

The Case for Ecoregion Rather than Regional Extension Water Education

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ABSTRACT In 2000 the National Water Quality program (USDA-CSREES) was refocused to provide water resources education to citizens on a regional basis. The Pacific Northwest—consisting of Alaska, Idaho, Oregon, and Washington—comprises one of these regions. Even though the Pacific Northwest appears to be a relatively homogeneous region, there are large internal differences in climate, demographics (urban vs. rural), natural resources, and agriculture within the region. The purpose of this study is to evaluate splitting the region into three sub-ecoregions and then targeting unique programming to clientele to better meet citizen educational needs. Zip code data was used to separate responses from a comprehensive regional needs assessment survey on water resources into three eco-regions. The data were then analyzed using SAS and chi-square analysis to compare water resource issue differences within the Pacific Northwest. Residents of the wetter Ecoregion (I) were more concerned with endangered species and less concerned with water quantity issues than residents of the drier Ecoregion II. Residents of Ecoregion II were more likely to need educational programming on irrigated agriculture and yard water use. Based on the data, dividing the region into three ecoregions for extension programming makes sense and could result in efficiencies of existing human resources.

Natural resource education has been a component of extension programs at the federal, state, and local levels for over 50 years. Extension water programs have effectively dealt with range (Larson et al., 2005) and animal issues (Hudson and Harrison, 2006). Extension programs have also effectively worked with many varied agricultural (Bridges, 2008; Sessoms et al., 2008) and conservation programs (Hoag et al., 1988; Krafts et al., 1996; Herendeen and Glazier, 2009). In particular, water quality has been a priority issue for extension since 1990. At that time, then President George H. Bush created a national Water Quality Initiative (WQI) within the USDA (Shepard, 2002). This initiative stressed solving water quality problems on a watershed scale through cooperation with other federal and state agencies. This initiative eventually resulted in formula funding passed through to land-grant institutions under the authority of the Smith-Lever Act (3d funds).

In 2000, the national water quality program was refocused to emphasize regional, rather than state-by-state education of adult clientele. At this time formula funds were changed to competitive funds and states formed into regions to compete for these dollars. Eventually, 10 distinct geographic regions consisting of multiple states were formed. The water quality emphasis evolved

into water availability to include water quantity issues. These 10 regions together with USDA-CSREES formed the National Water Program. The primary goal of the National Water Program is to protect or improve water resources throughout the United States, particularly in agricultural, rural, and urbanizing watersheds (Boellstorff and Addy, 2008). This program has been guided by a shared leadership model that includes representatives from each of the 10 regions, representatives from 1890 and 1994 land-grant institutions and the USDA-CSREES national program leader for water resources (Boellstorff, 2007). The National Water Program working through the 10 regions provides educational programming in the following thematic areas: (1) animal waste management, (2) nutrient and pesticide management, (3) drinking water and human health, (4) pollution assessment and prevention, (5) agricultural water conservation and management, (6) environmental restoration, (7) watershed management, (8) water policy and economics, and (9) climate change. This regional-federal partnership is now 10 years old and has resulted in many significant positive impacts to water resources and citizens across the United States (Boellstorff, 2006, 2007; Boellstorff and Addy, 2008).

One of these 10 regions is known as the Pacific Northwest and consists of the states of Alaska, Idaho, Oregon, and Washington. This region consists of 288.3 million ha or 26% of the United States' land area. Approximately 12 million people live in this region. Educators and scientists from the region's five land-grant institutions (Northwest Indian College, Oregon State University, University of Alaska, University of Idaho, and Washington State University) comprise the regional team. Regional programming has allowed institutions to effectively share human resources and more efficiently deliver programs in the nine water resource thematic areas. Administrators, educators, advisory com-

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Table 1. General geographic and demographic characteristics of the three ecoregions in the four Pacific Northwest states of Alaska, Idaho, Oregon and Washington.

Population	Description	Rainfall	Temperature regime
cm			
ECOREGION I			
9.2 million	Western Washington Western Oregon Southeast Alaska	90 to 500	Cool, wet winters; mild summers
ECOREGION II			
3 million	Idaho Eastern Washington Eastern Oregon	20 to 90	Cool or cold winters; hot, dry summers
ECOREGION III			
450,000	Alaska (except SE)	<100	Cold winters; short cool summers

mittees, partners and the public appear to be satisfied with this regional programming model; however, the Pacific Northwest Region Water Resources team believes that this model can be modified to be even more effective.

Even though the Pacific Northwest appears to be a relatively homogeneous region, there are large internal differences in climate, demographics (urban vs. rural), natural resources, and agriculture within the region. Consequently, the purpose of this study is to evaluate splitting the region into three sub-ecoregions and then targeting unique programming within ecoregions to clientele to better meet citizen needs. This article will evaluate results from a comprehensive regional citizen survey conducted in 2007 to determine the feasibility of this action.

Materials and Methods

The Pacific Northwest Region was divided into three ecoregions for this study (Fig. 1; Table 1). Ecoregion I consists of Washington and Oregon west of the Cascade Mountain Crest and southeastern Alaska. Approximately 8 million people live in this wet ecoregion that is character-

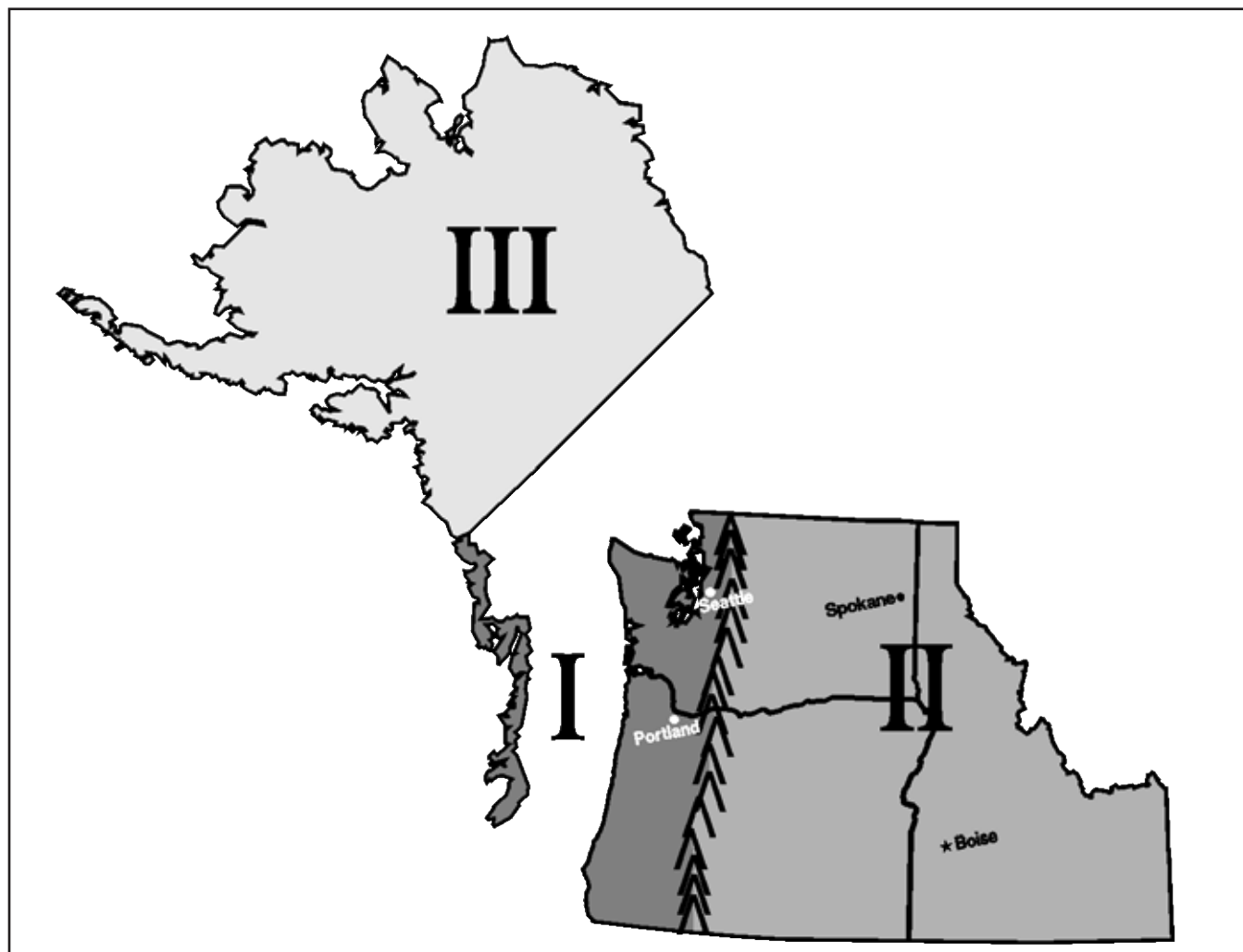


Fig. 1. Proposed ecoregion map of the four Pacific Northwest state.

ized by relatively high annual precipitation (>87 cm), cool, wet winters, and mild summers. Ecoregion II consists of the entire state of Idaho and Washington and Oregon east of the Cascade Mountain Crest. This ecoregion is relatively dry as annual precipitation ranges from 20 to 75 cm in the more densely population portions of this ecoregion. Approximately 3 million people call this region, which has cool or cold winters and hot, dry summers, home. Alaska, excluding the southeastern panhandle, is Ecoregion III. The climate here consists of relatively low precipitation, cold winters and short, cool summers.

A 48-question survey was developed to assess public attitudes and actions taken to address water resource issues in the Pacific Northwest in 2007. 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. A target of 900 completed questionnaires was chosen as the survey goal to result in a sampling error of 4 to 6% (Salant and Dillman, 1994). The survey process was designed to receive a completed survey return rate in excess of 50%. Consequently, 1800 surveys were sent to residents of Alaska, Idaho, Oregon, and Washington on a proportional population basis. Addresses were obtained from a professional social sciences survey company (SSI, Norwich, CT).

Four mailings were used to achieve the 50% return rate (Dillman, 2000). The mailing strategy used was identical to that of a similar survey conducted in the region in 2002 (Mahler et al., 2004). 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 (SAS Institute, 2004). The first level of analysis

Table 2. The effect of ecoregion on the likelihood of Pacific Northwest residents ranking the following water-related issues as very or extremely important.

Water issue	Ecoregion I	Ecoregion II	Significance I ≠ II
	(wet)	(dry)	
	%		
Drinking water	98.8	99.3	0.1278
Clean rivers	93.0	93.6	0.3268
Clean groundwater	92.3	95.7	0.5282
Water for agriculture	72.2	87.0	0.0011**
Water for salmon	80.9	55.3	0.000**
Wetlands	73.8	68.1	0.1469
Watershed restoration	74.8	71.0	0.9348
Power generation	70.0	74.2	0.2724
Water for economic development	63.5	67.0	0.1290
Water for recreation	49.8	42.6	0.0966
Water for landscapes	25.2	40.4	0.008**
Runoff from home landscapes	26.7	15.5	0.0234*

* Significant at the 0.05 probability level.

** Significant at the 0.01 probability level.

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 (Babbie, 1983). The general results of the 2007 regional survey are published elsewhere (Mahler et al., 2010).

In addition to the demographic data described above zip codes were also collected from all survey respondents. The zip code data was used to place each respondent into one of the three ecoregions in the Pacific Northwest. After this was done, SAS was then again used to analyze the data and significance as a consequence of ecoregion was tested using a chi-square distribution.

Results and Discussion

Zip codes were self-identified by 860 of 972 survey respondents. Based on zip codes, the survey returns were 602, 204, and 54 from Ecoregions I, II, and III, respectively. The number of survey returns from Ecoregion III was too few for statistical comparisons to be made with Ecoregions II and I. Consequently, all comparisons in this article are made between Ecoregions II and I.

Priority Water Issues

Survey respondents were asked to identify 12 different water issues as extremely important, very important, somewhat important, or not important (or having no opinion) to them. When the extremely important and very important responses are added together it is evident that residents of Ecoregions II and I have similar importance indices for eight of 12 water issues (Table 2). For these eight items regional extension programming would make sense. However, differences in the importance of water for salmon (*Oncorhynchus* spp.) ($P = 0.0001$), water for agriculture ($P = 0.0011$), water for landscapes ($P = 0.0081$), and runoff from landscapes ($P = 0.0234$) were related to ecoregion residence.

Residents of Ecoregion II placed more value on agriculture (87 vs. 72%), and water for landscapes (40 vs. 25%) than residents of Ecoregion I. Conversely, runoff from home landscapes (27 vs. 16%), and water for salmon (81 vs. 55%) were more important in Ecoregion I. Most of the observed differences make sense. Ecoregion II is drier and contains over 3 million ha of irrigated farmland, whereas irrigation (water for agriculture) is much less important in Ecoregion I because of abundant precipitation. Thus regional programming on agricultural water use, conservation, and irrigation techniques and efficiencies would be appropriate in Ecoregion II, but not widely used by clientele in Ecoregion I. Based on responses shown in Table 2, Ecoregion II citizens would also place greater value on programs about water in landscape plants because of lower precipitation.

On the other hand, programs dealing with endangered species (salmon), and runoff from home landscapes would be more appropriate and better received in Ecoregion I. Even though Pacific Northwest citizens have similar views on the importance of 8 of 12 water issues, differences in responses to 4 issues make ecoregional programming more appropriate than simple regional programming solutions.

Table 3. The effect of ecoregion on the tendency of Pacific Northwest residents to water a portion of their yard in the summer.

Citizen action	Ecoregion I	Ecoregion II	Significance I ≠ II
	(wet)	(dry)	
	%		
Water yard in summer	73.7	99.0	0.0001**
Water lawns	48.9	91.8	0.0001**
Water gardens	48.0	68.0	0.0005**
Water landscaping	40.4	61.9	0.0002**

* Significant at the 0.05 probability level.
 ** Significant at the 0.01 probability level.

Home Landscapes

Almost 99% of people living in the dry ecoregion (II) reported that they water at least some portion of their yard in the summer (Table 3). Conversely, only 73.7% of Ecoregion I residents use supplemental water in their yards during the summer. Residents of Ecoregion II were more likely to water lawns (91.8 vs. 48.9%), gardens (68.0 vs. 48.0%), and their landscaping (61.9 vs. 40.4%) than people living in the wet ecoregion (I). Extension programming addressing water lawns, gardens, and landscaping would be more appropriate for Ecoregion II. In addition, watering strategies for the yard ecosystem would be much different between ecosystems.

Even though residents of Ecoregion II were less likely to reduce summer lawn watering, they were more likely to implement other water conserving BMPs (best management practices) to conserve water use in lawn watering (Table 4). For instance 83.5% of drier ecoregion (II) residents confined their lawn watering to the early morning or evening hours (Table 4). This conservation practice was more widely used in Ecosystem II than I (84 vs. 66.4%). Residents of the drier ecoregion were also more likely to use the water conservation practices of drip irrigation for shrubs (41.2 vs. 18.8%), and use timers on sprinkler systems (59.8 vs. 23.3%). Based on the survey data, although residents of the drier ecoregion are more likely to water their lawns during the summer, they have adapted conservation practices to address water quantity issues in their region

Table 4. The effect of ecoregion on the tendency of Pacific Northwest residents to use conservation practices in their yard in the summer.

Citizen action	Ecoregion I	Ecoregion II	Significance I ≠ II
	(wet)	(dry)	
	%		
Less lawn watering	63.3	39.2	0.0001**
Earlier morning or evening watering	66.4	83.5	0.0012*
Drip irrigation, shrubs	18.8	41.2	0.0001**
Timers on sprinklers	23.3	59.8	0.0001**

* Significant at the 0.05 probability level.
 ** Significant at the 0.01 probability level.

through individual actions in their yards. These practices have been largely implemented over the last several years on a one-yard-at-a-time basis. Clearly, extension programs should focus on continuing to conserve water in individual yards in Ecoregion II, whereas in Ecoregion I education programs should introduce the water conservation concept to clientele. It will be some time until the urban public in Ecoregion I will have the willingness to expend monetary resources for water conservation (i.e., timers on sprinklers) in individual yards because of the illusion that there are plenty of water resources to go around.

Drinking Water

Approximately 89 and 71% of Ecoregion I and Ecoregion II residents obtain their drinking water from municipal/community water systems ($P = 0.006$). Conversely, almost 30% of Ecosystem II residents rely on private wells to supply drinking water. As would be expected, Ecoregion II residents are more than twice as likely (22 vs. 8%; $P = 0.001$) to have had their home drinking water sources tested for pathogens and inorganic chemicals. These differences indicate that potential extension programs on well-head protection and water testing would have significant audiences in Ecoregion II, but probably in only the most rural areas of Ecoregion I.

Water Information Sources

Based on the 2007 regional survey 65, 56, 51, 47, 41, 25, 20, and 18% of Pacific Northwest residents reported receiving water resource information from newspapers, television, municipal governments, environmental agencies, environmental nongovernmental organizations (NGOs), extension, the internet, and schools (K-12), respectively (Mahler et al., 2010). Ecoregion did not affect the frequency of receiving water resource information from newspapers, television, municipal governments, extension, the internet, and schools (K-12) (Table 5). However, Ecoregion II residents were less likely to obtain water resource information from environmental agencies, environmental NGOs, and the internet than people residing in Ecoregion I.

Table 5. The effect of ecoregion on the tendency of Pacific Northwest residents to receive water resource information from the following sources.

Water information source	Ecoregion I	Ecoregion II	Significance I ≠ II
	(wet)	(dry)	
	%		
Television	57.1	60.4	0.56
Newspapers	65.7	62.6	0.60
Internet	23.4	13.4	0.05*
Extension	17.7	21.7	0.42
Schools (K-12)	24.9	17.5	0.17
Environmental agencies	54.5	41.6	0.03*
Environmental groups	44.6	28.2	0.007**
Municipal government	55.0	45.5	0.12

* Significant at the 0.05 probability level.
 ** Significant at the 0.01 probability level.

These data would suggest that extension programs would be better received via the internet in Ecoregion I. In addition, government agencies and NGOs trying to dispense water information would also have a more effective reach in Ecoregion I. Educators working in Ecoregion II would tend to do better with traditional methods (television, newspapers, and extension meetings) of water resource information dispersal. These observations are likely to change over time as people obtain better access to existing technologies or as new technologies are developed and become mainstream.

Strategic Planning

Even though residents of Alaska, Idaho, Oregon, and Washington have many attitudes in common about water resource issues, the presented ecoregion data suggest that subregional differences about resource use, attitudes, and needs exist. A regional strategic planning exercise might consider the proposed ecoregion educational model to have merit and to be superior to the regional education model initiated and encouraged by USDA-CSREES in 2000. However, it is more likely that a hybrid model developed using a mix of the ecoregion and regional education models would work best in many areas of the United States.

Either model (regional or ecoregion) has cost advantages in the short and long terms. Most land-grant institution administrators in general, and extension administrators in particular, fail to see the financial writing on the wall. Based on tight state budgets including cutbacks today, the rapid increase in projected state health and welfare needs over the next decade, and projected slower state revenue growth over the long-term compared with the 1990s, it is likely that extension human resources will contract by at least 35% over the next 15 years. Land-grant institutions in the Pacific Northwest should take advantage of this ecoregion educational model at the specialist level. Assuming that extension chooses to deliver educational programming in six of nine national water resource programming areas because of limited resources, an Ecoregion II educational model would require six educational specialists (animal waste management, nutrients and pesticides, agriculture water use, watershed management, environmental restoration, and drinking water and human health). Since Ecoregion II covers all or parts of three states, each land-grant institution (Washington State University, Oregon State University, and University of Idaho) would need to contribute two specialists. The specialists for each of the six programming areas would develop programs and support county faculty in all three states within Ecoregion II.

Likewise, a similar model in Ecoregion I (assuming six programming areas) would also require six specialists—two contributed by each of the land-grant institutions (Oregon State University, Washington State University, and University of Alaska) in Ecoregion I. The net need based on an ecoregion model for Zones I and II would be 12 specialists—four each from Washington State University and Oregon State University, and two each from the University of Idaho and the University of Alaska. This would use existing financial resources more effectively and greatly increase cooperation between states. The six programming

areas in Ecoregion I would probably differ from Ecoregion II. For example, a water use specialist would be needed in Ecoregion II because large areas of irrigated farmland are found there. Conversely, urban water programs would be of higher priority in the more urban Ecoregion I. Although not covered in this article, Ecoregion III (central Alaska) would probably require two general specialists (watershed management and pollution prevention).

The data shown in Table 2 could also be used to help prioritize extension programming in water resources, because in reality there are not enough resources to program in all nine water areas. For instance, water use in agriculture is not a high priority in Ecoregion I (Table 2); however, there is a strong demand here for urban water resource programs. Conversely, needs in agriculture water management in Ecoregion II are prioritized by both educators and the public.

Conclusions

From an educational standpoint, programming on an ecoregion basis would appear to be superior to a four-state regional water resources educational model. By itself, the current regional educational model for water resources is superior to the traditional state-by-state model. The current regional model allows states to share resources more effectively during a time when fewer human educational resources are available. In the last 20 years the five land-grant institutions in the four Pacific Northwest states have lost at least 15 educational water resource positions. The successful introduction of the regional model in 2000 has at least in part compensated for this loss. It is reasonable to believe that budgets will continue to get tighter over the next decade. A further sharing of limited human resources using a concept such as the ecoregion model may be very important in offsetting future budget reductions.

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