Syllabus

Spring Semester

AREC 200: The Chesapeake Bay Ecosystem: Intersection of Science, Economics and Policy

The Chesapeake Bay is the largest estuary in the United States. Its watershed encompasses 64 thousand square miles, and is inhabited by 16.6 million people living in 6 states and the District of Columbia. Man's impact on the Bay is evidenced in sediment core samples dating back to the pre-Columbian era, but is most evident in the current impairments in water quality and the health of its living resources. Since the historic Chesapeake Bay Agreement signed in 1983, millions of dollars have been spent on better understanding the functioning of the Bay ecosystem and in trying to restore it to some former level of health and function. While progress has been made in some areas, it is generally held that the effort to restore the Bay has failed to this point.

In this course, students will learn about the unique aspects of the Chesapeake Bay ecosystem and the vexing economic and policy challenges that have limited our ability to meet restoration goals. Specifically, they will learn about economic techniques that can be used to understand the complexities of Bay restoration. They will see how these techniques are used to understand the economic benefits that may accrue from Bay restoration including commercial and recreational fishing values as well as aesthetic and non-use values. They will learn about sources of Bay pollution, the costs of controlling that pollution and different economic policies to achieve the pollution reduction goals. Special topics will include other important environmental topics such as climate change and its impact on Bay restoration, invasive species management and ecosystem based approaches to fisheries management being implemented in Chesapeake Bay.

At the conclusion of the course, students will have a greater appreciation of the complexities of achieving ecosystem restoration, particularly in relation to economic and policy constraints. Students who develop an interest for technical applications such as ecology or ecosystem modeling will understand the context in which those tools can be applied. Others may become interested in delving deeper into what they learned and pursue economics, environmental management or policy as a major.

Prerequisites: NONE

Course Structure and Format: The course will primarily be taught in a lecture format. Some guest lectures will be provided by Bay Program leaders and other Chesapeake Bay stakeholders. A few discussion and review sessions will be led by Teaching Assistants on certain topics. All examinations will be written with homework assignments or take home exams after the major topics (see outline), a mid-term exam and final. A group learning activity detailed below will entail preparation of 3 short papers during the semester, culminating in a power point presentation by the group. Grading will be based on the exams, and group and homework assignments. Regular homework will account for 20% of the grade, the group assignment for 25%, mid-term 25% and final 30%.

Active Learning Component – Economics and Tributary Strategies
Background: One of the ways Maryland is doing its part to restore the Chesapeake Bay Ecosystem is to divide the region into 10 major tributaries and develop a strategy for nutrient and sediment reduction for each tributary through the creation of Tributary Teams. The intent of this learning exercise is to build on the work of the Tributary Teams by utilizing economic tools and methods to analyze the issues and develop solutions for implementation. Students will self-select into one of 10 teams (number of teams may change depending on class size) that will be required to complete 3 short paper assignments during the semester that will culminate in a power point presentation to the class near the end of the term. Most of the organization of this assignment and team activity will occur during the one hour per week discussion period.

Team Project:

Paper Assignment #1: Describe the major characteristics of the selected tributary watershed, building on what the tributary teams have already done and researching and including additional important descriptive information not included in the Tributary Team descriptions or materials. Include:

a. General description of tributary and watershed
b. Major sources of nutrient and sediment loads
c. Recent trends in nutrient and sediment loads
d. What economic factors are contributing to trends in nutrient and sediment loads?

Paper Assignment #2: Describe strategies being proposed for nutrient and sediment reduction, and discuss the potential costs. Can you propose alternative market-based mechanisms to achieve nutrient and sediment reduction goals?

Paper Assignment #3: What are the potential benefits, both local and baywide, if nutrient and sediment reduction goals are achieved?

a. What are the major market benefits?
b. Choose one major area where market benefits are expected to be large and describe how you would go about trying to measure the benefits.
c. What are the major non-market benefits?
d. Choose one major area where non-market benefits are expected to be large and describe how you would go about trying to measure the benefits.

End of Semester Presentation: Group powerpoint presentation of 30 minutes based on the paper assignments. Describe the tributary you are working in and make the case to the class that the benefits of achieving nutrient and sediment reduction goals are greater than the cost. Discuss what policies you would use to get the greatest benefit at the lowest possible cost.

Availability for Students: Both professors teaching the course will keep regular office hours dedicated to this class during the semester to meet one-on-one with students or with groups wanting to discuss the group project. The schedule of office hours will be determined once the

course is scheduled, but will consist of a minimum of two hours per professor. We will also be available, by appointment, outside of regular office hours, and of course by telephone and email.

Other: Information about accommodation of students with disabilities as well as academic integrity and the honor code will be included in the final course syllabus made available to students.

The Chesapeake Bay Ecosystem: Intersection of Science, Economics and Policy
Course Outline

1. Overview of the Chesapeake Bay Ecosystem – As an introductory level course, it is assumed that most students will have limited knowledge about the Chesapeake Bay ecosystem, estuarine and watershed science. This brief overview will provide sufficient knowledge about this topics to make the specific case studies of economic and policy issues more meaningful.
    a. Estuarine Processes and Chesapeake Bay
    b. The Chesapeake Bay Watershed
        i. Land, air and water interactions
        ii. Historical and current land use
        iii. Population growth
    c. The Issues
        i. Nutrient and Sediment Pollution
        ii. Habitat Loss
        iii. Toxic Chemicals and Heavy Metals
        iv. Fisheries

2. Governance and Policy to Restore Chesapeake Bay – Students will learn about the history of the Bay Program and other regulations that currently impact decision making for Bay restoration. Existing and future legislation and regulation will be the mechanism through which innovative economic and policy analysis will influence the course of Bay restoration.
    a. The Chesapeake Bay Program
        i. Tributary Strategies
        ii. TMDLs
    b. The Regulatory Environment
        i. Clean Water Act
        ii. Clean Air Act
        iii. Coastal Zone Management

3. Valuing the Environment – How does one go about the seemingly impossible task of placing a value on restoring Chesapeake Bay? This section will explain valuation and willingness-to-pay. It will differentiate between Use Values, Option Values and Nonuse Values (Existence Value). This section will then develop the foundation for the techniques resource economists have developed to use observation of actual choices as well as stated preference choices to estimate environmental and ecosystem values.
    a. Productive values – fisheries
    b. Revealed preference methods
    c. Recreational values – travel cost and recreation demand
    d. Hedonic pricing – property values
    e. Replacement cost – habitat restoration
    f. Contingent valuation
    g. Competing values for Land
        i. Agricultural
        ii. Developed
        iii. Forested
    h. Using values in policy
        i. Benefit-Cost Analysis
        ii. Cost Efficiency
        iii. Economic Impact Analysis

4. Reducing pollution
    a. Economics of environmental externalities (agricultural, wastewater, atmospheric deposition , urban pollution sources)
        i. Point Sources vs. Nonpoint Sources
        ii. Property Rights
        iii. Public Goods and Open Access Goods
            1. Tragedy of the Commons
        iv. Opportunity Costs
    b. Waste water treatment plants
        i. Technology upgrades
        ii. Source control (phosphorus ban)
    c. Stormwater control
    d. Agricultural pollution control
        i. BMPs
        ii. Nutrient Management
        iii. Source control
    e. Nutrient trading
        i. EPA and the States
        ii. Market scope
        iii. Trading Program Design

5. Natural resource management – This section will provide a background in traditional fisheries management with an emphasis on unique Chesapeake Bay resources. Traditional effort and quota management will be compared with alternative rights-based management options.
    a. Chesapeake Bay fisheries
        i. Restoring Oysters
        ii. Striped bass –management success story
        iii. Blue crab
        iv. Ecosystem based management, a new paradigm
    b. Aquaculture (fish farming vs. natural fisheries)

6. Population and the watershed
    a. Land use – open space and development
        i. Maryland farmland preservation programs
    b. Urban development
        i. Smart growth
        ii. Traffic congestion, congestion pricing, HOT lanes

7. Special Topics (Will be included if time allows)
    a. Climate Change
        i. Sea level rise
        ii. Habitat loss
        iii. Shoreline protection
        iv. Storm events, changes in frequency and magnitude, runoff & water quality
    b. Invasive and Non-native Species
        i. Invasive species
            1. Nutria, mute swan, zebra mussel, non-native aquatic plants
        ii. Non-native
            1. Asian oyster

8. Looking to the Future

a. Recent developments in policy
    i. TMDLs
    ii. Executive Order
    iii. Milestones
b. Where should this effort go from here?

Textbooks: Due to the broad scope of this course, no appropriate text book exists for use in the course. Assigned readings, many available for free download on the web will form the basis for most of the lectures for the course. A list of sample readings are attached, but these will be developed and refined further during the next few months in preparations for the class.

Readings for Economics and Policy of the Chesapeake Bay Ecosystem

Abdalla, Charles, Tatiana Borisova, Doug Parker, and Kristen Saacke-Blunk, "Water Quality Credit Trading and Agriculture: Recognizing the Challenges and Policy Issues Ahead," *Choices*, Second Quarter 2007: 22(2), 117-124.

Blunk, K.S., Borisova, T., Abdalla, C. and Parker, D., "A Primer on Water Quality Credit Trading in the mid-Atlantic Region," November 2006.

Chesapeake Bay Commission, "Cost Effective Strategies for the Bay" December 2004: http://www.chesbay.state.va.us/Publications/cost%20effective.pdf

Chesapeake Bay Foundation Website: www.cbf.org

Chesapeake Bay Program Website: www.chesapeakebay.net

Chesapeake Bay Watershed Blue Ribbon Finance Panel. 2004. Saving a National Treasure: Financing the Cleanup of the Chesapeake Bay. A Report to the Chesapeake Executive Council.

Lichtenberg, E., Parker, D., and Lynch, L., "Economic Value of Poultry Litter Supplies in Alternative Uses," Center for Agricultural and Natural Resources Policy, October, 2002

Lipton, D.W. Economic Benefits of a Restored Oyster Fishery in Chesapeake Bay. Journal of Shellfish Research 27(3)619-623. 2008.

Lipton, D. and S. Kasperski. Chapter 4. Estuarine Restoration and Commercial Fisheries. In: The Economic and Market Value of Coasts and Estuaries: What's At Stake? (L. Pendleton, ed.) Published by Restore America's Estuaries. Washington, DC. 2008. pp. 65-81.

Lipton, D.W. The value of improved water quality to Chesapeake Bay boaters. Marine Resource Economics. 19(2):265-270. 2004.

Lipton, D.W. and R.Hicks. The cost of stress: Low dissolved oxygen and recreational striped bass (*Morone saxatilis*) fishing in the Patuxent River. *Estuaries* 26(2a):310-315. 2003.

Lynch, Lori, Selected articles on agricultural land preservation

Non-Native Oyster Environmental Impact Statement (various sections)

Parker, Doug, "Alternative Uses for Poultry Litter," *Economic Viewpoints*, Department of Agricultural and Resource Economics, University of Maryland, (3)1 Summer 1998.

Sanchirico, J.N., M.Smith and D. Lipton. Managing fish portfolios. *Resources.* Resources for the Future. Winter 2007 pp3-4.

Scientific and Technical Advisory Committee. 2008. Climate Change and the Chesapeake Bay State-of-the-Science Review and Recommendations. (various sections)

Secchi, Silvia, Manoj Jha, Lyubov Kurkalova, Hongli Feng, Philip Gassman, and Catherine Kling, "Privatizing Ecosystem Services: Water Quality Effects from a Carbon Market." *Choices*, Second Quarter 2007: 22(2), 97 - 102.

USGS. Synthesis of U.S. Geological Survey science for the Chesapeake Bay ecosystem and implications for environmental management. (Scott W. Phillips, editor.) 2008. (various chapters)