

CHANGES IN PUBLIC PERCEPTIONS OF RIVER BASIN MANAGEMENT PRIORITY ISSUES OVER THE LAST 28 YEARS IN THE PACIFIC NORTHWEST, USA

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ABSTRACT

Residents of the Pacific Northwest region of the USA have considered water issues their highest environmental resource priority for over 50 years. We surveyed the public living in the Columbia basin watershed in the states of Idaho, Washington and Oregon about the water issues they considered most important in 1988, 1994, 2002, 2007, 2012 and 2016. Each of these six mail-based surveys was unique; however, all surveys contained three identical questions so that changes in public opinions and priorities over time could be measured. Demographic information about survey respondent gender, age, community size and formal education level were also collected. The public opinion changes observed over this 28-year period were significant. The opinions that were constant regardless of time were: (1) most people considered water in the Columbia basin to be of good or better quality, (2) most residents considered the Columbia basin to provide adequate quantities of water, (3) and over 60% of the public found that power generation was the most important benefit provided by waters of the Columbia-Snake River System. Overall, the public living in the Columbia-Snake River Watershed is engaged and care about water issues. This engagement is becoming increasingly important as more interests compete for the limited supplies of water in the region.

Keywords: public concerns, public opinion, Columbia river basin, water quality, water quantity.

1 INTRODUCTION

The Columbia-Snake River Watershed (CSRW) has a large economic impact in both Canada and the USA. This system is key to the economies of British Columbia, Washington, Idaho, Oregon and Montana as it supports agriculture (5,000,000 irrigated ha), commerce, power production, direct human water consumption, food processing and recreation. Previously conducted surveys have shown that the public within the region consider water their most important natural resource and that there are significant concerns about both water quality and water quantity issues within this large river basin [1]–[4].

2 BACKGROUND

The Columbia-Snake River Watershed produces over 50% of the water flow to the Pacific Ocean from the contiguous portion of the western USA. Over 60% of the USA's hydropower production capacity is found in this watershed. The large amounts of water within this basin have resulted in the development of large tracts of irrigated farmland that produce over 100 commodities each valued at more than \$5,000,000.

The public in the Pacific Northwest has a high awareness level of the watershed benefits. Much of the water flowing through the watersheds rivers originates as snowpack in the Cascade and Rocky Mountains during the late fall, winter and early spring. Over 40 major dams capture the runoff water in reservoirs. Consequently, this water provides hydroelectric power in the spring and summer months, provides enough water to irrigate over 5,000,000 ha of farmland, serves as a major transportation artery because of locks present at most dams, and provides many recreational activities for the region's population. Even though river basin planning and management has occurred in most regions of the world over the last 85 years,



results have often been disappointing [5]. Today the emphasis on river basin management is an integrated approach [6]. The concept of river basin and river basin management has changed significantly over time [7]. For instance, international river basin treaties have largely focused on water use and water quantity issues; however, water quality aspects have become much more important in recent years [8]. Many integrated approaches have incorporated scenarios that address climate change [9]–[11]. It is important that the public have input in river basin management. Their perceptions on pollutants, water quality, water quantity, fisheries, health of riparian vegetation, local and national governance, and the effectiveness of existing programs to make river basin management satisfactory and sustainable is important [11]–[13].

The purpose of this paper is to document changes about public perceptions of water quantity and water quality within the Columbia-Snake River Watershed (CSRW) over a 28-year period. Public input has also been sought on a regular basis (1988, 1994, 2002, 2007, 2012 and 2016) to identify the major benefit of the Columbia-Snake River Watershed. A map of the Columbia-Snake River System is shown in Fig. 1.



Figure 1: Map of the Columbia-Snake River Basin. (Courtesy of the Columbia River Inter-Tribal Fish Commission, Portland, OR, USA.)

3 METHODOLOGY

Survey instruments containing between 24 and 40 questions were developed to access public attitudes, priorities and concerns about water resource issues, river management and the potential impacts of climate change in the Pacific Northwest in 1988, 1994, 2002, 2007, 2012 and 2016. All six surveys contained the three following questions which are the topic of this paper:

- In your opinion what is the quality of surface water where you live? Answer choices: excellent or good, fair, poor, no opinion/I don't know;
- In your opinion is the quantity of surface water enough to meet human needs? Answer choices: more than adequate, adequate, less than adequate, much less than adequate, no opinion/I don't know;
- In your opinion what is the most important benefit provided by the Columbia-Snake river system? Answer choices: biodiversity, drinking water, fisheries, food/agriculture, power generation, recreation, transportation/commerce.

The survey target audience was a representative sample of the 9,000,000 adult residents of Idaho, Oregon and Washington that live within the CSRW or highly dependent on its waters. In addition, demographic information, including state of residence, community size, length of time residing in the region, gender, age, and educational level were also collected from survey respondents.

In each survey year, a target of 1,000 completed questionnaires was chosen as the survey goal to result in a sampling error of 4–6% [14]. The survey process was designed to receive a completed survey return rate more than 50%. Addresses were obtained from a professional social sciences survey company (SSI, Norwich, CT). Four mailings were planned to achieve the 50% return rate [15], [16]. The mailing strategy used was identical in all six surveys that had been conducted in the region since 1970 [1]–[4].

It only took three mailings to achieve the target return rate of 50% in 2002, 2007, 2012 and 2016. Conversely it took four mailing to achieve the 50% return rate in 1988 and 1994. The first mailing included the water issues survey form, a business reply envelope, and a cover letter that: (1) identified the survey's authors; (2) explained the purpose of the survey; (3) assured the respondent of anonymity; and (4) asked the respondents to fill out and return the survey via the business reply envelope. The second mailing (four weeks later) consisted of a postcard that stressed the importance of the survey and remind the respondent to fill out and return the survey sent out in the first mailing. Five weeks later the third mailing was sent to residents who did not respond to the first or second mailing. This mailing included a reminder letter, another copy of the water issues survey, and a business reply envelope. The fourth mailing, used in 1988 and 1994 consisted of a reminder postcard six weeks after the third mailing.

Survey answers were coded and entered into Microsoft Excel. Missing data were excluded from the analysis. The data were analyzed at two levels using SAS [16]. The first level of analysis generated frequencies, while the second level evaluated the impacts of demographic factors. Significance ($P < 0.05$) to demographic factors was tested using a chi-square distribution [14]–[16]. Since similar response rates were observed in all six survey years, data analysis procedures were identical for each sampling.

4 RESULTS AND DISCUSSION

The survey methodology used in the study was not designed to be unique, but rather to be used as a tool to ascertain useful information. The survey methodology was designed to



access public attitudes and concerns about Columbia River Basin water quality, quantity and its priority human benefit over a 28-year time-period.

All six survey years achieved a survey return rate more than 50%. Fifty-one percent of the survey respondents were male. Over 40% of survey respondents lived in communities of more than 100,000 people. Conversely, 18% of respondents lived in towns with less than 7,000 people. Almost half of the survey respondents attended at least one year of college. The demographics of the survey respondents mirrored the 1990, 2000 and 2010 USA census data. Thus, the survey respondents were representative of the actual population living in the Pacific Northwest. Consequently, when coupled with the low sampling error of the survey, respondents can be equated to residents in the following discussion.

4.1 Water quality within the Columbia-Snake System

All survey residents of Idaho, Oregon and Washington were asked their opinion of surface water quality within the CSRW regardless of where they lived in the region (inside or outside of this watershed). In general, over 40% of respondents considered water quality to be good or excellent (Table 1). Conversely, between 9.1 and 22.2% considered surface water quality poor depending on survey year. Approximately 10% of the respondents had no opinion on the quality of surface water.

Table 1: Public views about the quality of surface waters (rivers) in the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Water quality	1988	1996	2002	2007	2012	2016
	%					
Excellent/good	46.2	44.2	47.0	50.1	55.3	58.3
Fair	21.4	24.2	20.1	18.6	19.7	20.3
Poor	20.4	22.2	21.6	15.7	10.3	9.1
No opinion	12.0	9.4	11.3	15.6	14.7	12.3

Table 2: The influence of the demographic factors of gender, time, age and education level on public views about the quality of surface waters (rivers) in the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Demographic factor	Parameter	Good/excellent (%)	Significance
Gender	Female	40.0	***
	Male	60.2	
Time	1988	46.2	**
	2002	47.0	
	2016	58.3	
Age	<30 years	37.6	***
	30–60 years	53.1	
	>60 years	62.1	
Education	<HS diploma	64.2	**
	HS diploma	49.2	
	College	50.3	



The demographic factors of gender, survey year, age and formal education level impacted how people viewed surface water quality in the watershed (Table 2). Males were twice as likely as females to give surface water quality a good or excellent quality rating. Water quality ratings changed over time – with quality ratings improving over this 28-year study period. 2016 survey respondents were significantly more likely to give surface water quality ratings of good or excellent (58.3%) than survey takers in 1988, 1996 and 2002. This 28-year change resulted in going from a majority of the public rating water quality from less than good to excellent in 1988 to a majority giving scores of good to excellent in 2016.

The age of survey respondent also impacted views on surface water quality (Table 2). Respondents younger than 30 years were less likely to give good or excellent water quality scores than older respondents. Respondents older than 60 years were most likely than other age groups to give good or excellent ratings. Formal education level also impacted views toward surface water quality. Respondents with high school diplomas or some college education were less likely to view surface water quality favorably than respondents who had not received high school diplomas.

4.2 Water Quantity within the Columbia-Snake System

Based on surveys conducted in the region between 1988 and 2016 at least 66% of the residents believed that the quantity of surface water in the CSRW was adequate or more than adequate (Table 3). Conversely, less than 25% of residents considered the quantity of surface water to be much less than adequate. The demographic factors of gender, survey year, age and education impacted how people viewed the water quantity issue in the region (Table 4). Males were more likely than females (79 vs. 66%) to consider the quantity of water in the system to be adequate or more than adequate.

Differences as a consequence of survey year were also significant. Survey respondents were more likely to consider water resources adequate in 1988 and 2002 than in 2016 (Table 4). The water needs within the region have grown since 1988 and people today are more likely to consider the water resources as not unlimited. The majority of the public still thinks that there are plenty of water resources within the region in 2016, but this number is substantially lower than the view just nine years ago.

Younger survey respondents (<30 years) were less likely to consider the region's water resources adequate than those in the 30–60 and >60-year age groups (Table 4). Many of the younger people surveyed were taught the importance of water conservation in schools and thus are more realistic about the region's limited water resources. Survey respondents with a college education were less likely to consider the amount of water resources adequate than people with less years of formal education (Table 4).

Table 3: Public views about the quantity of surface waters (rivers) in the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Water quality	1988	1996	2002	2007	2012	2016
	%					
More than adequate	60	58	57	52	53	49
Adequate	20	20	18	20	16	17
Less than adequate	7	7	9	9	13	18
Much less than adequate	2	2	4	3	5	6
No opinion	11	13	12	16	15	10



Table 4: The influence of the demographic factors of gender, time, age and education level on public views about the quantity of surface waters (rivers) in the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Demographic factor	Parameter	Good/excellent (%)	Significance
Gender	Female	66	***
	Male	79	
Time	1988	80	***
	2002	75	
	2016	63	
Age	<30 years	49	**
	30–60 years	72	
	>60 years	86	
Education	<HS diploma	86	***
	HS diploma	80	
	College	56	

Table 5: Local perception of the most important benefit of the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Most important benefit	1988	1994	2002	2007	2012	2016
	%					
Power production	59	60	62	58	56	53
Food/agriculture	17	20	16	19	20	23
Recreation	15	13	14	15	16	16
Transport/commerce	15	13	14	15	16	16
Drinking water	6	3	4	5	6	2
Fisheries	1	2	2	1	1	1
Biodiversity	1	0	0	0	0	1

4.3 Most important benefit of the Columbia-Snake Watershed

Over 50% of the respondents living in the CSRW cited power production as the main benefit of the system (Table 5). Watershed residents also often identified food/agriculture (from 16 to 23%) and recreation (from 13 to 16%) as the main benefit of the large watershed. Far fewer watershed residents listed transportation, drinking water, fisheries and biodiversity as the most important benefit provided by the river system.

Well over 60% of respondents living outside the CSRW, but within Idaho, Oregon and Washington identified power production as the most important benefit of the river system (Table 6). These residents also often identified drinking water (from 9 to 16%) and recreation

(from 11 to 16%) as the main benefit of the CSRW. Far fewer Idaho, Oregon and Washington residents living outside this watershed identified food/agriculture, fisheries, biodiversity and transportation/commerce as the most important benefit of this large watershed.

When people living in the CSRW were compared to people in Idaho, Oregon and Washington living outside the watershed differences about the most important benefit of the were observed (Table 7). First, people living outside the watershed were more likely to identify power generation as the most important benefit of the watershed (64 vs. 58%). Second, respondents outside the watershed were also more likely to identify drinking water source (13 vs. 4%) as the most important benefit of the Columbia-Snake watershed. Conversely, residents of the Columbia-Snake watershed were more likely than non-watershed residents (19 vs. 5%) to identify food/agriculture as the most important watershed benefit.

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Table 6: Perceptions of people living in the Pacific Northwest – but outside the Columbia-Snake River Watershed of the most important benefit of the Columbia-Snake River System based on 1988, 1994, 2002, 2007, 2012 and 2016 surveys.

Most important benefit	1988	1994	2002	2007	2012	2016
	%					
Power production	62	62	63	66	66	64
Drinking water	9	10	16	14	15	16
Recreation	16	14	14	12	11	12
Food/agriculture	6	8	5	6	2	4
Fisheries	3	4	2	2	0	0
Biodiversity	2	1	0	0	1	2
Fisheries	3	4	2	2	0	0
Transport/commerce	1	1	0	0	1	0

Table 7: Comparing survey respondents inside and outside the Columbia-Snake River Watershed on their view of the most important benefit provided by the watershed. Data from all six survey years are combined (1988, 1994, 2002, 2007, 2012 and 2016).

Most important benefit	Comparing		Significance
	Inside CSRW	Outside CSRW	
	% citing as most important		
Power generation	58	64	**
Recreation	15	13	NS
Drinking water	4	13	***
Food/agriculture	19	5	***
Transport/commerce	2	0.5	**
Fisheries	1	3	*
Biodiversity	<0.1	1	**



People in and outside the Columbia-Snake river watershed saw the benefit of recreation similarly. Although the numbers were low residents of the CSRW were more likely than non-residents to say that transportation/commerce was the number one benefit of the watershed. Conversely, residents of the Pacific Northwest living outside the Columbia-Snake river watershed were more likely to say that fisheries (3 vs. 1%) and biodiversity (1 vs. 0.1%) were the most important benefit of the large watershed system.

The next major comparison was between urban people living within the Columbia-Snake River Watershed with urban people in Idaho, Oregon and Washington residing outside the watershed. In this comparison, a person was identified as an urban resident if they lived in a community of more than 20,000 people. The urban public living outside the Columbia-Snake watershed were more likely to cite power generation (64 vs. 58%) and drinking water (16 vs. 2%) than their urban counterparts living within the watershed (data not shown).

When survey respondents living inside the CSRW are divided into urban and rural residents, three interesting observations can be made (Table 8). First, urban residents in the watershed are more likely to identify power generation (58 vs. 47%) as the most important benefit of the river system. Second, rural residents were more likely to identify food/agriculture (26 vs. 18%) or recreation (18 vs. 14%) as the most important benefit provided by the watershed. Third, urban and rural residents viewed drinking water, transportation/commerce, fisheries and biodiversity low, but similarly as to their likelihood to be the most important benefit of the Columbia-Snake river system.

Although most people in the western USA view the CSRW as primarily rural in character, there are over 49 cities in this watershed with more than 20,000 residents. This includes 11 cities in Idaho, 12 cities in Washington and 26 cities in Oregon. In fact, the watershed's urban population is more than five times larger than the rural population (people living in places with less than 20,000 people). Although urban residents dominate the watershed, their views on the value of benefits provided by the overall watershed are in-line with their rural counterparts. For instance, urban residents of the watershed see the importance of food/agriculture to a much greater extent than Pacific Northwest urban resident living outside the watershed boundaries.

5 CONCLUSIONS AND RECOMMENDATIONS

Residents of Idaho, Oregon and Washington appreciate quality and quantity of water provided by the Columbia-Snake River Watershed. This water source has both direct and

Table 8: Comparing answer of urban and rural survey respondents living in the Columbia-Snake River Watershed on their view of the most important benefit provided by the watershed. Data from all six survey years are combined (1988, 1994, 2002, 2007, 2012 and 2016).

Most important benefit	Comparing		Significance
	Urban residents	Rural residents	
	% citing as most important		
Power generation	58	47	**
Recreation	14	18	*
Drinking water	2	2	NS
Food/agriculture	18	26	**
Transport/commerce	4	5	NS
Fisheries	2	1	NS
Biodiversity	2	1	NS

indirect positive impacts on all residents of this region. One of the most important findings of this set of six surveys conducted over a 28-year period is the consistency of public answers about water quantity, water quality and the important benefits of this river system. Key findings of this study include:

- The perception of water quality in the Columbia-Snake River System improved over the 28-year study period. Over 58% of the public rated water quality as good or excellent in 2016 compared to 48% in 1988.
- Most survey respondents considered water quantity in the region adequate or more than adequate in all six survey years; however, this percentage has slipped from 80% in 1988 to 66% in 2016.
- Men were more likely to say that water quality was good or excellent and that water quantity was adequate or more than adequate than women.
- Survey respondents older than 60 years were more likely to give water quality and water quantity higher grades than respondents younger than 30 years.
- College educated respondents were more concerned about water quantity issues in the Columbia-Snake watershed than people with less formal education.
- Surveys conducted over this 28-year period showed that most people in Idaho, Oregon and Washington consider power production to be the main benefit provided by the Columbia-Snake River Watershed.
- Respondents living outside the Columbia-Snake River Watershed have consistently seen drinking water and recreation as important benefits of the watershed, while watershed residents view food/agriculture and recreation as the second and third most important benefits of the system.

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