Northwest Biological Assessment Workgroup - Cannon Beach, Oregon

WEDNESDAY November 7, 2007

Welcome, Logistics, etc.
Gretchen Hayslip, EPA Region 10

An Old Fashioned California Update
Rob Plotnikoff, Tetra Tech and Jim Harrington, CDFG

EMAP and Oregon DEQ's Evidence Based WQ Priority Setting Process
Doug Drake, Oregon DEQ

The Oregon DEQ Water Quality Program undertook a priority setting process - the goal of which is to: "By the end of 2007, identify the highest priority problems affecting the chemical, physical and biological integrity of waters of the State; identify the optimum approaches for DEQ, in partnership with others, to make statistically significant gains in water quality integrity". I will describe the process and the status of this project.

Database Dilemma: Development of a National USGS Database for Biological Data
Doreen MacCoy, USGS

It is the mission of the U.S. Geological Survey (USGS) to collect, analyze, and report to the public scientifically-based natural resource data. The initial focus of the USGS was to support the nation's mining efforts and the exploration of land and water resources. To that end, the USGS has been collecting water research data since the late 1800s. The USGS Water Resources Division, established in the early 1960s, began studies in water quantity and quality, and it established the National Water Information System (NWIS) to store collected data. In the 1980s, several national water-quality monitoring programs began to collect aquatic biological community data to support water-quality samples and to identify beneficial uses of U.S. rivers. One of these programs was the National Water Quality Assessment (NAWQA) program that was established to report the "state of the Nation's water". The NAWQA program was designed to assess water quality and biological resources in several watersheds across the country. This effort required developing biological sampling protocols, establishing a national taxonomic laboratory, and creating a national biological database. Since the establishment of the NAWQA program, several other cooperative district programs have been formed that include biological community data collection as part of water-quality assessment. Unfortunately, the NAWQA biological database cannot support non-NAWQA biological data. The Idaho Water Science Center (WSC) through cooperation with the National Biological Information Infrastructure (NBII) has created a Web-based database that contains aquatic community data. The need for a national biological database was expressed through the results of a survey that determined that 41 of the 51 USGS WSCs collect biological data with no centralized storage and retrieval system. Current actions for establishing a national biological database include identifying a system owner, creating a steering committee, creating a biological users group (BUG), choosing a data development team, and consulting with database experts. The initial steps have been taken in the development of a national database. With continued support from our cooperators and participating laboratories we hope to help our USGS biological data find a home.

Counting Small Snails in a Big River – *Survey Sampling to Estimate Population Size of a Threatened Snail*

Leska S. Fore, Statistical Design and William H. Clark and Barry Bean, Idaho Power Co.

The Bliss Rapids snail (BRS; *Taylorconcha serpenticola*) was listed as a threatened species in 1992 and since that time the US Fish and Wildlife Service and the Idaho Power Co. have funded research to evaluate the status of this species. BRS was initially thought to be associated primarily with spring habitat in the Snake River watershed. Although higher densities are sometimes found near springs, random sampling throughout the river found BRS at 45% of random locations. Using a two-stage survey sampling design, we estimated a population size of 3,000,000 with a 95% confidence interval of +/- 800,000 snails during 2007 for shoreline area up to 3m deep. We tested for changes in population size associated with changes in the operation of hydroelectric dams (load following) and found a significant decline in the first year of operation (2005 vs. 2006, significant at the 90% confidence level) but no change in the second year of operation (2007). We tested the influence of various predictors of snail presence (e.g., depth, proximity to rapids, river aspect, and substrate type) to identify predictor variables that could improve our population estimates. Information derived from this and related studies of the Bliss Rapids snail will be used to determine patterns of operation for hydroelectric facilities located along the Snake River.

A Calcium-based Risk Assessment for Zebra Mussel and Quagga Mussel (*Dreissena spp.*) invasion

Thom Whittier, Oregon State University

We used calcium concentration data from over 3,000 stream and river sites across the contiguous United States to classify ecoregions relative to their risk for *Dreissena* species invasion. We defined risk based on calcium concentrations as: very low (<12 mg/L), low (12 - 20 mg/L), moderate (20 - 28 mg/L) and high (>28 mg/L). Ecoregions comprising 9.4% and 11.3% of land area were classified as very low risk, and low risk. These areas included New England, most of the Southeast, and western portions of the Pacific Northwest. High risk ecoregions comprised 58.9% of land area. Ecoregions with highly variable calcium concentrations comprised 19.8% of land area; none could be classified as moderate risk. The majority of *Dreissena* occurrences (excluding the Great Lakes) were in high risk ecoregions, with most exceptions being in highly variable ecoregions. Mussel occurrences in low risk ecoregions were all in large rivers flowing from high calcium regions. Our map provides guidance about which areas should receive invasion prevention resources, as well as areas where those resources could be applied to other issues

Phytoplankton and Zooplankton Lab Methods for the National Lakes Survey
Dawn Hamilton, EcoAnalysts

The National Lakes Survey is a collaborative effort between the EPA, state and federal agencies, universities, tribes, and others to document the condition of the nation's lakes. The study was designed to provide uniform collection and laboratory procedures and documentation so that data can be compared across the US. The survey is collecting samples to evaluate seven indicators, including phytoplankton and zooplankton. One of the goals of the Survey is to provide baseline information and methods that can be replicated by any entity interested in the further monitoring and management of these water resources. Through a process of revision, ending with a meeting conducted in Spokane, Washington in early September, experts assembled by the EPA and EcoAnalysts reached consensus on the methods and protocols that will be followed in the analysis of these two indicators.

The National Lakes Assessment in Oregon
Greg Coffeen, Oregon DEQ

Biological Indicators for Lakes: do Benthic and Zooplankton Indicators Respond to Different Factors?
Chuck Hawkins, Utah State University

Use of Pico-cyanobacteria, Heterotrophic Bacteria and Detailed Hytoplankton Analysis to Determine the Trophic Status of Lakes
Darren Brandt and John Stockner, Terragraphics

Classical limnological measures are often poorly correlated to lake production and anthropogenic impacts. In this talk we discuss areas where classical measures would have resulted in erroneous conclusions and offer suggestions that would result in a more accurate lake assessment. We also explore measures that minimize the influence of top-down control in lakes and the use of some emerging techniques to better understand the food web and production dynamics of lentic systems.

Population Attributable Risk Combines Relative Risk with Stressor Extent, to Assess Aquatic Stressors
John Van Sickle and Steven G. Paulsen, EPA Office of Research and Development

EPA's EMAP surveys have used "extent" and "relative risk" to help assess the importance of aquatic stressors in a region. "Extent" measures the regional prevalence of elevated stressor levels, and relative risk measures the increased likelihood of degraded biological condition whenever a stressor is elevated. We describe how "population attributable risk" (AR) combines extent and relative risk into a single measure of regional stressor importance. AR is defined as the percent reduction in the extent of Poor biological condition that could be achieved if elevated stressor levels were eliminated from all streams. AR (like

relative risk) is borrowed from human epidemiology, and we describe its assumptions and limitations for assessing aquatic ecosystems. AR can be adjusted for effects of other stressors, and the combined AR of multiple, correlated stressors can be fairly allocated to them individually. We present examples using data from the recent, national-scale Wadeable Streams Assessment.

Pacific Northwest Side-by-Side Protocol Comparison Test

Steven H. Lanigan and Brett Roper, U.S. Forest Service

Eleven state, tribal, and federal agencies participated during summer 2005 in a side-by-side comparison of protocols used to measure common in-stream physical attributes to help determine which protocols are best for determining status and trend of stream/watershed condition. This protocol comparison was sponsored by the Pacific Northwest Aquatic Monitoring Partnership as part of an ongoing effort to enable different agencies to be able to share data and determine best measurement techniques. Field sites were located in the John Day Basin, eastern Oregon, in mountain channels that provide critical habitat for threatened and endangered salmonids. Twelve streams were examined, representing a range of alluvial channel types (pool-riffle, plane-bed, and step-pool) and a range of channel/habitat complexity (simple, free-formed channels vs. complex wood-forced ones). Study sites had bankfull channel widths of 3-15 m, slopes of about 1-7%, and median substrate sizes of 9-154 mm. Channel features of interest included reach-average width, depth, gradient, sinuosity, substrate characteristics (median size, percent fines), wood characteristics (number, size), pool characteristics (residual depth, area of pools), and channel entrenchment. Field crews from the USDA Forest Service Rocky Mountain Research Station determined "true" channel characteristics using a dense array of cross sections spaced every half bankfull width over stream lengths of 40-80 bankfull widths. A total station was used for surveying channel cross sections and the longitudinal profile of the stream bed, while Wolman pebble counts were used to sample substrate at each cross section. The sites were then inventoried by one to six field crews from 11 participating agencies using their measurement protocols. Preliminary results indicate that some monitoring group protocols performed better than others for particular attributes, no one monitoring group's protocols performed best for a majority of the attributes compared.

Longitudinal Variability in Pacific Northwest Rivers; Implications for Regional River Survey Design

Alan Herlihy and Robert M. Hughes, OSU

The riverscape concept favors study of an entire river and a frequently recommended number for probability sampling designs is 50 sites. However a riverscape census of an entire river and a 50 site sample are both daunting undertakings for most state water quality agencies, and they also limit the number of rivers that can be sampled with limited state resources. On the other hand, one or a handful of water quality samples from bridges underestimates the ecological variability expressed by a large river. We sought to determine the number of sites that would yield relatively precise estimates of physical, chemical, and biological condition for raftable rivers 100-200 km long and 20-120 km wide. We used a probability design to select 20 sites on each of two rivers in Washington (Chehalis, Okanogan) and four rivers in Oregon (Willamette, Malheur, Umpqua, Sprague). The rivers were selected to include those draining cold deserts, dry and wet forests, and agricultural plains. All sites were sampled by a four person crew from two rafts. The crews collected physical and chemical habitat and fish and macroinvertebrate assemblage data at each site through use of EMAP-West methods. The reach length for each site was 50 times the mean wetted width of the channel, and crews sampled 1-2 sites per day depending on site size and the distance between sites and access/egress locations. The data indicate considerable ecological change among upper and lower sites in some rivers and

little in others, as well as variability in biological assemblages associated with local changes in macrohabitat types. Based on preliminary analyses on these six rivers, our data suggest a high degree of spatial autocorrelation between sites that are < 10-40 km apart, and we observed no marked changes between adjacent sites. This autocorrelation needs to be taken into account in designing regional or river monitoring surveys.

Effects of nutrient enrichment on stream ecosystems in the upper Snake River Basin: The NAWQA Nutrient Effects Program

Chris Mebane, U.S. Geological Survey

In summer 2007, the U.S. Geological Survey's National Water Quality Assessment program (NAWQA) began investigating nutrient enrichment effects (NEET) on stream ecosystems in the upper Snake River basin. The study is providing nationally consistent and comparable data and analyses of nutrient conditions, including how these conditions vary as a result of natural and human-related factors, and how nutrient conditions affect algae and other biological communities. This information will benefit stakeholders, including the EPA and state environmental quality agencies, who are evaluating nutrient criteria to protect the aquatic health of streams in different geographic regions. The upper Snake is one of eight agricultural regions being studied nationwide.

The objectives of the study include (1) determining the total algal biomass and the abundance, type, and diversity of algal and invertebrate communities in streams with different nutrient conditions, watershed characteristics, habitat, climate, and other natural factors, and (2) determining the interrelations among nutrient conditions and stream metabolism, and (3) determining the extent to which associations between nutrient conditions and biological communities occur over geographic regions that share common natural features, landscape characteristics, and biological communities.

This study spans a two year period with the first year involving a one time large-scale synoptic study across the study area (n=30) and the second year involving temporal sampling at a subset of the sites (n=7). The synoptic study was conducted in the summer of 2007 and involved the collection of nutrients and other chemical characteristics, biological communities, and stream and riparian habitat. Stream metabolism was determined at eight of the 30 sites. The temporal study is planned to occur in 2008 and will include temporal changes in stream flow, nutrient chemistry, algal and macrophyte biomass, algal and invertebrate communities, and stream metabolism.

Preliminary review of data collected in summer 2007 indicates that algal and macrophyte standing crops are only weakly correlated with phosphorous or nitrogen concentrations in water, suggesting that other variables such as stream velocity or shading may be important co-factors. Background concentrations of phosphorous in the study area appear to be about 2 times higher than recommended EPA criteria for the Snake River basin ecoregion, whereas background nitrogen concentrations in streams other than spring creeks are more or less similar to suggested EPA criteria. Background nitrogen concentrations in spring creeks appear to be about 2-3 times higher than background nitrogen concentrations in surface water streams; whereas background phosphorous concentrations in the spring creeks appear to be about 0.3 to 0.5 times that of background in surface water streams.

Effects of Whole-River Fertilization and the Nuisance Alga Didymosphenia geminata on Benthic Macroinvertebrates in the Kootenai River, Idaho.

Gary T. Lester, EcoAnalysts, Inc. Moscow, Idaho and Charles Holderman, Kootenai Tribe of Idaho, Bonners Ferry, Idaho

In a controlled experiment, nutrients are being added to the Kootenai River in an effort to enhance instream productivity and offset losses caused by Libby Dam and extensive diking. Fertilization commenced in the summer of 2005, has continued seasonally through 2007, and will occur again in 2008 and 2009. Initial responses in macroinvertebrate abundance, biomass, and ChlA will be presented. In an unrelated situation, the nuisance diatom Didymosphenia geminata has had profound impacts on the benthic communities downstream from Libby dam through physical habitat alterations. Extremely dense mats of the diatom stalks have physically altered the benthic substrate and limited colonization by invertebrates in the area, causing additional concern for an already stressed fish community in the river.

The Oregon Statewide Assessment: Information and Issues

Shannon Hubler, Oregon DEQ

The Oregon Department of Environmental Quality (ODEQ) was one of 12 states that participated in the EMAP-Western Pilot project (W-EMAP). EMAP employs a probabilistic sampling design to make unbiased estimates of resource conditions. The targeted resource was all perennial stream and rivers in 12 western states. Surveys were conducted from 2000-2004. As part of W-EMAP, the ODEQ collected water chemistry, physical habitat, and biological assemblage data from ~60 random sites across the state of Oregon and ~100 random sites in the John Day basin. These data were used to make an assessment of the status of perennial wadeable streams (no rivers) at the state scale. Water quality and physical habitat indicators were ranked according to the most extensive stressors (failing to meet water quality standards or reference benchmarks) and those posing the greatest risk to the biointegrity of macroinvertebrate assemblages. Comparisons of the most important stressors were made among three probabilistic studies in Oregon at different spatial scales.

Updates

1. Status of the Idaho Springsnail

William H. Clark, Idaho Power Company

The Idaho Springsnail (*Pyrgulopsis idahoensis*) was described by Pilsbry from the Snake River near Homedale in 1933 and was listed as endangered in 1992 by the U.S. Fish and Wildlife Service (USFWS). The listing was based on few (10) collection localities in the middle Snake River. Idaho Power Company (IPC) has been tasked with the study of these snails to determine their distribution and to attempt to quantify any potential impacts of hydropower generation operations on the species. We have found it more widely distributed (nearly 200 collection locations in over 200 river miles) and in new habitats including reservoirs at very high densities. Additional study revealed that the snails were persistent at study sites and that the perceived threats to the species at the time of listing were minimal or no longer factors. A review of the life history, ecology and distribution of the taxon is in press and will appear in December (Lysne et al. 2007).

Hershler and Liu (2004) reviewed genetic and morphological characters in the group and determined that *P. idahoensis* and three other NW springsnails were synonyms of the Jackson Lake Springsnail, *P. robusta*

which had been described by Walker in 1908. The USFWS determined that since *P. idahoensis* is not recognized as a species, as defined by the Act, that it was determined that it is not a listable entity and thus removed it from the List. The Idaho Sprinngsnail was delisted (removed from the List of Endangered and Threatened Wildlife) on September 5, 2007 (see link to the Federal Register 72(150):43560-43563): http://www.fws.gov/idahoes/PDFs/ISS_FinalDelist_FR_080607.pdf

Previously only two invertebrates have been removed from the List: the Bahama swallowtail butterfly which was an error in listing and Sampson's pearlymussel which went extinct.

Hershler, R., and H-P. Liu. 2004. Taxonomic reappraisal of species assigned to the North American freshwater gastropod subgenus *Natricola* (Rissooidea: Hydrobiidae). The Veliger 47(1):66-81.

Lysne, S.J., L.A. Riley, and W.H. Clark. 2007. The life history, ecology, and distribution of the Jackson Lake springsnail (*Pyrgulopsis robusta* Walker 1908). Journal of Freshwater Ecology 22(4):647-653.

2. Report on the Latin American Entomological Congress and la Sociedad Mexicana de Entomología, Symposium: "Mexican Aquatic Entomology: Current State of Knowledge and Application" held in Acapulco, June 2007

William H. Clark, Idaho Power Company

I was invited to present a paper "The use of macroinvertebrates in assessing biotic integtrity and aquatic conditions in North America and potential for use in Latin America" at the joint VII Congreso Latinoamericano de Entomología y XLII Congreso Nacional de la Sociedad Mexicana de Entomología "Entomología Acuática Mexicana: Estado actual de conocimiento y aplicación." This was billed as the first national symposium on aquatic entomology held in Mexico. Of eight presentations, three were taxonomic and five related to assessment.

A brief history of bioassessment techniques for North America is given with examples from the State of Idaho. EPA's Rapid Bioassessment protocols and Environmental Monitoring and Assessment Program are standard methods for the United States and should be applicable to Latin American waters. The National Water-Quality Assessment Program (Upper Snake River Basin), is a national program of the U.S. Geological Survey and could be a pattern for study in other countries. Idaho has developed methods for reconnaissance sampling and more detailed bioassessment work which should also be useful in Latin America. There is a need to determine reference conditions to use for comparison with impacted waters. Several specialized types of studies and sampling are listed which may also be useful in Latin America. These include the Rock Creek Rural Clean Water Program, the Cedar Draw agricultural pollution study, and Endangered Species Act, threatened and endangered snails on the Middle Snake River. The taxonomy of aquatic insects and other invertebrates in Latin America needs attention. Scientists should always deposit voucher specimens from all aquatic studies in established museum collections so that they are available to further the science. There is a great need to learn more about the biology, ecology, natural history, and pollution-tolerance of aquatic taxa, especially for all instars of a given taxon.

The other seven presentations included: Perla Alonso – "Importancia del estudio de la entomofauna acuática para la conservación y manejo sustentable de los sistemas dulceacuícolas de México;" Ricardo Munguía – "Uso de los macroinvertebrados acuáticos en el monitoreo ambiental de ríos y arroyos;" W. Bruce Campbell – "Innovation in evaluating freshwater macroinvertebrates in Mexico: community – based volunteers and water quality biomonitoring;" Alonso Ramírez – "Biodiversidad de insectos acuáticos y funcionamiento en

los ecosistemas;" Joaquín Bueno – "Tricópteros (Insecta: Trichoptera) del Desierto de los Leones, D.F.;" Atilano Contreras – "Los Megaloptera de México: un grupo pequeño en un país megadiverso;" Rodolfo Novelo – "El estudio de los odonatos (Insecta: Odonata) en México. Enfoques y perspectivas."

3. Update on National Lakes and River and Streams Surveys

Lil Herger, EPA Region 10

I will give an update of the Lakes Survey field sampling conducted this summer in the PNW region. Timelines for lab analyzes and reporting will be discussed. The National Rivers and Stream Survey is a two-year EMAP type sampling effort starting summer of '08. Site distribution, proposed sampling protocols, and indicators will be presented.

4. NABS Taxonomic Certification Program

Gary Lester, EcoAnalysts

5. PNAMP Macroinvertebrate Protocol

Gretchen Hayslip, EPA Region 10

Based on work from the past two NBAW workshops (in Port Townsend and Post Falls), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) has published "Methods for the Collection and Analysis of Benthic Macroinvertebrate Assemblages in Wadeable Streams of the Pacific Northwest". It is available on the PNAMP website (www.pnamp.org).

Combining Multiple EMAP Project Data Sets from Oregon and Washington in the Marine West Coast Forest Level II Ecoregion

Rob Plotnikoff, Tetra Tech

The purpose for this project was to provide a description for how information gathered from multiple EMAP/REMAP (Environmental Monitoring and Assessment Program/Regional Environmental Monitoring and Assessment Program) projects is assembled and interpreted. Benefits from this analysis demonstrated consistency in assessments between differing scales of EMAP and REMAP projects: 1) watershed scale assessment, 2) Level III Ecoregion assessment, and 3) Level II Ecoregion assessment. Results focused on extrapolability for wadeable stream conditions between any two of the three geographic scales. Several important observations for combining and analyzing sets of data from individual EMAP/REMAP projects resulted from this effort:

1. Comparability among project data sets (non-comparability of measured variables),
2. Differing quantities of data among project data sets and the influence on assessments,
3. Implications for including longer time spans in stream assessments (1994-2004), and
4. Recommendations for improving use of EMAP monitoring strategy in assessments.

Stream assessments are useful for regulatory and tribal agencies at landscape scales consistent with their resource jurisdictions (e.g., county, watershed, HUC 6, or ecoregions). Use of the probabilistic site selection strategy enables multiple organizations to share costs for generating data that results in larger assessments. The larger assessments can be partitioned and re-interpreted for use at smaller scales. Coordination of information collection efforts results in a multi-use data set that is generated on the shorter-time frame. Since many of the regulatory and tribal agencies report environmental results on biennial (and sometimes shorter) timeframes coordination among agencies and tribes provides an advantage.

One of the benefits for conducting this Level II ecoregion analysis was to determine how results compared between stream assessments at smaller scales than Level II ecoregions and at larger scales than Level II ecoregions (*e.g.*, EMAP West). Comparisons of results between projects indicate that close assessment estimates for water quality, physical habitat, and biological condition are possible. Greater consistency in results for water quality and physical habitat occurred between the watershed and Level II ecoregion comparison. Agreement was greater for select taxonomic characterizations between the level II ecoregion assessment and the region-wide assessment for all Pacific Northwest mountainous areas. The benefit for this type of application may be realized in generating landscape information within shorter time frames and extrapolation of stream condition assessments to larger management regions (Water Resource Inventory Areas or Salmon Recovery Regions).

The Use of Invertebrates as Bioindicators of Willamette Valley Wetlands

Sarina Jepsen and Celeste Mazzacano, Xerces Society

The Xerces Society conducted a pilot study to assess the feasibility of using invertebrates as bioindicators of Willamette Valley Riverine Impounding wetlands. The goals of this study were to: 1) Identify the taxonomic composition of wetland invertebrate communities in the Willamette Valley, 2) Determine the degree of variability that exists in the invertebrate communities among least-impaired wetlands in a single subclass and single ecoregion, and 3) Begin to identify attributes that vary predictably between least-impaired and most-impaired wetlands. Thirteen wetlands were sampled in early May, ten of which were characterized as least-impaired and three of which were categorized as most-impaired by human activity. The taxonomic community was identified at each site and the most abundant taxonomic groups included: Chironomidae, Amphipoda, Isopoda, Gastropoda, and Oligochaeta. Nematoda and insects in the orders Coleoptera, Odonata, Corixidae, Ephemeroptera and Diptera (non-Chironomids) were also commonly encountered, but were less abundant than the previously listed taxonomic groups. The total number of taxa varied at each site from 8-41. Some of the attributes that should be further tested for use in developing a wetland invertebrate Index of Biological Integrity include: # of Chironomidae genera, Chironomini abundance, # of Odonata genera, Shannon's index of diversity, % Corixidae of total Hemiptera, # of highly tolerant taxa, and abundance.

Biodiversity Assessment in the Calapooia Watershed: Evaluating Conservation Impacts on Frogs, Fish and Bugs in Intermittent Streams and Ponds

Tiffany Garcia, William Gerth, Alan Herlihy, Randy Colvin and Nick Baker, OSU

Agriculture-related land uses and practices have affected the quality and quantity of water in many ecosystems at multiple scales. Agricultural fields are often drained to increase production capacity, altering hydrological regimes in watersheds while eroded soils and agro-chemicals are likely to find their way into neighboring water bodies, which may negatively affect ecosystem function. We seek to quantify linkages between conservation practices and biophysical responses, including water quality and biological indicators (such as aquatic invertebrates, fish, and amphibians). In addition we will develop a model to assess tradeoffs between agricultural practices that maximize economic benefits for producers and conservation actions that sustain or improve ecosystem services. We are only at the end of our first year of work and concrete results are difficult to document at this stage. Preliminary data for the stream and pond surveys will be presented.

Should Only Live Diatoms be Used in Stream Bioassessment?

Nadia Gillett and Yangdong Pan, Portland State University

Conventional diatom analysis in bioassessment does not separate live and dead diatoms in an assemblage. We counted live diatoms (cells with visible chloroplasts) and then compared the counts with those generated using the conventional method (clean counts) to assess if their relationships with the environmental variables would differ. We collected benthic diatom samples from 25 stream sites in the Northern Oregon Coast. A total of 149 species (134 in the clean counts and 90 in the live counts) were recorded. The mean species richness for the clean and live counts was 26 and 19, respectively. The most dominant species were *Achnanthidium minutissimum, Rhoicosphenia abbreviata, A. deflexum, Planothidium lanceolatum, Cocconeis placentula, Gomphonema pumilum* and *Nitzschia inconspicua.* On average, the percentage of live diatoms was 63.4% (range 50.5-79.4%). The diatom assemblages generated from the two counts were

similar overall. The mean Bray-Curtis (BC) similarity between the two counts was 77% (range 60-90%). The relationships between diatom assemblages (summarized as non-metric multidimensional scaling ordination axes) and the environmental variables were similar between the two counts. Both assemblages correlated well with in-stream physical habitat conditions (e.g., stream velocity, channel dimensions, substrate types, and canopy cover). Sites with the lowest BC between the clean and the live counts were narrow and shaded streams with coarse gravel and low algal production. Sites with the highest BC between the clean and the live counts were wide and open streams with small boulders as the dominant substrate and high primary production. In conclusion, despite relatively high proportion of dead diatoms in some diatom assemblages, their relationships with the environmental variables were similar.

Developing a Typology and Biologically Based Nutrient Criteria for Wadeable Streams in the Pacific Northwest

Alan Herlihy and Jean C. Sifneos, OSU

We compiled a database of 921 wadeable streams from the Pacific Northwest (PNW) states of Oregon, Idaho and Washington. Sample sites included measurements of total phosphorus (TP), total nitrogen (TN), water chemistry, physical habitat, macroinvertebrate community metrics, and watershed land use/land cover. Data analysis had three main objectives, examine potential nutrient criteria, develop a stream typology relevant to nutrients, and examine chlorophyll-nutrient relationships.

There was not very good agreement between the population 25th percentile based on the EMAP probability survey of streams and the Office of Water 25th percentiles based on compilations of found data. EMAP 25th percentiles are 40-60% lower than Office of Water percentile for TP in all three nutrient regions and for TP in the Willamette and Western Mountains nutrient ecoregions. There was a wide spread in reference site (undisturbed) nutrient concentrations among level III ecoregions in the Western Mountains nutrient ecoregion. Streams in the Northern Cascades ecoregion had a reference site 75th percentile for total phosphorus of 2 µg/L versus a 75th percentile of 45 µg/L for the Blue Mountains ecoregion (Table 3-5). This indicates that a single nutrient criteria value for the Western Mountains ecoregion is inappropriate**.** There was very little difference in population percentiles of TN and TP between large and small (< 50 km^2 watersheds) streams.

We used regression tree analysis to develop classifications for both total phosphorus (TP) and total nitrogen (TN) at reference sites. Both trees explained slightly less than half of the total deviance (46-48%). The TP tree had 5 classes based on long term runoff, ecoregion location, elevation and acid neutralizing capacity (Table 4-1). The TN tree had 7 classes based on ecoregion location, elevation, substrate size, and % hardwood forest in watershed.

Stream substrate surface chlorophyll-a was measured in the EMAP-West sites in the database. Neither chlorophyll, ash-free dry mass (AFDM), or the ratio of chlorophyll:AFDM was significantly related to streamwater nutrient concentrations alone. Four variable multiple regression models for chlorophyll (r^2=0.16) and chlorophyll:AFDM (r^2=0.33) did not explain the majority of the variance in the data and consisted of a measure of nutrients (either TP or TN), August mean air temperature, substrate size, and channel slope.