03	03	09	02	07	15	02	05
SPECIES																
JUTO	1													5	5	
LASE											5					1
LEOR				5	18		5									
LEDE																
LYAM					1			1								
LYAS							38					5				
LYDA			38		18											
MEAL	5		18								18			5	5	
MEAR												5		1	1	
OEBI																
PAVI						5										
PHLA			1		18							5	18			
PHVI																
POPR														1		1
POLA				1			18	5								
POPE	1			18		5	1									5
PODE					5	1						18		1	1	
RUCR				5	1		18							5	5	38
SAEX			1	5	38		5						5	5	5	
SARI				1	83											
SCAC																
SCAM			18	5	18								18			
SCFL																
SOCA																
SPPE			1		5						18					
SPOB			5	1										5	5	
SPCR	1															
TYLA				1												
VETH										5						
VEHA														1		
VEST																
VEFA											5					
VEAA	1							5		5		5		5		5
XAST	1			18	5			33								

TABLE C5. PERCENTAGE COVER MEADOW VEGETATION DATA FROM SITES 1 TO 68 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	1	1	8	20	20	20	41	41	41	41	42	44	44	44	44	53	53	53	58	58	59	68	68
PLOT	01	02	10	01	02	03	01	02	03	04	12	01	04	05	08	05	06	07	06	07	10	03	06
SPECIES																							
AGRO				1				18				18		5	63	5	5				1		
AGST					18		1	5		5	18	38		18		5	5	5					
AMAR		1	83	38	5	5		38	5	1	38	1		63		18	18	18	18	38		38	1
AMTR																							
AMFR	5	18	1					1					5						18	18	1	18	
ANGE	1						5	5	18	38					63						38		
ANSC						5				18								5					
APIO																							
APSB							1	1								1			1				
ARCA																							
ASIN													1	1		1		1					
ASVE					1	1	1			1											1		
ASPI						5		5	1	5							5						
BICE													38										
BIFR													18										5
BOCY																							
BRIN							83					18			18				1			5	
BRJA								1			5				38			18	5				
BRTE			5			18			18														
CAIN								1									1						
CALO																		38					
CAAQ																							1
CASP		1		18	5	1		33	5							1	18	5					
CHAL				5	1	1		5	1													1	
CISP					5	5					1				5	5	5	1	1	1			
COCA				1	1			1								1	1	1	5	1			
CODR																				5	5		
CRTE			1															5					
CYSP	1		5																				18
DEIL					1										1				83	18	1		18
DISP			18			18											5						
ECCR																							
ELAN											1												
ELPA		63		18	18			18		1						5	5	5					

TABLE C5 (CONTINUED)

SITE-PLOT	1-01	1-02	8-10	20-01	20-02	20-03	41-01	41-02	41-03	41-04	42-12	44-01	44-04	44-05	44-08	53-05	53-06	53-07	58-06	58-07	59-10	68-03	68-06
SPECIES																							
ELCA															1				1	5	5		
EQSP				1	1		1	1	1	5		1		1	18	1	1	1			1		
ERPE					1																		
ERST								1		1	18			5	38					1	1		
EUMA																							
EUMR																							
FRPE		5																	1	5			
GAAP																							
GLLE												5				1							
HEAN																							
HEPE	5																			18	1	18	5
HOJU			5	1	1	1		1	38			5				1	5	5				1	1
JUTO					1	18		5					1				5	1					1
JUVI										18													
LASE															1				1	1			
LAEC																							
LEOR																							18
LEDE	1																						
LYAM								1			1						1						
LYDA													38										5
MELU					1	18	1	5	1	18				5		5	1						
MEAL												1			1						1		
MORU		5																			1		
NECA																							
OEBI							1							1									
PACA																							
PAOL	1				5	1	1	1		5					1	5	5	5	18		1		
PAVI					18	5										5	5	5	5	38	5		5
PHAR																							
PHLA		1											38									5	38
POPR	5			1	1	1		5	5	18	38	38		5	18	18	18	18	5		63		
POPE		63					5	5															
PODE													18									1	
RHGL																					38		

TABLE C5 (CONTINUED)

SITE-PLOT	1-01	1-02	8-10	20-01	20-02	20-03	41-01	41-02	41-03	41-04	42-12	44-01	44-04	44-05	44-08	53-05	53-06	53-07	58-06	58-07	59-10	68-03	68-06
SPECIES																							
RHRA															1								
ROWO			5								5			38	1	5		5			1		
RUCR			18																	1			
SAEX		38											38			5			18	1		5	
SARI																							
SCAC		5																					
SCAM		63	18	18		1		5	5		1	5					5						63
SOCA																1	5	1	5	5			5
SPPE	5	1	5								5		5		18		1		5	1	5	63	5
SPOB																					1	5	5
SPCR	1														1			1					
SYOR																					5		
TAOF				1	5		1	18		1							18	1		1			
TRPR				38	63	5	1	1									1						
TYLA		5																					
ULRU																				1			
VETH																							
VEHA												1								1			1
VEST			5		1	5		1			18				1	1		1					
VEFA											5	5					1	1					1
VIRI		1																	1	1	5		
XAST		38																					

TABLE C6. PERCENTAGE COVER MEADOW VEGETATION DATA FROM SITES 74 TO 141 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	74	75	75	75	89	90	92	93	93	97	109	109	119	122	130	138	138	138	139	139	139	139	141
PLOT	01	02	17	18	09	04	1A	01	02	06	01	09	10	01	16	04	15	17	01	02	03	11	03
SPECIES																							
AGRO	18					18		1	5		18								18	1			
AGST	1					38		5	18			5							18				
AMAR	18			5	83		5	38	1		1	38	83	5	38	63	38	63	63	5	5		63
AMTR		1														5				5			
AMFR		1						5		1			18			5	5	5			63		1
ANGE						5		5		63	18												
ANSC	5					38				18										5			
APIO																							
APSB			1			5	5			5			18		1	5			1				1
ARCA														1									
ASIN		5	1																				
ASVE	1									1													
ASPI																							
BICE																							
BIFR		1																					
BOCY		18	1																				
BRIN						5		38						1						63			
BRJA	5					18			5			5		5	5	5	18	1	5	5			18
BRTE	5			1							5	18		38	18		5						38
CAIN												38											
CALO																							
CAAQ																18		5					
CASP	5						38	5	18		5	5					1		18		18		
CHAL				1				1			1					1							
CISP	1								5	1									5				
COCA	1							1				5			5								
CODR				18	1													1			18		1
CRTE																							
CYSP	1			5										5									1
DEIL					1	5				5									5	18			1
DISP											38	38							5				
ECCR																							
ELAN																			1	5			
ELPA	5	18					38	1	1			5											

TABLE C6 (CONTINUED)

SITE	74	75	75	75	89	90	92	93	93	97	109	109	119	122	130	138	138	138	139	139	139	139	141
PLOT	01	02	17	18	09	04	1A	01	02	06	01	09	10	01	16	04	15	17	01	02	03	11	03
SPECIES																							
ELCA						5				1						1							1
EQSP						1													5	1			
ERPE																							
ERST														5									5
EUMA																							
EUMR																							
FRPE					18															1	1		1
GAAP												18				1							
GLLE								5												1			
HEAN											5												
HEPE				5		5	18								1	1	1	5		1			
HOJU	1				1		5	5	1		5	1			1	5	5	1	5		5		
JUTO	1											5											
JUVI												5							1	1			1
LASE						5		1	1	1			1		5	5	1						
LAEC																							
LEOR		1					5																
LEDE	1											1	1										
LYAM		1																			1		
LYDA																							
MELU	5				5			5	5			5											18
MEAL					1	5				5				18							1		1
MORU					1														1				
NECA				1																			
OEBI					1	1								18				1					
PACA																							
PAOL	1			5		5			5	5									18	5			5
PAVI	5			63		18		5	5					5					18	5			5
PHAR							18	5								5						83	
PHLA		18	18				18											5			18		
POPR	5			5	18	18		18	38	38	5				1	1	18	1	38				18
POPE																							
PODE												5							5	5			
RHGL																							

TABLE C6 (CONTINUED)

SITE-PLOT / SPECIES	74-01	75-02	75-17	75-18	89-09	90-04	92-1A	93-01	93-02	97-06	109-01	109-09	119-10	122-01	130-16	138-04	138-15	138-17	139-01	139-02	139-03	139-11	141-03
RHRA				18		5																	
ROWO				1			18												5				
RUCR		1	1		5		5	1	1							1	1						
SAEX		1	38		1								5			5		1		5	5	5	
SARI		1														5	1	1			1		
SCAC			38																				
SCAM		18	18		1		18	1				5						5			1		
SOCA					5																		
SPPE					18	38	18	5		18		5	1			1	5	18	5				5
SPOB	1					5												5		1	5		
SPCR	5			18										5	5					1			1
SYOR					1																		
TAOF	1				1			18	1								1						
TRPR	1																						
TYLA		18	5																				
ULRU					5														1				1
VETH																							
VEHA										1									1				
VEST	1					1						5							5				
VEFA							5	1	1	18		5											
VIRI				5	1			1								1	1						
XAST																							

TABLE C7. PERCENTAGE COVER MEADOW VEGETATION DATA FROM SITES 141 TO 229 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	141	141	141	141	141	156	156	156	164	164	169	169	169	171	171	171	172	208	208	219	219	219	229
PLOT	04	08	10	13	14	01	02	10	01	14	07	09	12	04	05	06	04	01	11	10	11	17	01
SPECIES																							
AGRO								5			1	5	5		18				18			5	5
AGST							5	5															
AMAR	63	18	63	5	18	18	38		38	83		5	83	1	18	18	83		5	1		18	
AMTR																							
AMFR	1	1	1	18	38				5	18							5						
ANGE						18	18												5				18
ANSC															1								18
APIO																							
APSB	5				1				5	1							1						
ARCA																	5						
ASIN																							
ASVE	5				18							1				1			1				1
ASPI																							
BICE																							
BIFR							1																
BOCY																							
BRIN						38	5											38					
BRJA	38	38	63	63	38		38	5	1		5	18	18	5	18	18	18			63		18	18
BRTE							18	5	5	5	63	18	63	83	63	38	63			18	18		18
CAIN																							
CALO																							
CAAQ																							
CASP											1												
CHAL										1													
CISP						1													1				
COCA		1											18		1		5			1			
CODR		5		1	5		5				1	1											
CRTE											18	1											
CYSP							5																
DEIL	1			1	1																		
DISP						18	5		5		38				1								1
ECCR						18																	
ELAN						5	5														1	5	
ELPA																							

TABLE C7 (CONTINUED)

SITE–PLOT	141-04	141-08	141-10	141-13	141-14	156-01	156-02	156-10	164-01	164-14	169-07	169-09	169-12	171-04	171-05	171-06	172-04	208-01	208-11	219-10	219-11	219-17	229-01
SPECIES																							
ELCA		1	5														5		1				5
EQSP									1						1		5	5	1				1
ERPE													38	5									
ERST	18	1		1	1																		
EUMA							1				1	5	38				5			1	18		
EUMR											18	18	18				1			1			
FRPE	1		1																			1	
GAAP																							
GLLE											5						5						
HEAN													5	1									
HEPE							5		18	5					5								
HOJU			1		1		5															18	5
JUTO					1		1																
JUVI																	1			1		1	
LASE			5		5					1							5					1	
LAEC																							
LEOR																							
LEDE										1				1			5						
LYAM																							
LYDA																							
MELU	1	5	5	18		18					1	5	18							5		18	
MEAL						5	1		5	1					5	1							
MORU							1																
NECA																							
OEBI																							
PACA									1	18													5
PAOL	5	5	1	5				18							1								1
PAVI	5	5			5	5	5											5	5				5
PHAR																							
PHLA							5																
POPR	18		1	38	18			63				38				63		38	63	18	5	63	1
POPE																							
PODE					5	5	5										1			5		5	
RHGL																							

TABLE C7 (CONTINUED)

SITE-PLOT	141-04	141-08	141-10	141-13	141-14	156-01	156-02	156-10	164-01	164-14	169-07	169-09	169-12	171-04	171-05	171-06	172-04	208-01	208-11	219-10	219-11	219-17	229-01
SPECIES																							
RHRA		18																					1
ROWO	5				5		18	18		1						5		1		1	1	38	
RUCR				1					5													1	
SAEX			5														5						
SARI							1										5					5	
SCAC																							
SCAM																							
SOCA		1																					
SPPE	18	1	1	5	38		1			5							18		63			1	5
SPOB			1																				
SPCR							5	18	1	5	1		5	18	5	5				5	18		18
SYOR											1	38										5	
TAOF			1																	5		5	
TRPR						5																	
TYLA																							
ULRU					1							1										1	
VETH																				63	5	1	
VEHA	1																						
VEST	1			1			1	5			5	5	5		1		1			1		5	
VEFA		1	1		1																	1	1
VIRI	1		5							1											5		
XAST											1	1											

TABLE C8. PERCENTAGE COVER MEADOW VEGETATION DATA FROM SITES 229 TO 320 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	229	245	245	245	266	266	277	277	277	277	277	277	277	282	282	282	301	301	312	312	312	320	320
PLOT	08	05	07	10	04	06	04	05	08	09	10	13	15	01	06	07	03	04	04	06	11	11	05
SPECIES																							
AGRO	83			5								1		18	1	18						18	
AGST												18	5										
AMAR	1		5	38		1	18		1	5		18	1	5	1	1					1	1	
AMTR		5																					
AMFR	1				38					1		5						1		1			
ANGE											5											5	
ANSC														18									
APIO																							
APSB		5			1						1		1										
ARCA																							
ASIN					1																		
ASVE											1												
ASPI																							
BICE																							
BIFR																							1
BOCY																							
BRIN														18	5							5	
BRJA				18		63			1	38	38	18		63	38	63						5	
BRTE		5		18		63	38			5				38	63	18						5	
CAIN																		1					
CALO																							
CAAQ																			1				38
CASP					5						1		5					63	5		18	5	
CHAL																							
CISP										18	5							1					
COCA	1		5											5	18	5					1	5	
CODR																							
CRTE																							
CYSP																							
DEIL					1							1	18										
DISP	1		18																		5	5	
ECCR																		18					
ELAN																							
ELPA												1								5	5		

TABLE C8 (CONTINUED)

SITE	229	245	245	245	266	266	277	277	277	277	277	277	277	282	282	282	301	301	312	312	312	320	320
PLOT	08	05	07	10	04	06	04	05	08	09	10	13	15	01	06	07	03	04	04	06	11	01	05
SPECIES																							
ELCA																							
EQSP		5			5								1									5	
ERPE																							
ERST												1											
EUMA	5								1	1	1		1								1		
EUMR			5																				
FRPE												1	18										
GAAP																				1			
GLLE												1	5										
HEAN																							
HEPE								5															
HOJU				5								5	5									1	
JUTO												1											
JUVI									1	5	5	1											
LASE												1		5									
LAEC																							
LEOR																							
LEDE									1						1							1	
LYAM												1	1							1	1		
LYDA					5															5			5
MELU	5			18								1			5								
MEAL		5	18	18	38		1		1			5	5	18	5	5		5					
MORU																							
NECA																							
OEBI			5																				
PACA																							
PAOL					1				1	1		1				1							
PAVI					38					1	18		5	5							38	5	
PHAR																							
PHLA													5					5			5		
POPR	5	5		18							5	18		18		5						5	
POPE																							
PODE												1											
RHGL																							

TABLE C8 (CONTINUED)

SITE-PLOT	229-08	245-05	245-07	245-10	266-04	266-06	277-04	277-05	277-08	277-09	277-10	277-13	277-15	282-01	282-06	282-07	301-03	301-04	312-04	312-06	312-11	320-01	320-05
SPECIES																							
RHRA									1														
ROWO						5				5	5	5	5										
RUCR	1															1							
SAEX					18								18						5	5			
SARI												5								18			
SCAC																	18		5	38			83
SCAM					5								18				5	38	38	5	18		38
SOCA													5							5			
SPPE		5			5							38		5							5	5	
SPOB					5																		
SPCR	5	5		5		38	38		5	5	18			5		1						18	
SYOR												5											
TAOF	18			5														38					
TRPR																		1					
TYLA																	83		5	5			38
ULRU					5								1										
VETH		38	5	5				1				1											
VEHA																			1	1			
VEST	1		5	5			1	1		1	5		1									1	
VEFA		5										1	1					1			1		
VIRI												1	1										
XAST																							

TABLE C9. PERCENTAGE COVER MEADOW VEGETATION DATA FROM SITES 320 TO 404 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT / SPECIES	320-06	327-03	335-01	335-12	335-14	335-17	337-04	337-06	337-09	345-02	345-04	345-05	345-07	345-11	391-0C	402-01	404-02	404-06	404-09	404-13
AGRO				1											38			38		
AGST															5					
AMAR				63	83	38				1	63	5		38		5				
AMTR									1											
AMFR					1		5			1				1		5	5	18	1	
ANGE									83						1					
ANSC																				
APIO							18													
APSB					1									5						
ARCA																5				
ASIN																				
ASVE												1								
ASPI			1							5									5	
BICE																				
BIFR															1					
BOCY																				
BRIN															5					
BRJA				1		5									1		18	5		
BRTE				1												38	38	63		83
CAIN																				
CALO																				
CAAQ	18	5								5			5							
CASP	18		5		5			38		5				5	5				5	
CHAL				1		1									1	1	5			1
CISP																				
COCA																				
CODR																				
CRTE																				
CYSP																				
DEIL				1	1															
DISP															18					
ECCR																				
ELAN							1				18			5						
ELPA	5	63	38			5	18	18		38			5							

TABLE C9 (CONTINUED)

SITE	320	327	335	335	335	335	337	337	337	345	345	345	345	345	391	402	404	404	404	404
PLOT	06	03	01	12	14	17	04	06	09	02	04	05	07	11	0C	01	02	06	09	13
SPECIES																				
ELCA					5				1											
EQSP				1	1						5	1		1	1	1				
ERPE								5												
ERST																				
EUMA					1					5		1					5	5		
EUMR																				
FRPE		1			1									18		1			5	
GAAP																				
GLLE				1					1						1					
HEAN															1	5				5
HEPE					1	1			1								38	5		1
HOJU	1			5		1		5							18				1	
JUTO	5						5								5					
JUVI																				
LASE					5										1	1				
LAEC																	18	1		1
LEOR	5												1							
LEDE																18	18			
LYAM			5	1	5	1				18									1	
LYDA	5	1	1	1			38	1		1										
MELU															1					
MEAL					1															
MORU					5															
NECA					18															
OEBI					1															
PACA															5					
PAOL			5							1	5			1						
PAVI			38	18	18	38					5	18		18	5					
PHAR							5	1												
PHLA				18				5												
POPR				18		63										1				
POPE								5							18				18	
PODE											1	1				18			5	
RHGL																				

TABLE C9 (CONTINUED)

SITE	320	327	335	335	335	335	337	337	337	345	345	345	345	345	391	402	404	404	404	404
PLOT	06	03	01	12	14	17	04	06	09	02	04	05	07	11	0C	01	02	06	09	13
SPECIES																				
RHRA					5									5				5		5
ROWO					5				18					5					1	1
RUCR				1																
SAEX										18			1							
SARI										5						1				
SCAC	83	63											18							
SCAM	38	38	5	18	1	18	63	63		18			38		5				18	
SOCA			1																	
SPPE				5											18	1				
SPOB				1						1										
SPCR											1	1			5	18	5	18		1
SYOR														5				1		
TAOF					5															
TRPR				18		5														
TYLA	38	18																	63	
ULRU																				
VETH																				
VEHA				1	1	1		1		5										
VEST																				
VEFA		5		1		5				1	1	5	1		5					
VIRI					1															5
XAST																				

TABLE C10. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 1 TO 58 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	1	1	1	4	8	8	8	8	8	8	20	29	29	29	44	50	50	50	50	53	53	58	58
PLOT	03	05	06	03	01	02	04	06	14	17	05	03	06	07	03	01	08	11	12	01	03	01	02
SPECIES																							
ACNE							5												5				
AGRO																							
AMAR	1	5	1		38	38				18	5		18				5		1			1	
AMTR					5	1	5											1	1				
AMFR	1	63	18	18	18	63	38		38	38	38	83	5	5	18	38	1	63	18	1	1	5	5
ANGE										18													
ANSC																							
APSB							1							1		5							
ASIN									1			1					5		1			1	1
ASVE																				18			
ASPI													38			5	83					18	18
BICE		1										1				1	5					5	
BIFR						1						5	18				5	1				5	1
BOCY						1													18				
BRJA			1											1									
BRTE																							
CAIN			18																				
CAAQ									5		18												
CASP	5	5	1													5					1	1	
CHAL								5			5	5											
CISP										5						5		1					
COCA		5		5	1						1	5		5						1			
CODR		18	18		18	5	38	83	5					1	18	1							
COST																		5			18		
CYSP		1																					
DEIL				18	5					18												1	
ELAN							1																
ELPA	18	5																					38
ELCA				5	1		1			5				1									
EQSP		18																					
ERST		1	1	5	1					5													
EUMA														1									
FRPE	1	1	18	5	18		5		1	5			5					5	5				
GAAP								18			5												

TABLE C10 (CONTINUED)

SITE	1	1	1	4	8	8	8	8	8	8	20	29	29	29	44	50	50	50	50	53	53	58	58
PLOT	03	05	06	03	01	02	04	06	14	17	05	03	06	07	03	01	08	11	12	01	03	01	02
SPECIES																							
HEAN		5																					
HEPE					1								5	1									
HEHE						18	5		5	38													
HOJU		1														1							
IPPA						1			1			5						5	5				
JUTO		1											1									1	1
JUVI			5	5					1	5													
LASE														1									
LEOR																		1					5
LEDE		1	5											1									
LYAM		1				5					5	1	5				5	1		5			
LYAS						1							5									1	18
LYDA																1							5
MEAL		1	63											18									
MEAR						5							1				1						
MORU								1											1				
OEBI												1		1									
PAVI			1	5	63					18													
PAVT		1						5								1							
PHAR																							
PHLA	63	1											1	1					5	18		1	18
PHVI		1		1		5	5		5			18	1			1		5	1				1
POPR				1										5		18							
POLA																	1	5				1	
POPE						1					18		1					1	1				
PODE		1	18	5							63		18	18		5	38					18	5
RHRA			1	5			5	38		5					63	1			5				
ROWO							5	18										5					
RUCR		1					1					1	1				1		5			1	1
SAEX	63	5	18	63	1	18	5		63	1	83	5	38	18		63	18	18	63	18	5	63	63
SARI	18			18			5		5	1		5	18	18	18	18	1		5	5		5	5
SACA								5			38												
SCAC		1																1					1
SCAM						1											1	5		1			

TABLE C10 (CONTINUED)

SITE	1	1	1	4	8	8	8	8	8	8	20	29	29	29	44	50	50	50	50	53	53	58	58
PLOT	03	05	06	03	01	02	04	06	14	17	05	03	06	07	03	01	08	11	12	01	03	01	02
SPECIES																							
SCFL		1		1														5	1				
SOCA						1	18		38			18		5		5		38	18				1
SPPE	5	5	1	18	1	5	5		5	5			1	1		1						1	38
SPOB														1								1	
SPCR			1											1									
TAOF																1							
TYLA																							
ULRU			1				5		5	5						1							
VETH			5						1	1													
VEHA						1			5					1		1							
VEST		1	1							5													
VEFA		5	18								5					1			1		5		
VEAA	5	1																					
VIRI	1	1	5	1		5	5	18	5	5				5		5		5	18		1		
XAST		5										1	5	1			18	1	1			5	5

TABLE C11. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 58 TO 92 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	58	58	58	59	68	68	68	74	74	75	75	75	89	89	89	91	91	91	91	91	91	91	92
PLOT	03	09	12	06	02	08	15	06	08	05	07	12	04	05	07	02	03	05	07	09	10	14	03
SPECIES																							
ACNE										5			1										
AGRO																							
AMAR	1	1			38	5			5		1		18		38	38	5	5	5			38	63
AMTR		1		18				18	5			1	1		5	1	1					1	1
AMFR	38	63	1	38	38	38	63	18	18	83	5	1	63	63	18	18	1	38	63	5	63	18	38
ANGE																							
ANSC																							
APSB	18				1		1								1					1			
ASIN						1	1			5	1		1	1	5			1	1		1		
ASVE																							
ASPI	5			1							18		1				1	18	5			5	
BICE						5			5		1												
BIFR			1		1				5		18						1		5		1	5	
BOCY				1								1											1
BRJA													5	5	5	1		1	1		1		
BRTE														5									
CAIN																							
CAAQ				1		5				18		5								5	1	18	
CASP								5	18							1		1					18
CHAL					5										1			5	18	5	5		
CISP									1	5				5					1		1		1
COCA		1			1	1			5	5			5	5	1				5		1		
CODR	1										1		5			1				83		5	
COST						5						18											
CYSP																							
DEIL																							
ELAN																	1			1			1
ELPA									5		5												
ELCA				1	1	5								5				1					5
EQSP																							
ERST																							5
EUMA		5			1																		
FRPE										1			5										
GAAP																							

TABLE C11 (CONTINUED)

SITE-PLOT	58-03	58-09	58-12	59-06	68-02	68-08	68-15	74-06	74-08	75-05	75-07	75-12	89-04	89-05	89-07	91-02	91-03	91-05	91-07	91-09	91-10	91-14	92-03
SPECIES																							
HEAN					5	5			5														5
HEPE	1	5	1		1		38				18		5	18	18	5					1	1	5
HEHE				5																			
HOJU	1	1									5		1		5	1		5	1		5		
IPPA				1	5	1				5		1						5	1		1	1	
JUTO			1								1		1		1								
JUVI																							
LASE	5	5			1								5	5			5		5	1		1	
LEOR		1	1			1					1												
LEDE					1									5					5		1		
LYAM			5		5		63	5			1	1											
LYAS			5			5	5				5												
LYDA	1						5				1		1										
MEAL	5												5	5									18
MEAR			18				5	38	5		18					1							5
MORU				1									5	18									
OEBI																							
PAVI														1	1								
PAVT												1	1							5			
PHAR															5								
PHLA	5		5				83		5		5	5					5						
PHVI	1			1	5	1				1	1	1	1	1	5	5	5	5	1			5	5
POPR					5										5					5			
POLA						1					1			1	5								5
POPE											5			1									
PODE		5	5		5		18				1		1										18
RHRA								5															
ROWO													5				1						
RUCR			1	1			1		5	1	5		5	5	1		1					1	1
SAEX	38	1	38	63	18	38	38	5	18	18	38	83	18	38	5	18	83	38	1			18	63
SARI	18	5	5		18	5	5				5		1	5			5						5
SACA																							
SCAC			5											1				1	5				
SCAM	1		5								1			1	5	5		5	1				

TABLE C11 (CONTINUED)

SITE	58	58	58	59	68	68	68	74	74	75	75	75	89	89	89	91	91	91	91	91	91	91	92
PLOT	03	09	12	06	02	08	15	06	08	05	07	12	04	05	07	02	03	05	07	09	10	14	03
SPECIES																							
SCFL				1							1		1		1								
SOCA	5			18	5	5					1		5	5	5	5	5	5	5	1	18	5	
SPPE	1	1	1		5		1		5	5	5		38	5	38	5		5	5	1	5	1	38
SPOB	1												1		18	1	5	1	1			1	
SPCR																							
TAOF								1					1										
TYLA																							
ULRU										5			1										
VETH					5								1						1				5
VEHA	1				5									1				1	1				1
VEST																					1		
VEFA	1						1					1	5		1	1				1	5		
VEAA									5														
VIRI	5	5		5		18				1		5	5	5	5	1						5	
XAST			1		1	1			18		5		1										

TABLE C12. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 93 TO 130 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	93-04	97-03	98-02	98-03	98-04	98-05	98-09	111-08	111-11	111-16	111-18	119-03	119-05	119-07	119-11	119-13	122-04	122-07	130-05	130-06	130-08	130-11	130-13
SPECIES																							
ACNE													1			1			18				
AGRO																							
AMAR		63	5	1		83	1	63	63	38	38	38	38	38	63	38	1	1	1	63	18	18	83
AMTR		5				1				1	5	1	1	18	5	1			1	63			1
AMFR	18	1	5	1	63	18	38	38	38	38	38	5	38	63	38	63	18	18	1	1	18	18	38
ANGE																							
ANSC																							
APSB	5	1										1	5						5		5		1
ASIN			1	1											1								
ASVE																							
ASPI			1		5																		
BICE																		5					
BIFR	5						5					5										1	
BOCY												1											
BRJA		38				1					1			1	38		5				18		
BRTE		5											18		5						5		
CAIN		5																					
CAAQ	18							5		5		18	5	5	5	5				18			
CASP		5																	1				
CHAL				1					1				1			1						1	
CISP																1		1		1			
COCA	5		5	5	5	5							1			1	5	5					
CODR		38					1		5			1	5		1	83	5		63		18	5	
COST																						1	
CYSP																		5					
DEIL											5											1	
ELAN																1							
ELPA										1												5	
ELCA	18					1							1	5	5			1	18	5			
EQSP																1					5		
ERST		1																1				1	
EUMA			5																				
FRPE												1	5			1			5		1		1
GAAP								1	5				1	5	1		1		5	5	1		

TABLE C12 (CONTINUED)

SITE-PLOT	93-04	97-03	98-02	98-03	98-04	98-05	98-09	111-08	111-11	111-16	111-18	119-03	119-05	119-07	119-11	119-13	122-04	122-07	130-05	130-06	130-08	130-11	130-13
SPECIES																							
HEAN			1																				
HEPE							5			18	1		5	18	5	5				5	5	5	
HEHE																							
HOJU	5					1		1			38		1			1				1		1	1
IPPA					1	1	18																
JUTO																		1					
JUVI																							
LASE	1		1	1				1	1	5		1	5	1	1	1							5
LEOR												1						5					
LEDE			1					1	18							1					1		
LYAM		5																					
LYAS							1																
LYDA							1																
MEAL					1					1			1				38			1		18	1
MEAR												5											
MORU		38																			1		
OEBI			5				1		1	5	18		1	1		1						1	
PAVI											1												
PAVT											1		1										
PHAR	18									1					5			5					
PHLA			1				5					5											
PHVI		1			1	5	18					5	5		5	1			1				
POPR						5		5			1		5			5		18	18				
POLA							1											1					
POPE										5												1	
PODE	63	5	18	18	5	5	5				5					5	18	18			5		
RHRA																			18				
ROWO		5																	1				
RUCR		1						1				1	1			1						5	
SAEX		63	5	5	5		38	5	5	63	38	18	38	1	5	1	5	18	5	63		63	18
SARI		18	38	38	5		5					5		5	1				5	1		1	
SACA																							
SCAC																							
SCAM	1		5		1	5	1	1		1		1				1				1			

TABLE C12 (CONTINUED)

SITE	93	97	98	98	98	98	98	111	111	111	111	119	119	119	119	119	122	122	130	130	130	130	130
PLOT	04	03	02	03	04	05	09	08	11	16	18	03	05	07	11	13	04	07	05	06	08	11	13
SPECIES																							
SCFL		5	1				1			1		5								1			
SOCA			1	1	63	5	5			5					1	1			5			5	
SPPE			18	1	5	5		5	5	38	18		5	38	5	18	5	18	5	1	5	1	5
SPOB			5	1		1	1	5			1									1			1
SPCR																							
TAOF			1						1				1			5				1			1
TYLA												1											
ULRU											1								5				
VETH			5	18									1			1					1	5	
VEHA			1					1		1													
VEST																					1		
VEFA		5	1					1	5				1		1			5					
VEAA								1		5					5			1				5	
VIRI		5											5	5	5	5	5	5	5		5	1	
XAST					1			1		18					1			18				18	

TABLE C13. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 138 TO 188 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	138	138	138	138	138	139	139	139	139	139	141	156	160	160	164	164	164	164	169	169	172	188	188
PLOT	06	07	09	11	12	05	08	09	10	13	06	06	03	3A	02	03	10	13	01	04	03	02	04
SPECIES																							
ACNE			5	1	1					5												5	
AGRO																				18			
AMAR		18	5	63		18	1		18	1	1		5	38	18	1		5	1		5	18	
AMTR		1	1	1															1				
AMFR	18	38		18	38		18	5	18	5	38		38		5	5	18	18	83	18			
ANGE																							
ANSC															1								
APSB			1	1	1		63				5				1	1	5	5				1	
ASIN													1			1							1
ASVE											1						1			1			
ASPI																5							
BICE										5													5
BIFR																						1	
BOCY																							
BRJA	38	5	18	1	5		38		5		5				1					1			
BRTE	5	5		5	18	5			5					5	18			18		63	18		
CAIN			1					5															
CAAQ		1		5						38									18				
CASP									18		5	18								5			
CHAL		1												1						1	5		
CISP		1																					
COCA					1																	1	5
CODR					38			83			38	63			5		1					5	
COST				1															1				
CYSP						18																	5
DEIL											5					5			5				
ELAN	5				5									1	5	5							
ELPA										1								5					1
ELCA	5			5	1									1		1	5		5	1	18		
EQSP				1								5											
ERST																							5
EUMA																				1	5		5
FRPE	5		5		1						1									1			
GAAP	1		5																				

TABLE C13 (CONTINUED)

SITE	138	138	138	138	138	139	139	139	139	139	141	156	160	160	164	164	164	164	169	169	172	188	188
PLOT	06	07	09	11	12	05	08	09	10	13	06	06	03	3A	02	03	10	13	01	04	03	02	04
SPECIES																							
HEAN																							1
HEPE		5	5	1					1								1	1	1				
HEHE																							
HOJU		1	5	5										1									5
IPPA																			1				
JUTO													1										1
JUVI																							
LASE		1	5	1			1		1				5		1		1					1	1
LEOR																							5
LEDE		5																					
LYAM											1												5
LYAS																							
LYDA													18			1						5	5
MEAL										1	1	1							1	1	18		5
MEAR																							
MORU															5		5					1	
OEBI		1			1											18							
PAVI											18				1	1							
PAVT	1	1													1				1		5		
PHAR		5	38	5			18			38					1								
PHLA						5						18						5				18	18
PHVI	1		5		1		1										1		1				5
POPR	63		5	18	5				1		63	5			18		5				5		
POLA																		5					
POPE																							5
PODE			1	1			5	5	5				18	18	5	18	18	18			18		18
RHRA	1				1										5				5				
ROWO					1						5				5				5				
RUCR		1	1							1								1				5	
SAEX		18	18	5	1	38	38	5	38	63			63	63	5	30	18	18	18	5	1	38	63
SARI	5			18			1	5	5	1			18		5	18		18	1	5	5	1	
SACA																							
SCAC																							18
SCAM													5			5						1	

TABLE C13 (CONTINUED)

SITE-PLOT	138-06	138-07	138-09	138-11	138-12	139-05	139-08	139-09	139-10	139-13	141-06	156-06	160-03	160-3A	164-02	164-03	164-10	164-13	169-01	169-04	172-03	188-02	188-04
SPECIES																							
SCFL																						5	5
SOCA	5	18	5	1	1											1			5	1			
SPPE	1				5				63		18		5	38	5	5	5	5			5	18	5
SPOB												1				1							
SPCR		1		1	1																5		
TAOF	1	1	1								1												
TYLA																						5	5
ULRU												1			1		5		5	1			
VETH													1	1									
VEHA																							
VEST																				1			
VEFA	1		1											1		5			1	1			
VEAA										1				1									
VIRI	5			1	5						1				18		5		5			5	
XAST										5			5	5								1	

TABLE C14. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 208 TO 345 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT / SPECIES	208-08	208-10	219-03	219-05	219-07	229-04	229-06	266-07	266-08	277-02	282-03	301-01	312-01	312-03	312-05	312-07	312-12	327-02	327-07	327-11	335-04	335-05	345-06
ACNE					5							5											
AGRO								5	18							18							
AMAR			5	1				5	18							38		5					18
AMTR												5											
AMFR	18					38		63		5			1		1	1	5	38		38	5	5	
ANGE								5															
ANSC								5															
APSB			1		1								1			1							
ASIN																		1		1	5		
ASVE																							
ASPI										5	5					1				5			
BICE												5	5										
BIFR													1										
BOCY																			1		5		
BRJA	1							18	63														
BRTE																							
CAIN																					1		1
CAAQ				5						38			38				5		5		5		
CASP			5	5				1	5					5		5		63		18		38	
CHAL																							
CISP																1					1		5
COCA				1							5												
CODR			63	63								5											
COST														5					1		5	1	
CYSP		1												1									
DEIL									1									5		5			
ELAN			5							5				5	5	38					1		
ELPA													1	5		1	63					5	
ELCA				1		1	1														1	1	
EQSP										5						1		5				1	
ERST																							
EUMA																							
FRPE			1	5	1					5						1				1	5	1	1
GAAP																							

TABLE C14 (CONTINUED)

SITE-PLOT	208-08	208-10	219-03	219-05	219-07	229-04	229-06	266-07	266-08	277-02	282-03	301-01	312-01	312-03	312-05	312-07	312-12	327-02	327-07	327-11	335-04	335-05	345-06
SPECIES																							
HEAN																							
HEPE																							
HEHE																		5					
HOJU			5	1						5				1		1					1		
IPPA				1																			
JUTO		5																					
JUVI									38	18													
LASE	1			1			1																
LEOR					5								1										
LEDE																							
LYAM							1					18	1	1		5	5		5	1	18		
LYAS																							
LYDA														1			5	5		5		5	
MEAL																							
MEAR													5										
MORU					1		5					5							1				
OEBI																1						1	
PAVI					1			38	18	1								18		38			
PAVT																							
PHAR																							
PHLA							18				18	18											
PHVI			1			5						5				1			5				
POPR	63		38	18						5				1		5	5				1	5	
POLA													1										
POPE												5									1		
PODE				5									5	5	18								
RHRA									5			5					5				1		
ROWO						5			5	1				5		1							38
RUCR			1		5							5	1				1				1		
SAEX	38	63		1	83	63	83			1	83		63	38	63		38		63		83	38	5
SARI					5				5	1		63		5	5		5		5				18
SACA																							
SCAC					1		1					38					1				18	1	
SCAM										18			18	5		5		18		5		1	

TABLE C14 (CONTINUED)

SITE	208	208	219	219	219	229	229	266	266	277	282	301	312	312	312	312	312	327	327	327	335	335	345
PLOT	08	10	03	05	07	04	06	07	08	02	03	01	01	03	05	07	12	02	07	11	04	05	06
SPECIES																							
SCFL																							
SOCA									1	18				5		5			18				
SPPE	5			1	5	38	1		5	1	5		5	1		5	1	5	5	5		5	18
SPOB											1			1			1					1	
SPCR						5		5	18														
TAOF			18	1			5												5		1	1	
TYLA																	1				5		
ULRU				1					5														
VETH		63	1	5		5	5				5												
VEHA									5					1						5			
VEST														1									
VEFA			1	1	18											1	5	5	5	1	1	18	5
VEAA							1																
VIRI				5		5				1		5				1			1		1	1	1
XAST																			1				

TABLE C15. PERCENTAGE COVER SHRUB VEGETATION DATA FROM SITES 345 TO 404 (PLUS SITE 109) OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	345-09	345-14	345-17	345-18	391-0A	402-1A	404-14	404-15	109-04	109-06
SPECIES										
ACNE		1								
AGRO			5	5						
AMAR	5				5	63	1		18	38
AMTR										
AMFR		1	38	18	1	18	38	38	5	38
ANGE			38							
ANSC			1			38				
APSB		1	1		5				1	1
ASIN										
ASVE		5							1	
ASPI	5									
BICE										
BIFR										
BOCY										
BRJA			18	1				5		
BRTE							63			5
CAIN	5									
CAAQ	38									
CASP	5	18	1			1			5	18
CHAL			1	5			1	5		
CISP		5			18					5
COCA		1			18				5	1
CODR									5	1
COST										
CYSP										
DEIL			1							
ELAN	1		5			5				
ELPA	18				18					
ELCA										
EQSP			1							
ERST										
EUMA	1							1		
FRPE		1			5					
GAAP	5									5

TABLE C15 (CONTINUED)

SITE	345	345	345	345	391	402	404	404	109	109
PLOT	09	14	17	18	0A	1A	14	15	04	06
SPECIES										
HEAN			1	5	5					
HEPE			1	1		5	5	5	1	5
HEHE										
HOJU		1								
IPPA										
JUTO									5	
JUVI						38			1	1
LASE		1							1	5
LEOR										
LEDE			1	5					5	
LYAM	38								5	
LYAS	1									
LYDA	1				1					
MEAL										
MEAR					5				5	
MORU									1	
OEBI										
PAVI		1		5						
PAVT			1							
PHAR										
PHLA					5				5	
PHVI	5	1								
POPR				5					18	5
POLA	1									
POPE					5				5	
PODE					38	5			18	5
RHRA		5		1	5		18	18		
ROWO		5		1		18		5		
RUCR					1				1	
SAEX	83	63		5	63		1		38	18
SARI	5				5					
SACA										
SCAC					5					
SCAM	18				18				1	

TABLE C15 (CONTINUED)

SITE	345	345	345	345	391	402	404	404	109	109
PLOT	09	14	17	18	0A	1A	14	15	04	06
SPECIES										
SCFL										
SCCA		1		1						
SPPE		38	5	18	1	1			5	5
SPOB	1				5				5	5
SPCR		1	5				5	5	1	
TAOF									1	
TYLA					18					
ULRU										
VETH					5					
VEHA										
VEST				5					1	1
VEFA	1	1								1
VEAA										
VIRI		1	5	5	5		5		1	5
XAST										

TABLE C16. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 1 TO 53 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	1	1	4	8	8	8	8	8	8	8	8	29	29	42	42	42	44	44	44	50	50	50	53
PLOT	04	07	01	07	08	09	11	12	13	15	16	04	08	13	09	11	02	06	07	06	09	10	04
SPECIES																							
ACNE											5				5		38						
AGRO																		1					
AGST																	38	38					
AMAR		1	38	5	1		18	1	1			1	1				18	63					1
AMTR													5		18		5						
AMFR	1	5					1					5	1	5	18		5			18		18	18
ANGE																							
ANSC																							
APIO											5												
APSB		5													1							1	1
ASVE							1																
BRIN															5								
BRJA																5	5	5					
BRTE																							
CAIN	5	5									1			5									5
CAAQ				1								18	5							38			
CASP		5				1			5							38	18						5
CESC						5		1													5		
CEOC								1		1	18			5									
CHAL				1					5														
CISP				1	1											1							
COCA																							
CODR	5	5		38	38	5		18	38	5	63	5	1	63	63	83	5	5	83				63
COST																				18			
DEIL	1											1											
DISP																							
ELAN	1															5		5	5				
ELPA		5																					
ELCA					1			1		1		5	5	5						1	5		
EQSP					5					1													1
FRPE	5	5	18	18	38	5	38	18	18	18	18	18	38	38	38	5		18		5	63	18	5
GAAP					5			5	5	5	38			5					1				
GECA					5	1			5		5			5	5	5	5	1	5				
GLLE																		1					

TABLE C16 (CONTINUED)

SITE	1	1	4	8	8	8	8	8	8	8	8	29	29	42	42	42	44	44	44	50	50	50	53
PLOT	04	07	01	07	08	09	11	12	13	15	16	04	08	13	09	11	02	06	07	06	09	10	04
SPECIES																							
HEPE														1			5						5
HOJU																	63						1
JUNI																							
JUVI	18	18	18	18	18	83	63	5	5	18	5			18		5		38	5				1
LASE									1														
LYAM													5		1								
LYDA																							
MELU					5													1					5
MEAL	63	1		1				1	1						1	1	1	5			1		
MEAR															5								
MORU	1	1				1			18	5	5	5		18	5	18		18					
NECA				1	1		5					1				5	1		1				
PACA																							
PAOL	5	5		5			1																1
PAVI				1													5						5
PAVT	1			5		1			5	5		5		5	5				5	1		5	1
PHLA		18																					1
PHVI				1											1					1			
POPR			83	38	38		83					38				5	18	18			1		
PODE	63	63	38	18				63	18				18	5		5		38	38				63
RHAR																							
RHGL				1											5								
RHRA	5		5			18				5		5	63	18	5	5		18	63		38		5
ROWO	1	1	5	1	1	1	5	1				5		1		5	18	63			1	18	1
RUCR																	1					1	
SAEX		18																				63	5
SARI		18			5						5		5			5	5						18
SACA					5			1	1	83	5		5	5							5		
SCAM		1																18					
SHAR																							
SMST	1			5	1		1		5												1		
SOCA				1					5		5		38								5	38	
SPPE	5	18	5														5						5
SPOB																	1						1

TABLE C16 (CONTINUED)

SITE	1	1	4	8	8	8	8	8	8	8	8	29	29	42	42	42	44	44	44	50	50	50	53
PLOT	04	07	01	07	08	09	11	12	13	15	16	04	08	13	09	11	02	06	07	06	09	10	04
SPECIES																							
SPCR																							
SYOR				5					1	18		1			1			5			18		
TAOF				5	5			1	1			1											
ULAM													18							18			
ULPA																							
ULRU		1				18	1	38	5						5	5		5					
VETH																							
VEHA															1			5					
VEST			5	5			5																
VEFA	1	5					1										18			1			1
VIRI	1	1		1				1	5	5	18		1	5	5				5	5	18	1	1
ZAAM			18	18	1	5	5	5	5		5			5	18	5	5	18	5				

TABLE C17. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 58 TO 74 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	58	58	58	58	59	59	59	59	59	68	68	68	68	68	68	68	68	68	68	68	74	74	74
PLOT	04	05	08	10	01	04	07	08	09	04	05	07	09	10	11	12	13	14	16	17	02	03	05
SPECIES																							
ACNE																							
AGRO																							
AGST																							
AMAR		1				1	18			5	1			1	5	1		63	18		1	5	1
AMTR	1				1		5							5		1				38			
AMFR	5	5	5	5		1	18			1		1	5	1		63	1	5	5		5		5
ANGE																							
ANSC											5												
APIO									1	5													
APSB	5					18						1				5							1
ASVE																							1
BRIN																							
BRJA																							
BRTE							1																
CAIN																5					5	5	18
CAAQ		18		1		38	38	1	5			38	18	38	1	18	1		1				
CASP	5		1																		5		5
CESC					1			1	1	1													
CEOC				1	1	1				1				5		18				63			
CHAL			5	1								5								5			
CISP			5																				1
COCA				1											1			1	1	1	1		
CODR	5	63	1	63	38		1	38	38	83	38	38	5	38	63	18	83	1			18	63	5
COST						5	5								5								1
DEIL											1												
DISP																							
ELAN		5									5				18	5							
ELPA																							
ELCA			5	1	1			1	1	1		1	5	5		5	5	5		1	1	1	
EQSP									5	1	1							5					
FRPE	5	5	5		5	18	18	18	5	5	18	18	5	1	5		5		1	5	5	1	5
GAAP								1	1													1	1
GECA														5						18		5	
GLLE																							1

TABLE C17 (CONTINUED)

SITE	58	58	58	58	59	59	59	59	59	68	68	68	68	68	68	68	68	68	68	68	74	74	74
PLOT	04	05	08	10	01	04	07	08	09	04	05	07	09	10	11	12	13	14	16	17	02	03	05
SPECIES																							
HEPE							1		1					5		1			5				
HOJU							1									1							
JUNI																				38			
JUVI			5		1				1	5	38	5				5	5					5	5
LASE			1	1	1									1				1					I
LYAM														1		1					5		
LYDA																5							
MELU											1	1											
MEAL		1	5		1	1	5		1	1	5	1		1			1	1	1			5	18
MEAR	1											1											
MORU			18	1			1	1	5						1								
NECA														1									
PACA																							
PAOL			38				5			1	1					5						1	1
PAVI										1						5			1			1	
PAVT			1	1	1		1	1	1	1	1				5		1			5		1	1
PHLA	18					5	5					5				38			18		5		
PHVI	1			1		1	1									1			5				
POPR			18		1	18		1		18	38	18	18	5		38	5	38		18			
PODE	5	83	63	18	63	18		63	38	18	5	5		38		18	18	38	38		63	83	83
RHAR																							
RHGL									5		1												
RHRA		38		18	18	38			5	5	5	5		5		5	38					18	5
ROWO		1		18		1	5	1		5	1					1	5						
RUCR	1				1		5					1	1	1									
SAEX	83			1			5								18			5	38		5	1	1
SARI	38	1		18	5							5	38	18	18	5		5	63			5	5
SACA								1		1							1						
SCAM	5															5							
SHAR																							
SMST					1	1		5		1		1					1						1
SOCA	5		18	5		5	18	5	5	5	5	1	83	18	5		1	1	5				
SPPE	5			5			1		5				5			1	1		1		5	1	18
SPOB							1																

TABLE C17 (CONTINUED)

SITE	58	58	58	58	59	59	59	59	59	68	68	68	68	68	68	68	68	68	68	68	74	74	74
PLOT	04	05	08	10	01	04	07	08	09	04	05	07	09	10	11	12	13	14	16	17	02	03	05
SPECIES																							
SPCR			1																				
SYOR				5			1		5	38	5						18	1				18	
TAOF	R				1					1		5					5	5					
ULAM	R									1			18		5						1		
ULPA																							
ULRU		5			18	1		5	18			5					1						1
VETH																							
VEHA												1		5		1			1				
VEST																							
VEFA						5	1							1		5					1	1	
VIRI	5	18	5	18	5	1	5	5	1	1	1	1	1	5	5	5	1	5		5	1		5
ZAAM			1					5	18		38			5								5	5

TABLE C18. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 74 TO 91 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	74	75	75	75	75	75	75	75	75	75	75	75	89	89	89	89	89	89	89	89	90	91	91
PLOT	07	01	03	04	08	09	10	11	13	14	15	16	01	02	03	06	08	10	11	12	03	01	04
SPECIES																							
ACNE				1	1										5								
AGRO														1									
AGST																							
AMAR	1				18	1	18				1		1								18	5	18
AMTR						5		5					1				1			1	1	1	
AMFR	5		1	5	5	5	5	1	1	5	1		1	1	1	1					18	18	
ANGE																							
ANSC																							
APIO																				5			
APSB				5				5	1	18		1											
ASVE																							
BRIN																							
BRJA																							
BRTE																							
CAIN	5					5																	
CAAQ				38	5	18	38	18	5	18	5	18											
CASP																		5					
CESC																	1	18	18	5			
CEOC															1	5							
CHAL																	5		1				18
CISP		1			5					1						5		1		1			
COCA					5																		1
CODR	5	63		18	5	5	5	63	83	5			1	63	63	38	63	63	83	83	18	5	
COST											1	5			5								
DEIL												1											
DISP																							
ELAN						18							38										
ELPA																							
ELCA		1				1		1					1	18	5	18	5		1	18			
EQSP										18											1		
FRPE	5		5		38	5	18		1				5	18	5		5	18		5	38	18	
GAAP	5																						
GECA															1	5					1		
GLLE																							

TABLE C18 (CONTINUED)

SITE-PLOT	74-07	75-01	75-03	75-04	75-08	75-09	75-10	75-11	75-13	75-14	75-15	75-16	89-01	89-02	89-03	89-06	89-08	89-10	89-11	89-12	90-03	91-01	91-04
SPECIES																							
HEPE							1				1										5		5
HOJU																							
JUNI																							
JUVI				1		5									38	5		5	1	1			
LASE	1				1		1				1				1								5
LYAM			1	1			1	1	1														
LYDA																							
MELU																							
MEAL	1						1	1											5				1
MEAR	1			1								1											
MORU		5				1	1		1						5					38			
NECA															5	1			1				
PACA																							
PAOL																					5		
PAVI						5															38	18	
PAVT		18					1	1				1		1	18	18	5	5	5	1		5	
PHLA				63				5	1			63											
PHVI				18						1					1								
POPR						18	5	1	1				18	63				5	5			5	
PODE		63	38	63		38		63	63	18	63	38	18	5			63	18	5		18	38	63
RHAR																							
RHGL									5						5	63				1			
RHRA		63				5	1	38					38	38	38		38	18	18	63	18	18	
ROWO		5				5								5			5				5	1	
RUCR				1	1		1		1														
SAEX	1			18	5		5	5			1	18			1								1
SARI			18		5					18	5					38						5	
SACA	5	1				1											1	5	1	5			
SCAM				5	1							38											
SHAR																							
SMST		5															5	18	5	38			
SOCA		1	1	5	5	18	5	1					18	5		5						5	
SPPE				5	1		5	1	1	5		5	18									5	
SPOB																							

TABLE C18 (CONTINUED)

SITE	74	75	75	75	75	75	75	75	75	75	75	75	89	89	89	89	89	89	89	89	90	91	91
PLOT	07	01	03	04	08	09	10	11	13	14	15	16	01	02	03	06	08	10	11	12	03	01	04
SPECIES																							
SPCR																					5		
SYOR	5			1		5		1										38	1				
TAOF	1		1					1	1														
ULAM																							
ULPA																							
ULRU	5	5		5		5	5	1	1						1		5		5	5	5	5	
VETH																		1					
VEHA				1																			
VEST																							
VEFA		1						5			1		5	5							5		
VIRI		5	5	5	5	5	1	5	5	18	1	1	1	5	5		5			1	5	5	
ZAAM	5	5				5																	

TABLE C19. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 91 TO 111 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	91-13	91-15	92-01	92-02	93-03	97-01	97-02	97-05	97-07	97-08	97-09	98-06	98-10	106-06	109-02	109-03	109-07	111-01	111-02	111-03	111-04	111-05	111-06
SPECIES																							
ACNE						1																	
AGRO			18													1							
AGST																	5		1				
AMAR	5			38				1			5	18	18	1	18	18		1	18	18	18	1	38
AMTR	1												1						1	1			
AMFR		1		5		18	5		1	1	5	18	5		18	38	18	5	5	18	5	1	5
ANGE			63					5															5
ANSC			5					18															
APIO																							
APSB		5		5		5			5						1								
ASVE			5					5															
BRIN								1				1			5								
BRJA						1		63				5											1
BRTE																1							
CAIN	1																				5	1	
CAAQ		5									5	63	18					83	38				
CASP			5	1				1							18								
CESC	1	1																				63	
CEOC	1																						
CHAL	1												1										
CISP			5																1			1	
COCA						18	1								1								
COOR	5	38		63	18	18	63	18			18	5	1	1			38			5	83	18	5
COST									38	38													
DEIL			18			1															1		
DISP																							
ELAN	1		18					5	18					1									
ELPA											5				1					1			
ELCA												18							5	1	1	1	
EQSP			1				1	1	5				5				1						
FRPE	18			5		5	18		1	5	18												5
GAAP														1			1		1	5	1	1	
GECA	1			5		1																	
GLLE																							

TABLE C19 (CONTINUED)

SITE–PLOT	91–13	91–15	92–01	92–02	93–03	97–01	97–02	97–05	97–07	97–08	97–09	98–06	98–10	106–06	109–02	109–03	109–07	111–01	111–02	111–03	111–04	111–05	111–06
SPECIES																							
HEPE			18										1			5							
HOJU								5				1			5	18		1	1				
JUNI																							
JUVI		5				5	5	18	5					83	5	5	5		1			18	18
LASE	1		1			1				1				1			1		1	1	1		
LYAM																		1					
LYDA																							
MELU			1	5				1									5						38
MEAL									1		1										1		
MEAR																		1					
MORU		5		5			1	5	5	5	1			5									
NECA														1									
PACA			18																				
PAOL			18			5		5			1			5		1	1				1		5
PAVI																							
PAVT	5	18		18	5	5	5			5	1				1							1	
PHLA											1				5								
PHVI						1					1	5	1										
POPR		1		18		38	38	38	18	63	5	18					18					1	38
PODE	63	63		38	63	38	63	18	63	18	63	38		5	18	38	38	18	63			83	
RHAR														1									
RHGL														5									
RHRA	5	18		63	18	5	18		5	5	18			1	5	18	5			18	1	5	
ROWO	5	5	18	18	5		5	5	1	1	5			5	5	5	5				1	1	
RUCR															1	5			5	1	1		
SAEX				5			1		1		18		1		1	18	5	1					
SARI						5				1	5			1				5	1	5	18		
SACA		5																					
SCAM			18								5							1					
SHAR	1	18		18	5										5								
SMST	5	5		5		5	5		5	5	18			1									
SOCA	18	38										1	5							5			
SPPE			1			5		1			1	5	1		38	18	5		18	18	18	1	18
SPOB						1							1										

TABLE C19 (CONTINUED)

SITE	91	91	92	92	93	97	97	97	97	97	97	98	98	106	109	109	109	111	111	111	111	111	111
PLOT	13	15	01	02	03	01	02	05	07	08	09	06	10	06	02	03	07	01	02	03	04	05	06
SPECIES																							
SPCR														5									
SYOR	5	1						18						1									
TAOF						1	1		1	1							1		1		1		
ULAM							1			1	5		38										
ULPA																							
ULRU									1	5				1									
VETH																							
VEHA			1					5									1						
VEST				1								5											
VEFA			5			1		1			18		1		1			1	5	5	5		
VIRI	5			5		5	5		5	5	18	1	1	1			5		1	5	5	1	
ZAAM																							

TABLE C20. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 111 TO 130 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	111	111	111	111	111	111	111	119	119	119	119	119	119	119	119	119	119	119	122	122	122	130	130
PLOT	07	09	12	13	14	15	17	01	02	04	06	08	09	12	15	16	17	18	05	09	11	01	02
SPECIES																							
ACNE																							
AGRO																							
AGST																							
AMAR	63	18	38	38	63	5		38	18	38	1	1	5	5	5	5		5	1	5	5	1	18
AMTR			1				1			1	1	1	1	5									
AMFR	38	5	18	18	5	18	5		1	18	5	5	5		5	1			18	5	5		
ANGE																							
ANSC																							
APIO																							
APSB	1		1			1	5	5		5		1			1				1			1	1
ASVE			1			1																	
BRIN																							
BRJA				1				38				38		5					18		5		5
BRTE								1		1		18											
CAIN	1																		5	1	5		5
CAAQ							18						5		18								5
CASP	1				83				1	5										5	5	1	1
CESC																							
CEOC																1							
CHAL												1	1										
CISP	5							1		1			1					1		1			
COCA		1																	1		1		
CODR	63		18	5		38	5		38	5	38	38	18	38	83	18	38		5	63	5	18	5
COST																							
DEIL		5	1			1				1			1		1								1
DISP																							
ELAN			5											5		5	18	38		18	5	38	38
ELPA																							
ELCA	1			5		1		5	1	1	5	1	18	18									1
EQSP																						1	1
FRPE	1				5				1		1	18	5			5	1	18			5	1	5
GAAP	5		1	1	1			1	1	5	1		1	5					5	1	1		
GECA																							
GLLE																							

TABLE C20 (CONTINUED)

SITE-PLOT	111-07	111-09	111-12	111-13	111-14	111-15	111-17	119-01	119-02	119-04	119-06	119-08	119-09	119-12	119-15	119-16	119-17	119-18	122-05	122-09	122-11	130-01	130-02
SPECIES																							
HEPE		1						1		1		1		1									
HOJU		1			5										1							1	5
JUNI																							
JUVI	5		1	5		5			5				5	5	5	5	18	38	5	18	38	18	
LASE		1								5	1		18					1					
LYAM																			5				
LYDA																							
MELU																			1	1	5	1	5
MEAL															5		1				5	1	
MEAR																							
MORU												5											
NECA																							
PACA																							
POAL			5	1		5		1	5		1				1	5		1			5	1	1
PAVI				1	5																18		
PAVT	1										1				1		1			1		1	
PHLA																							5
PHVI												18									18		1
POPR	18					18		5	18	5	38	5		18	18	38	5	18				38	38
PODE	63	18	18	18	18	18	63	18	18	18	83		38	63	38	63	83	83	38	63	63	83	5
RHAR																							
RHGL																							
RHRA	18		1			5			18		5	1	5	5		63	18	38		18	5	5	
ROWO									5			5	5	1						5	1	18	5
RUCR							1	1		1												1	1
SAEX					18			5	1	1	1	1	5		1								
SARI					5			5				38	5										
SACA																							
SCAM															1								1
SHAR																							
SMST									5						5	5	5	18			5	5	
SOCA							38										1	1					
SPPE		38	63	63		38	18	38	5	38	5	5	5	18	5		1		5	5	5		
SPOB		1						5						1					18	1	5		

TABLE C20 (CONTINUED)

SITE	111	111	111	111	111	111	111	119	119	119	119	119	119	119	119	119	119	119	122	122	122	130	130
PLOT	07	09	12	13	14	15	17	01	02	04	06	08	09	12	15	16	17	18	05	09	11	01	02
SPECIES																							
SPCR													5										
SYOR																							
TAOF				1		1	18		1	5		1		1	5	1		5		1	5		1
ULAM									5														
ULPA																							
ULRU															1							1	
VETH														1									
VEHA																			5				
VEST	1										1												
VEFA	1				1	5	1									1	1				1		
VIRI	18		1	5	5	1	18		5	5	5	5	1	18	18	5	5			18			
ZAAM																							

TABLE C21. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 130 TO 139 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	130-03	130-04	130-07	130-09	130-10	130-12	130-14	130-15	130-17	130-18	138-01	138-02	138-03	138-05	138-08	138-10	138-14	138-16	138-18	139-04	139-06	139-12	139-14
SPECIES																							
ACNE		5																					38
AGRO																							5
AGST																							
AMAR	5	18	1		38	5		18	1			5	18	1				18	18	1	1		
AMTR			1	1	1	1			1		1			1									
AMFR			5	5		5	1				1	1	5	1	1	5	5	1	1	1	1	38	
ANGE																							
ANSC																							
APIO																							
APSB	1		1		1			1	1	1	5	1						1		5		1	1
ASVE									1				5										
BRIN	1																						
BRJA	1				5			18	1	1			38	5				18	5				
BRTE	5								1														
CAIN		1									1				1	18							
CAAQ		5	5		63						5	5		18						18			
CASP	1					5	1		1	1		1						1		18	5		5
CESC																							
CEOC																							
CHAL																							
CISP			1	1	1	5	1								1	1							
COCA					1		1																
CODR	18	38	63	38		63	83	5	5	5	5	63	5	18	63	63	38	5		38	38		63
COST																						5	
DEIL						1		1				1	18						1	1		1	
DISP																							
ELAN	5						18		18	18		5										1	
ELPA											38									5			
ELCA		5	5	18		18	1	5			1			5	5		5						
EQSP															5			1		1			
FRPE	1	5		5		1		5	1	1		1		1	5	5			1				38
GAAP	1	1	1	1	5	1								1	1	1							
GECA																							5
GLLE																							

TABLE C21 (CONTINUED)

SITE-PLOT	130-03	130-04	130-07	130-09	130-10	130-12	130-14	130-15	130-17	130-18	138-01	138-02	138-03	138-05	138-08	138-10	138-14	138-16	138-18	139-04	139-06	139-12	139-14
SPECIES																							
HEPE																			5				
HOJU	1				1						1		1					1	1				
JUNI																							
JUVI								5	5							1		1					
LASE		1			1	5								5				5			5		1
LYAM	1					1					1							1					
LYDA																							
MELU	38								1	1							1	1	1				
MEAL		1	1	1			1					1				1	1			1	1	1	
MEAR			5								18								1	5			
MORU		1													1								
NECA	1																						
PACA																							
PAOL	1					5	1		1	1		1	1		1		1	1	5	1			
PAVI														1					63				
PAVT		1					1								1		1						5
PHLA											18												
PHVI		5		1		1					5			1				5					
POPR	38	1	1	5		18	1	18	63	63		38	18	18	5	63	38	63		38	18	38	
PODE	63	38	63	83		18	83	18	63	18	18	63	18	38	83	63	63	18	18	63	63	63	63
RHAR																							
RHGL																							
RHRA	5	1	63			1	63	5	1			5			83	5	1			1	1		63
ROWO		1				5	1		5	18					1		5		1	5	5	5	
RUCR	1			1		1					1							1					1
SAEX		1	5		5	5					83		1						18	18	18		
SARI		1	5	1	18						5			1				5	1	1			1
SACA															1	1							
SCAM											1									5			
SHAR																							
SMST			1				1	1							1	1	1			5		1	1
SGCA		5		1	5		1								1		1						
SPPE	1	18	5	1	1	18		5			1	1	5	18			1	1		5	5	5	
SPOB																							

TABLE C21 (CONTINUED)

SITE	130	130	130	130	130	130	130	130	130	130	138	138	138	138	138	138	138	138	138	139	139	139	139
PLOT	03	04	07	09	10	12	14	15	17	18	01	02	03	05	08	10	14	16	18	04	06	12	14
SPECIES																							
SPCR								1					5										
SYOR																							
TAOF	5	1	1	1	1	5			5	1		5		1	1	1		1		1	1		1
ULAM																						1	
ULPA																							
ULRU	5			1						1		5				1	1						1
VETH																							
VEHA						1																	
VEST					1																	1	
VEFA			1		1								1	5								1	18
VIRI	5	5	5	5		5	5	18			1	1	5	1	5	5	5	1	1	18	1	1	1
ZAAM																							

TABLE C22. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 141 TO 164 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT / SPECIES	141-01	141-02	141-05	141-07	141-09	141-11	141-12	156-04	156-05	156-07	156-08	156-09	156-11	160-01	160-02	164-04	164-05	164-06	164-07	164-08	164-09	164-11	164-12
ACNE								5	1														
AGRO																							
AGST								5	5	5	18	5	5										
AMAR	1						1	18		1	18	18	5	18	5	18	5	5	5	18	5	1	63
AMTR																							
AMFR	1	1	1	1	1	1	1							1	38		18	1		1	5		1
ANGE																							
ANSC																	1						
APIO	18																						
APSB		1	1	1	38		1		5					1		5	1	1		1		1	
ASVE		5									5	5			5		1			1			
BRIN								5															
BRJA								63	1					5		1	1			5	1	1	1
BRTE					1			5								1				38		18	5
CAIN									5	5	5	5	5	18	5		1	1					
CAAQ		1	1	1	1		5																5
CASP		1	5			5		5	5		38	18						1		5		1	
CESC	5																						
CEOC		1	1	1																			
CHAL																1					1	1	5
CISP	1	1						1	5	1								1					
COCA		1							1	5	1	1							1	5	5	1	1
CODR	83	63	38	18	38	38	38	63	63	63	63	38	18	18	18		18	18	5	1	1	18	18
COST							5				1												
DEIL			1												1								
DISP								5		18	18												
ELAN		1	18		1		1	5		1			5	5		5	1		1	18			
ELPA										1													
ELCA	1	1	5	5			1	1							5	18	5	18			5	1	5
EQSP					1	1		1	5	1	1	1		5	5								
FRPE	18	18	5	1	5	1		5	5	5	5	18	5	5				5	18			38	
GAAP					1			5		1	1										5		
GECA	1	1	1	1	1			5	5	1												5	
GLLE																							

TABLE C22 (CONTINUED)

SITE PLOT	141-01	141-02	141-05	141-07	141-09	141-11	141-12	156-04	156-05	156-07	156-08	156-09	156-11	160-01	160-02	164-04	164-05	164-06	164-07	164-08	164-09	164-11	164-12
SPECIES																							
HEPE								5		1			5							1	1	1	1
HOJU								1				5											
JUNI																							
JUVI	5	5	38	5	5		5		5	5		5		1	5		5	5		1			
LASE		1	1				1	1	5	1						1	1		1	1	1	5	
LYAM			1						1	1													
LYDA										5													
MELU		5	18	5	5	18	5		18		1	18		5			1		18	5			
MEAL	1	5	1	1	5		1	1	1		1	5		5	18		1	1	1		18	1	1
MEAR		1	1							1											18		
MORU				1	1			5	5	1		5		1						5			
NECA																				1	5	5	1
PACA									18								1						18
PAOL		1				1		5		5	18	18		5	5	1	1		5	5			
PAVI														5	18								5
PAVT	5	5	1	5	1	1	1	5	5		1							5	1	5		18	
PHLA									1	18		5											
PHVI							1			5												1	
POPR	1	38	18	18	5	38	18	18	18			18	63				5	38	83	18		5	18
PODE	5	18	5	38	63	38	38	38	63	63	63	63	63	38	38	18	63	83	18	18	38		38
RHAR																							
RHGL																							
RHRA	38	5	5	18	18	5	18		5			5			5		63	63	5	1		38	
ROWO	5	5	18	18	18	5		18	5				18	1	1		5	5	18	18		5	5
RUCR		1	1	1	1			1						1									
SAEX																1					1		
SARI					1			5		18	5			1	1	5		1	5	5	5	5	5
SACA	1	1			1		1	1	1		1												
SCAM										5		1											
SHAR																			5				
SMST	1	5	1	5	18	5	1		5		5	1					1			5			
SOCA	5	5			1		5							5	1			5		1			
SPPE			1	1		5	5		5	5	5	18		18	18			1		5	5	1	
SPOB											5										1		

TABLE C22 (CONTINUED)

SITE	141	141	141	141	141	141	141	156	156	156	156	156	156	160	160	164	164	164	164	164	164	164	164
PLOT	01	02	05	07	09	11	12	04	05	07	08	09	11	01	02	04	05	06	07	08	09	11	12
SPECIES																							
SPCR																							5
SYOR	18							5	18														
TAOF	18	1	1	1	5	1	1	1	5		1	5					1	1	5	5		5	
ULAM	5																					38	
ULPA																							
ULRU	1	18	5	1				1	1		1						5						
VETH	1	1						5								1					5		
VEHA			1					1		5		5									1		
VEST														5		1			1	1			
VEFA		1					1	5		1		5		5	5	1	1	5	1	5	1	1	
VIRI	5	5	1	5	5	5	5	5	5			5		1	1		5	5				18	5
ZAAM	18	18	1		5		38	18		5	5												

TABLE C23. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 164 TO 208 OF THE PLATTE RIVER VEGETATION SURVEY

SITE	164	169	169	169	169	169	169	169	169	171	171	172	172	172	172	172	172	188	188	188	208	208	208
PLOT	15	03	05	06	08	10	11	13	14	07	08	01	05	06	07	09	10	01	03	06	02	03	04
SPECIES																							
ACNE		18																			5		
AGRO										5		1											
AGST																							
AMAR	38	1	1	5	1		5	38	5	18	18	38	18	5	18	5	18	5				5	18
AMTR																							
AMFR	5	5							5	18	5	18	18			5	18	5	5	5		1	1
ANGE																							
ANSC																							
APIO																							
APSB						1												5	5				1
ASVE	1										5	5	5									5	
BRIN											5												
BRJA	1	1		1	1		1	5	5	18	5			5	5			5		38		5	
BRTE	18			38	38		5	63	38	5	5	38		5	38	18	18	18		5	63	5	
CAIN																		5				1	
CAAQ						18																	
CASP					5		1											1					
CESC		1				5			5					5		5							
CEOC																5							
CHAL	5		1				1				1			5		1		5				1	
CISP						1				5						5							
COCA		1					1		5	5	5				5		5	1	5				
CODR	5	38	83	5	18	83	83		38					38	5			5	1	1		1	
COST																18							
DEIL																							
DISP																						1	
ELAN		1																1				1	
ELPA										5								5	18				
ELCA		18				1					1	5	5		1	5	18					38	
EQSP		1																					5
FRPE	1	5	5			5			5							5		5	1	5		38	5
GAAP																							
GECA		5	1			1	1																
GLLE																						1	

TABLE C23 (CONTINUED)

SITE	164	169	169	169	169	169	169	169	169	171	171	172	172	172	172	172	172	188	188	188	208	208	208
PLOT	15	03	05	06	08	10	11	13	14	07	08	01	05	06	07	09	10	01	03	06	02	03	04
SPECIES																							
HEPE	5							5	1		5	5		1	1	1	18	1		1			
HOJU										18	5								5				
JUNI																							
JUVI		1												18								5	
LASE	5	1						5	5	1						5	5	1					5
LYAM																			18				
LYDA																							
MELU		1		5	18	1	1			1			18		5								
MEAL	1					18			1			18	5				38	18	5			5	38
MEAR																							5
MORU	5	5	5		18		5	5	38					18	5	38				5	5	5	
NECA		1	1	1	1		5	5								18							
PACA																						5	
PAOL	5								18									5					
PAVI	38			1						5	18		18				5	18		5			1
PAVT		5	5	5	1	5	5		5				5	18		5		1					
PHLA										5									18				5
PHVI												5											
POPR		5	38	5	5	5	83						38	18	63	5		5		18		63	
PODE	38		18	38	5	18	18	18		38	38	18	38	38	38	18	63	18	18	18		63	38
RHAR																							
RHGL																							
RHRA				18		63			5			5	5	18	18	18		18		1			
ROWO	5	1	1	5	5	5			1					18	38						38	5	
RUCR										5									5			5	1
SAEX		5								5	1	5				5		5	5		63		1
SARI		5										18	5			5		1			1	5	
SACA										5													
SCAM																							
SHAR				18	5											1							
SMST		1	1				1									5		1				1	
SOCA		1	1	1																			
SPPE									5	38	5	5	5	5	5		38	5	5			5	18
SPOB										5													

TABLE C23 (CONTINUED)

SITE	164	169	169	169	169	169	169	169	169	171	171	172	172	172	172	172	172	188	188	188	208	208	208
PLOT	15	03	05	06	08	10	11	13	14	07	08	01	05	06	07	09	10	01	03	06	02	03	04
SPECIES																							
SPCR	5								38	5	18	18	5		5	18		5	5	18	5		18
SYOR		1	38	18	5	5	18																
TAOF		1			5	5	5									1						5	
ULAM													1			38		1					
ULPA												18									5		
ULRU		18	5	18	5	1	5							38	5	18			1	18	5		
VETH			1		1				1					1		5		1	5	1		1	
VEHA																							
VEST				5				5			1			1	5			5					
VEFA	5									1		5			5			5					
VIRI	5	5				5	5		5			5	5	5	5	5		5	1			5	5
ZAAM																							

TABLE C24. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 208 TO 266 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	208-07	208-09	219-01	219-02	219-04	219-06	219-08	219-09	219-12	219-13	219-14	219-15	219-16	229-02	229-05	229-07	245-01	245-02	245-04	245-06	245-08	266-01	266-03
SPECIES																							
ACNE				1							5				5			5	18			38	
AGRO												1		5				5				1	
AGST																							
AMAR		18	18	18	5	5	5		5	5		18	18	38	5		5	5	38			38	5
AMTR	1																			5	18		
AMFR				1	5		1							38	38	38							18
ANGE																							
ANSC																							
APIO																							
APSB		5		1	1	1	1				1	1		5			1						
ASVE										1				5	1	1							
BRIN		1	1														63						
BRJA								18	5					5		5		1	18	5			5
BRTE	63			18					38				5					18	18	5			
CAIN												1											
CAAQ						1					5												
CASP		1	1		18	1				1			1			18		1		18		38	1
CESC																							
CEOC													1										
CHAL	5	5					1	1	1	1			1							5			
CISP																							
COCA	1	5										1	1										
CODR	1			5	5		5		1	5		5		5	5	1					5		5
COST											38												
DEIL																					1		
DISP	18																	18		1			
ELAN					1			1	1			18	5			1		5	5	1		18	5
ELPA																							
ELCA		5			1					1				5							1		
EQSP					1						5	1	1	1				1					
FRPE				18	18	1		5	1	18		5	5	5	18		1	18	18	18			
GAAP																				5			
GECA																							
GLLE			1	1	1					18			5	1									

TABLE C24 (CONTINUED)

SITE	208	208	219	219	219	219	219	219	219	219	219	219	219	229	229	229	245	245	245	245	245	266	266
PLOT	07	09	01	02	04	06	08	09	12	13	14	15	16	02	05	07	01	02	04	06	08	01	03
SPECIES																							
HEPE	5																				1		
HOJU	5		1										1	1			5					5	
JUNI																							
JUVI					5	5	18	1	18	5		5		18	18	5	5	38	5	1		18	38
LASE		5		1	1	1		1				5	1								5		
LYAM	1														1							1	
LYDA																							
MELU			18	5		18	18	5	18	5		5	18		5	5		18		5	5		5
MEAL		18				1		1		1	5	1		1	5		5	18	5	18	18		18
MEAR																5						5	
MORU					1	1						5			5			1					
NECA		1		1	5	5							1		1								
PACA																				5			
PAOL				1			1	18	18	1		1		5	5			5		5			1
PAVI												1	1	18							1		
PAVT				5		1	5			1			1										
PHLA																63						63	
PHVI		18		38						1	5		1	5	1	5							
POPR		5	63	38	63	38	63	5	5	63		63	63	38	18	18	5	18	38	18	5	5	38
PODE	63	63	18		38	38	63	38	18	38		63	38	38	63	63	63	63	63	63		63	63
RHAR														1									
RHGL																							
RHRA						5	18			5				1	18	5		5		5			1
ROWO			18	5	1	5	18		5	5	1	5	5	1	1		5	5	18	5			
RUCR											1			1								1	
SAEX	1	1													18	1							
SARI	1	1		5							63		5	5	1		1	5		1		5	18
SACA																							
SCAM																5						5	
SHAR																				5		18	
SMST						5	5			5				1	1			1		1			
SOCA			1								5			5									
SPPE		18		1	1	5		5		5		1	1	5	18	38		5		18	38	1	
SPOB																							

TABLE C24 (CONTINUED)

SITE	208	208	219	219	219	219	219	219	219	219	219	219	219	229	229	229	245	245	245	245	245	266	266
PLOT	07	09	01	02	04	06	08	09	12	13	14	15	16	02	05	07	01	02	04	06	08	01	03
SPECIES																							
SPCR	1	5	1	1				1	38			1		5				5	5	18			5
SYOR				1														5					
TAOF		5	5	1	5	5	5	1				5	5		5	5		5		5	5	5	1
ULAM														1	1								
ULPA																							
ULRU		1		5			1			1		1								5			
VETH		5		5		1	1	5	1	1							5	5				1	5
VEHA		1															1						
VEST			5						1	1					5							1	5
VEFA			1	1	1	5	1			5	5	1			5					1	1	5	
VIRI	5				1		5	1		5	18	1	1	5	5	1		5		5			5
ZAAM																							

TABLE C25. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 266 TO 320 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	266-05	277-01	277-03	277-06	277-07	277-11	277-12	277-14	282-02	282-04	282-05	301-02	301-05	301-06	312-02	312-08	312-09	312-10	312-13	312-14	320-02	320-03	320-04
SPECIES																							
ACNE				1				5		1													
AGRO														5		18	18				1	5	5
AGST						1																	
AMAR	1			1	1						5		5			38	18	5			18	18	5
AMTR																							
AMFR		5									18				5								1
ANGE						18																5	1
ANSC					1	18				1								5					
APIO																							
APSB		1	1				1			5								1		1			
ASVE																							
BRIN	5																						
BRJA				1							18		5										
BRTE											18		5										
CAIN				1									1										
CAAQ		38	5					5							83				38	1			
CASP	38			1	1	1	1	1					18			5	18	18			18	38	38
CESC					1	1		5															
CEOC																							
CHAL										1													
CISP		1	1					1								1							1
COCA																					5		5
CODR	5											18		5	1			1					
COST								1		5									5	1			5
DEIL																							
DISP																18		38			38		5
ELAN													5	18	38		38	18			5	18	38
ELPA																	18				18	5	5
ELCA	5							1					5										
EQSP		5						1							18	1	1	1			5	1	
FRPE		18	1	5		5	5	18	5	5	18			1					38				5
GAAP																			1				
GECA																							
GLLE								1															

TABLE C25 (CONTINUED)

SITE	266	277	277	277	277	277	277	277	282	282	282	301	301	301	312	312	312	312	312	312	320	320	320
PLOT	05	01	03	06	07	11	12	14	02	04	05	02	05	06	02	08	09	10	13	14	02	03	04
SPECIES																							
HEPE																	1						
HOJU															1		1				5		1
JUNI																							
JUVI	83	5	83	63	38	83	38	38	5		5					5	5	1			1		5
LASE																							
LYAM	5	5													1	1	5		1		1		1
LYDA																		1				5	5
MELU								18													1		
MEAL	5	5		1	1		1	1		1	5	18	5	5		1					5		5
MEAR																							
MORU			1						18		5			5									
NECA									5					5									
PACA																							
PAOL	5	1		1			1	1								5	18	5				1	1
PAVI			1				1				5							5			5		
PAVT		1	1	1		1		1		5		1		1									
PHLA																					5		
PHVI										1									5				
POPR	5	1	1	5	5		5	38			18		18				5	5			38	5	5
PODE	63	95	18	38	5		18	5		38	38	38	63	83	38	18		5	18	63	18	38	63
RHAR	5	1	18	5	1	1		1															
RHGL																							
RHRA	83	5	1		1		5	1	38	18	5	18			1								
ROWO		1						1			18	5	5	18	5		1	1	5				
RUCR																							
SAEX										5	5				1				18	5			1
SARI									5	5	18	18							5	18		38	5
SACA			1																				
SCAM																			5		1	5	38
SHAR								18			18												
SMST			5	1		1	5													1			
SOCA		5														1	1						
SPPE		1	1							38	5		5		1		1	1			1		5
SPOB																							5

TABLE C25 (CONTINUED)

SITE-PLOT	266-05	277-01	277-03	277-06	277-07	277-11	277-12	277-14	282-02	282-04	282-05	301-02	301-05	301-06	312-02	312-08	312-09	312-10	312-13	312-14	320-02	320-03	320-04
SPECIES																							
SPCR	5			1						5	5		1										
SYOR		1	1	1	1	1	1	18									1	5					
TAOF			1	5	1		1	5					5		1						5		1
ULAM								5			5												
ULPA																							
ULRU		1	1					5															
VETH			1	1			1	1		5	1												
VEHA																						1	1
VEST										1								1					
VEFA		1						1									5		1		1	5	5
VIRI	5	1	5	5	1		18	5	18	5	5	5	5	5	1			1	1				5
ZAAM																							

TABLE C26. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 327 TO 337 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	327-01	327-04	327-05	327-06	327-08	327-09	327-10	327-12	335-02	335-03	335-06	335-07	335-08	335-09	335-10	335-11	335-13	335-16	335-18	335-19	337-01	337-03	337-05
SPECIES																							
ACNE																							
AGRO	5								5					1							18	1	5
AGST						5						38											
AMAR	38				18		5	38			5			18	38	83	63	5	38	18	38	38	18
AMTR																							
AMFR	1	1	5	1			5	5	1	1	5	5	1		1	1		1		5			
ANGE																							
ANSC									18		1			1				1					
APIO																							
APSB			1			1	1				1	1					1						5
ASVE											1												
BRIN	5					1	5			5													
BRJA									5	18				1			1						
BRTE										1													
CAIN				1																		5	1
CAAQ		18	18		5	63																	
CASP	1			5		1	18		18				38			5		18	18	18	18	5	
CESC																							
CEOC																							
CHAL	5							1							1								
CISP				5										1			18	1	5			1	
COCA									1					1				1				1	
CODR			1																				
COST				1		1					5	18	18					1					
DEIL							1				1						1						
DISP										18				83									
ELAN		1	1			1	38	18	38	38	1	5	1	18	38	18	38	63	38		63	83	18
ELPA		38	18				1			1			38								5		5
ELCA	1	5				1	1	18														5	5
EQSP			1						1		5	5	5		1		1	1	1	1	1	1	
FRPE	1	5	5			1	1	1			63	5	5		1	5	5	1	1			5	38
GAAP						1																	
GECA																							
GLLE								5				5							1				1

TABLE C26 (CONTINUED)

SITE-PLOT	327-01	327-04	327-05	327-06	327-08	327-09	327-10	327-12	335-02	335-03	335-06	335-07	335-08	335-09	335-10	335-11	335-13	335-16	335-18	335-19	337-01	337-03	337-05
SPECIES																							
HEPE	5						1	5								1	1			1			
HOJU					5			1				1	5					5	1			1	18
JUNI																							
JUVI									5	18													
LASE								1							1	1	5	5	5	1			5
LYAM		5	1			5	5		1		1	1	1			1	1		5			1	
LYDA				5			1				5		1					5		18	5		
MELU																		1					
MEAL					1		1												1			1	
MEAR				5																			
MORU																							
NECA																							38
PACA																							
PAOL									1	1	1	5					5				1	1	
PAVI	1						18		18	1	5			5	18	1	18		5	5			
PAVT								1				1							1			1	
PHLA		18																			18	1	
PHVI		1				1			1								1				1		
POPR	18	1		1	18		18	18	63	38	18	18	5		63	5	5	18		63	5	18	1
PODE	38	5	38		1	18	63	38		18		38		18	83	18			63	5	18	18	38
RHAR																							
RHGL																							
RHRA	5					1	5			1		18				1	1					1	
ROWD	5		1				1	1	1		1	1			1	1	5	1	5			5	
RUCR	5							5															5
SAEX		5		5	63						18		5					18					
SARI		5	5	63	38	18							18			1	5			63	5	5	18
SACA		1		1	1	1																	
SCAM		18	18		5				5		1				1	1	1	5	5	5	5	1	
SHAR																							
SMST												1										1	
SOCA	5			18	1				1		1	1						1					
SPPE	18		5		5	1		5		1	5		5					5		1	5		
SPOB																		5			1		

TABLE C26 (CONTINUED)

SITE	327	327	327	327	327	327	327	327	335	335	335	335	335	335	335	335	335	335	335	335	337	337	337
PLOT	01	04	05	06	08	09	10	12	02	03	06	07	08	09	10	11	13	16	18	19	01	03	05
SPECIES																							
SPCR																						1	
SYOR									18	1				18									
TAOF		18		1		5	18		1		5	5			5	1	5		18	1		5	
ULAM																							
ULPA																							
ULRU																							
VETH																							
VEHA																		1		1			
VEST									1	1													
VEFA		1	1	1	1	1		1	1		5	1	1			1	1	5	1	1	5		
VIRI		1	1	1		1	5	1	1		1				5	5	1		1			5	18
ZAAM																							

TABLE C27. PERCENTAGE COVER FOREST VEGETATION DATA FROM SITES 337 TO 404 OF THE PLATTE RIVER VEGETATION SURVEY

SITE-PLOT	337-07	337-08	345-01	345-03	345-08	345-10	345-12	345-13	345-15	345-16	391-0B	402-02	402-3A	404-01	404-03	404-04	404-07	404-08	404-10	404-11	404-12
SPECIES																					
ACNE																					
AGRO							1			18		18			1						
AGST																					
AMAR	18	18	5	18	38	63		63	38		5	63	5					1			
AMTR																					
AMFR					5				5	1	38	1	38	5	18	5	5	18			
ANGE													5							1	
ANSC				5							5	5	5								
APIO		18																			
APSB						1	1		1								5	1	1	1	
ASVE								1		1											
BRIN												5									
BRJA	38												18	63	5	1					
BRTE														18		18					
CAIN		5			18																
CAAQ																					
CASP		5	1		18	1						1				1					
CESC																					
CEOC																					
CHAL										5		18	1	5	5	18					
CISP											5										
COCA															1						
CODR																					
COST																					
DEIL				1																	
DISP												5									
ELAN	18		38	38	38	38	38	18			1										
ELPA									5												
ELCA	5									5	1	1								1	
EQSP		1		5	1	5		5	1		1										
FRPE	18	83			5	18	63	5	18		1								5		
GAAP																					
GECA																					
GLLE	18	18									5										

TABLE C27 (CONTINUED)

SITE-PLOT	337-07	337-08	345-01	345-03	345-08	345-10	345-12	345-13	345-15	345-16	391-0B	402-02	402-3A	404-01	404-03	404-04	404-07	404-08	404-10	404-11	404-12
SPECIES																					
HEPE	1		1		1				1	1		1	5	1	1	5	1				1
HOJU	18							1													
JUNI																					
JUVI				1		1	1				18	5	18		5	18	1		5	1	
LASE	1		5	1	1		1									1	1				
LYAM				1	5																
LYDA		5								1	63										
MELU																					
MEAL	5				1						1									1	
MEAR		18									5										
MORU							5														
NECA																					
PACA											5										
PAOL			1	5	5	5	1	5													
PAVI			18	18		1		5	63			1	5								
PAVT			1													1					
PHLA		1																			
PHVI																					
POPR	18		18	18	5	5	38			38	18	38									
PODE	38	5	18	38	63	18		38	38	38	38	83	38	18	18	18	38	18	18	18	38
RHAR							5														
RHGL																					
RHRA			5	1	18		18	5		5			1	1	5	18			1	18	
ROWO			1	1	5		5	5	1	1	5	1		1	5	1			1		
RUCR											18	1									
SAEX							1			1	5										
SARI	5	5	38								18	5									
SACA					1																
SCAM		18			1																
SHAR				5																	
SMST							5														
SOCA			1	1	5		5			1										1	
SPPE								1	1	1		1									
SPOB											18										

TABLE C27 (CONTINUED)

SITE	337-	337-	345-	345-	345-	345-	345-	345-	345-	345-	391-	402-	402-	404-	404-	404-	404-	404-	404-	404-	404-
PLOT	07	08	01	03	08	10	12	13	15	16	08	02	3A	01	03	04	07	08	10	11	12
SPECIES																					
SPCR													5	1	5	38	38	63	38	38	38
SYOR								5			5	1									
TAOF	1	5	5	1			5														
ULAM												1									
ULPA																					
ULRU																					
VETH																					
VEHA					1																
VEST							1	1				5									
VEFA				1		1	1	5	1		5										
VIRI		18			18		1	1			18		1	1		1					
ZAAM																					

APPENDIX D: VEGETATION CLASSIFICATION

TABLE D1. CLASSIFICATION OF THE STUDY SITES BY VEGETATION TYPE: ANNUAL MUDFLAT (AM), PERENNIAL MUDFLAT (PM), MARSH (M), WETLAND MEADOW (MW), SHRUB GRASSLAND (SG), GRAZED GRASSLAND (GG), PRAIRIE/HAYFIELD (PH), SANDY MEADOW/BLOWOUT (SMB), SALIX WETLAND (SW), SALIX SHRUB (SS), AMORPHA/SALIX (AS), CORNUS/AMORPHA (CA), AMORPHA CORNUS (AC), POPULUS/SALIX WETLAND (PSW), ELAEAGNUS/POPULUS (EP), POPULUS/ELAEAGNUS (PE), POPULUS SHRUB MEADOW (PSM), POPULUS OPEN MEADOW (POM), JUNIPERUS/POPULUS (JP), POPULUS/JUNIPERUS (PJ), POPULUS SHRUB (PS), MIXED HARDWOOD SHRUB (MHS)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
404-01																		●				
404-02								●														
404-03																		●				
404-04																			●			
404-05	●																					
404-06								●														
404-07																		●				
404-08																		●				
404-09				●																		
404-10																		●				
404-11																				●		
404-12																		●				
404-13								●														
404-14												●										
404-15													●									
402-1A													●									
402-01								●														
402-02															●							
402-3A																		●				
391-A										●												
391-B															●							
391-C							●															
345-01																●						
345-02				●																		
345-03																●						
345-04							●															
345-05							●															
345-06											●											
345-07			●																			
345-08																●						
345-09									●													
345-10																●						
345-11					●																	
345-12																				●		
345-13																●						

TABLE D1 (CONTINUED)

SITE	MUDFLAT		MEADOW						SHRUB					FOREST								
	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	PDM	JP	PJ	PS	MHS
345-14											●											
345-15																		●				
345-16																	●					
345-17													●									
345-18													●									
337-01															●							
337-02		●																				
337-03																●						
337-04				●																		
337-05																●						
337-06				●																		
337-07																●						
337-08														●								
337-09							●															
335-01				●																		
335-02															●							
335-03															●							
335-04									●													
335-05													●									
335-06															●							
335-07																				●		
335-08														●								
335-09															●							
335-10																●						
335-11																●						
335-12						●																
335-13																●						
335-14					●																	
335-15		●																				
335-16															●							
335-17						●																
335-18																●						
335-19															●							
327-01																	●					
327-02													●									
327-03			●																			

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
327-04														●								
327-05														●								
327-06														●								
327-07									●													
327-08														●								
327-09														●								
327-10																●						
327-11													●									
327-12																	●					
320-01							◐															
320-02															●							
320-03															●							
320-04															●							
320-05			●																			
320-06			●																			
320-07		◐																				
312-01										●												
312-02														●								
312-03										●												
312-04			●																			
312-05											●											
312-06			●																			
312-07													●									
312-08															●							
312-09															●							
312-10															●							
312-11				◐																		
312-12									●													
312-13														●								
312-14														●								
301-01									●													
301-02																				●		
301-03			●																			
301-04				●																		
301-05																	●					

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
301-06																				●		
282-01							●															
282-02																						●
282-03										●												
282-04																					●	
282-05																	●					
282-06								●														
282-07								●														
277-01																					●	
277-02													●									
277-03																				●		
277-04								●														
277-05								●														
277-06																			●			
277-07																			●			
277-08								●														
277-09								●														
277-10							●															
277-11																			●			
277-12																				●		
277-13					●																	
277-14																			●			
277-15				●																		
266-01															●							
266-02	●																					
266-03																	●					
266-04				●																		
266-05																				●		
266-06								●														
266-07													●									
266-08													●									
245-01																		●				
245-02																			●			
245-03	●																					

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	FS	MHS
245-04																	●					
245-05								●														
245-06																	●					
245-07								●														
245-08																	●					
245-09		●																				
245-10								●														
229-01							●															
229-02																	●					
229-03	●																					
229-04											●											
229-05																				●		
229-06										●												
229-07																	●					
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219-17						●																
208-01							●															
208-02																					●	
208-03																	●					

TABLE D1 (CONTINUED)

SITE	MUDFLAT		MEADOW						SHRUB					FOREST								
	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
208-04																	●					
208-05		●																				
208-06	●																					
208-07																		●				
208-08												●										
208-09																	●					
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208-11							●															
188-01																	●					
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188-06																					●	
172-01																	●					
172-02		●																				
172-03												●										
172-04								●														
172-05																	●					
172-06																			●			
172-07																	●					
172-08		●																				
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172-10																		●				
171-01	●																					
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171-03		●																				
171-04								●														
171-05								●														
171-06								●														
171-07																		●				
171-08																		●				
169-01											●											
169-02		●																				

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
169-03																						●
169-04													●									
169-05																			●			
169-06																			●			
169-07								●														
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164-01								●														
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164-03													●									
164-04																	●					
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164-09																	●					
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164-11																					●	
164-12																	●					
164-13										●												
164-14								●														
164-15																		●				
160-01																	●					
160-02																	●					
160-03										●												
160-3A										●												
160-04		●																				
160-4A	●																					
160-4B	●																					
156-01							●															

TABLE D1 (CONTINUED)

SITE	MUDFLAT		MEADOW						SHRUB					FOREST								
	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
156-02							●															
156-03		●																				
156-04																			●			
156-05																				●		
156-06													●									
156-07														●								
156-08																●						
156-09																●						
156-10								●														
156-11																				●		
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141-02																				●		
141-03					●																	
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141-06													●									
141-07																				●		
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141-14					●																	
139-01						●																
139-02					●																	
139-03				●																		
139-04														●								
139-05										●												
139-06																	●					
139-07	●																					
139-08											●											
139-09												●										
139-10											●											
139-11				●																		
139-12																	●					

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
139-13									●													
139-14																						●
138-01														●								
138-02																				●		
138-03																	●					
138-04					●																	
138-05																	●					
138-06												●										
138-07											●											
138-08																						●
138-09											●											
138-10																				●		
138-11											●											
138-12												●										
138-13		●																				
138-14																				●		
138-15					●																	
138-16																	●					
138-17					●																	
138-18																		●				
130-01																				●		
130-02																●						
130-03																				●		
130-04														●								
130-05												●										
130-06											●											
130-07																					●	
130-08												●										
130-09																					●	
130-10														●								
130-11										●												
130-12																	●					
130-13											●											
130-14																				●		
130-15																	●					
130-16								●														

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
130-17																				●		
130-18																				●		
122-01								●														
122-02	●																					
122-03		●																				
122-04												●										
122-05																	●					
122-06	●																					
122-07										●												
122-08	●																					
122-09																				●		
122-10	●																					
122-11																	●					
119-01																	●					
119-02																				●		
119-03									●													
119-04																	●					
119-05											●											
119-06																				●		
119-07											●											
119-08																	●					
119-09																	●					
119-10					●																	
119-11											●											
119-12																				●		
119-13												●										
119-14		●																				
119-15																				●		
119-16																				●		
119-17																				●		
119-18																				●		
111-01														●								
111-02														●								
111-03																	●					
111-04																	●					

TABLE D1 (CONTINUED)

SITE	MUDFLAT AM	PM	MEADOW M	WM	SG	GG	PH	SMB	SHRUB SW	SS	AS	CA	AC	FOREST PSW	EP	PE	PSM	PQM	JP	PJ	PS	MHS
111-05																						●
111-06																	●					
111-07																				●		
111-08											●											
111-09																		●				
111-10		●																				
111-11											●											
111-12																	●					
111-13																	●					
111-14														●								
111-15																	●					
111-16										●												
111-17														●								
111-18											●											
109-01							●															
109-02																●						
109-03																		●				
109-04										●												
109-05		●																				
109-06											●											
109-07																				●		
109-08	●																					
109-09						●																
106-06																			●			
98-01		●																				
98-02										●												
98-03										●												
98-04										●												
98-05											●											
98-06																	●					
98-07		●																				
98-08		●																				
98-09										●												
98-10														●								

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JF	PJ	PS	MHS
97-01																				●		
97-02																				●		
97-03												●										
97-04		●																				
97-05															●							
97-06					●																	
97-07																				●		
97-08																				●		
97-09																					●	
93-01						●																
93-02						●																
93-03																				●		
93-04												●										
93-05		●																				
92-01															●							
92-1A				●																		
92-02																				●		
92-03										●												
91-01																					●	
91-02											●											
91-03										●												
91-04																		●				
91-05										●												
91-06		●																				
91-07										●												
91-08		●																				
91-09												●										
91-10											●											
91-11		●																				
91-12		●																				
91-13																						●
91-14										●												
91-15																						●
90-3A		●																				

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	PJM	JP	PJ	PS	MHS
90-03																	●					
90-04					●																	
89-01																					●	
89-02																					●	
89-03																						●
89-04											●											
89-05											●											
89-06																						●
89-07											●											
89-08																						●
89-09					●																	
89-10																			●			
89-11																						●
89-12																						●
75-01																						●
75-02			●																			
75-03														●								
75-04														●								
75-05											●											
75-06		●																				
75-07										●												
75-08														●								
75-09																						●
75-10																					●	
75-11																					●	
75-12									●													
75-13																					●	
75-14														●								
75-15														●								
75-16														●								
75-17			●																			
75-18					●																	
74-01						●																
74-02														●								
74-03																			●			
74-04		●																				

TABLE D1 (CONTINUED)

SITE	MUDFLAT AM	MUDFLAT PM	MEADOW M	MEADOW WM	MEADOW SG	MEADOW GG	MEADOW PH	MEADOW SMB	SHRUB SW	SHRUB SS	SHRUB AS	SHRUB CA	SHRUB AC	FOREST PSW	FOREST EP	FOREST PE	FOREST PSM	FOREST POM	FOREST JP	FOREST PJ	FOREST PS	FOREST MHS
74-05																				●		
74-06													●									
74-07																						●
74-08										●												
68-01		●																				
68-02										●												
68-03					●																	
68-04																						●
68-05																			●			
68-06				●																		
68-07																					●	
68-08									●													
68-09																					●	
68-10																					●	
68-11																					●	
68-12														●								
68-13																						●
68-14																	●					
68-15										●												
68-16														●								
68-17																						●
59-01																						●
59-02		●																				
59-03		●																				
59-04																					●	
59-05		●																				
59-06											●											
59-07														●								
59-08																						●
59-09																						●
59-10					●																	
58-01										●												
58-02										●												
58-03										●												
58-04														●								

TABLE D1 (CONTINUED)

SITE	MUDFLAT AM	MUDFLAT PM	MEADOW M	MEADOW WM	MEADOW SG	MEADOW GG	MEADOW PH	MEADOW SMB	SHRUB SW	SHRUB SS	SHRUB AS	SHRUB CA	SHRUB AC	FOREST PSW	FOREST EP	FOREST PE	FOREST PSM	FOREST PDM	FOREST JP	FOREST PJ	FOREST PS	FOREST MHS
58-05																					●	
58-06					●																	
58-07					●																	
58-08																				●		
58-09											●											
58-10																					●	
58-11		●																				
58-12										●												
53-01										●												
53-02		●																				
53-03									●													
53-04																	●					
53-05						◐																
53-06						◐																
53-07						◐																
50-01											●											
50-02		●																				
50-03		●																				
50-04		●																				
50-05		●																				
50-06																					●	
50-07		●																				
50-08										●												
50-09																						◐
50-10																					●	
50-11									●													
50-12									●													
44-01						●																
44-02																	●					
44-03													●									
44-04				●																		
44-05						◐																
44-06																			●			
44-07																				●		
44-08							●															

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
42-09																						●
42-10		●																				
42-11																			●			
42-12						●																
42-13																						●
41-01							●															
41-02						●																
41-03						●																
41-04							●															
29-01		●																				
29-02		●																				
29-03										●												
29-04																					●	
29-05		●																				
29-06										●												
29-07										●												
29-08																					●	
20-01						●																
20-02						●																
20-03						●																
20-04		●																				
20-05									●													
8-01													●									
8-02										●												
8-03		●																				
8-04												●										
8-05		●																				
8-06													●									
8-07																			●			
8-08																						●
8-09																			●			
8-10						●																
8-11																			●			
8-12																						●

TABLE D1 (CONTINUED)

	MUDFLAT		MEADOW						SHRUB					FOREST								
SITE	AM	PM	M	WM	SG	GG	PH	SMB	SW	SS	AS	CA	AC	PSW	EP	PE	PSM	POM	JP	PJ	PS	MHS
8-13																						◐
8-14											●											
8-15																						◐
8-16																						◐
8-17													●									
4-01																			●			
4-03													●									
1-01					●																	
1-02				⊙																		
1-03										●												
1-04																				●		
1-05										●												
1-06												●										
1-07														●								

APPENDIX E: RIVER DISCHARGE AND PRECIPITATION DATA

TABLE E1. MAXIMUM AND MEAN ANNUAL DISCHARGE (CUBIC METERS/SEC.), TOTAL NUMBER OF DAYS WITH NO FLOW, TOTAL MARCH THROUGH JULY PRECIPITATION (MM), AND TOTAL ANNUAL PRECIPITATION (MM) ALONG THE NORTH PLATTE RIVER NEAR NORTH PLATTE FROM 1910 TO 1979. DEVIATIONS FROM LONG TERM PRECIPITATION AVERAGES ARE ALSO PROVIDED. (AFTER WILLIAMS 1978)

	DISCHARGE		DAYS	PRECIPITATION			
YEAR	MAXIMUM	MEAN	OF NO FLOW	MARCH-JULY	DEVIATION	ANNUAL	DEVIATION
1979	•	•	•	356	17	498	-16
1978	•	•	•	276	-62	443	-72
1977	85	19	0	459	120	614	99
1976	100	24	0	258	-81	395	-119
1975	85	17	0	314	-25	385	-130
1974	124	46	0	257	-82	402	-113
1973	196	49	0	321	-18	590	75
1972	94	26	0	341	3	494	-20
1971	271	44	0	426	87	677	163
1970	84	17	0	305	-34	464	-50
1969	61	18	0	292	-46	498	-17
1968	90	18	0	193	-146	455	-60
1967	71	16	0	441	102	517	2
1966	79	17	0	307	-31	485	-30
1965	54	14	0	495	156	741	226
1964	72	15	0	354	15	461	-54
1963	71	17	0	214	-124	469	-45
1962	100	14	0	649	311	800	286
1961	58	14	0	378	39	519	4
1960	59	16	0	262	-77	414	-101
1959	59	14	0	355	16	550	36
1958	105	14	0	469	130	665	151
1957	56	17	0	432	93	610	95
1956	60	15	0	320	-19	436	-79

TABLE E1 (CONTINUED)

YEAR	DISCHARGE MAXIMUM	DISCHARGE MEAN	DAYS OF NO FLOW	PRECIPITATION MARCH-JULY	DEVIATION	ANNUAL	DEVIATION
1955	61	15	0	286	-53	490	-24
1954	61	15	0	113	-226	206	-309
1953	71	17	0	206	-133	323	-192
1952	86	34	0	211	-128	370	-144
1951	153	17	0	605	266	781	266
1950	54	17	0	247	-92	417	-98
1949	73	18	0	479	140	654	139
1948	95	19	0	258	-81	426	-88
1947	74	17	0	354	15	500	-14
1946	58	19	0	260	-78	491	-23
1945	75	21	0	362	23	579	64
1944	71	14	0	343	4	464	-51
1943	69	17	0	265	-9	364	-103
1942	187	13	0	478	204	755	288
1941	45	9	0	343	69	508	41
1940	66	17	0	156	-117	279	-189
1939	111	28	0	216	-58	303	-164
1938	142	46	0	352	78	554	87
1937	110	27	0	208	-66	314	-153
1936	181	22	0	201	-72	286	-182
1935	331	37	0	387	113	487	20
1934	109	40	0	137	-137	344	-123
1933	283	64	0	260	-14	435	-32
1932	179	45	0	327	54	452	-15
1931	195	55	•	182	-92	254	-213
1930	312	75	•	369	95	629	162
1929	592	102	•	254	-20	537	70
1928	442	103	•	374	101	503	36

TABLE E1 (CONTINUED)

YEAR	DISCHARGE MAXIMUM	DISCHARGE MEAN	DAYS OF NO FLOW	PRECIPITATION MARCH-JULY	PRECIPITATION DEVIATION	PRECIPITATION ANNUAL	PRECIPITATION DEVIATION
1927	261	97	•	278	5	483	15
1926	306	101	•	216	-58	365	-102
1925	178	74	•	159	-115	287	-181
1924	524	118	•	185	-89	335	-132
1923	297	71	•	362	88	577	109
1922	306	77	•	274	1	438	-29
1921	683	105	•	147	-126	292	-175
1920	425	108	•	281	8	492	25
1919	122	64	•	358	85	571	104
1918	283	96	•	233	-40	384	-84
1917	592	141	•	289	15	468	1
1916	142	59	•	166	-107	329	-138
1915	309	80	•	582	309	831	363
1914	231	57	•	235	-39	401	-66
1913	256	81	•	324	50	485	18
1912	425	103	•	318	44	475	8
1911	101	39	•	225	-49	443	-24
1910	195	44	•	165	-108	272	-195

TABLE E2. MAXIMUM AND MEAN ANNUAL DISCHARGE (CUBIC METERS/SEC.), TOTAL NUMBER OF DAYS WITH NO FLOW, TOTAL MARCH THROUGH JULY PRECIPITATION (MM), AND TOTAL ANNUAL PRECIPITATION (MM) ALONG THE PLATTE RIVER NEAR KEARNEY FROM 1910 TO 1979. DEVIATIONS FROM LONG TERM PRECIPITATION AVERAGES ARE ALSO PROVIDED. (AFTER WILLIAMS 1978)

YEAR	DISCHARGE MAXIMUM	DISCHARGE MEAN	DAYS OF NO FLOW	PRECIPITATION MARCH-JULY	PRECIPITATION DEVIATION	PRECIPITATION ANNUAL	PRECIPITATION DEVIATION
1979	•	•	•	551	188	725	101
1978	•	•	•	395	31	611	-13
1977	134	31	•	630	267	902	279
1976	65	32	0	356	-8	517	-107
1975	156	33	0	457	93	658	35
1974	249	94	0	239	-124	360	-264
1973	541	109	0	487	123	880	256
1972	135	53	0	276	-88	602	-22
1971	445	89	0	347	-16	615	-8
1970	245	49	0	238	-126	466	-157
1969	206	38	0	305	-59	736	112
1968	72	31	0	310	-53	621	-3
1967	173	34	0	633	270	795	172
1966	97	41	0	274	-89	464	-160
1965	413	35	0	536	173	890	266
1964	67	24	0	293	-71	491	-132
1963	86	28	0	201	-163	394	-229
1962	201	38	0	537	174	746	122
1961	99	24	0	430	66	682	58
1960	197	30	0	483	119	718	94
1959	84	25	0	364	1	600	-23
1958	164	37	0	430	66	569	-54
1957	213	23	0	517	153	812	188
1956	56	16	0	257	-107	436	-188

TABLE E2 (CONTINUED)

YEAR	DISCHARGE		DAYS OF NO FLOW	PRECIPITATION			
	MAXIMUM	MEAN		MARCH-JULY	DEVIATION	ANNUAL	DEVIATION
1955	67	19	0	302	-62	549	-74
1954	83	22	0	265	-99	488	-134
1953	131	27	0	364	1	589	-35
1952	162	57	0	484	121	643	19
1951	214	48	0	436	73	668	44
1950	91	36	0	425	62	616	-7
1949	428	54	0	516	152	697	73
1948	170	36	0	343	-20	571	-53
1947	530	46	0	415	51	604	-20
1946	99	28	0	291	-73	773	149
1945	157	34	0	359	-4	583	-40
1944	115	28	0	455	92	652	28
1943	109	33	0	382	19	459	-164
1942	430	46	0	552	189	819	195
1941	66	7	66	393	29	561	-63
1940	253	18	95	160	-203	296	-328
1939	274	42	48	321	-42	441	-183
1938	217	44	9	384	21	507	-116
1937	200	22	124	357	-7	501	-122
1936	173	23	96	208	-156	344	-280
1935	1065	48	106	399	36	643	19
1934	148	35	134	105	-258	299	-325
1933	239	59	61	420	56	647	24
1932	173	38	41	346	-17	552	-71
1931	300	69	•	234	-129	573	-50
1930	282	92	•	525	162	852	229
1929	538	113	•	179	-185	432	-191
1928	651	126	•	382	19	566	-57

TABLE E2 (CONTINUED)

YEAR	DISCHARGE MAXIMUM	DISCHARGE MEAN	DAYS OF NO FLOW	PRECIPITATION MARCH-JULY	PRECIPITATION DEVIATION	PRECIPITATION ANNUAL	PRECIPITATION DEVIATION
1927	362	116	•	378	15	516	-107
1926	439	111	•	198	-165	463	-160
1925	•	77	•	220	-143	439	-185
1924	•	159	•	285	-79	537	-87
1923	623	98	•	475	112	707	83
1922	266	79	•	339	-25	490	-134
1921	1048	107	•	314	-25	457	-167
1920	609	139	•	303	-60	539	-84
1919	255	66	•	527	163	790	167
1918	•	88	•	284	-80	536	-87
1917	830	173	•	262	-102	507	-116
1916	147	50	•	297	-66	588	-36
1915	555	119	•	705	341	1018	394
1914	•	•	•	304	-60	494	-130
1913	•	•	•	279	-85	524	-100
1912	•	•	•	298	-66	467	-156
1911	•	•	•	196	-167	518	-105
1910	•	•	•	235	-128	446	-178

APPENDIX F: INCREMENT TREE CORE DATA

TABLE F1. INCREMENT TREE CORES COLLECTED IN 1978 AND 1979 DURING THE PLATTE RIVER VEGETATION SURVEY. THE YEAR OF ESTABLISHMENT, AGE (RELATIVE TO 1979), AND DBH (DIAMETER AT BREAST HEIGHT IN CENTIMETERS), ARE PROVIDED FOR EACH CORE

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N78-719-6	FELTZ	402-1	1940	39	29
POPULUS	N78-719-7	FELTZ	402-1	1951	28	28
POPULUS	N78-719-8	FELTZ	402-1	1949	30	38
JUNIPERUS	N78-719-9	FELTZ	402-1A	1963	16	11
POPULUS	N78-719-10	FELTZ	402-2	1936	43	40
POPULUS	N78-719-11	FELTZ	402-2	1923	56	43
POPULUS	N78-719-2	FELTZ	402-3A	1943	36	29
JUNIPERUS	N78-719-3	FELTZ	402-3A	1941	38	24
JUNIPERUS	N78-719-4	FELTZ	402-3A	1957	22	11
POPULUS	N78-719-5	FELTZ	402-3A	1940	39	34
SALIX	N78-718-10	BUCKHORN	391-B	1954	25	30
JUNIPERUS	N78-718-11	BUCKHORN	391-B	1969	10	8
POPULUS	N78-718-12	BUCKHORN	391-B	1939	40	40
POPULUS	N78-718-13	BUCKHORN	391-B	1943	36	29
JUNIPERUS	N78-718-14	BUCKHORN	391-B	1963	16	10
POPULUS	N78-711-9	BOYLE	337-1	1934	45	38
POPULUS	N78-711-10	BOYLE	337-1	1941	38	16
SALIX	N78-711-11	BOYLE	337-1	1934	45	37
POPULUS	N78-711-5	BOYLE	337-3	1930	49	24
SALIX	N78-711-6	BOYLE	337-3	1934	45	18
ELAEAGNUS	N78-711-7	BOYLE	337-3	1952	27	29
POPULUS	N78-711-8	BOYLE	337-5	1944	35	28
POPULUS	N79-620-1	SUMMERS	335-10	1918	61	53
POPULUS	N79-620-2	SUMMERS	335-11	1921	58	43
SALIX	N79-620-4	STAR	327-8	1952	27	28
POPULUS	N79-620-5	STAR	327-10	1939	40	32
POPULUS	N79-620-6	STAR	327-10	1949	30	32
POPULUS	N79-620-7	STAR	327-12	1933	46	50
POPULUS	N79-620-8	STAR	327-12	1935	44	45
POPULUS	N78-711-1	APPLEGATE	320-2	1923	56	38
POPULUS	N78-711-2	APPLEGATE	320-2	1923	56	39
POPULUS	N78-711-3	APPLEGATE	320-2	1935	44	21
POPULUS	N78-711-4	APPLEGATE	320-2	1939	40	30
POPULUS	N78-712-5	APPLEGATE	320-4	1947	32	30
SALIX	N78-712-6	APPLEGATE	320-4	1944	35	33
POPULUS	N78-712-7	APPLEGATE	320-4	1940	39	21
SALIX	N78-712-8	APPLEGATE	320-4	1951	28	18
POPULUS	N79-621-1	COFER	312-2	1944	35	43
POPULUS	N79-621-3	COFER	312-11	1921	58	54

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N79-621-4	COFER	312-13	1943	36	39
POPULUS	N79-621-5	COFER	312-14	1946	33	26
POPULUS	N78-712-1	GOLDEN	301-2	1951	28	27
SALIX	N78-712-2	GOLDEN	301-2	1951	28	29
POPULUS	N78-712-3	GOLDEN	301-5	1954	25	42
POPULUS	N78-712-4	GOLDEN	301-6	1967	12	22
JUNIPERUS	N78-719-12	MAXWELL	282-2	1942	37	22
SALIX	N78-719-13	MAXWELL	282-2	1959	20	16
POPULUS	N78-719-14	MAXWELL	282-4	1948	31	29
POPULUS	N78-719-15	MAXWELL	282-5	1950	29	25
JUNIPERUS	N78-719-17	MAXWELL	282-5	1963	16	14
JUNIPERUS	N79-621-10	MARTIN	277-1	1949	30	18
POPULUS	N79-621-11	MARTIN	277-1	1928	51	34
JUNIPERUS	N79-621-12	MARTIN	277-1	1924	55	24
JUNIPERUS	N79-630-1	MARTIN	277-6	1941	38	23
POPULUS	N79-630-2	MARTIN	277-6	1904	75	50
JUNIPERUS	N79-630-3	MARTIN	277-6	1947	32	18
POPULUS	N79-630-4	MARTIN	277-6	1921	58	46
JUNIPERUS	N79-630-5	MARTIN	277-9	1924	55	40
POPULUS	N79-630-6	MARTIN	277-10	1900	79	63
JUNIPERUS	N79-630-7	MARTIN	277-11	1930	49	34
POPULUS	N79-630-8	MARTIN	277-12	1924	55	40
JUNIPERUS	N79-630-10	MARTIN	277-12	1951	28	22
POPULUS	N78-718-6	BRADY	266-3	1927	52	30
JUNIPERUS	N78-718-7	BRADY	266-3	1949	30	14
POPULUS	N78-718-8	BRADY	266-3	1945	34	31
JUNIPERUS	N78-718-9	BRADY	266-3	1962	17	19
POPULUS	N78-718-1	BRADY	266-5	1943	36	32
POPULUS	N78-718-3	BRADY	266-5	1894	85	37
JUNIPERUS	N78-718-4	BRADY	266-5	1935	44	21
POPULUS	N78-718-5	BRADY	266-5	1919	60	34
JUNIPERUS	N78-718-15	BRADY	266-5	1926	53	28
JUNIPERUS	N78-810-9	GOTHENBURG	245-1	1969	10	8
POPULUS	N78-810-10	GOTHENBURG	245-1	1942	37	33
SALIX	N78-810-11	GOTHENBURG	245-1	1943	36	42
POPULUS	N78-810-7	GOTHENBURG	245-2	1935	44	29
JUNIPERUS	N78-810-8	GOTHENBURG	245-2	1940	39	25
JUNIPERUS	N78-810-5	GOTHENBURG	245-6	1945	34	27
POPULUS	N78-810-6	GOTHENBURG	245-6	1939	40	50
POPULUS	N78-810-1	GOTHENBURG	245-8	1950	29	30
POPULUS	N78-810-2	GOTHENBURG	245-8	1947	32	33
JUNIPERUS	N78-810-3	GOTHENBURG	245-8	1957	22	15

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N78-810-4	GOTHENBURG	245-8	1940	39	38
POPULUS	N78-810-12	KOCH	229-2	1938	41	28
JUNIPERUS	N78-810-13	KOCH	229-2	1958	21	19
JUNIPERUS	N78-810-14	KOCH	229-2	1940	39	30
POPULUS	N78-810-15	KOCH	229-2	1929	50	35
JUNIPERUS	N78-810-17	KOCH	229-2	1954	25	15
SALIX	N78-810-18	KOCH	229-5	1926	53	16
POPULUS	N78-810-19	KOCH	229-5	1936	43	42
JUNIPERUS	N78-810-20	KOCH	229-5	1948	31	25
POPULUS	N78-810-21	KOCH	229-7	1939	40	43
POPULUS	N78-810-22	KOCH	229-7	1935	44	43
JUNIPERUS	N78-810-23	KOCH	229-7	1957	22	14
JUNIPERUS	N79-710-1	COZAD	219-4	1944	35	36
POPULUS	N79-710-2	COZAD	219-10	1932	47	23
POPULUS	N79-710-3	COZAD	219-10	1945	34	38
JUNIPERUS	N79-710-4	COZAD	219-10	1955	24	16
POPULUS	N79-710-5	COZAD	219-16	1935	44	60
POPULUS	N78-811-9	DARR	208-3	1924	55	47
JUNIPERUS	N78-811-10	DARR	208-3	1938	41	26
POPULUS	N78-811-11	DARR	208-3	1945	34	52
POPULUS	N78-811-5	DARR	208-4	1944	35	19
POPULUS	N78-811-6	DARR	208-4	1951	30	17
POPULUS	N78-811-7	DARR	208-4	1950	29	27
POPULUS	N78-811-8	DARR	208-4	1946	33	20
POPULUS	N78-811-3	DARR	208-7	1952	27	21
POPULUS	N78-811-4	DARR	208-7	1952	27	19
POPULUS	N78-811-1	DARR	208-9	1949	30	26
POPULUS	N78-811-2	DARR	208-9	1950	29	23
POPULUS	N78-74-6A	LEXINGTON	188-1	1952	27	20
POPULUS	N78-74-7	LEXINGTON	188-1	1945	34	26
POPULUS	N78-74-3	LEXINGTON	188-4	1974	5	4
POPULUS	N78-74-4	LEXINGTON	188-4	1974	5	4
POPULUS	N78-74-1	LEXINGTON	188-6	1936	43	31
POPULUS	N78-74-2	LEXINGTON	188-6	1941	38	29
POPULUS	N78-630-1	JEFFREY	172-5	1956	23	17
POPULUS	N78-630-2	JEFFREY	172-6	1908	71	51
POPULUS	N78-630-3	JEFFREY	172-6	1907	72	46
POPULUS	N78-630-4	JEFFREY	171-7	1939	40	31
POPULUS	N78-630-5	JEFFREY	171-7	1934	45	50
POPULUS	N78-630-6	JEFFREY	171-8	1944	35	23
POPULUS	N78-630-7	JEFFREY	171-8	1944	35	24
POPULUS	N79-713-1	JEFFREY	166-1	1951	28	23

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N79-713-2	JEFFREY	166-1	1957	22	34
POPULUS	N79-713-6	JEFFREY	166-2	1929	50	42
POPULUS	N79-713-7	JEFFREY	166-2	1945	34	43
POPULUS	N79-713-8	JEFFREY	166-2	1954	25	48
POPULUS	N79-713-9	JEFFREY	166-3	1938	41	49
POPULUS	N79-713-10	JEFFREY	166-3	1957	22	24
POPULUS	N79-713-12	JEFFREY	166-3	1951	28	30
POPULUS	N79-713-15	JEFFREY	166-4	1958	21	17
POPULUS	N79-713-16	JEFFREY	166-4	1966	13	26
POPULUS	N79-713-18	JEFFREY	166-5	1952	27	27
POPULUS	N79-713-19	JEFFREY	166-5	1953	26	26
POPULUS	N79-713-21	JEFFREY	166-6	1942	37	27
POPULUS	N79-713-22	JEFFREY	166-6	1942	37	17
POPULUS	N79-713-24	JEFFREY	166-6	1930	49	34
POPULUS	N79-713-26	JEFFREY	166-7	1936	43	24
POPULUS	N79-713-27	JEFFREY	166-7	1951	28	34
POPULUS	N79-713-28	JEFFREY	166-7	1949	30	31
POPULUS	N79-713-29	JEFFREY	166-8	1944	35	21
POPULUS	N79-713-30	JEFFREY	166-8	1948	31	33
POPULUS	N78-89-17	PETERSON	160-1	1942	37	36
POPULUS	N78-89-18	PETERSON	160-1	1940	39	26
POPULUS	N79-719-8	PETERSON	160-2	1934	45	31
POPULUS	N79-719-10	PETERSON	160-2	1947	32	30
POPULUS	N79-719-11	PETERSON	160-2	1934	45	41
POPULUS	N79-719-12	PETERSON	160-2	1937	42	31
POPULUS	N78-89-19	PETERSON	160-2	1944	35	21
POPULUS	N78-89-20	PETERSON	160-2	1944	35	37
POPULUS	N79-719-1	PETERSON	160-4	1961	18	18
POPULUS	N79-719-3	PETERSON	160-4	1957	22	36
POPULUS	N79-719-5	PETERSON	160-4	1942	37	22
POPULUS	N79-719-13	PETERSON	160-5	1938	41	25
POPULUS	N79-719-16	PETERSON	160-5	1939	40	32
POPULUS	N79-719-17	PETERSON	160-5	1942	37	37
POPULUS	N79-719-19	PETERSON	160-6	1940	39	35
POPULUS	N79-719-20	PETERSON	160-6	1928	51	34
POPULUS	N79-719-21	PETERSON	160-6	1949	30	24
POPULUS	N79-719-22	PETERSON	160-6	1941	38	54
POPULUS	N79-719-25	PETERSON	160-6	1937	42	30
POPULUS	N79-719-26	PETERSON	158-3	1935	44	26
POPULUS	N79-719-28	PETERSON	158-3	1917	62	37
POPULUS	N79-719-29	PETERSON	158-3	1931	48	17
POPULUS	N79-719-30	PETERSON	158-3	1926	53	20

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N79-719-32	PETERSON	158-3	1923	56	21
POPULUS	N79-719-33	PETERSON	158-3	1929	50	41
POPULUS	N79-719-34	PETERSON	158-3	1920	59	28
POPULUS	N79-719-36	PETERSON	158-3	1937	42	34
POPULUS	N79-720-37	PETERSON	158-4	1937	42	23
POPULUS	N79-720-39	PETERSON	158-4	1946	33	36
POPULUS	N79-720-40	PETERSON	158-4	1941	38	38
POPULUS	N79-720-41	PETERSON	158-4	1925	54	37
POPULUS	N79-720-43	PETERSON	158-4	1937	42	24
POPULUS	N79-720-45	PETERSON	158-4	1954	25	38
POPULUS	N79-720-46	PETERSON	158-4	1954	25	33
POPULUS	N78-89-1	PETERSON	156-4	1903	76	59
SALIX	N78-89-2	PETERSON	156-4	1919	60	26
SALIX	N78-89-3	PETERSON	156-4	1930	49	22
POPULUS	N78-89-4	PETERSON	156-4	1915	64	39
JUNIPERUS	N78-89-5	PETERSON	156-5	1965	14	11
POPULUS	N78-89-6	PETERSON	156-5	1920	59	43
JUNIPERUS	N78-89-7	PETERSON	156-5	1940	39	32
SALIX	N78-89-8	PETERSON	156-7	1916	63	26
POPULUS	N78-89-9	PETERSON	156-7	1951	28	26
POPULUS	N78-89-10	PETERSON	156-7	1955	24	20
JUNIPERUS	N78-89-11	PETERSON	156-7	1962	17	13
POPULUS	N78-89-13	PETERSON	156-8	1941	38	31
POPULUS	N78-89-14	PETERSON	156-9	1934	45	30
POPULUS	N78-89-15	PETERSON	156-9	1934	45	25
POPULUS	N78-89-16	PETERSON	156-9	1933	46	31
JUNIPERUS	N78-76-10	MC CORMICK	139-2	1936	43	41
JUNIPERUS	N78-76-11	MC CORMICK	139-2	1937	42	32
POPULUS	N78-76-8	MC CORMICK	139-4	1954	25	28
POPULUS	N78-76-9	MC CORMICK	139-4	1954	25	21
POPULUS	N78-76-6	MC CORMICK	139-9	1955	24	29
POPULUS	N78-76-7	MC CORMICK	139-9	1954	25	24
POPULUS	N78-76-3	MC CORMICK	139-12	1955	24	17
POPULUS	N78-76-4	MC CORMICK	139-12	1952	27	21
JUNIPERUS	N78-76-5	MC CORMICK	139-12	1958	21	12
POPULUS	N78-76-1	MC CORMICK	139-14	1956	23	25
POPULUS	N78-76-2	MC CORMICK	139-14	1961	18	46
POPULUS	N78-77-15	ODESSA	122-5	1943	36	31
POPULUS	N78-77-10	ODESSA	122-7	1957	22	17
JUNIPERUS	N78-77-11	ODESSA	122-7	1969	10	8
JUNIPERUS	N78-77-6	ODESSA	122-9	1958	21	13
POPULUS	N78-77-7	ODESSA	122-9	1951	28	40

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
JUNIPERUS	N78-77-8	ODESSA	122-9	1966	13	8
POPULUS	N78-77-9	ODESSA	122-9	1961	18	34
JUNIPERUS	N78-77-1	ODESSA	122-11	1958	21	14
JUNIPERUS	N78-77-2	ODESSA	122-11	1956	23	22
POPULUS	N78-77-3	ODESSA	122-11	1942	37	23
POPULUS	N78-77-4	ODESSA	122-11	1940	39	42
POPULUS	N79-614-1	VOLENTINE	119-6	1958	21	29
POPULUS	N79-614-2	VOLENTINE	119-6	1951	28	32
POPULUS	N79-614-3	VOLENTINE	119-16	1934	45	26
JUNIPERUS	N79-614-4	VOLENTINE	119-16	1961	18	14
POPULUS	N79-614-5	VOLENTINE	119-18	1937	42	27
JUNIPERUS	N79-614-6	VOLENTINE	119-18	1959	20	13
JUNIPERUS	N79-613-2	JOHNSON	111-9	1949	30	18
POPULUS	N78-628-5	KAHLE	109-5	1961	18	35
POPULUS	N78-628-6	KAHLE	109-5	1962	17	23
JUNIPERUS	N78-628-1	KAHLE	109-6	1957	22	22
JUNIPERUS	N78-628-2	KAHLE	109-6	1964	15	13
POPULUS	N78-628-3	KAHLE	109-6	1957	22	16
POPULUS	N78-628-4	KAHLE	109-6	1929	50	28
JUNIPERUS	N78-816-1	CAMP	106-6	1920	59	33
POPULUS	N78-816-2	CAMP	106-6	1881	98	35
JUNIPERUS	N78-816-3	CAMP	106-6	1922	57	33
POPULUS	N78-816-4	CAMP	106-6	1893	86	36
JUNIPERUS	N78-816-5B	CAMP	106-6	1916	63	42
JUNIPERUS	N78-816-6	CAMP	106-6	1929	50	34
POPULUS	N78-73-3	BASSWAY	97-1	1929	50	45
JUNIPERUS	N78-73-4	BASSWAY	97-1	1951	28	27
JUNIPERUS	N78-73-1	BASSWAY	97-2	1962	17	11
POPULUS	N78-73-2	BASSWAY	97-2	1930	49	31
POPULUS	N78-73-11	BASSWAY	97-3	1945	34	34
JUNIPERUS	N78-73-7	BASSWAY	97-5	1957	22	20
JUNIPERUS	N78-73-8	BASSWAY	97-5	1962	17	23
JUNIPERUS	N78-73-9	BASSWAY	97-5	1958	21	22
POPULUS	N78-73-10	BASSWAY	97-5	1916	63	53
JUNIPERUS	N78-73-5	BASSWAY	97-7	1964	15	17
POPULUS	N78-73-6	BASSWAY	97-7	1915	64	45
POPULUS	N78-82-1	AUDUBON	92-2	1917	62	36
POPULUS	N78-82-2	AUDUBON	92-2	1914	65	34
POPULUS	N78-82-3	AUDUBON	92-3	1969	10	6
SALIX	N78-82-4	AUDUBON	91-15	1927	52	26
POPULUS	N78-82-5	AUDUBON	91-15	1937	42	45
POPULUS	N78-82-6	AUDUBON	90-5	1949	30	33

TABLE F1 (CONTINUED)

SPECIES	CORE	LOCATION		YEAR	AGE	DBH
POPULUS	N79-721-1	WOODMAN	75-1	1938	41	41
POPULUS	N79-721-2	WOODMAN	75-3	1952	27	24
POPULUS	N79-721-3	WOODMAN	75-11	1945	34	27
POPULUS	N79-721-4	WOODMAN	75-11	1950	29	43
POPULUS	N79-721-5	WOODMAN	75-13	1951	28	32
POPULUS	N79-721-6	WOODMAN	75-15	1960	19	23
POPULUS	N79-730-1	SHORT	68-4	1922	57	34
POPULUS	N79-730-2	SHORT	68-4	1919	60	34
JUNIPERUS	N79-730-3	SHORT	68-4	1949	30	23
POPULUS	N79-730-4	SHORT	68-12	1960	19	44
JUNIPERUS	N79-730-5	SHORT	68-12	1963	16	14
POPULUS	N79-613-1	MORMON	44-4	1936	43	35
JUNIPERUS	N78-81-1	MORMON	44-6	1955	24	20
POPULUS	N78-81-2	MORMON	44-6	1891	88	53
POPULUS	N78-81-3	MORMON	44-6	1890	89	24
POPULUS	N78-81-4	MORMON	44-7	1918	61	37
POPULUS	N78-81-5	MORMON	44-7	1912	67	45
SALIX	N78-714-4	MORMON	42-9	1934	45	33
POPULUS	N78-714-1	MORMON	42-11	1961	18	36
SALIX	N78-714-2	MORMON	42-11	1940	39	34
JUNIPERUS	N78-714-3	MORMON	42-11	1962	17	21
JUNIPERUS	N78-81-6	MORMON	42-13	1943	36	29
JUNIPERUS	N78-81-7	MORMON	42-13	1969	10	11
CELTIS	N78-81-8	MORMON	42-13	1950	29	19
JUNIPERUS	N79-81-1	BAIM	8-6	1943	36	39
JUNIPERUS	N79-81-3	BAIM	8-9	1957	22	18
JUNIPERUS	N79-81-2B	BAIM	8-9	1953	26	17
JUNIPERUS	N79-81-5	BAIM	8-15	1959	20	22
JUNIPERUS	N79-81-6	BAIM	8-15	1941	38	26
POPULUS	N78-727-1	BOERSON	4-1	1938	41	66
POPULUS	N78-727-2	BOERSON	4-1	1931	48	50
JUNIPERUS	N78-727-3	BOERSON	4-1	1952	27	21
POPULUS	N78-727-4	BOERSON	4-1	1940	39	44
CATALPA	N78-727-5	BOERSON	4-1	1941	38	23
POPULUS	N79-711-1	BOERSON	4-1	1918	61	106
POPULUS	N78-727-6	BOERSON	4-3	1957	22	39
JUNIPERUS	N78-727-7	BOERSON	4-3	1965	14	12
SALIX	N78-727-8	BOERSON	4-3	1960	19	19
POPULUS	N78-629-1	CHAPMAN	1-4	1954	25	30
JUNIPERUS	N78-629-3	CHAPMAN	1-4	1957	22	15
JUNIPERUS	N78-629-4	CHAPMAN	1-4	1962	17	11