

**Comprehensive Exam Prospectus**

**Ph.D. in Environmental Sciences and Resources**

Submitted by: Christine L. Weilhoefer  
February 2002

For Examinations to be taken:  
April 2002

Comprehensive Examination Committee  
Portland State University

Dr. Yangdong Pan  
Dr. Roy Koch  
Dr. Joseph Maser  
Dr. John Rueter

**Approvals**

The Comprehensive Examination proposal submitted herein for Christine L. Weilhoefer is hereby approved.

Examination Committee:

Dr. Yangdong Pan \_\_\_\_\_ Date \_\_\_\_\_

Dr. Roy Koch \_\_\_\_\_ Date \_\_\_\_\_

Dr. Joseph Maser \_\_\_\_\_ Date \_\_\_\_\_

Dr. John Rueter \_\_\_\_\_ Date \_\_\_\_\_

Curriculum Vitae  
Christine Lynn Weilhoefer  
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Portland, OR 97214  
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**Education:**

- 2000 - present *Portland State University, Portland, OR* GPA 3.9  
enrolled in Ph.D. program in Environmental Sciences and Resources  
Awards: EPA STAR Graduate Fellowship (2001 - 2004)  
Oregon Sports Lottery Scholarship (2000 - 2001)
- 1995 - 1998 *University of Texas at Austin, Austin, TX* GPA 4.0  
MA, Marine Science  
Thesis: The effects of freshwater inflow, salinity and nutrients on salt  
marsh vegetation in south Texas.  
Awards: University Graduate Fellowship (1995 - 1996)
- 1990 - 1994 *Connecticut College, New London, CT* GPA 3.9  
BA, Environmental Studies and Botany  
Honors Thesis: Assessment of recent and long-term limnological trends  
in a eutrophic lake in western Connecticut.  
Awards: graduated summa cum laude and with Honors

**Work Experience:**

- 3/00 - 9/01: *Graduate Research Assistant, ESR Dept., Portland State University, Portland, OR*  
Assessment and classification of Oregon Coastal Range ecoregion streams based on diatom  
assemblages as part of the Oregon DEQ Salmon Initiative. Duties included: diatom identification,  
data analysis and result publication.
- 8/00 - 9/01: *Adjunct Professor, The Art Institute of Portland, Portland, OR*  
Responsible for designing the curriculum and teaching the lectures and laboratory activities for  
introductory Environmental Science course.
- 1/01 - 6/01: *Adjunct Professor, Clark College, Vancouver, WA*  
Responsible for teaching lectures and laboratory activities for introductory Biology course.
- 6/95 - 8/98: *Graduate Research Assistant, Department of Marine Science, UT Austin, TX*  
Researched impacts of freshwater diversion and increased nutrient loading on salt marsh vegetation.  
Responsible for data analysis, presentation and publication. Teaching Assistant for Marine Botany and  
Estuarine Ecology courses: designed and supervised lab activities.
- 1/98 - 6/98: *Teaching Assistant, Department of Biological Science, UT Austin, TX*  
Assisted in supervision of laboratory and fieldwork exercises and graded laboratory reports for  
introductory Ecology course.
- 5/94 - 9/94: *Senior Research Intern, The Nature Conservancy/Essex Land Trust, Essex, CT*  
Co-designed and supervised study of Connecticut River shoreline vegetation. Duties included: vegetation  
identification and mapping and creation of management guidelines.

8/93 - 5/94: *Independent Researcher, Department of Botany, Connecticut College, New London, CT*

Assessed the impacts of changing land-use patterns on aquatic ecosystems. Duties included: diatom identification, water chemistry analysis and GIS work.

**Publications:**

Weilhoefer, C. L. and Y. Pan. 2001. Using diatom assemblages to assess freshwater wetland health in the Columbia River Basin, OR (manuscript in prep.).

Weilhoefer, C. L. and Y. Pan. 2001. Using periphyton to assess stream quality in Oregon coastal range streams (manuscript in prep.).

Weilhoefer, C. L. and K. H. Dunton. 2001. Salinity and nutrient regulation of photosynthesis and tissue composition in *Salicornia virginica*. Estuaries (in review).

Weilhoefer, C. L. 1998. Effects of Freshwater Inflow, Salinity and Nutrients on Salt Marsh Vegetation in South Texas. Master's thesis, University of Texas at Austin.

Garnett, C. and C. Weilhoefer. 1994. Essex Shoreline: Vegetation and Management Guide. Published by Essex Land Conservation Trust, Essex, CT.

Weilhoefer, C. L. 1994. Assessment of Recent and Long Term Limnological Trends in a Eutrophic Lake in Western CT. Connecticut College, New London, CT.

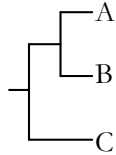
**Research Abstract:**

Can a Biota-Based Model Be Used to Assess Wetland Mitigation?

Research Rationale and Goals: Loss of wetland acreage continues to be a problem in the United States despite the “no net loss” policy advocated by the National Wetlands Policy Forum. Section 404 of the U.S. Clean Water Act calls for mitigation of wetland acreage lost as a result of development activities. Wetland mitigation has become a common practice, but successful restoration has not been well documented. The imperiled status of wetlands warrants a scientifically based method to assess the success of wetland mitigation projects. One of the key elements in undertaking a study of mitigation wetlands is having a reference standard for comparison of ecological structure and function. Reference wetlands should exhibit typical, pre-disturbance conditions for the study area. However, reference wetlands may differ from one another based on key abiotic factors that can cause changes in wetland structure even in the absence of environmental stress. This can confound their utility to serve as benchmarks for mitigation success. The goal of my dissertation research is to develop a predictive model for assessing the success of mitigated wetlands.

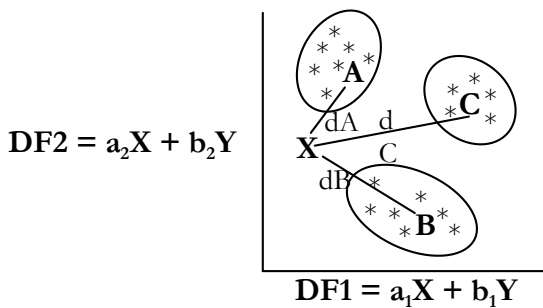
Approach: My dissertation research will consist of three main steps:

1. Develop a biota-based classification system to account for heterogeneity of natural wetlands. This will be accomplished by classifying natural wetlands into several biologically similar groups based on diatom assemblages.



2. Identify a suite of environmental variables that can best be used to distinguish among groups using multiple discriminant function analysis. This discriminant function will also serve as a predictive tool.

3. By predicting what group a mitigated wetland falls into, the discriminant function model will be able to predict the species membership for that site based on its environmental conditions. A comparison of the expected species with the observed species (O/E ratio) will provide a measure of success of mitigation because it tells how closely the biotic component compares with reference wetlands of similar environmental characteristics.



X, Y: environmental variables

a, b : discriminant function coefficients

**Graduate Course Work:**

Course	Instructor	Term	Credits	Grade
ESR 529: Environmental Impact Assessment	Maser	Winter 2002	4	In progress
ESR 601: Res: Wetland Algae	Pan	Winter 2002	4	In progress
ESR 607: Environmental Science Seminar	Ervin	Winter 2002	1	In progress
G 510: Geomicrobiology I	Cady	Fall 2001	4	A
ESR 601: Res: Wetland Ecology	Pan	Fall 2001	4	A
ESR 607: Environmental Science Seminar	Koch	Fall 2001	1	Pass
ESR 510: Algal physiology	Rueter	Spring 2001	4	A
ESR 527: Terrestrial biogeochemistry	Yeakley	Spring 2001	4	A-
ESR 601A: GA Research	Pan	Spring 2001	6	P
ESR 607: Environmental Science Seminar	Staff	Spring 2001	1	Pass
BI 523: Microbial Ecology	Reysenbach	Winter 2001	4	A
ESR 525: Watershed Hydrology	Koch	Winter 2001	4	A
ESR 601A: GA Research	Pan	Winter 2001	6	Pass
ESR 607: Environmental Science Seminar	Staff	Winter 2001	1	Pass
ESR 510: Biostatistics	Koch	Fall 2000	4	A
G 543: Groundwater Geology	Fountain	Fall 2000	4	A
ESR 607: Environmental Science Seminar	Staff	Fall 2000	1	Pass
ESR 510: Water Quality Problem Solving	Fish	Spring 2000	4	A
ESR 524: Wetland Ecology and Management	Maser	Spring 2000	4	A
ESR 601: Stream Research	Pan	Spring 2000	1	A
ESR 601A: GA Research	Pan	Spring 2000	6	Pass

**Areas of Expertise:**

**Major Area: Aquatic Ecology**

G 510	Geomicrobiology I	Dr. Cady
ESR 510	Algal Physiology	Dr. Rueter
BI 523	Microbial Ecology	Dr. Reysenbach
ESR 524	Wetland Ecology	Dr. Maser
ESR 601	Res: Wetland Algae	Dr. Pan
ESR 601	Res: Wetland Ecology	Dr. Pan
ESR 601:	Res: Stream Research	Dr. Pan
ESR 527	Terrestrial Biogeochemistry	Dr. Yeakley
ESR 525	Watershed Hydrology	Dr. Koch
G 543	Groundwater Geology	Dr. Fountain
ESR 510	Biostatistics	Dr. Koch

**Minor Area: Ecological Restoration**

ESR 529	Environmental Impact Assessment	Dr. Maser
ESR 524	Wetland Ecology and Management	Dr. Maser
ESR 510	Water Quality Problem Solving	Dr. Fish

## Topic for Exam Questions:

### Area 1: Algal Ecology and Bioassessment: (Dr. Pan)

Key Topics: hierarchical concept of ecosystems, ecological heterogeneity, periphyton pattern in freshwater wetlands, interactions between benthic algae and their substrata, ecological integrity, reference condition, paleolimnology

### Area 2: Wetland Ecology and Management: (Dr. Maser)

Key Topics: wetland ecosystem development, wetland classification (HGM), wetland legislation (federal and Oregon State), freshwater wetland mitigation (restoration, creation, enhancement)

### Area 3: Hydrology: (Dr. Koch)

Key Topics: flow patterns (overland flow, subsurface flow, base flow), aquifer properties (i.e. porosity, hydraulic conductivity, specific yield), Darcy's Law, hydrograph,

### Area 4: Physiology/Biogeochemistry: (Dr. Rueter)

Key Topics: algal growth and nutrient uptake, optimization, biogeochemical cycles (C, N, P), soil chemical reactions, soil structure/development, species interactions (i.e. competition),

### Area 5: (Statistics)

Key Topics: normal distribution, binomial/Poisson distribution, data types (i.e. categorical, continuous, nominal), hypothesis testing (single group, two group, multiple group comparisons), correlation, regression (simple linear, multiple), concepts of multivariate statistics

### Reference List:

Dingman, S. L. 1994. Physical Hydrology. Prentice-Hall, Inc., Upper Saddle River, USA.

Fetter, C. W. 1994. Applied Hydrology. Prentice-Hall, Inc., Upper Saddle River, USA.

Kolasa, J. and S. T. A. Pickett (eds). 1991. Ecological Heterogeneity. Springer-Verlag, New York, USA.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands. Van Nostrand Reinhold, New York, USA.

O'Neill, R. V., DeAngelis, D. L., Waide, J. B. and T. F. H. Allen. 1986. A Hierarchical Concept of Ecosystems. Princeton University Press, Princeton, USA.

Reynolds, C. S. 1984. Photosynthetic activity of phytoplankton. Chapter 4 in C. S. Reynolds, The Ecology of Freshwater Phytoplankton. Cambridge University Press, Cambridge, England.

Rueter, J. G. 1993. Limitation of primary productivity in the oceans by light, nitrogen and iron. P126-135 in H. Y. Yamamoto and C. M. Smith (eds). Photosynthetic Responses to the Environment.

Schlesinger, W. H. 1997. Biogeochemistry. Academic Press, San Diego, USA.

Stevenson, R. J., Bothwell, M. L. and R. L. Lowe. 1996. Algal Ecology. Academic Press, San Diego, USA.

Zar, J. H. 1999. Biostatistical Analysis. Prentice Hall, Upper Saddle River, USA.

## APPENDIX: Course Syllabi and Reading Lists

(only syllabi for courses not taught by committee members provided)

### Area 2: Wetland Ecology and Management

ESR 524 Wetland Ecology: Dr. Maser

Text: Wetlands, 2<sup>nd</sup> edition, W. J. Mitsch and J. G. Gosselink

### Area 3: Hydrology

1. ESR 525 Watershed Hydrology: Dr. Koch

Text: Physical Hydrology, 1<sup>st</sup> edition, S. L. Dingman

2. G 543 Groundwater Geology: Dr. A. Fountain

Text: Applied Hydrogeology, 3<sup>rd</sup> edition, C. W. Fetter

1. Hydrologic Cycle (pp 1-11, 27-70)
2. Definitions and Properties of Aquifers (pp 77-102)
3. Flow Equations (pp 103-126; 131-153)
4. Aquifer Tests (pp154-171; 197-264)
5. Regional Groundwater (pp275-308)
6. Groundwater Geology (pp319-377)
7. Unconfined Flow (pp163-170)
8. Unsaturated Flow (pp175-191)

### Area 4: Physiology/Biochemistry

1. ESR 510 Algal Physiology: Dr. J. Rueter

Readings:

Falkowski, P. G. and J. A. Raven. 1997. Aquatic Photosynthesis. Blackwell Science, Malden, USA.

Kirk, J. T. O. 1994. Light and Photosynthesis in Aquatic Ecosystems. Cambridge University Press, Cambridge, England.

Reynolds, C. S. 1988. Functional morphology and the adaptive strategies of freshwater phytoplankton. p. 388 – 433 in C. D. Sandgren, ed. Growth and reproductive strategies of freshwater phytoplankton.

Reynolds, C. S. 1993. The Ecology of Freshwater Phytoplankton. Cambridge University Press, Cambridge, England.

Rueter, J. G. 1993. Limitation of primary productivity in the oceans by light, nitrogen and iron. p. 126-135 in H. Y. Yamamoto and C. M. Smith, eds. Photosynthetic Responses to the Environment.

Shuter, B. 1979. A model of physiological adaptation in unicellular algae. *Journal of Theoretical Biology* 78:519-552.

Turpin, D. H. Physiological mechanisms in phytoplankton resource competition. Chapter 8 in C. D. Sandgren, ed. Growth and Reproductive Strategies of Freshwater Phytoplankton. Cambridge University Press, Cambridge, England.

2. ESR 527 Terrestrial Biogeochemistry: Dr. A. Yeakley

Topics:

- (1) Earth as a biogeochemical system, atmospheric processes
- (2) Lithosphere and soil processes
- (3) Carbon cycling
- (4) Biogeochemical processes in terrestrial ecosystems
- (5) Hydrology and chemistry of forested ecosystems
- (6) Nutrient cycling of forested ecosystems
- (7) Biogeochemical processes in riparian zones
- (8) Management Considerations

Texts:

- A. Biogeochemistry- W. H. Schlesinger (ch 1, 3, 4, 5, 6)
- B. Biogeochemistry of a Forested Ecosystem. 1997. Likens, G. E. and F. H. Bormann.

Papers:

- Driscoll, C. T. et al. 2001. Acidic deposition in the Northeastern United States: sources and inputs, ecosystem effects, and management strategies. *BioScience* 51:180-198.
- Henderson, G. S., Swank, W. T., Waide, J. B. and C. C. Grier. 1978. Nutrient budgets of Appalachian and Cascade Region watersheds: a comparison. *Forest Science* 24:385-397.
- Hornbeck, J. W. and W. T. Swank. 1992. Watershed ecosystem analysis as a basis for multiple-use management of eastern forests. *Ecological Applications* 2:238-247.
- Sollins, P., Grier, C. C., McCorison, F. M., Cromack, K., Jr., Fogel, R. and R. L. Fredriksen. 1980. The internal element cycles of an old-growth Douglas-fir forest ecosystem in western Oregon. *Ecological Monographs* 50:261-285.

3. Bi 523 Microbial Ecology: Dr. A. Reysenbach

Course Topics: Basic ecology definitions, overview of microbial diversity, species concept, methods in microbial ecology, population ecology and biogeography, community ecology, productivity and diversity, biogeochemical cycles (C, N, O, S, Fe, P, Mn)

Readings from:

- Microbial Ecology, 4<sup>th</sup> edition, Atlas, R. M. and R. Bartha
- Ch 3: Interactions among microbial populations
- Ch 4: Interactions between microorganisms and plants
- Ch 7: Quantitative ecology: numbers, biomass and activities

Papers:

- Bordenstein, S. R., O'Hara, F. P. and J. H. Warren. 2001. *Wolbachia*-induced incompatibility preceded other hybrid incompatibilities in *Nasonia*. *Nature* 409:707-710.
- Hambright, K. D. and T. Zohary. 2000. Phytoplankton species diversity control through competitive exclusion and physical disturbances. *Limnology and Oceanography* 45:110-122.
- Kassen, R., Bucling, A., Bell, G. and P. B. Rainey. 2000. Diversity peaks at intermediate productivity in a laboratory microcosm. *Nature* 406:508-512.
- Kaunzinger, C. M. and P. J. Morin. 1998. Productivity controls food-chain properties in microbial communities. *Nature* 395:495-497.
- Strassmann, J. E. 2000. Bacterial cheaters. *Nature* 404:555-556.
- Velicer, G. J., Kroos, L. and R. E. Lenski. 2000. Developmental cheating in the social bacterium *Myxococcus xanthus*. *Nature* 404(6):598-600.
- Wade, M. J. 2001. Infectious speciation. *Nature* 409:675-677.

**Area 5: Statistics**

**ESR 510 Biostatistics: Dr. R. Koch**

Text: Biostatistical Analysis, J. H. Zar