Monitoring, Maintenance, Rehabilitation and Enhancement of Critical Whooping Crane Habitat, Platte River, Nebraska[1]

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Abstract. In May, 1978 the U.S. Fish and Wildlife Service designated a portion of the Platte River from Lexington to Denman, Nebraska as critical habitat for the whooping crane. Changes in the flow regime of the Platte River have resulted in modification of the "pristine" riverine habitat, especially with respect to increasing vegetative encroachment on channel islands and decreasing wet meadow habitat. Desirable whooping crane roosting and feeding habitats have been adversely affected by vegetative encroachment, and by decreasing groundwater levels, respectively. This paper explores the process of vegetative succession on Platte River islands, compares various river stretches on the basis of vegetative change (1938-1969), and discusses the potential for monitoring, maintaining, rehabilitating, and enhancing critical whooping crane habitat as means to mitigate future natural and/or man-made changes in the Platte River flow regime.[4]

INTRODUCTION AND HISTORICAL PERSPECTIVE

The Platte River system in Nebraska (fig. 1) has been subjected to manipulation by man since early settlers first began to divert water from its natural watercourse. Since the turn of the century, increasing demands upon the system have caused a significant decline in the natural flow reaching the "Big Bend" area of the Platte River in south-central Nebraska. Throughout most of its length in western and central Nebraska, numerous sandbar islands create an intricately braided stream. Decreases in annual peak and mean discharges (fig. 2-4) have allowed vegetation to establish within the main channel on the sandbar islands where once higher flows scoured the islands and effectively controlled vegetational succession. Today the Platte River in the "Big Bend" area, is a series of small channels which meander through large stands of herbaceous and woody vegetation on various sized sandbar islands. Williams (1978) has documented the shrinkage of channel width, decrease in flows, and relative vegetative encroachment within the Platte River system. Most areas along the river have changed dramatically over the past 70-100 years, while a few areas have remained relatively stable over this period (Frith 1974).

The "Big Bend" area is an extremely important natural resource, especially with respect to wildlife values. Bald eagles, ducks, geese, sandhill cranes, whooping cranes, and many other important species utilize the central Platte River valley.

When vegetation is established within the main channel on sandbar islands and is left to proceed through normal successional stages, the vegetation achieves a height at which the sandbar island habitat is considered unusable for in-channel night roosting by whooping cranes (Grus americana) or sandhill cranes (Grus canadensis) (Frith 1974). These birds utilize the "Big Bend" area of the Platte

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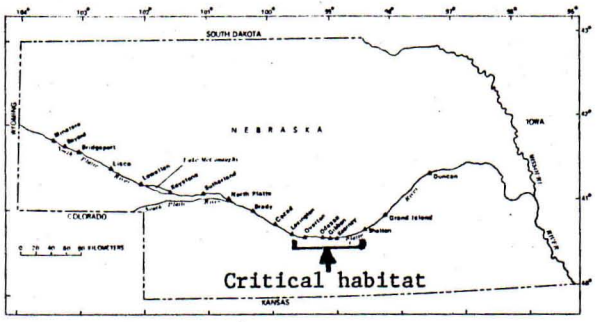

Figure 1. Platte River study area (after Williams 1978).

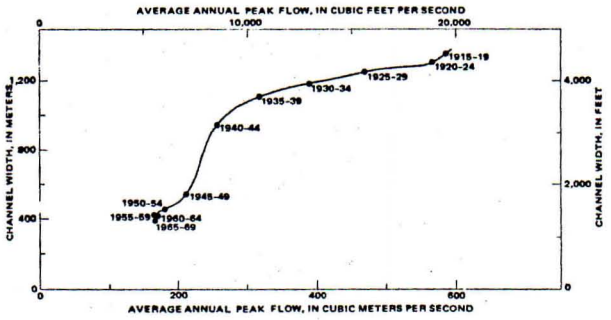

Figure 3. Relation of channel width to 5-year-averaged annual peak flows, Platte River near Overton (after Williams 1978).

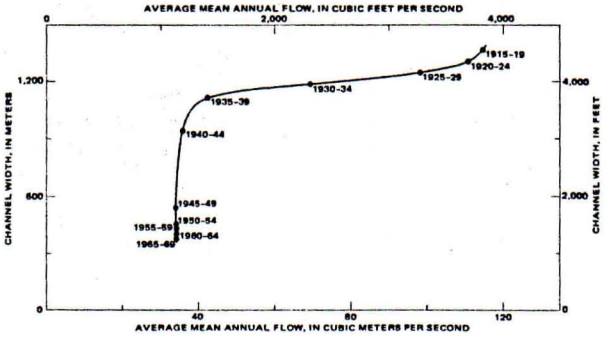

Figure 4. Relation of channel width to 5-year-averaged mean annual flows, Platte River near Overton (Williams 1978).

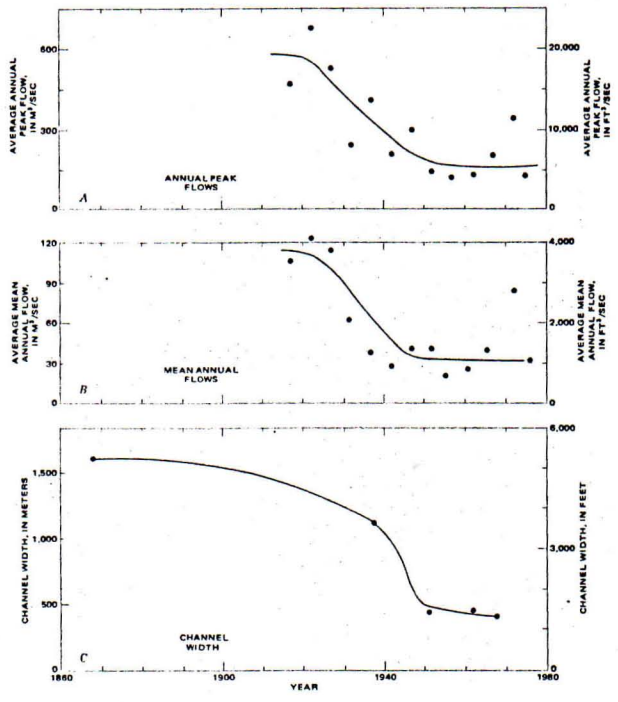

Figure 2. Historical trends of annual peak flows, mean annual flows and channel width, Platte River near Overton (after Williams 1978).

River in the spring months (late February to early May) as a staging area and in the fall months as a stopover point during their normal migratory flights between their overwintering grounds in southern North America and their breeding grounds in Canada. Wetland habitats (wet meadows) adjacent to the river are considered important feeding areas for cranes (Frith 1974). These wet meadows are intimately linked to the Platte River hydrological system. (Keech 1964). Thus, changes in river level are reflected in the groundwater levels of wet meadow habitats.

In May, 1978 the U.S. Fish and Wildlife Service (FWS), designated the area of the Platte River from Lexington to Denman, Nebraska (about 53 river miles) as critical habitat for the threatened and endangered whooping crane

(Federal Register, Vol. 43(94)-May 1978). Thus it is important to ensure that no destruction or modification of this critical habitat occurs, either in the river channel itself or in the wetlands (wet meadows) immediately adjacent to the river.

Figure 5. Whooping cranes at overwintering habitat, Aransas, Texas.

In September 1977, a research program concerning the Platte River in Nebraska was undertaken by ERT/Ecology Consultants, Inc. to study various parameters including flow, fisheries, wildlife, vegetation, water quality, and migratory waterfowl utilization (including whooping and sandhill cranes). Effort was concentrated in the critical habitat area, with emphasis upon the stretch from Overton to Gibbon, Nebraska.

Beginning in the spring of 1977, and continuing through winter 1978, quarterly aerial reconnaissance using color infrared photography techniques was conducted. In the summer of 1978, specific field investigations of vegetative succession and encroachment were performed to determine the basic characteristics of the vegetated islands occurring in the Platte River. Based upon these investigations, data were collected on the status of vegetational encroachment in the main channel and on the successional sequences that take place during this process.

Comparisons of aerial photographs taken in 1938 with those from 1969 and 1976 were conducted separately by the FWS and by ERT/Ecology Consultants, Inc. Results of both studies indicated that the response to upstream and instream flow depletions has varied, depending upon location. However, there is no doubt that there has been a degradation of usable crane habitat in some locations, and the evidence strongly suggests that the decline in flow has reduced the natural scouring which once kept vegetative encroachment from becoming well established within the main channel.

As a result of degradation that has occurred to the Platte River crane habitat, three general classes of crane habitat have been identified: pristine, transitional, and degraded (Frith 1974). This classification was based upon the amount of loss in open habitats (open water plus low herbaceous vegetated sandbar islands). Based upon the 1938-1969 comparison, degraded crane habitat was characterized by losses in open habitat of about 80%. Transitional classification was divided into low order and high order. Low order transitional areas were represented by a loss in open habitat very close to degraded (60-75%). High order transitional areas experienced losses of about 30-50%. Pristine areas exhibited loss of open habitat of 20% or less.

Within the stretch of Platte River designated as critical whooping crane habitat, all three types of areas occur in various places. Evaluation of river channel shrinkage data coupled with analysis of comparative aerial photography indicated those areas that exhibited the narrowest channels (historically), today exhibit the least amount of vegetative encroachment. This tends to support the concept that the annual scouring of the channel islands is an important factor for controlling crane habitat degradation. Generally speaking, in areas where the river channel is wide, flows have not been able to keep vegetation scoured. Where channels have been narrow, even recent flows have been able to keep islands scoured.

Wet meadows have also been affected by decreasing stream flow. Since the Platte River flow level is a reflection of alluvial groundwater level and vice versa (Keech 1964), wet meadows that do not receive adequate subirrigation are converted to cultivated land. Higher water levels prevent local farmers from converting wet meadows to fields of small grains and row crops.

In light of the increasing demand for agricultural, municipal and industrial use of Platte River water (utilizing both on-stream

diversion and ground water pumping), maintenance of desirable crane habitat, namely, night roosting areas and wet meadow areas for feeding, is of increasing importance and concern.

The basic problem of habitat degradation due to decreasing flow is complicated by several other factors:

a) Water rights and appropriations, interstate and intrastate

b) Operational constraints of irrigators

c) Variable precipitation in the basin

d) Use of vegetated islands by other important species such as eagles, deer, herons, etc.

e) Increasing economic pressure to convert wet meadows to cultivated land.

With such a number of powerful forces working against maintenance of critical whooping crane habitat, it appears at this time that more positive measures will need to be employed in order to maintain the status quo. Indeed, recommendations by the FWS (1977), Frith (1974), Wicht (1979) and ERT (1978) indicate that much needs to be done in the way of habitat maintenance, rehabilitation, and enhancement in the near term to prevent a deterioration of existing conditions.

The primary purposes of this paper are to elucidate the current status of the critical habitat area, to describe the process of vegetative encroachment on Platte River sandbar islands, and to explore various potential monitoring, maintenance, rehabilitation, and enhancement measures to be used to mitigate impact to the critical habitat area by future man-made and/or natural flow depletions within the Platte River system.

VEGETATIVE SUCCESSION AND ENCROACHMENT

Studies of plant succession in floodplains of the Mississippi River system (Aikman 1926, Wilson 1970, Lindsey et al. 1961, Peterson 1957, Shelford 1954, Weaver 1960) demonstrate that a universal primary successional sequence occurs on shorelines and islands of frequently flooded rivers. This sequence consists of initial colonization of barren sandbars by herbaceous annual and perennial plants and by seedlings of eastern cottonwood and various willow species. Willow saplings begin to stabilize the sandbars by extending lateral roots which bind the soil. Willows predominate on the sandbars until cottonwoods attain sufficient size to shade the willows. Since willows are intolerant of shade, they begin to decline. In turn, cottonwoods begin to decline after 30 to 40 years because cottonwood seedlings cannot survive in the shade of the parent trees. More shade-tolerant trees such as American elm, green ash, mulberry and box elder constitute the climax plant community in much of the lower Platte System.

The predominant process affecting vegetation succession on the Platte River islands is continuing disturbance due to river action (flooding and ice scouring) and man's efforts to clear islands and shorelines using fire and mechanical methods. These factors have accelerated or reversed the successional process intermittently and incompletely across the floodplain. As a consequence, all stages of succession occur simultaneously within the same river reach.

Remote sensing studies support the contention of Frith (1974) and Williams (1978) that woody vegetation has encroached on the river channel over the last 40 years, reducing the width of the channel and reducing the area of sandbars and low islands used by cranes.

In some areas, loss in area of the main channel was estimated to be 70%. In areas classified as transitional or degraded crane habitat (Frith 1974), the loss of open habitat ranges from approximately 40 to 80%. In the one pristine habitat sampled, there was a main channel loss of 30%, but loss of open habitat of only 27%. Shifts in vegetation classes were not consistent among transects. There was a general increase in area of tree-dominated islands between 1938 and 1969, but some declines also occurred. Tall shrub islands also showed variable shifts in acreage between 1938 and 1969, but changes were not large as compared to changes in tree and sandbar habitat.

Table 1 presents a successional sequence which may be expected through a period of approximately 40 years within the area studied on the Platte River. Approximately the first 15 years of this cycle are of primary interest in determining the availability of crane habitat. The overlap in time among the different stages accounts for differing degrees of exposure to disturbance factors over time. For example, an island may persist in the low

shrub stage for ten years (and perhaps indefinitely) if it is subject to annual river scouring. On the other hand, an island may contain shrubs ten feet tall and young trees 20 feet tall within ten years after establishment if the stand is protected from scouring and other disturbance factors.

Table 1. Vegetation succession on Platte River isalnds near Kearney, Nebraska.

Years	Height (feet)	Species Composition
0	0	gravel and sand
1	1-2	cocklebur, ragweed (mesic), white clover (xeric)
2-3	2-3	willow and cottonwood seedlings, cocklebur
4-9	3-6	willow, indigo bush (low stage, subject to frequent scouring)
10-15	7-12	willow, indigo bush, tree saplings (tall stage)
10-20	tree: 15-20 shrub: 10-15	willow, indigo bush, red dogwood, tree saplings
20-30	tree: 20-40 shrub: 10-15	young cottonwood and juniper trees, red dogwood
30-40	tree: 40-60 shrub: 10-15	mature cottonwood, juniper, American elm, red dogwood

The following section discusses different successional stages observed on Platte River Islands. Dominant plant species and river vegetation interactions are discussed for each major stage.

Herb-Dominated Islands (Early Succession)

The herb-dominated islands consist primarily of annual species (cocklebur, ragweed, toad rush) which establish themselves each year on sandbars after the spring runoff recedes. Hadenfeldt (1978) found that cocklebur had the highest importance value among herbaceous species sampled on islands in the vicinity of Kearney. These species are successful because they produce large numbers of seeds, and the river disperses these seeds over a wide area (Lindsey et al. 1961). Annual species also germinate quickly to take advantage of available moisture, or develop a long taproot (cocklebur) to take advantage of deeper soil moisture. Plant canopy cover was estimated to be extensive (75 to 100%), and maximum average plant height in July was approximately 3 feet.

Included on herbaceous islands are scattered willow and eastern cottonwood plants which attained the same height as the surrounding herbaceous vegetation. Excavation of these woody species indicated that nearly all of these plants were sprouts from old (5-10 years) woody crowns. A similar observation was made by Walters (1978) on islands in the same area. At the same time thousands of cottonwood and willow seedlings were observed on bare sand in the channel adjacent to islands. These seedlings matured from seeds deposited on the bare sand during late spring 1978. These two observations taken together (numerous current-year seedlings, old root systems) suggest that there is almost complete mortality of each annual willow and cottonwood seedling crop either by drying of the channel bed or by scouring by spring runoff flows, and that sprouts from the occasional survivors are buried or sheared off annually by flooding or ice. Lindsey et al. (1961) found that "action of ice accompanying more usual stream levels damages the low growing Salix interior so chronically that this is a highly unstable woody plant community".

Figure 6. Platte River island - early successional stage.

Shrub-Dominated Islands (Intermediate Succession)

The capacity of willow species to stabilize sandbars and river channel banks has been documented for several river systems (Wilson 1970, Lindsey et al. 1961, and Weaver 1961). Willows extend shoots from shallow, widely branching root systems. Willows are also capable of layering (rooting from nodes on buried stems) (Lindsey et al. 1961). The thickets that arise from these root systems trap additional sand and silt, and raise the level of the island. Willows can resprout when buried at least three feet under deposited sediment (Peterson 1957). This characteristic enables these plants to persist under conditions of rapidly fluctuating substrate depth caused by variable river sediment deposition patterns. The capacity to resprout is an important adaptive characteristic to survive frequent severe injury from floods and ice.

Sandbar willow and false indigo dominate the early stages of shrubby islands in the Platte River. Shrubs usually range in height from 5 to 7 feet, and provide approximately 30% canopy cover. Most shrub stems average from 4 to 7 years old.

As islands mature there is a transition from low shrub to tall shrub islands containing young trees. The primary compositional change is the increasing importance of shade-tolerant red dogwood in the shrub stratum, and the appearance of a tree stratum (greater than 15 feet) consisting of eastern cottonwood, American elm and green ash. A horizontal stratification of woody species becomes evident as the island matures. Walters (1978) found that sandbar willow, peachleaf willow, diamond willow, false indigo and elderberry occurred over 50% of the time on the island edge; eastern redcedar, red dogwood, green ash, slippery elm, American elm and viburnum occurred 50% of the time in the center. These data suggest that the more flood-tolerant and shade-intolerant species occur on the island perimeter. Cottonwoods were also found to increase in number at the island center over time, which may be a consequence of protection from floods and ice.

Walters (1978) determined composition coefficients of similarity for the different ages and sizes of islands studied. She found a high degree of compositional similarity (all coefficients 0.80 or above) among the islands regardless of size and age. These data suggest that a large fraction of the woody species establish themselves early in the history of the island, and then different species groups assume dominance depending upon the degree of disturbance suffered by particular islands.

Maximum age of shrub stems on the tall shrub islands ranged from 10 to 15 years. It appears that 15 years may be near the maximum stem age for these species since standing dead stems were frequently seen. Because new shoots are constantly arising from root systems of these species, shrub thickets are maintained for much longer periods than the maximum age of individual stems.

Tree species sampled from the tall shrub islands demonstrate a capacity to grow to a height of approximately 20 feet in 10 years. Other studies indicate that cottonwood can grow very quickly. Peterson (1957) found that cottonwoods grew 18 feet in four years along a reservoir margin in southwestern Nebraska; Lindsey et al. (1961) reported a cottonwood on the Wabash River in Indiana that grew 40 feet in 14 years.

Figure 7. Platte River island - shrub dominated successional stage.

Tree and Shrub-Dominated Islands (Late Succession)

The oldest successional stage in the Platte River near Kearney consists of an overstory of eastern cottonwood estimated from 40 to 60 feet tall and a shrub stratum 10-12 feet tall consisting primarily of red dogwood.

Combined shrub and tree canopy was estimated to be in excess of 100%. Eastern cottonwood tree age was estimated to be between 27 and 51 years.

False indigo and sandbar willow were scarce to absent in these stands, indicating that these intolerant shrubs had been shaded out. Red dogwood maximum age was 19 years, and showed no evidence of dying out. Young eastern redcedar, green ash and American elm were recorded, indicating that these stands have not proceeded to the regional climax consisting primarily of green ash and American elm.

Tree age data suggest that cottonwood establishment occurred primarily in the last 30 to 40 years, coinciding with the closure of Kingsley Dam upstream.

Table 2. Plant species discussed in the text.

Common Name	Species Name
Trees	
American elm	Ulmus americana
Boxelder	Acer negundo
Eastern cottonwood	Populus deltoides
Eastern redcedar	Juniperus virginiana
Green ash	Fraxinum pennsylvanica
Mulberry	Morus rubra
Peachleaf willow	Salix amygdaloides
Slippery elm	Ulmus rubra
Shrubs	
Diamond willow	Salix eriocephala
Elderberry	Sambucus canadensis
False indigo	Amorpha fruticosa
Red dogwood	Cornus stolonifera
Sandbar willow	Salix exigua ssp. interior
Viburnum	Viburnum edule
Herbaceous	
Cocklebur	Xanthium strumarius
Prairie cordgrass	Spartina pectinata
Ragweed	Ambrosia sp.
Toad rush	Juncus bufonius

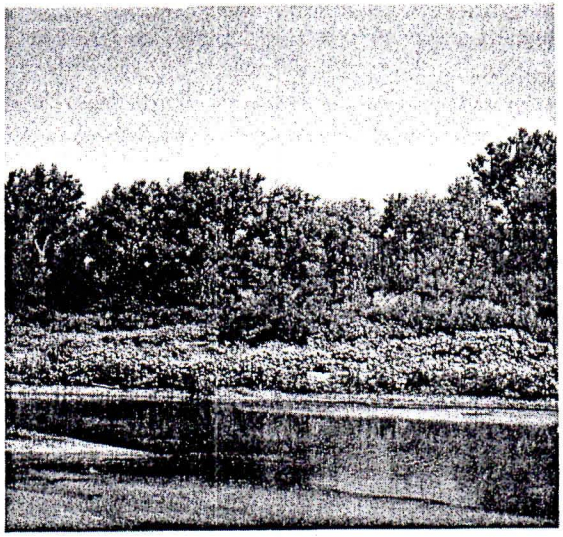

Figure 8. Platte River island - late successional stage.

WET MEADOW CONSIDERATIONS

Wet meadow habitats, important areas for crane feeding, have also been affected by declining Platte River flows. Recent investigations by the FWS indicate that certain critical food items which are high in protein may be important in the diet of sandhill cranes (Krapu 1978), and that wet meadows near the Platte River supply the bulk of this type of food. Due to the hydraulic connection between groundwater level and Platte River flow (Keech 1964), wet meadow habitats depend largely upon water within the alluvial system. Upstream depletions and local groundwater pumping for irrigation combine with the naturally occurring summer decrease in river flow to produce a severe drying effect upon wet meadows. Groundwater recharge from irrigation return flows is seen as evidence for the linkage between river flow, vegetative encroachment, and wet meadow deterioration in certain stretches of the Platte River.

When, within the annual hydrological cycle, wet meadows no longer receive adequate moisture, local farmers often convert these areas to cultivated land. There exist firms today which are willing to drain, grade, and tile wet meadows for conversion to cropland.

According to Frith (1974), sandhill cranes prefer wet meadow complexes for feeding in early spring, usually until mid-March. He

believes that as the wet meadow food sources become exhausted, the cranes seek alternate food items in croplands. Although cranes are quite omnivorous, whether or not croplands alone could maintain the physiological well-being of the populations is unknown. Reinecke and Krapu (1978) do not believe croplands alone could support cranes, because of differences in food items taken in different areas. With respect to whooping cranes specifically, practically nothing is known about their food habits within the Platte River critical habitat area. Allen (1952) indicates that animal food items may be more important in the diet of the whooping crane, than for the sandhill crane.

All evidence suggests that wet meadow habitats protected from human disturbance represent an important component of the total habitat for sandhill cranes and whooping cranes. Thus, efforts should be taken to maintain, rehabilitate and enhance these habitats whenever possible.

HABITAT MONITORING

The importance of implementing sensitive habitat monitoring techniques which are capable of identifying changes in vegetative encroachment and wet meadow status within the critical habitat area cannot be overemphasized. A sound habitat management plan must rely upon an understanding of past history as well as current processes to be able to be responsive to the needs of the habitat, and ultimately to the needs of the species occurring in that habitat. Three important elements of the critical habitat area can be identified for monitoring:

a) Hydrology - surface and groundwater

b) Vegetative encroachment - areal extent and height

c) Wet meadows - areal extent and food supply.

Hydrological concerns, both surface and groundwater, are currently monitored by the USGS at several locations within the Platte River system. A coordinated effort is needed to tie together the surface and groundwater regimes to gain an understanding of the hydraulic connection between the two. Substantial historic river flow and groundwater data currently exist and will continue to be monitored for year to year comparisons.

Vegetative encroachment and wet meadows could both be monitored effectively and efficiently using existing aerial photography techniques. Complete black and white aerial coverage of the critical habitat area is available for several years since 1938. It is suggested that reliance be placed upon stereo color-infrared aerial imagery at a scale of 1:4800 (1 inch = 400 feet) or less. Sufficient vertical exaggeration is required to be able to delineate between vegetation that is less than 18" and that which is greater than 48" to determine useful and non-useful crane roosting habitat, respectively. Sufficient coverage would be required to photograph a corridor 3 miles wide centered on the main channel. The optimal time to photograph the system would be during the summer months when flow is least and vegetative growth is maximum. The monitoring of vegetative change in this manner could use spring imagery of crane roosts in a comparative process to relate habitat use and habitat status from the previous year. Locations of important crane roosts would be analyzed carefully for vegetative change. This would help to identify desirable habitat characteristics which could be used in habitat management during the summer preceding each spring migration period. In this way, preparation could be made each summer for the next high crane use period the following spring.

Figure 9. Color infra-red aerial photograph of critical whooping crane habitat - oblique view near Kearney.

Interpretation of the photographs would consist of identifying islands and wetlands occuring in the Platte River. Islands would be divided into three categories:

- Category I - Open sandbar and low annual herbaceous vegetation; considered very desirable crane habitat.

- Category II - Transitional shrub vegetation; consisting of shrub saplings and seedlings ranging from 2 to 4 feet in height and considered marginal for crane habitat.

- Category III - Tall shrub and tree vegetation; consisting of shrubs and trees in excess of 4 feet in height - unusable for crane habitat.

All available wetland areas would be identified. The structural classifications obtained by photo-interpretation could be confirmed using ground-based surveys within the actual habitats to verify the height of vegetation and vegetation density on the islands, to assess the degree of natural scouring, and to assess the effectiveness of various habitat management techniques (as discussed below). Wetlands would be checked from year to year for areal coverage. Again, photo documentation would be used to establish trend data on the height of island vegetation. Islands would be photographed at the midpoint of their longitudinal and transverse axes to provide a record of their classification. Each island could be numbered during photointerpretation and crosschecked in the field. Photography and standard survey techniques could be implemented at standard river locations such as important crane roosts, sites of transitional islands, areas of disturbance, experimental management areas, refuges, etc. It is anticipated that this process could be completed within one growing season so that subsequent vegetative change could be compared on an annual basis. All areas of the island classes, open channels, and wetland habitat would be computed using standard dot grid or digitizing methods and used for future comparisons.

Photography taken in subsequent years would then be interpreted using the same classification criteria used during the first year. The emphasis of this analysis would be to define transitional islands which might become undesirable as crane habitat and to document changes in areal extent of wetland habitat. The purpose of each year's interpretation would be to determine the acreage within the transitional class so an assessment can be made as to the extent of habitat degradation or improvement from year to year.

Major vegetative changes of bare or early stage succession islands (as related to crane habitat) should not appear until after three growing seasons have passed (the time required for riparian shrub species to grow from seedlings to about 4 feet tall). Extent of vegetation cover within the river channel should be compared with baseline vegetation cover to determine increases or decreases in transitional islands and wetland habitat. All areas interpreted as transitional should be field checked each year and identified for maintenance.

It is anticipated that any potential effects to wetland habitats would be related to agricultural conversion following two or more dry periods in the wet meadow. Thus, a record of annual flow must be established using a statistical base for correlation with loss of crane habitat. Each year, annual flow could be averaged for all U.S. Geological Survey gaging stations occurring in the critical habitat area (Lexington to Denman). A statistical analysis of past flows could be performed to establish a reasonable mean base flow along with its variation (standard deviation). By comparing annual data on river flow with the historic levels, it should be possible to predict effects on crane habitat with some degree of reliability. For years with a flow higher than the base flow, little habitat maintenance should be required for a period at least three years hence. However, continued monitoring should be performed, and habitat maintenance could be recommended for those islands which do not respond to the scouring action of these higher flows.

During lower-than-normal base flow years, maintenance of habitat would probably be required due to the rapid growth of the vegetation.

MAINTENANCE, REHABILITATION AND ENHANCEMENT

In this paper, maintenance refers to the continued preservation of current conditions. Rehabilitation refers to the process of returning habitat to a previous state. Enhancement goes a step beyond rehabilitation to provide additional benefits to wildlife, in this case cranes.

Controlling Vegetative Encroachment Within the Platte River Channel

Various techniques have been utilized to control vegetative growth within the Platte

River system. Of primary interest here are crane habitat management techniques which have been attempted by the National Audubon Society at the Lillian Annette Rowe Wildlife Refuge on the Platte River, between Nebraska State Highway 10 and Gibbon, Nebraska. (Logan, et al. 1975). According to Wicht (Pers. comm. 1979) and Frith (Pers. comm. 1979), the following general types of experimental programs have been conducted or proposed for control of vegetative encroachment:

1) Manual clearing
2) Mechanized clearing
3) Burning
4) Island obliteration (clearing and leveling)
5) Herbicide spraying
6) Flow maintenance

Manual clearing is very labor intensive and has only a short term effect since new shoots of willows, cottonwoods, dogwood, and indigo bush rapidly develop from the remaining stumps. Although local hunters regularly use this technique in constructing waterfowl hunting blinds on the river islands, the amount of labor required for such a short term benefit is very high, and thus not attractive for long term habitat management.

Mechanized clearing has been used by pulling various types of machinery over the vegetated islands. Disks, loaders, and rotary mowers ("bush hogs") have been used to knock down existing vegetation during minimum flow periods in late summer when this type of farm machinery can negotiate the river. Again, this type of clearing has only a short term effect due to rapid regrowth.

Burning has been practiced for some time on islands used for waterfowl hunting blinds to reduce understory vegetation on islands with willows growing to 8-10 feet tall. Although this is a very effective mechanism for removing understory vegetation, the willow growth seems to be enhanced since competing vegetation is removed and large willows are not destroyed by fire. Therefore, additional work is required to remove the willows.

Island obliteration has proven to be the most effective, and hence most promising, habitat management technique yet attempted. This procedure involves mechanical clearing of the vegetation and then leveling of the island to near base flow using a large caterpillar tractor. The technique removes most of the buried root stocks of the fast growing species, and promotes natural scouring (which represents very low cost maintenance) by returning the island to near base level. In the past, several waterfowl hunting blinds were constructed in the main channel near areas that had been cleared, levelled and diked to provide a more attractive waterfowl habitat. Until very recently no permits were required for this activity. Now, under Section 404 of the Clean Water Act, a permit is required by the U.S. Army Corps of Engineers, Omaha District, for this type of habitat management. To the author's knowledge, no permits have yet been denied.

Areas on the Lillian Annette Rowe Wildlife Refuge that had been subjected to island obliteration in 1977, had good sandhill crane utilization during the 1979 spring migration (Wicht, Pers. Comm. 1979). Also, vegetation remains in a very early successional phase as expected. The cost of this technique is high, on the order of $600/acre, but the longer term benefit promises to be more attractive than other methods.

Herbicide spraying is another alternative which has not received much attention, due to the relatively high risks associated with application to an aquatic system. However, in the late summer when little or no water occurs in the Platte River in this area, and most fish and other aquatic organisms have been caught, have moved on or died, potential exists for selective herbicide application to transitional islands with little risk to the aquatic environment. However, the problem of effective subsequent scouring has not been alleviated since no effort to reduce the height of the island would have been made.

Flow maintenance (to maintain scouring) has been the focus of attention for many years. However, due to the decrease in flow compared to historic values, the increasing demand for water upstream, and the acceleration of vegetative encroachment in recently utilized crane habitat, even the most optimistic outlook would be one of maintenance or slight decrease in open habitats. A massive flood could conceivably return much transitional crane habitat to the pristine condition, but the process of vegetative encroachment would immediately begin again. To achieve a positive approach toward rehabilitation and enhancement in light of decreasing flow, it appears that mechanical means should be considered as a viable habitat management tool.

Wet Meadow Habitat Management

The primary concern for wet meadow habitat management is centered on availability of groundwater. Without an adequate supply of water, wet meadows soon change toward a more xeric assemblage, and then become candidates for conversion to cultivation. Little research has been done on the relative use of wet meadows at different groundwater levels. Acquisition of wet meadows and diversion of water to them in the spring appears to be the only current technology for maintenance of wet meadows close to a "natural" state.

Just as the increasing height of vegetation on Platte River islands can discourage crane utilization (Frith 1974), sandhill cranes have shown an avoidance to wet meadows that grow too high (18-20") (Wicht, personal communication, 1979; Frith, personal communication, 1979). The National Audubon Society performed meadow burning in spring 1979 to remove higher vegetation from selected meadow habitats. The cranes did not utilize the areas (except at the fringes) before burning, but utilized these areas heavily within one week following burning. The only real drawback to this method is that there is a relatively rapid regrowth, and the method needs to be implemented frequently. However, mechanical removal by haying or grazing could probably also be used.

POTENTIAL ADVERSE EFFECTS

Any type of habitat management scheme has the potential for producing adverse effects, especially when habitat management is concentrated on one or two species. Any Platte River habitat management plan for maintenance of critical whooping crane habitat should give serious consideration to the other species that occur in the region, and depend upon the resource, including bald eagles, ducks, geese, various amphibians, reptiles, mammals, and other birds, especially breeding birds. The following potential adverse impacts are by no means inclusive, but indicate the different types of problems associated with the various habitat management schemes:

- Vegetation cleared from islands by manual or mechanical means could contribute to the trash and organic load of the Platte River.
- Burning causes air pollution.
- Many species of other important game and non-game wildlife utilize the existing habitat; including bald eagles, golden eagles, deer, cottontails, quail and herons.
- The fishery, although limited primarily to rough fish, could be affected by in channel activites which would alter water quality.
- Local waterfowl hunters utilize transitional islands for hunting blinds. Hunting opportunities may decrease due to open habitat maintenance in certain areas.
- Herbicide spraying could introduce toxic chemicals into the environment, and could affect desirable plant species.

There are, of course, a host of mitigation measures available to deal with these potential environmental impacts.

SUMMARY

Remote sensing studies utilizing 1938 and 1969 aerial photography indicate that there has been a substantial reduction (losses of 40 to 70%) in open river habitat potentially utilized by cranes due to channel narrowing and encroachment by woody vegetation within the "Big Bend" area of the Platte River system.

Vegetation succession in the Platte River islands consists of a low (1 to 3 foot) herbaceous dominated stage, followed by a low (4-6 feet) to tall (up to 15 feet) shrub stage dominated by sandbar willow, false indigo, and red dogwood. Eastern cottonwood saplings assume dominance and shade out intolerant sandbar willow and false indigo. Cottonwoods attain a height of 40 to 60 feet. Red dogwood persists as an understory shrub in cottonwood communities. Platte River island communities are too young (or too frequently disturbed) to have reached the regional climax floodplain forest community of green ash, American elm and boxelder.

The rate of successional change is directly related to the severity of flooding and scouring action by water and ice. The woody vegetation is highly adapted to tolerate mechanical injury from abrasion and burial in deposited sediment. The woody vegetation also

shows a high potential for rapid growth when released from the scouring cycle. It appears from field observations that if an herbaceous island can remain free from major disturbance for a period of four to five years, it is unlikely to revert back to its original composition; if a tall shrub island is left undisturbed for a period of 10 to 15 years it is likely that it will succeed toward a tree-dominated island.

The river is extremely efficient in removing young woody seedlings from the channel, but the persistence of living woody root systems which send up shoots annually provides a source for a rapidly expanding shrub population.

The implications of these studies on maintenance, rehabilitation, and enhancement of open crane habitat are as follows:

1. When possible, efforts should be made to maintain the current river scouring cycle which is efficient in removing woody plant seedlings and new woody shoots.

2. Due to high potential growth rates in the absence of scouring, changes in vegetation structure can occur quite rapidly. This suggests that monitoring for vegetation change should be conducted at short intervals (1 to 2 years).

3. The great capacity of river shrub species to resprout after disturbance indicates great difficulty in eliminating these shrubs from existing islands. Complete removal of the root system is required for effective control.

4. Rehabilitation and enhancement efforts should probably be directed at islands with stems 8 to 10 years old, since these islands are at a successional stage where they will probably not be brought back to a lower successional stage by natural forces. Immediate action is required as many islands will pass through this transitional phase within the next two years.

5. The high level of use of the low to tall shrub islands by waterfowl hunters implies a potential use conflict between hunting and crane habitat maintenance.

6. Any habitat maintenance, rehabilitation, and/or enhancement should take into account the impact on other ecosystem components, especially other threatened, endangered, or otherwise important species.

7. Several habitat manipulation techniques exist for mitigation of flow depletion effects upon in-channel vegetative encroachment. Few techniques exist for maintenance of productive wet meadow complexes under reduced flows.

8. Intensive experimentation of selected habitat management techniques should be carried out, and success or failure should be determined by detailed monitoring. At this time, island obliteration followed by burning, disking, or mowing appears to be most promising.

9. Much additional research on whooping crane, sandhill crane, and other Platte River wildlife will need to be accomplished in order to formulate more specific habitat management plans.

10. A radiotagging program should be undertaken to identify whooping crane habitat use patterns within the Platte River valley and elsewhere. Continual reevaluation of the existing critical habitat designation should be made based upon new data and developing knowledge of whooping crane behavioral biology, and distribution.

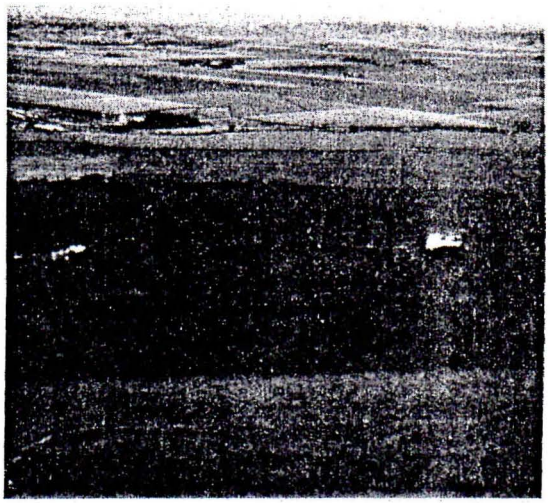

Figure 10. Color intra-red aerial photograph of mature cottonwood stand in the Platte River channel upstream of the critical whooping crane habitat.

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