The Water Center's
Watershed Review
information on water and watersheds

Volume 4 Number 1 **http://depts.washington.edu/cwws**

Director's message

Anne C. Steinemann

Exciting things are happening at the Center! We have many new research projects, educational opportunities, and outreach activities. We are tackling problems and developing solutions on critical issues, such as the effects of climate change on water resources, the sources of emerging contaminants in urban watersheds, the impacts of droughts and floods, the need for water treatment and sanitation in developing countries, and the value of climate and hydrologic forecasts to improve operations. Please visit our website for more details on these and other activities.

We are proud to feature work in this issue from our Center students: Matthew Fontaine reports on drought in Washington State, Eija Vinnari shares findings on water utilities and regulation, and Greer Anderson examines Columbian River estuarine impacts on food webs supporting juvenile salmon in this portion of the river.

It was wonderful to see so many of you at our Annual Review and at our other events. Thank you for your continued support of The Water Center. ♦

In this issue

The economic regulation of publicly owned water utilities: The case of Finland

In the wake of the global privatization boom of the 1990's, the question of privatizing public water supply and sewage (WSS) services became a matter of discussion and research in Finland. The development was noted in the drafting of new legislation, which expressly does not prohibit a municipality from outsourcing the operations or selling the assets of its WSS undertaking to a private company. Currently, practically all of the assets of the Finnish WSS undertakings are owned by the municipalities. However, increased emphasis on the profitability of operations and the possibility of completely privatizing municipal WSS undertakings has raised discussion of the extent to which the economic activities and performance of the water and wastewater utilities should be regulated.

The current system of economic regulation of WSS utilities in Finland is rather passive and narrow in scope, concerning only the magnitude of customer charges. According to the European Union and national legislation, the charges should be designed so that they cover the operating expenditures and investments of the undertakings in the long run. In addition, they are also allowed to include a "reasonable rate of return" for the capital investment of the owner municipality. However, no specific definition has been provided for the term "reasonable," which in reality has led to various practices across the country. The customer charges are supervised on an ad-hoc basis by the Finnish Competition Authority, mostly as a result of customer complaints.

This research set out to determine whether Finnish WSS utility managers believe there is a need to reform the current system of economic

Continued on page 2

*This article, by **Eija M. Vinnari**, MSc (Economics), MSc (Engineering), summarizes a forthcoming article in the Utilities Policy journal (Elsevier). Ms. Vinnari is a Research Scientist at the Institute of Environmental Engineering and Biotechnology, Tampere University of Technology, Tampere, Finland.*

Ms. Vinnari was a Water Center student from September 2005 to March 2006, funded by the Valle Scholarship and Scandinavian Exchange Program (see Note, page 2).

She wishes to thank Professor Anne C. Steinemann, Water Center Director, and Adjunct Professors Tapio Katko and Jarmo Hukka, from the Institute of Environmental Engineering and Biotechnology, Tampere University of Technology, Finland, for their invaluable comments.

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Continued from page 1

regulation, and to outline options for arranging regulation in the future. Surprisingly, the majority of the utility managers interviewed for this research were in favor of increasing regulation, which is usually something that business units try to avoid. The research results indicate two main reasons for the respondents' views: Firstly, it was regarded as unfair to make WSS utility customers pay several times for the same infrastructure. This can be considered a form of hidden taxation that is inconsistent with the principle of open and transparent democratic decision-making. According to this principle, citizens are entitled to know which functions their money supports and to be able to challenge those if necessary. Secondly, the obligation to provide returns for the municipality leaves some of the utilities without enough funds for infrastructure rehabilitation. If allowed to persist, postponing essential infrastructure investments may lead to water main leaks or breaks, thus decreasing the quality of service and, especially in the case of wastewater, posing a threat to public and environmental health. Also, the accumulated damage will result in the eventual repair and rehabilitation costs being higher than if the repairs had been made on time.

Solutions to the situation depend on the future dominating form of ownership of the WSS undertakings. If privatization of the utilities is considered likely to take place in the future, the degree and scope of regulation and the identity of the regulator would need to be carefully weighed in light of all of the potential costs and benefits. In the case of continued public ownership, it would be useful to study the feasibility of a less rigid system, organized by an interest organization concerned with the WSS sector, based on self-assessment, peer-reviews, and benchmarking. Compared to more official approaches, self-regulation of this type is likely to be more flexible, cost-effective, efficient, and better targeted due to the expertise of the interest organization. ♦

Note: Henrik Valle, a Northwest civil engineer and native of Norway, established the Valle Scholarship and Scandinavian Exchange Program. It has a dual mission: (1) To promote and fund the exchange of graduate students between the University of Washington and programs in the Nordic countries; (2) To support outstanding graduate students in Civil and Environmental Engineering and Architecture and Urban Planning. More information about the Valle Program is available at: http://www.engr.washington.edu/valle/

Snapshots of current research

Changes in the Columbia River and their consequences for food webs supporting juvenile salmon in the estuary

Greer Anderson, Aquatic and Fishery Sciences (MS)

Major recovery efforts have been enacted to restore diminishing salmon (Oncorhynchus spp.) populations in the Columbia River. Through habitat loss and other changes, salmon production in the Columbia River has been reduced to 12% of historic levels with 12 salmon stocks listed under the Endangered Species Act. We are studying the effects of flow regulation and habitat alteration on the estuarine portion of the river, which extends from Bonneville Dam to the mouth of the river at Astoria, Oregon. This area has been widely understudied yet represents what is thought to be a critical aspect of salmon recovery. In this area, urban and industrial watershed development has led to widespread loss of wetland habitat and significant losses in total estuarine area. These changes have affected the base of the food web, causing a shift from a system based primarily on marsh plant production to one dependent on phytoplankton produced primarily in dam- impoundment reservoirs. The impact of this change has had unknown consequences on the ability of the estuary to support various populations of salmon and could threaten the resilience and productivity of many Columbia River salmon species.

We are investigating contemporary food web pathways supporting juvenile salmon in the Columbia through stable isotope analysis using carbon (δ13C), nitrogen (δ15N), and sulfur (δ34S). This method

Continued on page 3

Greer is towing for zooplankton for isotope analysis to determine food web pathways in the Columbia River estuary.

Continued from page 2

uses a ratio of the rare, heavy isotope (e. g. 13C, 15N, 34S) to the more common, lighter isotope (e.g. 12C, 14N, 32S). This ratio is produced in primary producers, such as plants or algae, and passed up the food chain to consumers, allowing us to trace both the fate of organic matter and the ultimate source of energy for a food web. In this manner we are able to contrast the importance of phytoplankton, produced upriver in dam impoundments, to that of naturally produced vascular plants, diatoms, and algae in the diets of juvenile salmon. We have also been able to identify the origin, either hatchery or wild, and migration patterns of individual fish.

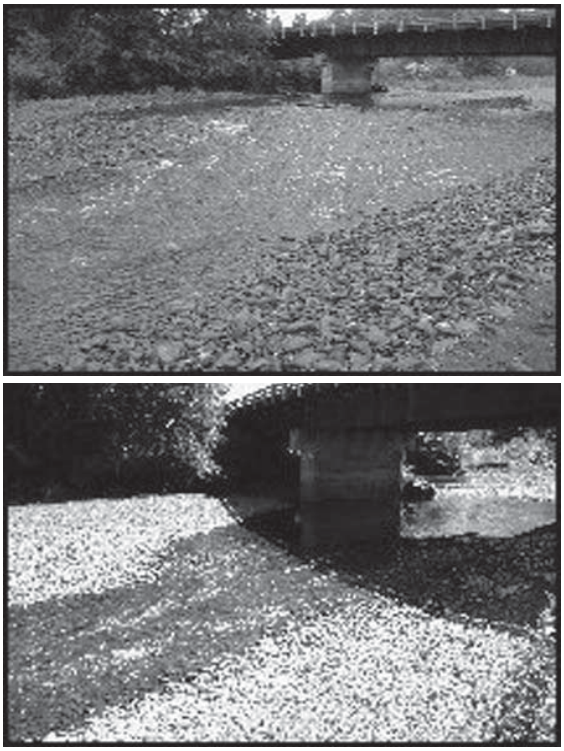
Our results indicate that a majority of the fish caught in the estuary are of hatchery origin (91%). Fish migrating through the estuary utilize a variety of different migration patterns, choosing from a variety of different habitats for lengths of time from days to months. Interestingly we found that although phytoplankton sustains a large part of the food web, small, wild-type Chinook are strongly linked to marsh plant production. The consequences of this apparent shift in the base of the food web over the past 150 years has had unknown consequences to juvenile survival, but may affect the stability of the food web and the overall ability of the estuary to support some life history types of salmon. In combination with coordinated studies of juvenile salmon habitat use in the Columbia River estuary, this work will be used in restoration scenarios that predict the impacts of flow management and habitat restoration on the ability of the estuary to support juvenile salmon. As the majority of river systems now have some form of flow regulation, this study is pertinent to organizing activities aimed at maintaining the ecological integrity of our river systems. ♦

Droughts and water shortages: Assessing economic impacts and reducing vulnerability

Matthew Fontaine, Civil and Environmental Engineering (MS)

Recently, drought has had severe impacts throughout Washington State. These impacts are expected to increase, as demands increase for limited and uncertain water supplies. In the wake of the state-declared 2005 drought, we are conducting a comprehensive study of drought and water shortages in Washington State, funded by the Washington Department of Community Trade and Economic Development (CTED).

In this study, we (a) analyze impacts from recent droughts, (b) identify the most vulnerable areas and sectors, (c) develop indicators to monitor and forecast drought conditions, and (d) determine ways to reduce drought vulnerability and impacts in the future. Research methods include data analysis, interviews, and meetings with water officials and stakeholders throughout the state. To date, we have conducted interviews with more than 60 representatives of the agriculture, municipal water supply, environment, power, and recreation sectors in the state. We targeted representatives who had known difficulties with water shortages and droughts, and ask them a range of questions, such as how droughts have affected them in the past, what lessons they have learned in dealing with droughts, and what information and resources could improve their ability to respond to droughts in the future.



Above: August 2004, Dungeness River at Woodcock Road Bridge in Clallam County. Below: August 2005, same location at about the same time. (WDFW Photos)

Results indicate that impacts of drought have been severe for water users with junior water rights (especially those that grow perennial crops); dryland farmers; growers, wholesalers, and retailers of landscape plants; fisheries in watersheds with large quantities of summer extraction; hydropower generators; and ski area operators. Interviewees from these sectors reported reduced crop quality, reduced crop yield, reduced sales of landscape plants, increased mortality of adult and juvenile fish, reduced power generation, and reduced ski area visits. Economic losses were

Continued on page 4

Continued from page 3

reported to range from hundreds of thousands to hundreds of millions of dollars during drought years.

Many interviewees were also able to identify lessons learned from dealing with past droughts, and strategies for dealing with future droughts. Their recommendations included designing robust and efficient irrigation systems; basing seasonal hiring decisions on good forecast information; focusing drought education on individuals and small groups facing specific challenges rather than large general sessions; organizing essential drought resources before drought occurs; diversifying crops to reduce drought vulnerability; using extra reservoir storage to provide water for environmental needs; balancing the water needs of agriculture with those of the environment to benefit both sectors; and declaring drought on a state level to enable the activation of emergency services, sharing of drought costs, and drilling of new emergency wells.

Interviewees also identified ways to reduce drought impacts more effectively, such as improved mid range and long range forecasts of timing and quantity of precipitation, better nowcasts (descriptions of current conditions) of soil moisture and evapotranspiration, education programs for water users, regionally specific drought monitoring and planning tools, multi-benefit storage projects, and a more streamlined water transfer system. The results of this study are intended to help decision makers to take early actions to reduce drought impacts, to allocate resources most effectively, and to improve drought preparedness and response in the future. ♦

Congratulations to the winners of The Water Center's 2006 Annual Review of Research Awards:

Best student presentation:
Todd Seamons, Aquatic and Fishery Sciences

Best student rehearsal presentation:
Scott Stolnack, Aquatic and Fishery Sciences

Best student posters:

First place: Stephanie Kampf, Civil and Environmental Engineering

Second place: Greer Anderson, Aquatic and Fishery Sciences

Third place: Jennifer Adam, Civil and Environmental Engineering

The high quality and professionalism of all student presentations and posters were greatly appreciated.

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