

POSTER SESSION:  
*Advances at the Interface between Water Science  
and Water Policy*

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Water for a Sustainable and Secure Future

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ALBIETZ, JESSICA, T.M. CRONIN, G.L. WINGARD and D.A. WILLARD. U.S. Geological Survey. **Salinity Changes in Biscayne Bay, Florida: Human and Natural Influences.**

**Abstract:** During the 20th century, rapid urbanization and the alteration of natural freshwater flow patterns across southern Florida changed the adjacent Biscayne Bay ecosystems. Before any restoration goals can be set by the Biscayne Bay Coastal Wetlands Project of the Comprehensive Everglades Restoration Plan (CERP), it is necessary to examine the patterns of temporal change in salinity, water quality, vegetation and benthic fauna in Biscayne Bay and the nearby wetlands during the last 100-500 years and establish the range of natural and anthropogenic impact on ecosystems. We applied paleoecological and geochemical analyses to radiometrically-dated sediment cores collected throughout the Bay, and determined that the salinity of central Biscayne Bay has become increasingly marine and stable over the last 100 years. In southern Biscayne Bay, we found that while Card Bank has experienced comparatively large swings in salinity over multi-decadal and centennial timescales, marine influence has increased over the last century. These results suggest that natural variability in climate and rainfall have influenced corresponding changes in the salinity of Biscayne Bay; continuing studies are being conducted to document the impact of 20th century water diversion on the pattern of natural variability.

ALLENDER-HAGEDORN, SUSAN and CHARLES HAGEDORN. Virginia Polytechnic Institute and State University. **Bridging the Gap Between Water Quality Science and Policy: Environmental Detection News.**

**Abstract:** Environmental Detection News is a new, refereed international newsletter which fills a vital niche located between the scientific community working in water quality and the public. The newsletter started as a vehicle to interpret and facilitate a developing technology, microbial source tracking, among the public, scientists, regulatory communities, and policy makers. (Microbial source tracking is one of the most promising new technologies analyzing the causes of non-point source pollution.) Finishing Volume 1 (5 issues) at the end of 2003, the newsletter also plans to move into the bio- and agroterrorism arena where the concerns of all of these water quality stakeholders intersect. Authors come from all sectors of interest in water quality; their articles and editorials range from a local ("Development of a Bacterial Source Tracking Program at a Small Liberal Arts College") to a global perspective ("Faecal Source Tracking in the UK: A European Perspective"). This poster will summarize the content of the first volume and relate the problems encountered by an interface between diverse communities with differing agendas united by a common goal--safe water.

BRIGGS, CHAD. California State University. **Science and Administrative Capacity in Water Regulation: a Case Study of Hungary.**

**Abstract:** New regulations for water quality and treatment are now being adopted by countries soon to join the European Union in October 2004. Although these regulations and directives are meant to increase environmental quality, substantial questions remain as to whether East-Central European states possess the necessary resources to

implement EU directives. Of particular concern is the ability of states to monitor effectively environmental quality in their region, or to enforce standards once they are put into place. The models of environmental sustainability adopted by the European Union are not necessarily the most applicable to environmental, geographic and economic conditions present in Eastern Europe. Adoption of such standards into unique contexts may actually prove to be counter-productive absent necessary scientific and administrative resources within new member states. This paper presents a background of the related issues, and uses the case study of water policies in Hungary to highlight the difficulties posed to new EU member states by the accession process.

BROWN, LESLEY and LIZA AGUDELO. University of Maryland. **Reducing Nutrient Pollution at the Watershed-level: Decentralized Wastewater Treatment and Composition of Detergents.**

**Abstract:** Limitation of the external phosphorus and nitrogen load remains the most effective long-term approach to counteracting artificial eutrophication of lakes. The focus in developing nations should be on an integrated watershed-level approach that reduces the original phosphorus load entering wastewater (from laundry detergents) and also improves the success of nutrient removal in wastewater treatment (by decentralized methods such as constructed wetlands). Through this combination of prevention and subsequent treatment, developing nations can improve lake water quality with the greatest efficacy.

The conventional centralized aerobic wastewater treatment plants utilized in North America and western Europe should not be indiscriminately applied to developing nations. These systems have very high operating costs, land requirements, energy usage and technical maintenance demands. Decentralized treatment alternatives that have comparatively low operational requirements, such as constructed wetlands and waste stabilization ponds, should be utilized when possible. Constructed wetlands can be specially designed to enhance nutrient removal, such as selecting native wetland vegetation with efficient nutrient uptake and soil/gravel with high phosphorus-adsorbing capabilities.

Synthetic detergents increase the level of phosphate in wastewater due to their sodium tripolyphosphate (STPP) content. Although detergent consumption in developing countries is lower than in industrialized countries, reduction of STTP is still an important way to prevent further nutrient pollution in lakes. Evidence suggests that voluntary agreements between governments and the detergent industry are the most powerful tools. The public and local NGOs in developing countries can play important roles by expressing consumer choice and leading campaigns to pressure detergent manufacturers to engage in voluntary STTP-reduction agreements.

CZARNECKI, JOHN B., BRIAN R. CLARK, GREGORY P. STANTON and THOMAS B. REED. U.S. Geological Survey. **Optimization Modeling of the Mississippi River Valley Alluvial Aquifer in Arkansas.**

**Abstract:** Conjunctive-use optimization modeling was done to assist water managers and planners by estimating the maximum amount of ground water that hypothetically could be withdrawn from wells within the Mississippi River Valley alluvial aquifer without violating hydraulic-head or stream-discharge constraints. In 1997, nearly 6 million acre-feet of water were pumped from the aquifer by more than 45,000 wells, primarily for irrigation and for fish farming. Several large cones of depression over 100 feet deep have formed in the potentiometric surface, resulting in lower well yields and degraded water quality in some areas. MODFLOW-based ground-water flow models were developed for the north and south portions of the aquifer, primarily in eastern Arkansas. MODMAN optimization models based on these flow models showed that continued pumping at 1997 rates are unsustainable without violating head constraints imposed as a part of Arkansas' Critical Ground-Water Area criteria. One of these criterion states that if ground-water levels drop below half the original saturated thickness of the formation, then a "critical ground-water area" may be designated. In addition, streamflow constraints were established based on minimum flow requirements for maintaining water quality and fish habitat. Preliminary results show that continuous pumping at 1997 rates indefinitely resulted in water levels dropping below the half-thickness constraint, making these rates unsustainable. Optimized sustainable pumping was obtained such that water levels were maintained at or above the half-thickness constraint or a total saturated thickness of 30 feet, and streamflow was maintained at or above minimum levels. Optimized sustainable yields from streams were nearly 2 orders of magnitude greater than for ground water.

DENNISON, BILL, ADRIAN JONES, FRANCIS PANTUS and JANE THOMAS.  
University of Maryland. **Developing a Chesapeake Bay Report Card.**

**Abstract:** Coordination and feedback between monitoring, management and research is essential in achieving healthy Chesapeake waterways. With the aim of maintaining fisheries and improving water quality, management objectives such as clear water and reduced nutrient inputs can be linked to ecosystem health indicators which can then be quantified, mapped and integrated. A reference value for each of these indicators provides information on whether the management objectives are being met. These indicators should ideally provide information on various interconnected ecosystem elements. There is a need for a scientifically rigorous, spatially explicit ecosystem health report card on Chesapeake Bay and its watershed, and so a pilot study was conducted in July 2003 on the Patuxent and Choptank Rivers.  $\delta^{15}\text{N}$  signatures in the Choptank River showed elevated sewage nitrogen levels adjacent to and downstream from sewage treatment plants. The Choptank River had generally lower ecosystem health than the Patuxent River, except in the upper reaches where both rivers exhibited low ecosystem health. This study indicates the potential for a Bay-wide ecosystem health report card to provide rapid, effective, and spatially and temporally explicit monitoring feedback to managers, scientists and the broader community.

DESLAURIERS, SARAH, MASAYUKI KANZAKI, AKSHAY KUMAR, GREGORY KEOLEIAN and JONATHAN BULKLEY. Center for Sustainable Systems, University of Michigan. **Life Cycle Assessment as a Decision Support Tool in the Water Industry.**

**Abstract:** Drinking water quality and sanitation are of utmost importance both to public health and to conservation of water bodies. We maintain quality standards for both potable water and wastewater effluent to inhibit the spread of any waterborne diseases and to protect receiving water quality. While achieving these water quality standards, it is necessary to consider the treatment that is required for such standards to be met. The treatment trains of both potable water and wastewater involve energy intensive processes that necessitate significant economic costs and produce major environmental burdens. This study endeavors to support decision-making contributing to the reduction of adverse impacts of potable water production and distribution as well as wastewater collection and treatment by creating a database of life cycle inventory parameters. These parameters result from a life cycle assessment conducted on each system according to pre-determined boundaries. Subsystem 1 includes the production and distribution of potable water, and Subsystem 2 includes the collection and treatment of wastewater. For each subsystem, common treatment trains are developed using information from literature and surveys conducted within the U.S. prior to this study. Data is collected for each unit process based on the tool of life cycle assessment (LCA). The assessment required a comprehensive literature review of studies done prior to this one that also incorporated LCA into their analysis. The results include estimates of energy consumption and atmospheric and aquatic emissions based on a functional unit of one million gallons of water for potable water service and for wastewater collected and treated. From this analysis, a database is formed that can be utilized by decision-makers designing and/or evaluating treatment systems for enhanced overall economic and environmental efficiencies.

GBAKIMA, AIAH, MITCHEL GRAHAM and AISHA TURNBULL. Morgan State University. **Detection of Excherichia coli and E. coli 0157:H7 in Water Sources in Baltimore and Ghana.**

**Abstract:** Waterborne microbial diseases, once expected to be eliminated as public health problems, not only remain the leading cause of death worldwide, but the spectrum of disease is expanding and the incidence of many waterborne microbial diseases once thought conquered is increasing. Escherichia coli is a common part of the normal facultative anaerobic microflora of the intestinal tracts of humans and warm-blooded animals. Escherichia colki 0157:H7 is transmitted mostly in contaminated meat that is largely under cooked. It is also transmitted by contaminated recreational water, surface water, and ground water intended for drinking. It is the causative agent of hemorrhagic colitis, and haemolytic-uremic syndrome (HUS), a potentially fatal disease that affects mostly children under 10 years of age, the elderly, and the immunocompromised individuals. The development of HUS is associated with Shiga toxin 2 (Stx2) production by E. coli 0157:H7. Antibiotic treatment has been shown to increase the production of Stx2 and has been associated with progression to HUS in some clinical studies, but not in others. In this preliminary study, we have used an efficient filtration (osmonics 0.45 um), method and incubated over night at 370C in mimnimal lactose broth (MLB) to examine 15 ml of water samples from water sources in Baltimore and in Accra, Ghana.

The sample in MLB was centrifuged and supernatant was discarded, except 30  $\mu$ m of the pellet. Two hundred microliters of Intragene matrix (BioRad) to obtain quality DNA. The samples were screened conventional lacZ and Tir primers using specific primers for E. coli 0157:H7.

GRUDEN, CYNDEE,<sup>1</sup> P. ADRIAENS,<sup>2</sup> S.C. CHANG<sup>2</sup> and A. KHIJNIAK.<sup>2</sup> <sup>1</sup>University of Toledo; <sup>2</sup>University of Michigan. **Mico-Flow Cytometry Application for Microbial Assessment in Complex Matrices.**

**Abstract:** The applicability of flow cytometry (FCM) for microbial detection, quantification, activity assessment, and identification in environmental matrices through the concurrent use of multiple fluorescent markers is assessed. Environmental matrices may impact label specificity, fluorescent response, and method sensitivity. Benchmarked against epifluorescent microscopy (EPM), FCM quantification ( $1 \times 10^4$  to  $1 \times 10^8$ /mL) and metabolic activity assessment (~3 - 90%) of total and target (*Mycobacterium parafortuitum*) organisms is accomplished using non-specific stains, a tetrazolium redox dye (CTC), and labeled antibodies. EPM and FCM-based *Mycobacterium* counts were linear over four orders of magnitude. To allow for distributed sensing, a technology platform is being developed based on the integration of FCM principles with micromachining approaches, the micro-integrated flow cytometer (MIFC). Using air or water as sheath fluids, polydimethylsiloxane (PDMS) for the observation cell, and embedded optical fibers for signal acquisition, the instrument is designed for a two order of magnitude reduction in size and cost.

HAGEDORN, CHARLES,<sup>1</sup> ANNIE CHAPMAN,<sup>1</sup> SUE HERBEIN<sup>1</sup> and PHILIP McCLELLAN.<sup>2</sup> <sup>1</sup>Virginia Polytechnic Institute and State University; <sup>2</sup>MapTech, Inc. **Microbial Source Tracking as a Technology for Identifying Sources of Fecal Pollution in Water.**

**Abstract:** Microbial source tracking (MST) represents new and novel technologies that are being developed, tested, and deployed to identify sources of fecal pollution in water. The microbiological quality of U.S. waters is a topic of great concern. The latest National Water Quality Inventory (2000) reported that approximately 40% of streams, 45% of lakes, and 51% of estuaries were not clean enough to support recreational uses such as fishing and swimming. The leading cause of impairments to the rivers and streams (according to the U.S. EPA) is pathogenic microorganisms. The microbiological maintenance of waters that have primary or secondary human contact is imperative, as contamination from fecal material can create serious health risks. Establishing the sources of fecal contamination is crucial for the evaluation of health risks, sustainable management of water, achieving acceptable water quality and sanitation, and directing remediation efforts. Different MST methodologies will be described along with the strengths and weaknesses of each method, plus future directions. Results of case studies from both rural and urban watersheds (fresh and marine waters) will be presented to illustrate how MST technologies have been deployed around the U.S.

HEANY, CHRISTOPHER D. Department of Environmental Sciences and Engineering. **Survey of Microbial Contamination in Ground and Surface Water Supplies in an Underserved African-American Community in Alamance and Orange Counties, North Carolina.**

There is high vulnerability of groundwater contamination in rural areas with lower socioeconomic populations that are likely to have failing on-site septic tank soil absorption systems and private, unregulated drinking water wells of inadequate depth and construction quality. Short-term surveillance for microbial indicator organisms in ground water supplies and surface water of three underserved African-American communities in rural Alamance and Orange Counties, North Carolina was undertaken to aid in policy decisions concerning public health risks and the need for provision of a public, regulated community drinking water supply and sewer system.

Water was collected and analyzed for fecal coliforms, *E. coli*, *enterococci*, and coliphages infecting the *E. coli* C3000 host bacterium from 60 private residences in 3 African-American enclaves of a small town of just under 8000 people. Many of the sampled homes have private wells for household water. All samples were negative, except one that was positive for coliphages only. A total of 17 surface water samples were collected and microbially analyzed from 7 streams in close proximity to houses with known failing septic systems. A round of 7 surface water samples collected during extreme drought conditions showed no evidence of microbial contamination. Second and third sampling rounds of 5 samples each resulted in levels of contamination exceeding the USEPA and NC Division of Water Quality single sample MCLs for fecal coliforms, *E. coli*, and *enterococci* in waters to be used for primary contact recreation. Third round surface water samples also were positive for total coliphages, with concentrations ranging from 1.5 to 46 infectious units per 100ml. The results of this study suggest a need to address possible failing septic systems in these African-American, NC communities. The presence of coliphages in a household water sample also suggests possible fecal contamination of community drinking water supplies, the need for further investigation of drinking water microbial quality, and consideration of the provision of a regulated, public water supply.

HOWARI, FARES M. Southwest Earth and Environmental Services. **Hydrochemical Analyses and Management Options to Route Water from Elephant Butte Dam to El Paso del Norte region, U.S.-Mexico Border.**

**Abstract:** The supply of freshwater from the Rio Grande is vital to the economic development of the United States of America and Mexico border. The main groundwater aquifers in El Paso del Norte region serve as the main source for drinking water for El Paso, USA and Cd. Juarez, Mexico. They have limited life time and are degrading. Thus alternative water sources like the Rio Grande will have to play an important role in providing municipal water for the region in the future. Unfortunately, the competing demands made on this surface water source have affected not only its supply and future availability, but also its quality. The present work evaluated the hydrochemistry status of the water, and some management options to deliver water from the main upstream dam on the Rio Grande, Elephant Butte Dam. The study used hydrochemical analyses coupled with a mass balance approach of water quantity and quality. The study used statistical analyses to: i) demonstrate the trends of ions concentrations and flux in the Rio Grande, and ii) predicted the quality of water to be delivered by the proposed routing

scenarios. EXTEND visualization environment was used as a tool to demonstrate the routing scenarios. The current work used other tools to achieve its objectives such as Landsat ETM+, Color Infrared Film (CIR) and high-resolution field spectroradiometer (GER 3700). The study found that the concentration of most of the studied ions increase from the upper to the lower reaches. The reported results indicate that delivering water from the Elephant Butte Dam by means of river canal itself and narrows conveyance is one of the best methods. The study showed that the simple approach presented is useful to be considered as a preliminary screening tool for surface water routing options on the basis of water quantity and quality. Attempts to include additional variables is being considered.

KESHAWARZ, M. SALEH<sup>1</sup> and SAYED SHARIF. <sup>2</sup> <sup>1</sup>University of Hartford; <sup>2</sup>FAO Afghanistan. **Water Security and Sustainability in Afghanistan.**

**Abstract:** More than two decades of war in Afghanistan has had a devastating effect on its people, infrastructure, and the socio-economic structure of the country. The manmade catastrophe, war, compounded by natural disasters like earthquakes, floods, and drought have taken a heavy toll on the Afghan people. The impact of these disasters were particularly felt hard in the rural Afghanistan where more than 80% of the population live and rely heavily on sufficient water, functioning irrigation system, and adequate rainfall for their livelihood.

Given the rainfall pattern in Afghanistan, the country is not water secure and with another prolonged drought, the country will, once again, experience wide spread migration. There is no policy in place for drought mitigation and sustainable water use. The 1981 water law is only in the books and is yet to be revised and enforced. Water conservation and water harvesting techniques are unknown to the majority of the population. Lack of watershed management has resulted in soil erosion and wastage of water.

The posters will present the current water resources condition and will provide recommendation for improvement of the system toward a water secure country.

KING, STANLEY, XINGLONG XU and ISABEL ESCOBAR. University of Toledo. **Improving Desalination Through Membrane Modifications.**

**Abstract:** Through research, it is the goal of the academic and industrial communities to improve membrane technology such that there is a change in the flux/selectivity relationship and a resistance to fouling is obtained. To accomplish this goal, there are three areas of interest when it comes to improving membrane performance; the synthesis process, the application process, and post-synthesis modifications. Improvements to the synthesis process involve the techniques, methods and materials of the manufacturing process. The application process involves the specific operating parameters for a membrane system. This includes selecting the raw water characteristics, operating pressure and cleaning intervals to allow the system to operate at maximum efficiency. Post-synthesis modification involves modifying the membrane after the initial manufacturing process is complete. Post-synthesis modification has been chosen as the area of interest for this study. To improve the operating parameters

of membranes, ion beam irradiation, a post-synthesis surface modification technique is applied. Ion beam irradiation is the bombardment of ions through the surface of the membrane. As the ions penetrate the membrane, they lose energy to the polymer. This energy transfer results in bond breaking, bond formation and microstructure alterations. The theory behind this technique is that additional crosslinking of the polymer occurs (i.e. to make the pores more rigid), helping to increase selectivity without sacrificing flux. Also, it is believed that ion beam irradiation results in a smoother membrane surface.

KLAIN, STEPHEN J.,<sup>1</sup> M. SCHLAUTMAN,<sup>1</sup> R. ENGLISH,<sup>2</sup> J. HAYES,<sup>3</sup> T. KARANFIL,<sup>4</sup> S. TEMPLETON,<sup>5</sup> J. SMINK,<sup>1</sup> C. POST.<sup>2</sup> <sup>1</sup>Environmental Toxicology Program, Clemson University; <sup>2</sup>Department of Forestry and Natural Resources, Clemson University; <sup>3</sup>Public Service and Administration, Clemson University; <sup>4</sup>Department of Environmental Engineering and Science, Clemson University; <sup>5</sup>Department of Agricultural Economics, Clemson University. **A Watershed Approach to Characterize the Influence of Land Use Change on Aquatic Resources.**

**Abstract:** The objective of the Changing Land Use and the Environment (CLUE) project is to characterize the cause and effect relationships between land use change and the quality of aquatic resources. This research project is being conducted on the Saluda-Reedy river watershed in the upstate of South Carolina. Development in this watershed ranges from the heavily urbanized area of Greenville to more rural, agricultural and forestry land uses. An automated water sampling system was established both on the main stems of these two rivers as well as on smaller tributaries undergoing land use change. A teach site both base and storm flow water samples were taken for chemical and physical analyses. In addition, benthic invertebrate community analyses were conducted regularly at each site. Results of this work are being integrated into a riverine health index to be used by policy and decision makers within the watershed and at the state level. A satellite telecommunication system will provide real-time water quality data at two sites using in line sensors for various parameters. These data will be automatically analyzed and displayed on the web page for use by decision-makers, educators and the general public. Results to date verify that nonpoint discharge is the most significant source of nutrients entering Lake Greenwood, the downstream critical water body in this watershed. Potential for the use of this information to change decisions regarding resource management will be discussed.

KNOWLES, GRAHAM. National Environmental Services Center, West Virginia University. **Ensuring Sustainable Water Resources and Managing Growth: Putting Onsite Wastewater Management in the Mix.**

**Abstract:** Septic systems also known as onsite wastewater disposal systems (OWDS) treat and dispose of sanitary waste. When properly sited, designed, constructed, and managed they pose a relatively minor threat to drinking water sources. However, unmanaged OWDS's can be a significant source of ground water contamination leading to waterborne disease outbreaks and other adverse health effects. Historically, one in every four housing units in the United States has utilized an OWDS as a means of sewage disposal. Over the past decade rapid population growth and housing unit construction has seen a dramatic increase this ratio. Today, one in every three housing

units constructed over the past decade utilizes an OWDS as a means of sewage disposal. In its (1997) Response to Congress on Use of Decentralized Wastewater Treatment Systems the USEPA indicated the importance of "adequately managed" OWDS's stating that they are "a cost-effective and long term option for meeting public health and water quality goals." However, a recent national survey indicated that less than 10% of all OWSD's are in a managed setting. Triangulating key growth variables, including, population increase, population density increases, households, housing unit increases, well densities, and OWSD's this study clearly shows clusters and pockets of real growth nationwide. Highlighting areas with high densities of OWDS's, this study maps out significant growth trends and patterns across America. Using twice the national population growth rate of 26.4% to benchmark "rapid growth" and historical data on OWDS densities the results offer valuable insights for policymakers, planners, public health and environmental professionals amongst others, into existing and future areas of concern; as unmanaged OWDS's continue to be increasingly utilized in exponentially growing and environmentally sensitive areas with limited water resources.

LANG, MICAH. Thomas J. Watson Foundation. **World Water Scarcity: The Feedback Among Water, Culture, and the Environment.**

**Abstract:** In every community in the world there is an inextricable connection between water use, culture, and the environment. Similarly, in all but the most isolated localities, currents of change are sweeping through communities and affecting peoples' perception of water and their actual water use. In an attempt to assemble an overview of the feedback among water, culture, and the environment at the community level-in the context of current development and change-and to add a human face to the sterile statistics that are currently telling the world water story, a one year investigation was undertaken. In Peru, Bolivia, Cyprus (Greek and Turkish), Namibia, Botswana, Kenya, and Tanzania a variety of types of people were interviewed, from illegal squatters to national water ministers, to gain an understanding of the issues that people are facing. A reoccurring theme found in every country was a patchy adoption of western practices, coupled with rapid loss of traditional culture, which is resulting in increased water consumption, pollution, and is exacerbating the effects of drought and water scarcity.

McPHERSON, WENDY. U.S. Geological Survey. **Monitoring Water Levels from Drought to Recovery in Maryland and Delaware.**

**Abstract:** One year after the Mid-Atlantic region's worst hydrologic drought, above normal precipitation led to a full recovery with very high water levels. During the drought, many record low water levels were recorded in wells and streams monitored by the U.S. Geological Survey (USGS) in Maryland. In June 2002, most of the ground-water levels were below normal and 6 of 16 wells reached their lowest June levels in more than 40 years, exceeding the low water-level records set during the drought of the 1960s. Several months of abundant rainfall led to a full recovery from the drought and by June 2003, all the wells were at above normal levels, and 6 wells were at their highest June levels in 40 years. Long-term data indicate that this number of sites has never before shown such an extreme change in water levels during a short period of time. Ground-water data compared to the historical record has not been readily. In Maryland

and Delaware, the USGS measured shallow ground-water levels twice a month during the drought of 2002 and displayed the data on a clickable map that ranked how the water level compared to the historical record. Although abundant rainfall recharged the shallow aquifers, water levels in many of the deep wells continues to decline because the aquifer is being pumped more quickly than it can be recharged. With more accessible water-level data, ground-water data may be used to assess the sustainability of ground-water resources.

PIDLISNYUK, VALENTYNA<sup>1</sup> and Iryna Pidlisnyuk.<sup>2</sup> <sup>1</sup> University of Georgia; <sup>2</sup>Academy of Foreign Trade, Sustainable Development and Ecological Education Center.  
**Sustainable Use of Water Resources: Challenges for the Future.**

**Abstract:** State of water resources and water management in Ukraine, national priorities in ecological policy deal with water issues as well as current results of their implementation are observed. Other topics include some aspects of the today's Ukrainian legislative framework, legal and institutional instruments in water issues and how-if UN Aarhus Convention " On Access to Information, Public Participation in Decision Making process and Access to Justice in Environmental Matters " affects the Ukraine. Also brief review of EU Water Framework Directive as well as ways of it's presentation and implementation in Ukraine and Byelorussia is observed. An attempt of corresponding analysis of current water policy and water management in Ukraine with some main principles of sustainable water use is presented. Discussion the elements of the sustainable water use are included into existing ecological legislation, newly adopted laws in water's issues as well as in legal documents regarding Sustainable Development in Ukraine; discussion the possibility of using existing structure stemming from international agreements for coordination the International River Basin districts; state of monitoring system of surface water status, groundwater status and protected areas; existed system of public information and consultation, some examples about NGOs actions in the process of preparation the governmental documents. Results of some international projects regarding Water Policy and Water Management carried out in Ukraine are presented. Positive case-study deals with current water policy and strengthening the role of public in water management plan developing is observed regarding the local territory in Kyiv region.

SEMPIER, STEPHEN H., KATY R. LLOYD, ROGER J. HARRIS and HILLARY S. EGNA. Aquaculture Collaborative Research Support Program, Oregon State University.  
**Sustainable International Aquaculture Research: A Focus on Low Food Chain Species.**

**Abstract:** Since 1982, the primary focus of the Aquaculture Collaborative Research Support Program (ACRSP) has been on constructing strategies that provide sustainable sources of finfish for local consumption. A mounting emphasis on low trophic species has emerged while executing these strategies. As the program addresses topics such as aquaculture effluent, fish feed and nutrition, production systems, and indigenous species development in host countries there is a natural tendency and concerted effort to study low trophic species due to their positive attributes for aquaculture. Benefits of rearing low food chain species include improved feed costs, improved water quality, less

infrastructure, increased farm profits, and improved production. As the ACRSP looks to the future, emphasis on studying aquaculture species that thrive on low food chain diets will continue to intensify.

SUGIURA, SHOZO H. and RONALDO P. FERRARIS. New Jersey Medical School.  
**Aquaculture, Water Pollution, and Policy-Making: Better Technology or More Regulation?**

**Abstract:** Aquaculture contributes to the pollution of nearby aquatic environments by discharging effluent water high in phosphorus (P), nitrogenous compounds, and organic matter. In response to escalating environmental concern, state and federal regulation of the aquaculture industry increased, thereby threatening to reduce aquaculture production. In contrast, state and federal support of research to develop technologies that alleviate environmental pollution while maintaining fish production did not materialize. This mostly unilateral approach failed to consider the numerous health and economic benefits that high levels of aquaculture production provide. Recently, we have been developing newer technologies that may reduce the environmental impact of aquaculture. The ultimate source of pollution in aquaculture is nutrients excreted by fish from feeds in excess of required, or of poor quality. Advances in aquaculture engineering improve solid waste collection, but there has been no viable solution that can reduce soluble components eventually discharged into nearby waters. We therefore proposed methods to reduce soluble P production at its source: intestinal and renal P excretion. Our recent data identified some genes sensitive to dietary P. By using genetic markers that reflect and predict the true P status of fish, P in fish feeds can now be reduced to levels precisely optimal for fish production, minimizing soluble P excretion without risking P deficiency. Hence, reduction of P pollution associated with aquaculture can be achieved by research and technology development. Environmental policies must, therefore, supplement and/or replace regulation with increased support for newer technologies that can ensure sustainable development of aquaculture.

SUGIURA, SHOZO H. and RONALDO P. FERRARIS. New Jersey Medical School.  
**Effluent Profile of Rainbow Trout Aquaculture Fed Commercial Low-Phosphorus Feeds.**

**Abstract:** Excessive amounts of phosphorus (P) in commercial aquaculture feeds increase excreted P concentrations in effluent water, which cause undesirable algal blooms in freshwater bodies. Reducing P excretion to natural waters is a priority issue for clean water environment. We studied the effluent P profile of rainbow trout aquaculture fed regular (1.43%P; \$0.34/lb) and low-P feeds (1.00%P; \$0.395/lb) purchased from a major US feed manufacturer. Because insufficient dietary P decreases fish growth, we also determined the growth and P status (P concentrations in body, bone and plasma) of fish. We stocked ~450 lbs of fish each into six raceway ponds. Three ponds received low-P feed and the other three received regular feed. After 46 days, soluble, particulate and fecal fractions of effluent water were collected every hour for 24 hours to see the pattern of P excretion in each fraction. The total fecal amount and the fecal P concentration were both significantly greater in regular feed than low-P feed. Fish growth, P status, and effluent soluble and particulate P concentrations

did not differ significantly between the feeds. Thus, the low-P feed containing highly digestible ingredients for P may be environmentally sustainable and capable to support comparable growth of fish. In commercial trout production, feed is the single largest variable cost, representing ~50% of the total variable expense. Since the price of the low-P feed is ~16% higher than the regular feed, the use of low-P feed may pose a concern for economical sustainability of commercial aquaculture.

VAN WALSUM, PETER and ERIN DOYLE. Balor University. **Improving the Economic Incentive for Effective Manure Treatment: Removal of Phosphate Through MixAlco Conversion of Dairy Cattle Manure to Value-Added Fuels and Chemicals.**

**Abstract:** The MixAlco process has been proposed for conversion of dairy cattle wastes to fuels and chemicals. The MixAlco process converts biomass to mixed-alcohol fuels or chemicals via alkaline pretreatment, non-sterile, acidogenic digestion, product concentration, thermal conversion and hydrogenation. Because it is non-sterile, the MixAlco fermentation can process problem waste streams such as manure and biosludges and utilizes low-cost materials of construction. The flexibility of the downstream processing, which enables the production of a wide variety of value-added products, is also a unique and advantageous characteristic. It is hypothesized in this study that dairy farm-derived phosphate contamination of surface waters could be reduced by the application of the MixAlco conversion process to dairy waste streams. Thus, it is proposed that conversion of manure wastes to renewable fuels and chemicals will financially benefit dairy farmers, reduce phosphate pollution in local watersheds and provide a renewable source of chemical feedstocks.

Thermodynamic solubility studies were carried out to determine the ultimate fate of phosphate through the MixAlco fermentation system. It was found that phosphate is present in both the solid and liquid phases. The high calcium content of the fermentation results in calcium phosphate salts precipitating out of solution together with calcium carboxylate salts during the concentration step. Thus, it is predicted that the MixAlco process should effectively sequester phosphate into the solid phase, removing it from problematic waste streams. Further downstream processing may enable recycling of the phosphate compounds as fertilizer components.

WILDERMAN, CANDIE. Dickinson College. **The realization of a Pipe Dream: Effective Partnerships in Community-Based Urban Stream Restoration.**

**Abstract:** Environmental mitigation and restoration projects are currently taking place across the country, providing a need for collaboration of a wide array of stakeholders and technical experts. Such purposeful human intervention into natural systems has the potential of resulting in increased functionality of perturbed systems; these activities also have the potential to increase public awareness and build community capacity for sound stewardship of local resources. This poster will document a stream mitigation/restoration project on a small urban waterway (the Mully Grub) within the Letort Spring Run watershed in Cumberland County, PA, that has involved a critical partnership between Dickinson College and the community of Carlisle, PA. During this project, the community defined the problem and the research agenda, and the College

students and faculty designed and implemented a background study and designed a conceptual mitigation plan. In an effort to implement the mitigation plan, the community developed a partnership with the Alliance for Aquatic Resource Monitoring (ALLARM), a project of the Environmental Studies Department, which provides technical and programmatic support to watershed groups throughout the state of PA. ALLARM was able to secure funding for several mitigation and restoration projects on both the Mully Grub and the Letort Spring Run in the vicinity of the confluence, from a variety of sources, including the PA Department of Environmental Protection. The project was implemented, maintained, and assessed by a cooperative effort of community groups and individuals, professional contractors, and College employees and students. This project provides a stunning model for the power of college/community partnerships in engaging communities in sustainable stream restoration projects

**WILDERMAN, CANDIE. Dickinson College. Top Down or Bottom Up? Models for Community-Based Participatory Watershed Research, With a Discussion of Their Impacts on the Development of Sustainable Water Policy**

**Abstract:** Sustainable water policies rely on community support and understanding for successful implementation. Such support can best be provided by a community that has experienced the needs, that has been involved in the planning process, and that understands natural systems. The Alliance for Aquatic Resource Monitoring (ALLARM), a project of the Environmental Studies Department at Dickinson College in Carlisle, PA, establishes collaborative efforts among scientists, managers, policy makers, and the public by engaging watershed communities in citizen science. Over the past 100 years, citizen science in the United States has assumed a number of different operational models, which vary in the level of community involvement -- from a simple consulting model to a model of community-based participatory research. The roles in which ALLARM has engaged citizen-scientists have varied over the past 18 years, as we evolved from a single-issue, "top-down" program focused on the effects of acid deposition on PA waterways, to a multi-issue "bottom up" program, working with volunteers to address community-identified issues of concern. This experience has given us some special insights into the strengths and challenges of the different models. This poster will focus on the range of operational models adopted by water-focused community science projects in the U.S., using the experience of ALLARM to evaluate two of these models in terms of: . the necessary investment by professional scientists; the interest and engagement of the participants; the ownership and understanding of the data; . the empowerment of community members for decision-making; and. the building of community capacity for developing and implementing sustainable water management projects.