1998

1998 Platte River Basin Ecosystem Symposium Proceedings

1998 Platte River Basin Ecosystem Symposium

February 24, 1998: Kearney, Nebraska

Program

- 1998 Symposium Program

Papers

Mid-Platte River Qualitative Analysis of Community, Special Interest Groups and Policy Decision Makers Relating to Management Issues
John C. Allen, Ph.D., Associate Professor, Rural Sociology Department of Agricultural Economics and Department of Sociology University of Nebraska-Lincoln | Abstract

Biological Responses to Hydrologic Fluctuation in Wetland Sloughs of the Central Platte River
Matt R. Whiles, Kansas State University, Department of Entomology, Manhattan, KS; **Beth S. Goldowitz**, Platte River Whooping Crane Maintenance Trust, Inc., Wood River, NE | Abstract

Hydrologic Uncertainty Resulting from the Basin-Wide Program for Recovering Endangered Species Habitat Along the Central Platte River, Nebraska
Charles, F. Leaf, P.E. and **Forrest A. Leaf**, P.E. | Abstract

Selenium Concetrations in Biota from the Kendrick Reclamation Project, Natrona County, Wyoming
Pedro Ramirez, Jr. and **Kimberly Dickerson**, U.S. Fish and Wildlife Service, Cheyenne, Wyoming | Abstract

Ninth Platte River Basin Ecosystem Symposium

Program

Tuesday, 24 February 1998

8:30 am **Registration** (Regency Inn Lobby)

9:00 am **Opening Remarks**, Gary Lingle, Platte Watershed Program Coordinator

9:10 am **Biological Studies**- Moderator Dr. Julie Savidge

**Biological responses to hydrologic fluctuation in wetland sloughs of the central Platte River.* Matt R. Whiles, Dept of Entomology, Kansas State University

***Sandhill crane use of lowland grasslands along the Platte River, Nebraska.* Tammy Vercauteren, UNL School of Natural Resource Sciences

***Selenium concentrations in biota from the Kendrick Reclamation Project, Natrona County, Wyoming.* Pedro Ramirez, Jr., U.S. Fish & Wildlife Service

***Estimating root depths from diurnal water-table fluctuations along the Platte River in Nebraska.* Bob Henszey, Platte River Whooping Crane Trust

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10:30 am **Poster Presentations** (with refreshments)

Crane Meadows Nature Center. Eric Volden, Crane Meadows Nature Center

Field data collection and management in support of statewide GAP land cover mapping. Michael J. Bullerman, CALMIT, UNL.

Nitrate contamination of groundwaters in the United States-- evaluating the risk. Robert B. Swanson, USGS

Cooperative Platte River wet meadow alternatives study. Mark M. Czaplewski, Central Platte NRD.

Piping plover nest success on Lake McConaughy. Jason E. Palmer, Chadron State College

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11:15 am **Habitat/GIS-** Moderator Dr. Allan Jenkins

***Comparative cartographic analysis of two wetlands in the Rainwater Basins.* Matthew Bohnenkamp, Geography Dept, UNK

**Development of a GIS for the central Platte River.* Sunil Narumalani, CALMIT, UNL

***Can cranes and cottonwoods coexist in the Platte River?** W. Carter Johnson, Dept of Horticulture, South Dakota State University

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12:15 pm **Luncheon** (Fundome) **The Proposed Great Platte River Road Archway Monument**. Ron Tillery, Buffalo County Economic Development Council, Kearney.

1:15 pm **Water/Hydrology**- Moderator Mark Czaplewski

***Water quality in the central Nebraska Basins, 1992-95.** Robert B. Swanson,USGS

**Hydrological dynamics of backwater and side channel system in the middle Platte River valley, Nebraska.* Wanli Wu, UNL School of Natural Resource Sciences.

***Hydrologic uncertainty resulting from the basin-wide program for recovering endangered species habitat along the central Platte River, Nebraska.** Charles F. Leaf, Platte River Hydrologic Research Center, CO

2:15 pm **Middle Platte Topics**- Moderator Robert Fenemore

***Mid-Platte River qualitative analysis of community leaders, special interest groups, and policy-makers perceptions.** John Allen, Dept of Agricultural Economics, UNL

***Platte River nature recreation study.** Ted Eubanks, Fermata, TX

****Preview of economic modeling study.** Allan Jenkins, Dept of Economics, UNK

3:25 pm **Break** (with refreshments)

3:45 pm **Field Trip Introduction to the Speidell Tract.** Brent Lathrop, The Nature Conservancy, Aurora, NE.

4:10 pm Depart for Speidell Tract to view TNC's unique tree-clearing project.

6:10 pm Arrive back at Regency Inn.

6:30 pm **Dinner** (Fundome)(optional, please pre-register).

7:15 - 9:00 pm **Evening Session** (in meeting room)

***Platte River nature recreation study.** Ted Eubanks, Fermata, TX

***Mid-Platte River qualitative analysis of community leaders, special interest groups, and policy-makers perceptions.** John Allen, Dept of Agricultural Economics, UNL

Wednesday, 25 February 1998

8:00 am **Registration**

8:30 am **Information/Education**- Moderator Jan Whitney

**The lower Platte River Corridor Alliance & Corps of Engineer's lower Platte River & feasibility study- progress report.* Diana Allen, Lincoln

***EPA funded community-based efforts by Prairie Plains Resource Institute.* William S. Whitney, Prairie Plains Resource Institute

***The Platte River Ecology Workshop.* William S. Whitney, PPRI

**North Platte Valley Water Coalition: North Platte River Return Flow Model.* Michael Sayler, Bishop-Brogden and Associates

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9:45 am **Break** (with refreshments)

10:30 am **U.S. Geological Survey's Platte River Ecosystem Project*****
Moderator Randy Parker

Intro/Background/History/ Objectives of first year efforts. Jim Kircher & Randy Parker, USGS

A study of the geologic evolution of the Platte River. Steven Condon & David Seeland, USGS

A framework to examine the interaction of channel morphology and sediment transport. Randy Parker & M. Karlinger, USGS, Denver

Channel change due to devegetation. W.R. Osterkamp, Tucson, AZ

Modeling flow and sediment dynamics in short time scales to assess channel evolution. Jon Nelson, USGS

11:30-11:45 am Discussion

12:00 **Luncheon** (Fundome). **FERC Relicensing & Cooperative Agreement Update.** Jay Maher, Central Nebraska Public Power and Irrigation District, Holdrege, NE.

1:00 pm **U.S. Geological Survey's Platte River Ecosystem Project** cont'd

Relationships between hydrology and biotic communities of riparian meadows of the central Platte River floodplain. Janet Keough, Northern Prairie Wildl. Res Center

Staging ecology of sandhill cranes in the central Platte valley- and evaluation of long-term changes in habitat use, food resources, nutrient storage, and carrying capacity. Gary Krapu, Northern Prairie Wildl. Res Center

Spring-staging ecology of greater white-fronted geese, lesser snow geese, and northern pintails in the central Platte River valley and Rainwater Basin of Nebraska. Robert Cox, Jr., Northern Prairie Wildl. Res Center

Data management activities of the USGS Platte River Ecosystem Project. Michael Starbuck, USGS

2:00 pm Summary/Feedback/Discussion. Jim Kircher & Randy Parker, USGS, Denver.

2:30 pm **Adjourn until 1999!**

* =progress report ** =completed research *** =forthcoming research

MID-PLATTE RIVER QUALITATIVE ANALYSIS OF COMMUNITY, SPECIAL INTEREST GROUPS AND POLICY DECISION MAKERS RELATING TO MANAGEMENT ISSUES
Presented to 9th Platte River Basin Ecosystem Symposium
FEBRUARY 24, 1998

John C. Allen, Ph.D., Associate Professor, Rural Sociology Department of Agricultural Economics & Department of Sociology University of Nebraska-Lincoln

Introduction

In recent years it has become apparent that the management of natural resources requires the linking of current attitudes and beliefs of residents adjacent to natural resources to those of policy makers and users external to the local system. The need for linking attitudes, beliefs and perceptions of natural resource usage can be illustrated by several phenomena. The first is the reduced speed of adoption of conservation practices by agricultural producers. The second is the tension between economic development within municipalities and alternative uses such as recreation, wildlife protection and, agricultural production, especially irrigation. The development of special interest groups including public utilities and commodity associations focused on natural resource management for their particular interests has continued to fragment the discussion. Therefore insight is needed into the primary interested of each group separated form organizational positions individuals may have taken. The conceptual framework used in analyzing attitudes, beliefs and behaviors includes two primary concepts. They are structural perceptions based on culture, historical events and external factors influencing locality and social psychological values and beliefs. Structural values and beliefs re tied directly to meeting everyday needs. These include attitudes towards industrial diversification, agriculture, household and municipal use of water from the Platte River. The second is social psychological linked to personal identity as it relates to a natural resource, in this case the Platte River or its tributaries. The primary question addressed by the qualitative examination of attitudes, beliefs and behaviors of local residents and external decision makers is, Do the social psychological values and beliefs tied to the personal identity of local residents and policy makers differ from the organizational values articulated by the differing interest groups involved in discussions about the long term management of the Mid-Platte River? The second questions is: "If the personal identity and organizational positions differ, are there commonalties across the

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Methodology:

The research methodology used in this study was in-depth face-to-face semi structured personal interviews (see Appendix A for complete interview guide). The sample population was identified as key influentials in the communities within the mid-Platte River and external policy makers involved in decision making in the region of the mid-Platte River. These groups were then divided into two primary categories of individuals. They include: 1) key influentials in communities or policy arenas within Nebraska and, 2) representatives of special interests, i.e., agricultural producers, public power utilities, and environmental groups. A clustered sample approach was also used to ensure data input from at least one interview from each primary municipality located in the study area. The geographic boundaries of the study were Gothenburg, Nebraska and Grand Island, Nebraska. Additional interviews were conducted west and east of the Mid-Platte River to identify any community differences in perceptions that may exist. These differences may provide insight into issues to address in long term planning that extends beyond the Mid-Platte River region. Interviews were conducted June and July of 1997. Thirty-one interviews were conducted within the Mid-Platte region and nine interviews were conducted within the Columbus/Fremont communities and North Platte and Ogallala communities.

Anticipated Outcomes of qualitative Data collection for community Profiling: Through in-depth personal interviews explanation of aggregate (poll) findings can occur. A contextual framework can be developed providing insight into local community cultures and individual perceptions and beliefs about natural resource conservation. A more precise identification of personal values, beliefs and behaviors can be

developed because of the individual level of data collection. Questions such as, Is the view of the Platter River and environmental conservation tied to individual beliefs or collective beliefs such as an organizations public statement? Can be address. Where do individuals go for information and how do they prioritize the value of that information? And what would a long-term management Plan look like if "you" were to design it? Can be useful for long term sustainable plans to be developed Respondents were generally interviewed in their place of business or personal homes. The interviews ranged in time from one and half-hours to four hours.

Structural Perceptions Related to the Mid-Platte River:

Attitudes and beliefs related to the Platte River were addressed by asking individuals,

"As a representative of _____ (organization, municipality, interest group) what do you think is the interest in the Platte River of that group?

and, "When you think of yourself as an individual what are your interests in the Platte River?

Conservation interest group positions focused on preservation of the Platte River for habitat and recreation. As one small town resident explained,

"We (those concerned with habitat would all like to see it not destroyed. I think that position has been the some for along time and there's increased concern all the time with vegetation clogging up the river more all of the time."

Other conservationists saw sharing the beauty and recreational opportunities as their primary interest. As one Grand Island resident explained,

"We (Betty's family) use the river in recreational sense. One time we had five Catholic Sisters and another time we had a group of mentally retarded youth from Grand Island. We just enjoy the area and we like to share it with others."

Other perceptions by individuals identifying themselves as conservationists identified the link to the local communities and there future. As one individual stated:

"I think it is linked to the economic vitality of the Platte Basin, towns associated with the Platte Basin, tender loving care we will have to provide to maintain that resource because it will become more important...as we move forward."

Agricultural interest groups saw the organizational position as tied to income and maintaining jobs and a state economy. As one agriculturists stated,

"The Platte River is tied to everyone's income. I'm going to come right out and say it, the most important use of water of the Platte and it has been for a hundred years is for irrigation. The economy of Nebraska is based on irrigation. We don't have many natural resources in this state so our major industry is farming."

Another agency representative tied to agriculture explained the relationship this way:

"Right now we see a lot of industry along the Platte. It brings a lot of opportunity to the state-the huge production potential of the Platte brings opportunity across the state. Although, if production (agricultural) decreases in the Platte it will have an impact on where we produce crops in the rest of the state."

Utility representatives support the economy orientation articulated by the agricultural producers and agricultural associations. As one utility representative stated,

"Power is a primary use of the river. There has been a need for a cheaper source of power and the river can supply this."

Although personal values and beliefs place many agriculturists, municipality representatives and utility representatives in conflict with their organizational positions. As the utility representative said,

"I'm stuck in a place between my job and the River. I know by altering the River to increase power benefits could change the habitat or even the flow rate."

External policy makers and experts in the Platte River management issues view the river somewhat differently. One long time observer and policy maker summed up the history of the Mid-Platte River this way.

"For a long time the primary interests were agriculture and power. While the construction of the Tri-county project and N.P.P.D. and the private irrigation all of these have major interests in the Platte."

Environmental groups are more recent and they promote a major force in our state. There are many environmentalists that feel there needs to be a turn made back to Earth First legislation but this clearly will not happen. On the other side there are farmers who would like to see the Whooping cranes extinct.

The key to these groups is finding a consensus. The federal role is crucial because the state would definitely not support the endangered species act. A deal also needs to be made between Nebraska, Colorado and Wyoming to bring about a plan for an adequate water level in the Platte. Then and only then would the national agencies supply their input on the issue.

Community identity and personal values were also often in conflict. The communities adjacent to the Mid-Platte differ in their orientation to the river by size. The larger communities such as Grand Island and Kearney view economic development as a key.

The Platte River is a primary factor in their development plans. These retail hubs draw municipal water and receive income from agricultural producers buying farm inputs. They perceive a win-lose proposition with the conservationists. If the habitat is maintained they believe they will lose their "growth engine" and therefore their viability.

Smaller communities such as Gothenburg, Wood River, and Gibbon view the river as a natural resource to be preserved for aesthetic, environmental and economic uses. One small town resident summarized the feeling of others interviewed by saying,

"The Platte River is beauty. All winter long you can see geese, that's because of the river. I try to imagine 60 miles North of here without the river; it wouldn't be the same place at all. I love the scenic beauty of the Platte, its braided appearance. It's always changing, unlike deeper trench like rivers it meanders."

And yet the economic value is also an interest. "Traditionally the river was sold on its ability to produce a crop, grain, and now its almost always sold based on its wildlife or recreational worth."

As Table 1 illustrates differences exist between individual attitudes and beliefs about the Platte River and the organizational positions taken.

Table 1. Interest Groups by Personal (community) values and Organizational Values attitudes and beliefs about the Platte River and the organizational positions taken.

		Econ.Growth	Habitat	Rec.	Power	Crops (Irrig.)	Beauty	General Ecology
Conservationists	Org.Values		X	X				
	Ind.Values		X	X			X	

Utilities	Org.Values	X			X	X	
	Ind.Values		X	X			X
Ag.	Org.Values	X				X	
	Ind.Values	X		X		X	
Muni.	Org.Values	X			X	X	
	Ind.Values		X	X			X
Policy	Org.Values	X		X		X	
	Ind.Values		X	X			X

An examination of the similarities and differences among the different interests groups' values and those of the individuals' who make up the interests groups provides some insight into possible areas for consensus building. Within all groups, at the individual level, beauty of the river was a high value. Recreation and its ties to personal identity were also articulated among all of the interest groups. Small town representatives agreed that the beauty of the river and the recreational opportunities it affords was a high personal value to them.

Why focus on areas of consensus? Among every interest group member interviewed the strong need for consensus building for the development of a long-term plan. As one community leader associated with agriculture stated,

"There are two different mind sets out there and until these two can sit down and realize that we need to work together we will not have a plan. My mind set is that I use water for my source of income. It provides me with a livelihood. The other side looks at the water as an aesthetic value. In my thinking they would put me out of business if they got their way. The only way we are ever going to solve the problem of the Platte River is going to be with a compromise."

While tension has existed for a long time one resident explained the situation from a 75 year perspective.

"I think it (a plan) has to be a cooperative plan that everyone can take part in not just one particular group. Audubon can't do it all; they're doing all they can in the little bitty area they have, but that's just a small portion of the channel. We need something that will pull people together. I think the irrigators and the environmentalists are starting to listen to one another more."

Barriers to a Cooperative Platte River Plan: Respondents were asked; What do you think are the barriers to developing and sustaining a mid-Platte River plan that would be supported by the majority of people along the Platte? A common theme identified as a barrier was:

"Suspicion, turf protection, arrogance by all sides arguing over the Platte water...To develop a plan involve everyone. Need a power broker-Federal government, University to mediate, need someone/something to force movement on the management issue."

One agency representative tied to agriculture also suggested a barrier was turf. He said;

"Special interest not being able to come together has been to our detriment. The time needed to get things started is a barrier."

People not understanding the facts about the Platte River was also highlighted by a majority of the respondents. As one respondent indicated;

"I think it is a two part problem. Nebraskans care about Nebraska, so I don't think that is an issue. We have not taken the time to adequately educate the public about the Platte. Part of it has been that I'm not sure we were as knowledgeable about the Platte as we needed to be in the past; we have learned a lot ourselves. The Public has learned some with us, but we have not shared as much information with the public as we need to."

The issue of education and where residents adjacent to the Platte River get information was also addressed in the interviews. The list of information sources varies based on special interest involvement by the respondent and whether or not they live in the regional hubs of Kearney, Grand Island, and Columbus. Agricultural interests get their information from sources such as Nebraska Public Power District, Loup Public Power District, Local Newspapers, although mostly associated with licensing efforts. Coffee shops, friends and television and radio were mentioned by almost all respondents as information sources. Federal sources and University sources were not cited as primary information sources. Given the local culture and often anti-government sentiment by rural Nebraskans this makes some sense.

The Perfect Platte River Plan:

Respondents were also asked to speculate about what a "perfect" long-term Platte River plan would look like. These findings provide a glimpse of how different interests groups, municipal residents and policy makers view as a plan that they would devise.

Highlights of the responses looking forward to the "perfect" plan follow:

"We came close to one with Prairie Bend, but the environmental side was not satisfied with the habitat they got." "Habitat and land can be developed without the use of water. These techniques must be mentioned when considering a new plan."

"A plan the provided irrigators to be highly efficient in their use of water. Water rights need to be bought and sold."

"What I think needs to be done is a shift in the mentality that built the reservoirs: It's water flowing right past our front door so we'd better use it before it dumps in the ocean. We need to shift from a capitalizing, damming mentality to a recognition of the natural cycles of the river and come to a more common ground so that we don't lose our past heritage and all the benefits to the various wildlife. It doesn't have to be a river for just irrigation or just wildlife but, we need to be willing to sacrifice some of the surplus corn for quality of life."

"A perfect plan would provide a balance between the ecological needs of the Platte River system and the financial needs of power generation and the political needs of recreation. Everybody's happy and nature can still live with man."

"You never will come up with a plan that will satisfy everyone."

"We need to realize that we can't take all the water out of the river."

"The dams are a thing of the past."

"A perfect plan would be non-damaging to the river. It would address the legal points while still satisfying moral obligations to future generations."

"If you could keep the flows up to stop the vegetation from closing in."

The respondents focused on the future. Organizational affiliation did not seem to influence the vision for the future plan of the mid-Platte. Balance was argued among all respondent categories. While some pessimism surfaced among some respondents, on average a facilitated planning process was argued for, as a method for developing a long-term sustainable plan.

Conclusion:

The competition between water users was highlighted multiple times. The importance of the federal role was also highlighted. As one respondents said, "The federal role is crucial because otherwise the state of Nebraska would definitively not support the endangered species act." All key informants agreed that consensus on a long term plan was needed.

Agricultural interests focused on private property rights and the long state history of irrigation driving the economy. Key informants representing municipalities expressed concern that their economic growth would be stifled. When asked where they get their information about the conservation of the Platte and the issues surrounding those efforts they unanimously explained that it was from the media and their state and national associations. When asked about a long-term plan the primary species identified was "the cranes." The diversity of the Platte seemed to be unrealized in their perspectives.

While these two perspectives exist at the organizational level it is interesting to note that at an individual level the aesthetic and recreational value of the Platte River as a natural resource cuts across groups. The environmental spokespersons linked their personal and organizational values much more closely than the other two groups or the public utility groups.

Overall, the traditional friction between smaller communities and larger retail hubs adjacent to the mid-Platte River still exists. Several key leaders from the smaller communities believe they have been left out of the planning process. Education of the public was also highlighted. A specific targeted educational program will probably be necessary given the different ways community resident gain information about the Platte River. The role of the Federal government and the University was highlighted as that of a facilitator versus an advocate.

Further research suggested by this study are the development of holistic community profiles and a specifically focused data collection from community leaders, formal and informal, to identify specific issues to be included in plan development.

Key Findings:

Personal values of key informants and special interest groups were much more closely aligned than the organizational values.

Distance from the Platte is related to increased value placed on the Platte for environmental reasons.

If personal income is perceived as directly tied to Platte River water then respondents were more likely to place a lower value on the aesthetic and environmental factors associated with the river.

Information about the Platte River issues is gathered differently in communities based on size. Large communities rely on "experts" for the information while smaller community residents rely on "local long term residents with a holistic perspective."

Community residents place a somewhat neutral priority on gaining information about the Platte River until a "Crisis" develops.

All respondents voiced an opinion that a collaborative agreement between municipalities, agricultural

interests, and environmental interests must be developed.

Quality information to the public and across the groups was suggested.

Name
Address
Phone Number
Confirmation Date
Q.1 When you think about the Platte River in Nebraska what are your first thoughts?
PROBE: Is that tied to your personal life or to your business or job?
PROBE: (If personal) What about professional or job?
Q.2 Do you think the Platte River is somehow linked to your individual household income?
PROBE: If no, is it linked to overall community economic vitality?
PROBE: Do you think that will change in the future?
Q.3 As a representative of _____ (organization, municipality, interest group), what do you think is the interest in the Platte River of that group?
PROBE: Has that position been the same for a long time?
Q.4 When you think of yourself as an individual what are your interests in the Platte River?
PROBE: If no, do you fish, bird, or canoe?
PROBE: Is that the same as members of your organization?
Q.5 What do you think manages the Platte?
PROBE: Do you think that is positive or negative?
Q.6 Do you see a great deal of change in the future in the way the Platte River is managed?
PROBE: What do you think is driving that change (or no change)?
Q.7 When you think of the Platte River and how it is managed do you see any problems?
PROBE: Why do you think these are problems?
Q.8 How do you think the other interest groups and community leaders in this area think of the Platte River and how it is managed?
PROBE: Why do you think they believe that?
Q.9 What do you think is the most important use of the Platte River water?
PROBE: Why?
PROBE: What are some other important uses?
Q.10 What do you think a perfect mid-Platte River plan would look like?
PROBE: Why do you think that would be perfect?
Q.11 Who would be the best managers of the Platte?
PROBE: Why? Q.12 What do you think are the barriers to developing and sustaining a mid-Platte River Plan that would be supported by the majority of the people along the Platte?
PROBE: Why do you think these barriers exist?
PROBE: Are there any other barriers you can think of?
PROBE: What do you think would motivate people to be involved in this?
Q.13 What do you think needs to happen to facilitate the development of a management plan that would incorporate everybody's interests?
PROBE: Are you willing to participate in such a process?
PROBE: What do you think would motivate people to be involved this way?
Q.14 Do you think most people in your community and area know the facts about the Platte River?
PROBE: If no, is that because they don't care or what?
PROBE: Do you think they want to know?
PROBE: How would you get the word out?
Q.15 Where do local residents go to get information about the Platte River?
PROBE: Do you talk with neighbors?
PROBE: Do you talk about cafes, 4-H, church or other places?
Q.16 Is there anything else you would like to say about the Platte River, its future, or the way it is managed?

BIOLOGICAL RESPONSES TO HYDROLOGIC FLUCTUATION IN WETLAND SLOUGHS OF THE CENTRAL PLATTE RIVER

Matt R. Whiles, Kansas State University, Department of Entomology, Manhattan, KS 66506-4004, and Beth S. Goldowitz, Platte River Whooping Crane Maintenance Trust, Inc., 6611 W Whooping Crane Dr, Wood River, NE 68883.

To investigate hydrologic influences on biotic communities of central Platte River wetland habitats, we began a long term study in 1997 which includes monitoring hydrology and aquatic invertebrate, amphibian, and fish communities in five backwater sloughs southwest of Grand Island, Nebraska. Biotic community monitoring at each site consists of monthly benthic sampling of aquatic macroinvertebrates; continuous emergence trapping of adult insects; continuous sampling, during favorable weather conditions, of amphibian populations and migrations using drift fence and pitfall trap arrays; and monthly electroshocking of fish communities.

During the first year of this project, hydrologic regimes of our study sites varied from ephemeral to permanent. A significant positive relationship ($p<0.01$) between river discharge and slough water volume was evident at the permanent site, but this relationship was unclear at the intermittent and ephemeral sites. Invertebrate sampling revealed the presence of a new species of Ironoquia (Trichoptera: Limnephilidae) in one intermittent site, but this caddisfly did not occur in permanent or ephemeral sites. The two dominant amphibian species showed distinctly different breeding habitat preferences: leopard frogs (*Rana blairi*) were most abundant at the permanent site, and chorus frogs (*Pseudacris triseriata*) were most common at intermittent and ephemeral sites. Due to dry conditions during spring and early summer of 1997, only one amphibian species (*R. blairi*) reproduced successfully and only at the permanent site. Among the two sites with fish, species richness was highest at the permanent site, which served multiple functions as a spawning, rearing, seasonal, and year-round habitat for different fish species. The intermittent site was used seasonally as a spawning and nursery area during 1997, though habitat availability for spawning was truncated due to the dry summer.

Preliminary results suggest that wet meadows in the central Platte River support a patchwork of hydrologically diverse slough habitats, and that physical/hydrological diversity may promote biological diversity on a larger scale. Thus, successful management of this floodplain system

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Abstract

To investigate hydrologic influences on biotic communities of central Platte River wetland habitats, we began a long term study in 1997 which includes monitoring hydrology and aquatic invertebrate, amphibian, and fish communities in five backwater sloughs southwest of Grand Island, Nebraska. Biotic community monitoring at each site consists of monthly benthic sampling of aquatic macroinvertebrates; continuous emergence trapping of adult insects; continuous sampling, during favorable weather conditions, of amphibian populations and migrations using drift fence and pitfall trap arrays; and monthly electroshocking of fish communities.

During the first year of this project, hydrologic regimes of our study sites varied from ephemeral to permanent. A significant positive relationship ($p<0.01$) between river discharge and slough water volume was evident at the permanent site, but this relationship was unclear at the intermittent and ephemeral sites. Invertebrate sampling revealed the presence of a new species of Ironoquia (Trichoptera: Limnephilidae) in one intermittent site, but this caddisfly did not occur in permanent or ephemeral sites. The two dominant amphibian species showed distinctly different breeding habitat preferences: leopard frogs (*Rana blairi*) were most abundant at the permanent site, and chorus frogs (*Pseudacris triseriata*) were most common at intermittent and ephemeral sites. Due to dry conditions during spring and early summer of 1997, only one amphibian species (*R. blairi*) reproduced successfully and only at the permanent site. Among the two sites with fish, species richness was highest at the permanent site, which served multiple functions as a spawning, rearing, seasonal, and year-round habitat for different fish species. The intermittent site was used seasonally as a spawning and nursery area during 1997, though habitat availability for spawning was truncated due to the dry summer.

Preliminary results suggest that wet meadows in the central Platte River support a patchwork of hydrologically diverse slough habitats, and that physical/hydrological diversity may promote biological diversity on a larger scale. Thus, successful management of this floodplain system may require maintaining and promoting hydrologic diversity of backwater and slough habitats.

Introduction

Wet meadows of the central Platte River are important resources for a variety of flora and fauna, including microbes, plants, invertebrate and vertebrate communities, numerous migratory bird species, and a number of federally protected endangered and threatened species. Some of these are closely tied to slough and backwater wetlands in the meadows (e.g., fish and other completely aquatic species), while others are dependent upon them for at least some period of time (e.g., amphibious and migratory species). Other groups which appear independent of these wetlands may actually rely, directly or indirectly, on species that are closely tied to aquatic systems. For example, Gray (1993) recently demonstrated a strong link between feeding activities of insectivorous birds and aquatic insect emergence. In the Platte, wetlands are essential habitats for migratory birds, particularly sandhill cranes and whooping cranes, because they provide food items that are necessary for successful migration and nesting (US Fish and Wildlife Service 1997).Thus, wetlands in the Platte River valley are likely an important component of regional biodiversity and play a major role in ecosystem function, as has been suggested for aquatic systems in the Great Plains region in general (Matthews 1988).

Despite their ecological importance, wet meadows and slough wetlands constitute some of the most seriously degraded and diminished habitats in the Platte River valley. After a century-long period of regulation and reduction of the Platte's flow, combined with agricultural conversion of land to row crops,

the majority of the native meadows in the central Platte have disappeared (Sidle et al. 1989, US Fish and Wildlife Service 1997). Currently, wet meadows comprise less than 5% of the land area in the Platte River valley (US Fish and Wildlife Service 1997).

Notwithstanding the rather obvious importance of these habitats, their limited availability, and their potential linkages with other components of the Platte River ecosystem, backwater and slough wetlands have not been well studied. Understanding the basic structure and function of these wetlands, and their importance on a larger scale, such as their influence on surrounding habitats and systems, is essential for effective management. The influence of the physical template on structure and function of aquatic systems is well documented (e.g., Vannote et al. 1980, Poff and Ward 1990, Townsend and Hildrew 1994). Thus, a key starting point for Platte River wetlands is identifying the important components of the physical template and elucidating their influence on animal communities and ecosystem processes. In particular, hydrology is likely to be the single aspect of the physical environment that has the most pervasive influence on resident communities and associated processes.

Wetlands in the Platte River vary from being ephemeral pools to perennial aquatic habitats. In addition, the hydroperiod in these habitats may change substantially from year to year, as a result of annual variation in local precipitation, river discharge, and evapotranspiration. The influence of this hydrologic variability on aquatic communities and processes is undoubtedly profound. For example, spring peak (or flood) flows are considered "elemental" for maintaining the Platte River system, because of their role in maintaining biodiversity of wet meadows and the meadows' ecological function and usefulness for numerous animal and plant species (US Fish and Wildlife Service 1997). Previous study has established that groundwater level fluctuations in the meadows are linked to river flow, especially during spring peak flow periods (Wesche et al. 1994), but there is almost no information about the influence of hydrologic variability in the river on the surface wetlands in wet meadows. Hydrologic factors play an important role in structure and function of a variety of aquatic systems (Van Der Valk 1981, Moses 1987, Matthews 1988, Resh et al. 1988, Stanley and Fisher 1992, Poff and Allan 1995), and understanding their effects, as well as the factors influencing them, is essential for understanding and managing these unique aquatic systems and the species that depend upon them.

Our objective in this study is to examine and quantify the tripartite relationship between river discharge, wetland hydrology, and biotic communities of central Platte River sloughs. Specifically, we are examining: 1) hydrologic relationships between sloughs, river discharge, and local precipitation; 2) response of aquatic macroinvertebrate communities to hydrologic variability in sloughs; 3) influence of slough hydrology on aquatic insect emergence patterns and energy transfer to terrestrial habitats; and 4) influence of slough hydrology on amphibian and fish communities. This study incorporates both spatial and temporal components: our study sites represent a wide range of hydroperiods during any given year, and annual hydrologic variability also is high in this sytem. Hence, our study is designed to examine the influence of hydrologic variability on biotic communities in sloughs with different hydroperiods, and among years within individual sloughs.

Study Areas

We studied five slough and backwater wetlands in the central Platte River southwest of Grand Island in Hall County, Nebraska. Three sites are located on Mormon Island Crane Meadows (MI1, MI2, and MI3), and two sites are on the adjacent island at Wild Rose Ranch (WR1 and WR2). All five sites are in close proximity to each other and to the main channel of the Platte River. Habitat surrounding all sites is a mosaic of wet and mesic prairie. In the Platte River, these grasslands (often called wet meadows) have groundwater levels which are high for much of the year, and the vegetation is dominated by grasses, sedges, and forbs typical of tall grass prairie.

Each study site is a 20 m linear reach of slough. Sloughs flow into and are connected to the main channels of the river when water levels are high, but some may become disconnected from the river during dry periods. The study sites vary from ephemeral to perennial (Table 1), with water depths ranging from 0.25-1.0 m at the deepest points. Water flows at slow velocities (<5 cm/s) in all the study sloughs. Although some gravel is present at one site, substrates in the sloughs are dominated by sand, silt, and

detritus. Aquatic macrophytes (*Potamogeton, Typha, Scirpus, Carex, Lemna, and others*) are abundant at all sites except MI3 and WR1, where grasses and other prairie vegetation encroach because of shorter hydroperiods. Filamentous algae are also abundant seasonally at all sites. The sloughs freeze over during the winter, except one site which remains open year-round.

Methods

Hydrology monitoring

In spring 1997, we installed staff gauges at all the sites and read them daily thereafter (except when sloughs were dry or frozen). At approximately weekly intervals, depth profiles and wetted surface area of each site were measured. We obtained depth profiles of each site by measuring water depth at 1 m intervals across the width of the slough along three fixed transects that were 10 m apart (0 m, 10 m, 20 m). From depth profiles and wetted area measurements, we calculated slough volume and surface area, then regressed these against staff gauge readings from the same dates. In all cases but one, significant relationships were obtained ($p < 0.01$ for all). No significant relationship was detected with the surface area at WR2 because channel morphology is such that surface area changes very little. Regression equations were then used to predict daily volume and surface area from staff gauge readings taken on days when depth profiles and wetted area were not measured. Because WR2 wetted surface area changed very little throughout our first study year, we used a seasonal average of wetted area values for this site instead of a regression equation.

In conjunction with the hydrologic measurements, we also installed data loggers to continuously monitor water temperature in all the sloughs and air temperature and relative humidity in the general study area. Precipitation at all sites was monitored with rain gauges which were read daily.

Macroinvertebrate communities

Benthic macroinvertebrate communities were sampled monthly (except when sloughs were dry or extensively frozen). On each sampling date, three samples were taken with a 20 cm diameter coring device at random locations in each site. The coring device was driven into the substrate, and all material (substrates, vegetation, water, etc.) was removed by hand and cup down to ca 10 cm into the substrate and placed in a 5 gallon bucket. Samples were then elutriated and poured through a 250 μm sieve, rinsed, preserved in 7-8% formalin solution with phloxine B stain (to facilitate sorting), and transported to the laboratory.

Adult insects that emerged from the sloughs were collected continuously (except when sloughs were dry or frozen) from three emergence traps placed at each site. Each trap sampled a 550 cm2 surface area of the slough. Traps consisted of a plastic cylinder that was suspended on electric fence posts and placed ca. 3 cm into the water of the slough. They were placed at random locations in each site and mounted in a manner which allowed adjusting for fluctuating water levels. Each trap was topped with a fine mesh cap (250 μm mesh), which directed insects into a plastic pipe connected to a bottle filled with a dilute solution of ethylene glycol. Emerging insects that became trapped in the bottles were collected ca. every 2-4 weeks. During drying periods when slough surface areas were shrinking, traps were often moved into deeper water to allow for continuous sampling.

Because one site (MI1) contained larvae of Ironoquia (a genus of caddisfly in which final instar larvae migrate onto land to pupate and metamorphose into adults), we placed three additional emergence traps over the meadow at this site, adjacent to the slough in areas where pupae were evident. These traps were used to quantify adult *Ironoquia* emergence. Because larval production of *Ironoquia* occurs in the water, *Ironoquia* values will be added to estimates from traps positioned over the water to obtain total emergence production of insects from this site.

Amphibian communities

Amphibian movements into and out of each site were monitored continuously during favorable weather conditions with drift fences and pitfall trap arrays (Gibbons and Semlitsch 1981). The length of each

slough was bordered, on both sides, by 20 m drift fences constructed of aluminum flashing which was buried ca. 15 cm into the ground and supported with electric fence posts (ca. 0.5 m height above ground). Drift fences were oriented parallel to each slough, and were 5-10 m away from water's edge during wet periods. Pitfall traps (5 gallon buckets buried flush with the ground) were placed at 10 m intervals on each side of each drift fence (drain holes were drilled in each pitfall bucket prior to installation). During use, each pitfall bucket was equipped with a sponge to keep trapped animals moist and a styrofoam float to prevent drowning. Additionally, we suspended a strip of burlap from the adjacent meadow into each bucket to facilitate the escape of small mammals that fell into the traps.

During favorable conditions (spring, autumn, and rainy periods during the summer), traps were opened before dark and checked the following morning. Trapped amphibians were identified, sexed (when possible), weighed, measured (snout-vent length), marked by clipping toes, and released on the opposite side of the fence. When not in use, lids were placed on traps to prevent incidental catches.

While performing routine hydrologic measurements and monthly sampling, all study sites were searched for the presence of amphibian egg masses and larvae. Presence or absence was noted, and egg masses and larvae were identified when possible. Occasional estimates of larval densities were made using a frame sampler.

Fish communities

Two of the study sites (MI1 and WR2) contained fish communities, and they were sampled monthly (except at MI1 when it was dry or frozen). Sampling at each site consisted of single-pass electroshocking of the entire 20 m study reach (using a Coffelt model Mark-10 backpack electroshocker). Stunned fish were collected with dip nets, identified, measured (standard length), and released. Additionally, notes on reproductive status (e.g., presence of breeding adults or young-of-the-year) were recorded on each date.

Results and Discussion

Hydrology

During the 274-day study period in 1997, slough hydroperiods ranged from 72-274 days with water (Table 1). The two ephemeral sites had the shortest hydroperiods (MI3 and WR1) and were wet in spring (dry by late April), dry during the summer, and re-filled with water in late November. These ephemeral sites also filled temporarily during rainy periods in the summer. Two intermittent sites had intermediate hydroperiods (MI1 and MI2); they were wet from spring into early summer (dried in late June), occasionally filled during rainy periods in the summer, and re-filled in mid-September.

Although total annual precipitation during 1997 was slightly above average for the region, much of that precipitation, especially during spring months, was concentrated into a few days. For example, March 1997 ranked as the tenth driest March in the long-term record (National Weather Service, 1997 data for Grand Island). Furthermore, all the precipitation in May and June was almost completely concentrated into 4 and 2 days, respectively. Only during the period of August-October was precipitation significantly above average. Thus, any influence that local precipitation has on hydrology of these sloughs, particularly in spring and early summer, may have been reduced during our first study year, and hydroperiods may vary under different climatic conditions.

Discharge of the Platte River also was higher than average during 1997, though the timing of flow peaks was somewhat unusual. On average, June and then March rank as the highest-flow months in the central Platte (US Geological Survey, statistics for water years 1942-1997). During 1997, June was indeed the highest-flow month of the year, but the next highest flows occurred from October-December (flows were double to triple the average levels).

Preliminary analysis of slough hydrology data revealed some relationships with river discharge. In particular, we detected a highly significant relationship ($p < 0.001$) between slough volume and river discharge at the perennial site, WR2 (Table 1). This positive relationship was apparent throughout most of year, with the exception of a period in November when water volume rapidly declined for no apparent

reason (Figure 1). The other sites showed a pattern of decreasing correlations between slough volume and surface area with river discharge as slough hydroperiods decreased, with the exception of WR1 volume (Table 1). Thus, hydrology of sloughs with longer hydroperiods is apparently more closely linked with river discharge. Future analysis incorporating river discharge, local precipitation, evapotranspiration estimates, and antecedent conditions will allow us to identify the factors governing hydrology of individual sloughs more completely.

Macroinvertebrate communities

Processing and identification of the benthic core and emergence trap samples has just begun; however, initial macroinvertebrate sampling has revealed the presence of a previously unidentified caddisfly of the genus *Ironoquia*, which we are currently in the process of describing. The discovery of this new species in our MI1 study site extends the known range of *Ironoquia* in North America westward by a significant amount (Wiggins 1996). As has been observed in other members of this genus (Williams and Williams 1975), final instar larvae migrated from MI1 before the site dried in early summer, aestivated and pupated in grass litter on land through the remainder of the summer, and emerged as adults in late September. This life history demonstrates an adaptation to intermittent aquatic habitats and may explain why this caddisfly is not present in our study sites that have different hydroperiods (i.e., intensive sampling in nearby drier [WR1, MI2, MI3] and wetter [WR2] sites has failed to produce specimens of *Ironoquia* elsewhere). Thus, it appears that there may be hydrologic thresholds governing the distribution of this new species in Platte River sloughs.

Amphibian communities

During 1997, our study sloughs contained a total of four species of anuran amphibians. They included plains leopard frog (*Rana blairi*), bullfrog (*Rana catesbeiana*), western chorus frog (Pseudacris triseriata), and Woodhouse's toad (*Bufo woodhousii*). However, only leopard frogs and chorus frogs occurred in large numbers. Although generally abundant in our area, plains spadefoot toad (S*pea bombifrons*) was not collected during our first study year. This is presumably a result of weather patterns, as this species is an explosive, opportunistic breeder (Wells 1977) that emerges from the ground and breeds during warm rainy periods in late spring and summer (Collins 1993). These weather conditions scarcely occurred in the study area during 1997.

Chorus frog catches were highest in spring and fall, whereas leopard frog catches remained fairly constant throughout the study period (Figure 2). Eggs and larvae of both species were observed in several sloughs by April, and larvae of both species were present shortly thereafter (Figure 2). However, emerging metamorphs of *R. blairi* only were collected during the summer. This is likely a result of different breeding habitat preferences of the two species and the weather patterns during 1997. *R. blairi* showed a distinct preference for the perennial site, WR2 (Figure 3A), regardless of the presence of predatory fishes. Successful recruitment of this species was documented only at WR2. In contrast, *P. triseriata* preferred intermittent and fishless sites (Figure 3B), but these sites dried early in the year during 1997. As a result, although breeding adults were abundant in spring, we were unable to document successful recruitment by *P. triseriata* at our sites during 1997.

Breeding habitat preferences exhibited by leopard frogs and chorus frogs at our study sites are consistent with other observations of these species (Fitch 1958, Whitaker 1971, Johnson 1992, Skelly 1996), and recent investigations suggest that adult breeding site choice is only one of many factors which may influence distribution of anuran larvae across hydrologically variable habitats. Skelly (1997) suggests that there are trade-offs associated with breeding site permanence, and that feeding rates, growth rates, size at metamorphosis, risk of predation, and other factors affecting fitness vary among anuran species which breed in habitats with different hydroperiods. In general, smaller species such as *P. triseriata* are often more successful in intermittent habitats where predator populations are reduced but risk of desiccation may be higher (Skelly 1996). Presumably, we will be able to document successful recruitment of P. triseriata at our intermittent sites in years when weather patterns and river flow differ and hydroperiods in our intermittent sites are longer.

Fish communities

The two sites with the longest hydroperiods, MI1 and WR2, contained fish communities for at least part of the year. The perennial site, WR2, contained a more diverse assemblage of 13 species, while the more intermittent site, MI1, contained only three species (Figure 4). Brassy minnow (*Hybognathus hankinson*i) dominated the community in the intermittent site, MI1. We observed spawning adults in early April and young-of-the-year in late June (Figure 5), suggesting that MI1 is used seasonally as a spawning habitat by this species. In early June, prior to the appearance of young-of-the-year brassy minnows, no fish were present in MI1, and this site dried shortly after our 28-June sample was collected (Figure 5). Although reproduction of brassy minnow is not well documented (Lee et al. 1980), our data indicate that, in the Platte River, this species moves into intermittent sloughs in spring to spawn, adults leave after spawning, and young hatch prior to summer drying. Interestingly, large numbers of adult brassy minnows appeared in the perennial site (WR2) in mid-summer (Figure 6), but no reproduction was evident at this site, suggesting that fish may use permanent and intermittent sloughs for different purposes.

In the perennial site, WR2, composition of the fish community varied throughout the year. A few species were present on most sampling dates and appeared to be year-round residents (Figure 6), e.g., brook stickleback (*Culaea inconstans*) and Iowa darter (*Etheostoma exile*). Both are species of special concern in Nebraska (Clausen et al. 1989), and neither occupied the more intermittent site. Some other species moved into this slough and used it during a single season only: brassy minnow and fathead minnow (*Pimephales promelas*) occupied WR2 during the summer only, while largemouth bass (*Micropterus salmoides*) moved in during the autumn. These varied patterns suggest that perennial wetlands may serve multiple functions for the different fish species in the Platte.

Conclusions and future considerations

This paper presents the results from only the first year of a long-term endeavor, and portions of the data have not been analyzed yet; however, our initial results indicate that there is a relationship between hydrology and biotic diversity in central Platte River wetlands. Preferences for hydrologic regimes among species in each of the three biological communities we are examining are evident. For example, *Ironoquia* is present only at one intermittent site (MI1); the two dominant anurans show distinctly different preferences for breeding habitats; and, although many fish species utilize only in the perennial site (WR2), at least one species selects intermittent wetlands for spawning.

Initial results also indicate that the hydrology of these slough habitats, at least those with longer hydroperiods, is significantly influenced by river discharge. Therefore, temporal variation in factors influencing wetland hydrology may be crucial to reproductive success of their inhabitant species. For example, breeding adult chorus frogs were quite abundant at several of our sites during 1997, indicating past reproductive success. However, factors influencing slough hydroperiod inhibited their successful recruitment in 1997. Identifying these factors, and the extent to which human activities are influencing them, will provide a basis for successful future management of the Platte River basin ecosystem.

Thus, our results to date indicate that hydrologic diversity among the wetlands is related to flows of the Platte River and has a positive influence on biological diversity in those habitats. This suggests that maintaining biodiversity, and thus ecosystem integrity, in the Platte River basin should include managing for hydrologic heterogeneity (i.e., a mosaic) of backwater and slough wetland habitats.

Additional investigation, encompassing years with different climatic and river discharge patterns, will allow us to elucidate more completely the role of individual factors that govern the hydrology of Platte River wetlands and to quantify their influence on biotic diversity, amphibian and fish reproductive success, and processes such as energy transfer between aquatic and terrestrial habitats. We also anticipate that future work will allow us to identify specific hydrologic thresholds governing distribution of a variety of species which depend on these wetland habitats. In addition to furthering understanding of the Platte River ecosystem, this information about the function of these wetland habitats should be a useful reference for measuring the success of current wetland restoration efforts.

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Table 1. Slough hydroperiods (April-December, 1997), with correlation coefficients and p values from linear regressions performed on slough volume and surface area vs. discharge of the Platte River (n=245 for all regressions). "n.s." indicates that no significant relationship was detected ($p > 0.05$). No regression was performed of surface area vs. discharge at WR2; because of the channel morphology at that site, there is essentially no variation in wetland surface area.

Site	Number of days with water	Regressions of wetland size against Platte River discharge			
		volume vs. discharge		surface area vs. discharge	
		r	p	r	p
MI 1	237	0.11	n.s.	0.27	<0.001
MI 2	201	0.10	n.s.	0.18	<0.01
MI 3	72	0.09	n.s.	0.07	n.s.
WR 1	87	0.18	<0.01	0.15	<0.05
WR 2	274	0.55	<0.001	---	---

HYDROLOGIC UNCERTAINTY RESULTING FROM THE BASIN-WIDE PROGRAM FOR RECOVERING ENDANGERED SPECIES HABITAT ALONG THE CENTRAL PLATTE RIVER, NEBRASKA

Charles, F. Leaf, P.E. and Forrest A. Leaf P.E.

Of some 157,000 acre-feet (af) per year of re-regulation potential, the Basin-Wide Recovery Program proposes to utilize approximately 104,000 af/year to reduce United States Fish and Wildlife Service (USFWS) target flow shortages at Grand Island, NE. The resulting impact on Lake McConaughy will be reduction in storage during most years of some 350,000 af compared to existing conditions. Moreover, if the program is successful, an outstanding target flow shortage of approximately 292,000 af/year will still remain. Hydrologic uncertainty resulting from the significant reduction of drought protection in Lake McConaughy and outstanding target flow shortages are potentially negative impacts on the human ecology of the Central Platte River.

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Introduction

On July 1, 1997, the Governors of Nebraska, Wyoming, and Colorado signed a "Cooperative Agreement" with the Secretary of the Interior for "*Platte River Research and Other Efforts Relat-ing to Endangered Species Habitats Along the Central Platte River, Nebraska*". That document is included as Appendix A in a recently issued Biological Opinion for the Kingsley Dam and re-lated projects prepared by the U.S. Fish and Wild-life Service (FWS, 1997). In that opinion, the FWS identified some 417,000 acre-feet (af) of flow "*shortage*" in the Central Platte River from Lexington to Chapman Nebraska

One of the most important components of the subsequent "Program" is the reduction of "*shortages*" relative to FWS target flows (Bowman, 1994; and Carlson, 1994) by an average of 130,000 to 150,000 af/year primarily through reregulation of river flows. Reregulation will be accomplished by several projects designed to shift existing flows which exceed the targets to peri-ods of shortage. These projects include: (1) Tama-rack recharge on the South Platte in Colorado, (2) Pathfinder Reservoir enlargement on the North Platte in Wyoming, (3) Environmental Accounts in Lake McConaughy and other reservoirs in Nebraska, and (4) water conservation. The anticipated sum total 70,000 af for projects in each state and 60,000 af for water conservation measures plus certain wildlife habitat measures is called the "*Reasonable and Prudent Alternative*"(RPA). This discussion is an attempt to present a lucid evaluation of the probable ef-fectiveness of the RPA.

Incremental Flow Excesses v. Shortages

Figure 1 shows a graphical representation of mean flow excesses and short-ages for ten time intervals during the average year at Grand Island, Nebraska . As seen in Figure 1, during average and wet years, flow excesses exceeded shortages during 6 intervals, whereas shortages exceeded excesses during 4 intervals. For the 37 wet and average years analyzed, mean annual target flow shortages were some 417,000 af/year and target flow excesses were some 478,000 af/year. Review of Figure 2, could lead to the conclusion that flow excesses were more than adequate to compensate for short-ages each year. However, this is far from true, as discussed belo

Year-To-Year Flow Excesses v. Shortages

Figure 2 summarizes year-to-year excesses and shortages for the 1943-1992 record period. Similar to Figure 1, average excesses nearly equaled average shortages. But, closer scrutiny of Figure 2 reveals that only in 11 of 50 years did excesses exceed shortages. Without exception, these excesses occurred during "wet" years. Moreover, during 8 of those 11 years, peak storage in Lake McConaughy was near 1.7 million af or greater, leaving limited capacity for storing these large excess flows. It should also be noted that FWS simulation of Lake McConaughy storage under the RPA predicts near-maximum storage during most wet years where excess exceeds shortage (FWS, 1997). Therefore, it can reasonably be

concluded that in wet years, re-regulation will make up shortages during those years, but not much more, given the existing limitation of stor-age capacity in the Platte River System. Data presented in Figures 1 and 2 are summarized in tabular form in Leaf (1997).

The average re-regulation potential of flow excesses is approximately, 157,000 af/year determined from Figure 2. This was computed by setting flow excess equal to shortage for those years when the excess exceeded the shortage. For example, in 1974 the 1.388 million af excess was set to 296,000 af as the excess. The RPA proposes to utilize approximately 104,000 af of this potential, leaving a net shortage relative to the target flows of some 292,000 af/year. This estimate is within 12 percent of the shortage pre-dicted for the RPA by the Opstudy hydrologic model (FWS, 1997) of some 257,000 af/year.

Confidence limits were computed from the data contained in Figure 2 to give an indication of their reliability. These limits are summarized in Table 1.

Table 1

95 Percent Confidence Limits For Re-Regulation Potential, RPA Target Flow Shortage, and RPA Shortage Reduction.

	Confidence Limits (af/yr)
Mean Annual	157,000 ±26,000
Re-Regulation Potential	
Mean Annual	296,000 ±47,000
RPA Target Flow Shortage	
Mean Annual	104,000 ±25,000
RPA Shortage Reduction	

Impact of RPA on Existing Storage in Lake McConaughy

Figure 3 shows a graph of actual end-of-month storage content in Lake McConaughy and USFWS simulated RPA end-of-month storage (FWS, 1997). As can be seen in Figure 3, the impact on end-of-month storage in Lake McConaughy due to the RPA would result in a significant reduction in drought protection totaling 7.5 million af and a 14 year increase in storage recovery back to present storage content (1957 - 1971). During this period, the maximum loss in drought storage totaled 661,000 af in 1968. Under an extended drought, this unmitigated loss in drought storage will result in hydrologic uncertainty for agricultural and other users of Lake McConaughy water.

For example, after the severe drought of the mid-1950's Lake McConaughy recovered to maximum storage content in approximately 3 years. Under the RPA scenario simulated by the FWS, recovery would take more than 14 years. Figure 4 is a storage duration curve for the 1943 - 1992 record period which shows that reduced storage in Lake McConaughy would average 411,000 af approximately 50 percent of the time. Under existing conditions, Lake McConaughy was at capacity 40 percent of the time, under RPA it would be at capacity 20 percent of the time. This confirms that the RPA will lesson drought storage in Lake McConaughy.

Conclusions

Potential re-regulation of flows in the Platte River Basin could reduce target flow shortages by approximately 157,000 af/year. However, if successful, the 104,000 af/year average reduction pro-posed by the RPA might well be the maximum attainable. Beyond this, it is likely that a reduction of consumptive use will be necessary to meet FWS target flows. To put the foregoing into perspective, the target flow shortage, after the RPA has been fully imple-mented in 13 to 15 years, is equivalent to 45 percent of the average consumptive use estimated by Hurr, et al. (1975) for all irrigated crops grown in the South Platte Valley between Henderson and Julesburg, Colorado. Moreover, the reduction in drought protection in Lake McConaughy due the RPA without compensation to existing uses will likely result in a negative impact to the rural economies in the Central Platte of Nebraska during time of future drought. It is not unreasonable to assume that future dry periods will have equal severity, or perhaps greater severity and frequency than the droughts that occurred during the past 50 years.

Acknowledgments

The target flow shortage and excess data presented in Figures 1 and 2 were provided by the U.S. Fish and Wildlife Service. Lake McConaughy storage data were provided by the Central Nebraska Power and Irrigation District.

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Hurr, R.T., Schneider, P.A., and D.R. Minges, 1975. Hydrology of the South Platte River Valley, Northeastern Colorado. Colorado Water Re-sources Circular No. 28, Colorado Water Conservation Board, Denver, CO.

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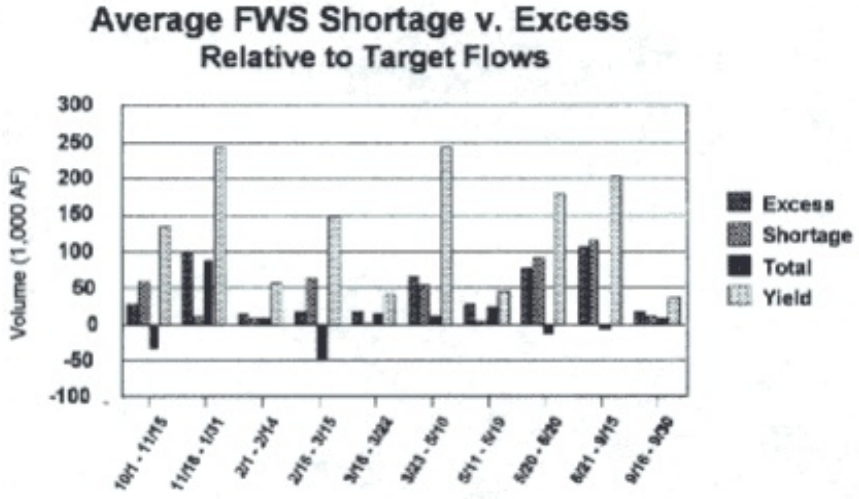
Figure 1



Year-To-Year Flow Excesses v. Shortages

Figure 2

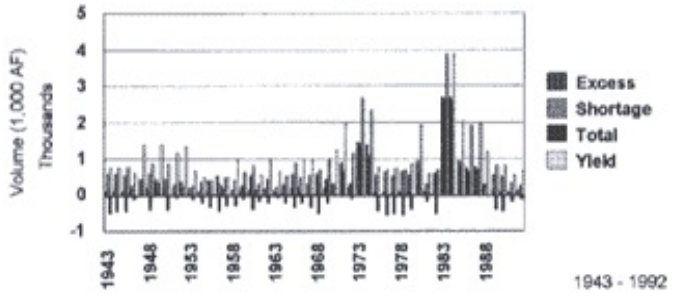
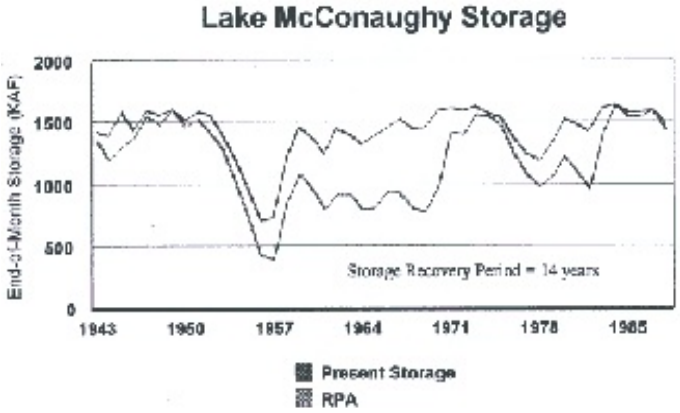
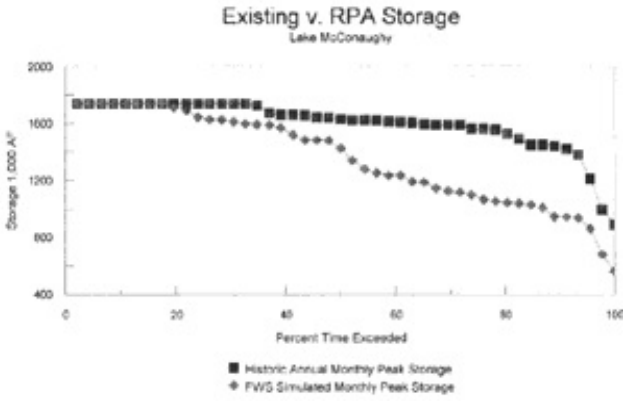


Figure 3


Lake McConaughy Storage
End-of-Month Storage (KAF)
2000
1500
1000
500
0
1943
1950
1957
1964
1971
1978
1985
Storage Recovery Period = 14 years
Present Storage
RPA


Existing v. RPA Storage
Lake McConaughy
Storage (1,000 AF)
2000
1600
1200
800
400
0
20
40
60
80
100
Percent Time Exceeded
Historic Annual Monthly Peak Storage
FWS Simulated Monthly Peak Storage

SELENIUM CONCENTRATIONS IN BIOTA FROM THE KENDRICK RECLAMATION PROJECT, NATRONA COUNTY, WYOMING

Pedro Ramirez, Jr. and Kimberly Dickerson, U.S. Fish and Wildlife Service, 4000 Morrie Avenue, Cheyenne, Wyoming 82001

Irrigation of seleniferous soils is known to mobilize selenium into the aquatic food chain (Presser 1994). Selenium mobilization associated with irrigation return flows from the Kendrick Reclamation Project (Kendrick), Natrona County, Wyoming is causing bioaccumulation in fish and aquatic birds (See et al. 1992, Naftz et al. 1993). Field studies conducted in 1986, 1988 and 1989 by the U.S. Geological Survey (Survey) and the U.S. Fish and Wildlife Service (Service) as part of the National Irrigation Water Quality Program (NIWQP) revealed elevated selenium concentrations in water, sediment and biota at Kendrick and immediately downstream in the North Platte River (Peterson et al. 1988, See et al. 1992). Selenium concentrations in pondweed (Potamogeton vaginat.us), aquatic invertebrates, aquatic bird eggs and livers, and fish exceeded threshold levels known to cause mortality and embryonic deformities. Additionally, reduced hatchability was also documented in nesting aquatic birds. As part of the NIWQP, the U.S. Bureau of Reclamation (Reclamation) initiated a remedial planning study in 1992 to find a solution to the selenium contamination problem at Kendrick. Monitoring of selenium concentrations in water, sediment and biota was conducted by the Service and the Survey from 1992 to 1996 to assist Reclamation in developing a remediation plan as well as determine trends and assist in measuring remediation effectiveness.

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Study Area Description

Kendrick is located immediately west of Casper in central Wyoming and encompasses 188 square miles (mi2). Approximately 38 mi2 or 20 percent of the project area is irrigated. The Kendrick area is semi-arid and receives an average of 12 inches of precipitation each year. Soils at Kendrick are derived from seleniferous Cretaceous shales (See et al. 1992). Irrigation at Kendrick began in 1946. Alfalfa and improved pasture are the principal crops grown at Kendrick. Over 9,000 acres of wetlands occur at Kendrick and provide habitat for aquatic birds, fish and other wildlife. Wetlands at the study area consist of large closed basins, small reservoirs and stock ponds, and riparian areas. Selenium monitoring in biota focused on four major wetlands at Kendrick: Rasmus Lee Lake (120 acres); Goose Lake (100 Acres); Illco Pond (2 acres); and 33-Mile Reservoir (10 acres).

Methods

Pondweed (Potamogeton vaginatus), aquatic invertebrates, and bird eggs were collected from the four major wetlands at Kendrick (Figure 1). Fish were collected from Illco Pond, 33-Mile Reservoir, major tributaries draining Kendrick and from the North Platte River. Pondweed and or aquatic invertebrates were also collected from several smaller wetlands and tributaries at Kendrick (Figure 2).

Pondweed was collected by hand, placed in whirl-pak bags and immediately frozen. Aquatic invertebrates were collected with dip nets and light traps as described by Espinosa and Clark (I 972), placed in chemically-clean glass vials and immediately frozen. Biota were collected between March and August from 1992 through 1996. Aquatic invertebrates collected included midge fly larvae (Chironomidae), damselfly larvae (Odonata), amphipods (Amphipoda), water beetles (Coleoptera) and waterboatmen (Corixidae). Addled American avocet eggs *(Recurvirostra americans) were* collected from the nesting colony at Rasmus Lee Lake. Addled eared grebe eggs *(Podiceps nigricolis)* were collected from Goose Lake in 1994 and 1995. Grebes did not nest at Kendrick in 1992, 1993 and l996. Addled Canadagoose (Brantacanadensis)eggs were collected from Rasmus Lee Lake in 1993. Aquatic bird eggs were dissected, examined for deformities and placed in chemically-clean glass jars and immediately frozen.

Rainbow trout *(Onchyrhynchus mykiss)* were collected from several reaches of the North Platte River using an electro-fishing boat in 1992, 1994, 1995 and 1996. The reaches consisted of a reference site upstream of Kendrick and sites downstream of tributaries draining the irrigation project.'Commoncarp (Cyprinuscarpio)

werecollectedfromIIIcoPondand33-MileReservoirwith gill nets. Fish do not inhabit Rasmus Lee and Goose lakes. In 1994 and 1995 creek chubs *(Semotilus. atromaculatus)* were collected with minnow traps from tributaries draining Kendrick. Large fish such as trout, and carp were wrapped in aluminum foil and immediately frozen. Smaller fish were placed in whirl-pak bags and frozen. Samples were submitted to the Research Triangle Institute (RTI) Laboratory, Research Triangle Park, North Carolina for selenium analyses. Selenium was analyzed using graphite furnace absorption spectroscopy.

Quality assurance/quality control (QA/QC) was assured by the National Biological Services'Patuxent Analytical Control Facility (PACF), formerly with the Service. QA/QC was confirmed through procedural blanks, duplicate analysis, test recoveries of spiked materials and reference material analyses with oversight by PACF. Selenium concentrations in muscle tissue from rainbow trout collected in 1988 and reported in See et al. (I 992) were converted to whole-body concentrations as described in Lemly and Smith (1987) to allow comparison with whole-body concentration data obtained in 1992 and 1994. Data from pondweed, aquatic invertebrates and aquatic bird eggs collected in 1988 and 1989 were obtained from See et al. (1992). All selenium concentrations in biota are reported in m g/g (ppm) dry weight. Medians were computed for the selenium data to avoid influence by extreme values or outliers.

Results

Rasmus Lee Lake

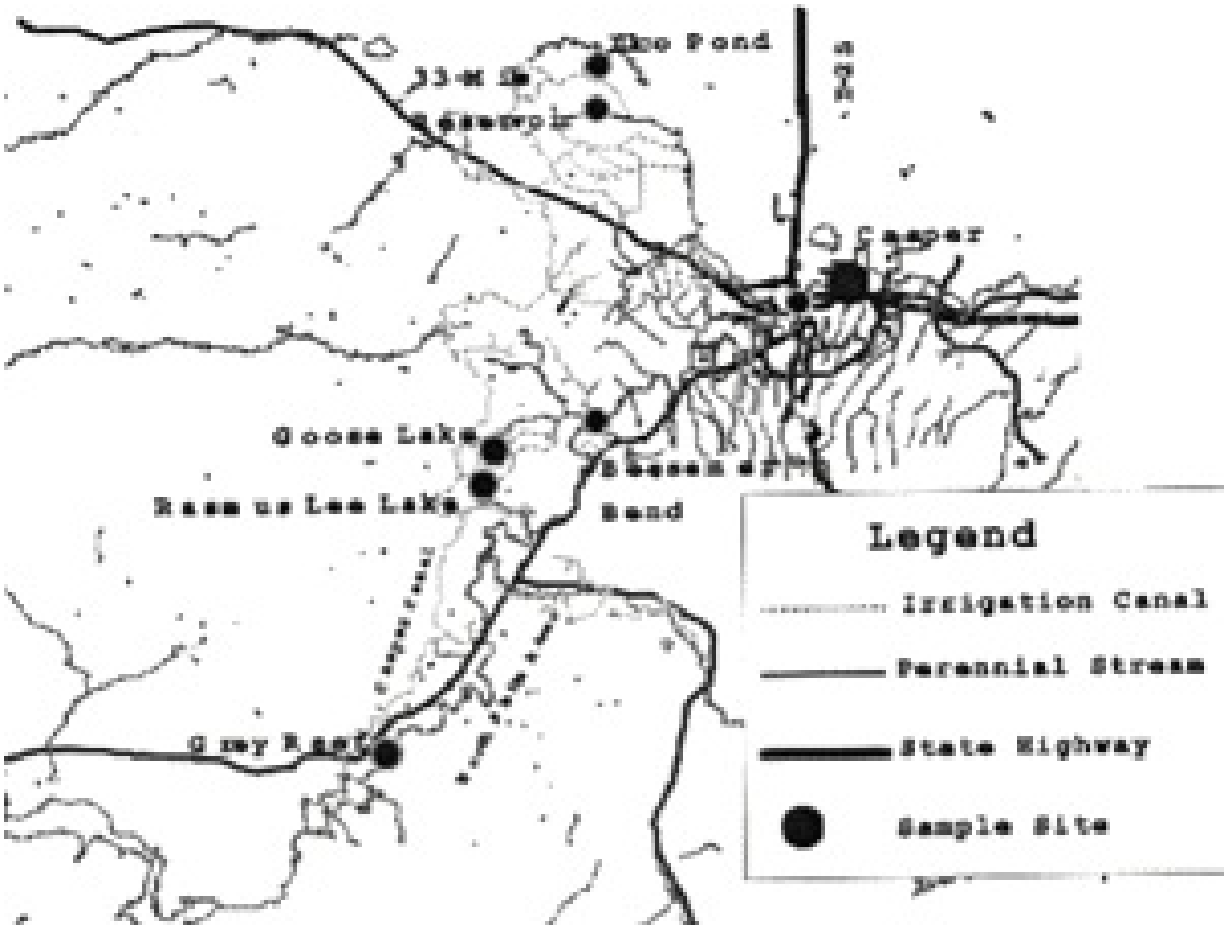
Selenium in pondweed and aquatic invertebrates exceeded the 3 [ig/g dietary threshold for aquatic birds reported by Lemly and Smith (1987) and Lemly (1993). The overall trend in selenium bioaccumulation in pondweed from 1988 to 1996 appears to decline slightly; however, a trend analysis was not done to verify this statistically (Figure 3). American avocet eggs collected from 1992 to 1996 contained selenium exceeding the 15 lig/g level reported by J. Skorupa (Personal communications, December 14, 1995) to cause impaired egg hatchability (Figure 4).

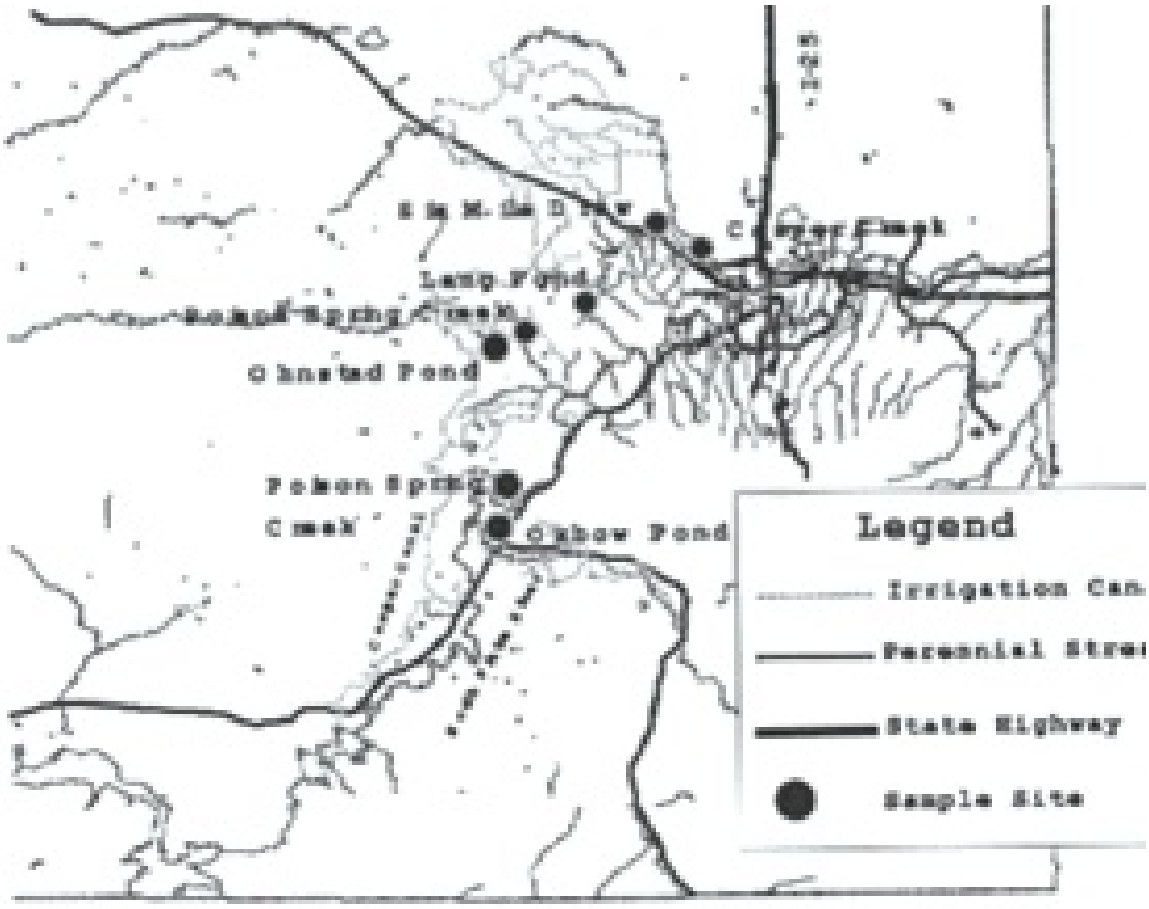
In 1993, eight out of 62 avocet embryos (I 3 percent) examined contained deformities. The occurrence of embryo terata in wild uncontaminated bird populations is normally less than I percent (Austin I969,Gilbertson et al. 1976), Hilland Hoffman I984, Pomeroy I962, Smith and Diem I971, and Threfall 1968). Selenium concentrations in avocet eggs changed from 1988 through 1996; however, a trend analysis was not conducted to determine if levels are decreasing or increasing over time. Selenium concentrations in Canada goose eggs collected in 1993 ranged from 3.75 to 29.9 g/g with a median of 7.7 g/g.

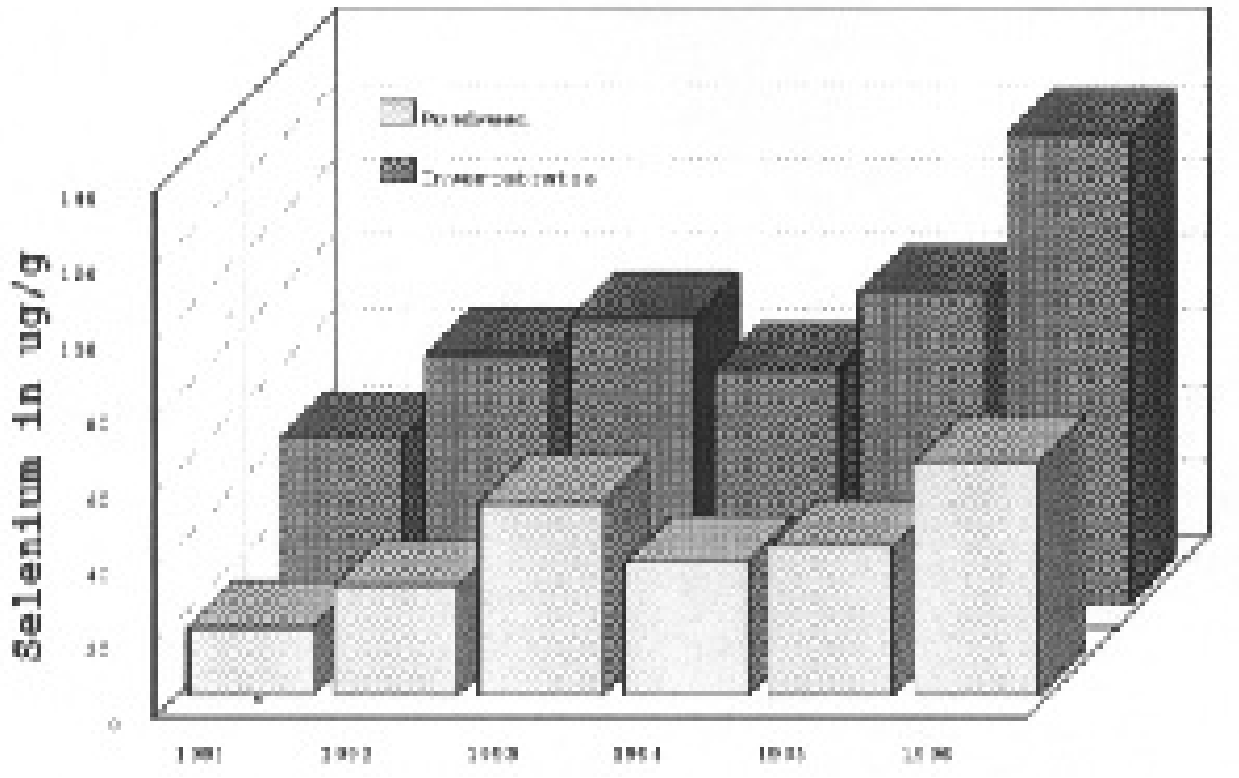
Goose Lake

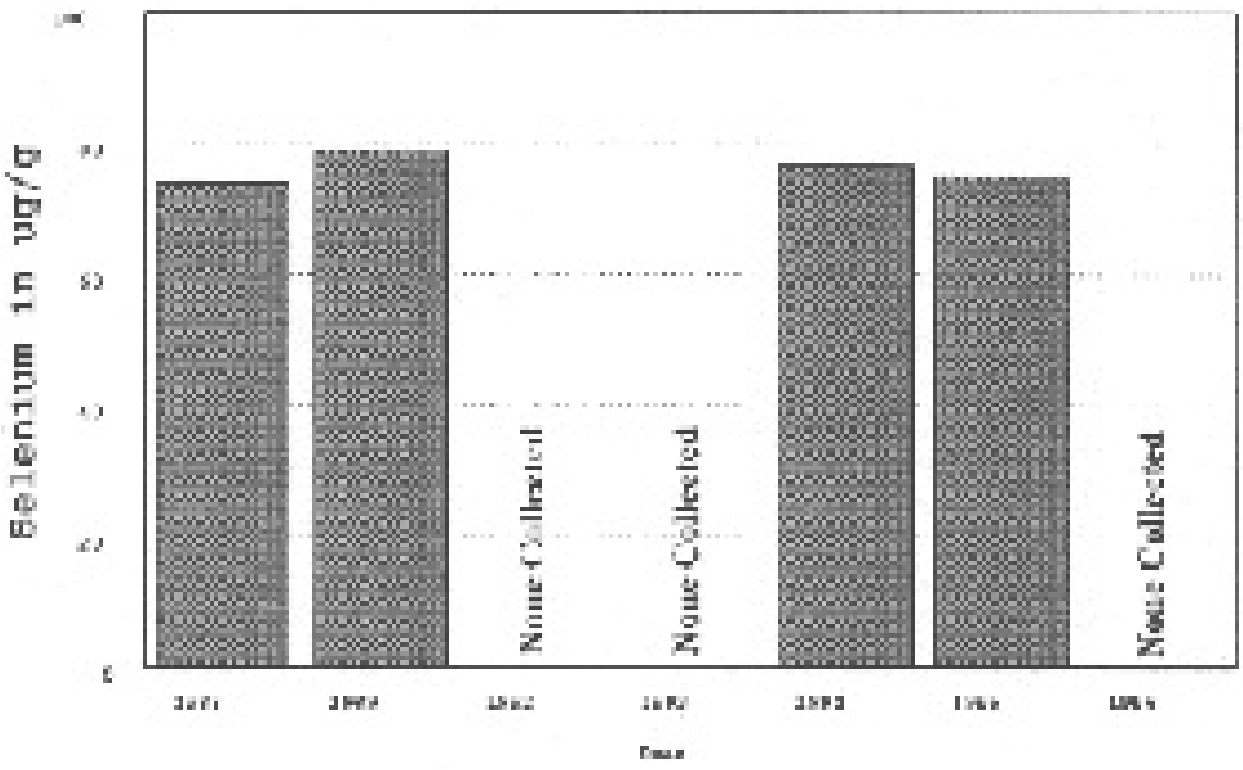
Selenium concentrations in pondweed and aquatic invertebrates exceeded the 3 m g/g dietary threshold for aquatic birds reported by Lemly and Smith (1987) and Lemly (1993) (Figure 5).

Eared grebe eggs were only collected in 1994 and 1995 as grebes did not nest at Goose Lake in 1992, 1993 and I996. Lower water levels anda possible changeinthe species composition and abundance of aquatic invertebrates could have contributed to the lack of nesting; however, the actual cause is unknown. Selenium concentrations in eared grebe eggs exceeded the levels shown by Skorupa and Ohlendorf (1991) to cause embryo toxicity (> 8 m g/g) and teratogenesis (> 13 m g/g) . Selenium concentrations in eared grebe eggs in 1994 ranged from 40.8 g/g to 111 m g/g with a median of 76.6 g/g. Eared grebe eggs collected in 1995 had selenium concentrations ranging from 59.4 to 111 g/g with a median of 75.5 g/g (Figure 6).


Duck Pond
Reservoir
Goose Lake
Bass us Lee Lake
Sand
Legend
Irrigation Canal
Perennial Stream
State Highway
Sample Site


Lang Pond
Ohnstad Pond
Oxbow Pond
Legend
Irrigation Can
Perennial Strea
State Highway
Sample Site


Selenium in ug/g


Selenium in ug/g
None Collected
None Collected
None Collected