

ASSIGNMENT HANDOUTS

HOMEWORK ASSIGNMENT 1: READING SUMMARY OF OSTROM (2009)

Read 1) Ostrom, E. (2009) A general framework for analyzing sustainability of social-ecological systems. *Science*. 325:419-422

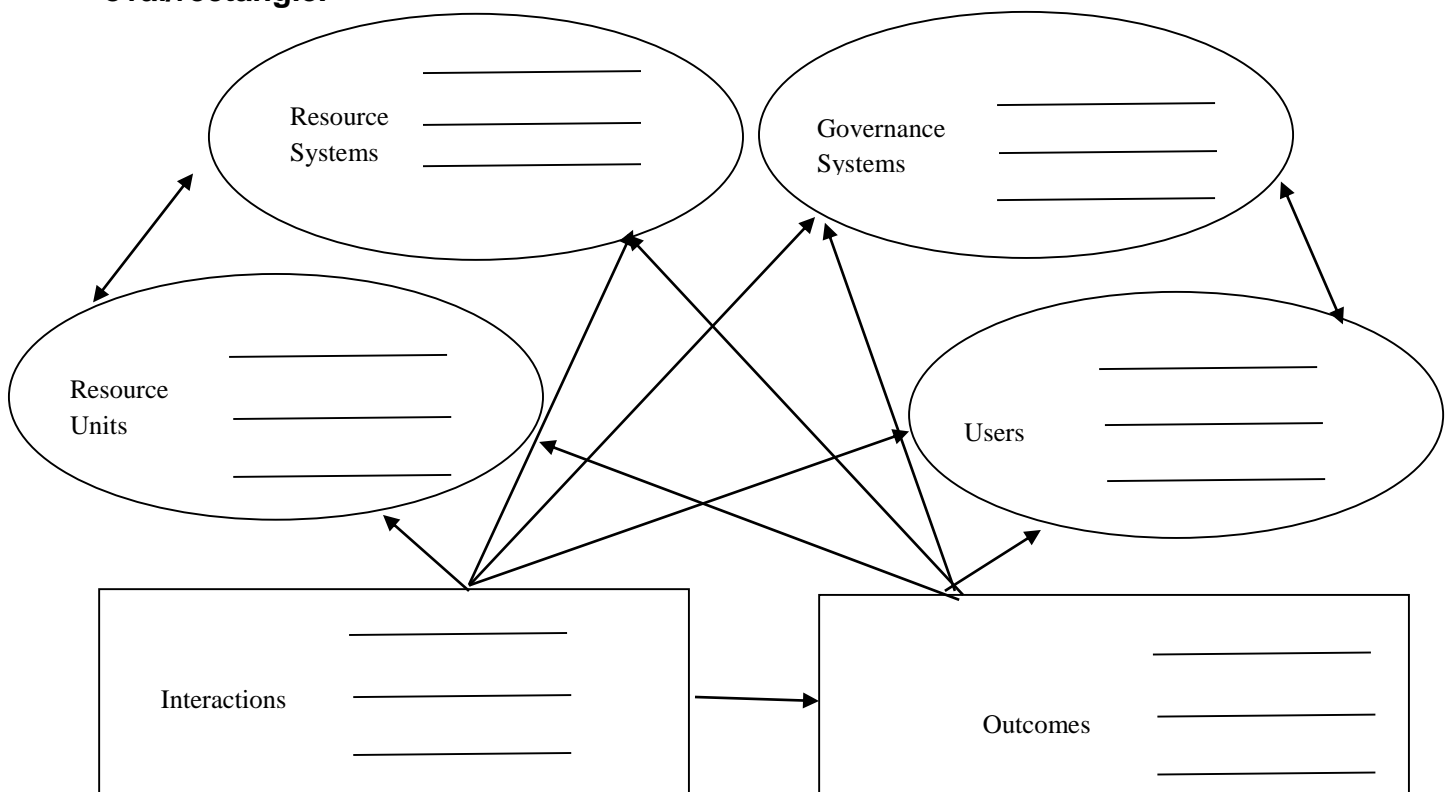
2) Ahearn, A. (2012) Farming geoducks: a mixed bag for tidal critters. Oregon Public Broadcasting. <http://earthfix.opb.org/water/article/geoduck-farming-heddy/> March 6, 2012, KUOW.

Complete the following questions based on the readings.

Define any new terms that you learned:

Summarize, in bullet points, what you perceive to be the key points of the Ostrom article:

Based on OPB article and the class discussion, what are some of the components of the social –ecological system for understanding geoduck aquaculture that would fit into Figure 1 and Table 1 of the Ostrom paper? Identify at least two components per oval/rectangle.



HOMEWORK ASSIGNMENT 2: SYSTEMS MAP OF GEODUCK AQUACULTURE IN PUGET SOUND

Step 1. For this assignment, you will take the System Map that you and a classmate designed in class and put that map into CMAP (<http://cmap.ihmc.us/>). CMAP is free software that you will have to sign up for and download onto your computer. It allows you to define important components and relationships of a social-environmental system. If you have problems with the CMAP software, see this video demonstration (https://www.youtube.com/watch?v=TMNq_oCFyi8) or contact me.

Step 2. In this case, you will be developing the system map for geoduck aquaculture in Puget Sound. You will use your basic map from Assignment 1, your in-class map, and any other components that you have identified through the lectures and other materials in this class to identify important components of the social-environmental system in terms of resource systems, governance systems, resource units and users. You should save this as a CMAP file and also export the systems map as an image file (.jpg).

Step 3. Please identify at least four (4) components of each of these categories and at least one connection between each of those components in the table below and in the map.

Category	Component (e.g. fisheries, WDNR, beach, landowners)	Connection (e.g. landowners <u>pay extra to live near the beach</u>)	Other Component (e.g. fisheries, WDNR, beach, landowners)
Resource Systems			
Governance Systems			
Resource Units			
Users			

Step 4. You should print two copies of the map and the table: one for submission to me at the beginning of the class (NEXT CLASS IN WHICH S-E WILL BE DISCUSSED) and one for your own use in subsequent classes.

Grading Rubric for Assignment #2 (50 points total)

CONTENT:	4	3	2	1
Four components/ category (2 points each, 32 total)	Relevant components are identified for each category			Components were not identified and/or were not appropriate
Relevant connections identified (1 point each, 16 total)	Connections are well-thought out and represent actual connections in the S-E system			Connections were not identified or were not relevant to the S-E system
Mechanics (2 points total): -format -grammar & spelling	Format and grammar are correct in both the table and the map			Substantial grammatical or format errors in the table and/or map
TOTAL SCORE: 50 points possible				

HOMWORK ASSIGNMENT 3: WHITE MEMO AND SUB-SYSTEM MAP OF ONE COMPONENT OF THE S-E SYSTEM

In a group of 3-5 students, prepare a white paper and a sub-system map of your assigned component of the S-E system. White papers are reports that aim to provide information for readers to understand an issue, solve a problem, or make a decision. White papers are often used by government agencies and businesses. The intended audiences are governmental officials, legislators, business managers, and other decision-makers. Your component will be assigned, and may be the: ecological, environmental, economic, social, cultural, or policy dimension.

The objective of the white paper assignment is to write a two-page memo that identifies the key factors (processes, stakeholders, etc.) of one component of the S-E system. On the third page, include a sub-system map of the component. Each white paper should include the following elements:

- A summary.
- A bullet point list of key factors (at least five) of the component.
- For each factor, list key information.
- Consult the list of references the instructor has prepared and use at least two additional resources. White memos should draw on at least five different published sources. Correctly cite references and list references in a References section at the end of the memo.
- Include 2-3 images that illustrate key factors in the component. Include image captions and citations for each image.
- White memos should be well-written, spell-checked, organized, and concise.
- White memos should be 2 pages in length, with 1" margin, 11 pt font, single spacing, and 6 pt spacing before and after paragraphs (not for the references section). References and images are included in the 2-page limit.
- On the third page, include a sub-system map of the component. The sub-system map and the white memo should be complementary to each other. Each map should have at least five factors and connections between key factors mapped out. Include a short paragraph tracing the connections between the key factors. The map should be prepared using CMAP.

Grading Rubric for Assignment #3 (Total Points: 20 Points)

Criteria	Points	Ratings			
		4	3	2	1
Identifying key factors in a sub-system	5	Identifies at least 5 key factors in a sub-system. The list of factors covers the component thoroughly. Information for each of the key factors is well presented.			Identifies at less than 1 key factor in a sub-system. No attention to assignment requirement.
Organization and quality of writing	5	Follows the format requirements. The information is well-organized. The writing is nearly flawless and concise.			No attention to organization and structural requirements. Writing does not meet college-level standards.
Research and additional resources	3	5+ sources of which 2+ are additional sources. In-text citations and References list with correct formatting.			Uses less than 1 source. Missing citations or references.
Use of images	2	Images chosen are great match for topic and help illustrate the points of the memo. Include 2+ images with correct caption and citation.			No images. Missing captions or references.
Sub-system map	5	Includes at least 5 key factors and factors are connected in a meaningful way. The list of connections is complete. Map is organized and prepared with CMAP.			Includes less than 1 key factor and no connections are mapped. The list of connections is missing. No attention to assignment requirement.

Example of a White Memo for the Ecological Component

Ecological Component of the Geoduck Aquaculture Case¹

Summary

Five key factors are identified for the ecological component of the geoduck aquaculture case: water quality, aquaculture structures, harvest, cultured-wild interactions, and diseases. Other than water quality, which improves with aquaculture, there are negative impacts among the other factors in the ecological sub-system of the geoduck aquaculture case. Key information is listed in this white memo along with a sub-system map at the end.

Key Factors

- **Water Quality**

- Filter feeding removes nitrogen and phosphorus from the water column, and these nutrients may ultimately be removed from the ecosystem via harvest. As a result, geoduck aquaculture can improve water quality and mitigate eutrophication pressure in coastal systems (Cornwell et al. 2013)
- Filter feeding removes inorganic particles from the water column and thus reduces turbidity. The reduced turbidity results in deeper light penetration, which can improve the condition for submerged aquatic vegetation (Cornwell et al. 2013).

- **Aquaculture structures**

- Geoduck aquaculture involves outplanting juvenile geoducks in PVC tubes covered with nets for protection (Figure 1). These structures enhance habitat complexity and reduce interactions among competitors and currently research has found little influence of the structures on resident benthic macrofauna; however, the effects on the abundance and composition of transient macrofauna are significant (McDonald et al. 2012).

- **Harvest**

- Geoducks are harvested using pressurized water to quickly liquefy the sediment (Figure 2). This process produces disturbances such as displaced sediments, changes in sediment water content, and chemical modification of the sediment. Such disturbances may impact infaunal densities, population dynamics, productivity, and biodiversity (Price et al., 2012).



Figure 1: Aquaculture structure
(Source: Washington Sea Grant)



Figure 2: Geoduck harvesting using pressurized water at low tide (Source: Washington Sea Grant)

¹ The Geoduck Research Program 2009-2013 was funded by the Washington Sea Grant, which convened experts on shellfish research and published several reports and journal articles. The research program website (<http://wsg.washington.edu/research/geoduck/>) is a good starting point for researching the ecological component of the geoduck aquaculture case.

- **Cultured-Wild Interactions**

- Wild geoduck populations have high levels of genetic variability that could be perturbed by an influx of cultured genotypes. Minimizing gene flow between cultured and wild populations is the key to maintaining natural genetic variability in wild geoducks (Straus et al. 2013).
- Broodstock may be collected from distant geographic points. Even if broodstock are collected locally, hatchery populations may differ from wild populations owing to random genetic drift or different selective pressures in the hatchery. These differences may reduce the fitness of cultured geoducks and cultured–wild hybrids in the natural environment (Straus et al. 2013).

- **Diseases**

- Crowding, temperature fluctuations, inadequate dissolved oxygen, excessive handling, inadequate diets, or toxic substances may stress the cultured bivalves. When the level of stress exceeds the ability to adjust, susceptibility to disease occurs (Straus et al. 2013)
- Presence of several previously unreported parasites in Puget Sound geoducks has been found and special attention needs to be paid to the management of the host and the microenvironment of the parasite (Dorfmeier et al. 2012).

References

Cornwell, J., Friedman, C., McDonald, P., Ruesink, J., Vadopalas, B., VanBlaricom, G. (2013). Geoduck Aquaculture Research Program Final Report to the Washington State Legislature. Washington Sea Grant Technical Report WSG-TR 13-03.

Dorfmeier, E., Vadopalas, B., Friedman, C., Strenge, R., Elston, R., Frelter, P., and Olden, J. (2012). Multivariate Statistics Reveal Seasonal Patterns in Pacific Geoduck (*Panopea Generosa*) Disease in the Pacific Northwest. *Journal of Shellfish Research*, 31(1): 277-277.

McDonald, P., Stevick, P., Galloway, A., McPeck, K., Armstrong, D., and VanBlaricom, G. (2012). Nekton, Nets, and Tubes: Macrofauna Response to Intertidal Geoduck Aquaculture Operations in Puget Sound, Washington, USA. *Journal of Shellfish Research*, 31(1): 320-320.

Price, J., VanBlaricom, G. McDonald, P. (2012). Effects of Harvest Activity on Infaunal Communities in Geoduck Clam Aquaculture Plots in Southern Puget Sound, Washington, USA. *Journal of Shellfish Research*, 31(1): 334-334.

Straus, K., McDonald, P., Crosson, L., and Vadopalas, B. (2013). Effects of Geoduck Aquaculture on the Environment: A Synthesis of Current Knowledge. Produced for the 2013 Washington State Legislature. Washington Sea Grant Technical Report WSG-TR 13-02.

Images: National Oceanic and Atmospheric Administration Website:

<http://seagrant.noaa.gov/News/FeatureStories/TabId/268/ArtMID/715/ArticleID/167/Washington-Sea-Grant-Releases-Final-Geoduck-Aquaculture-Report.aspx>

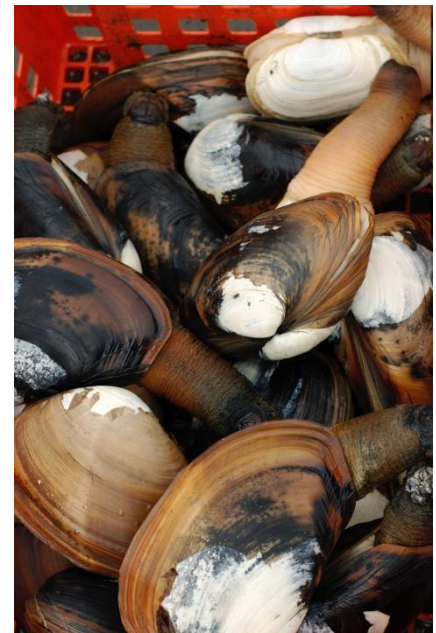
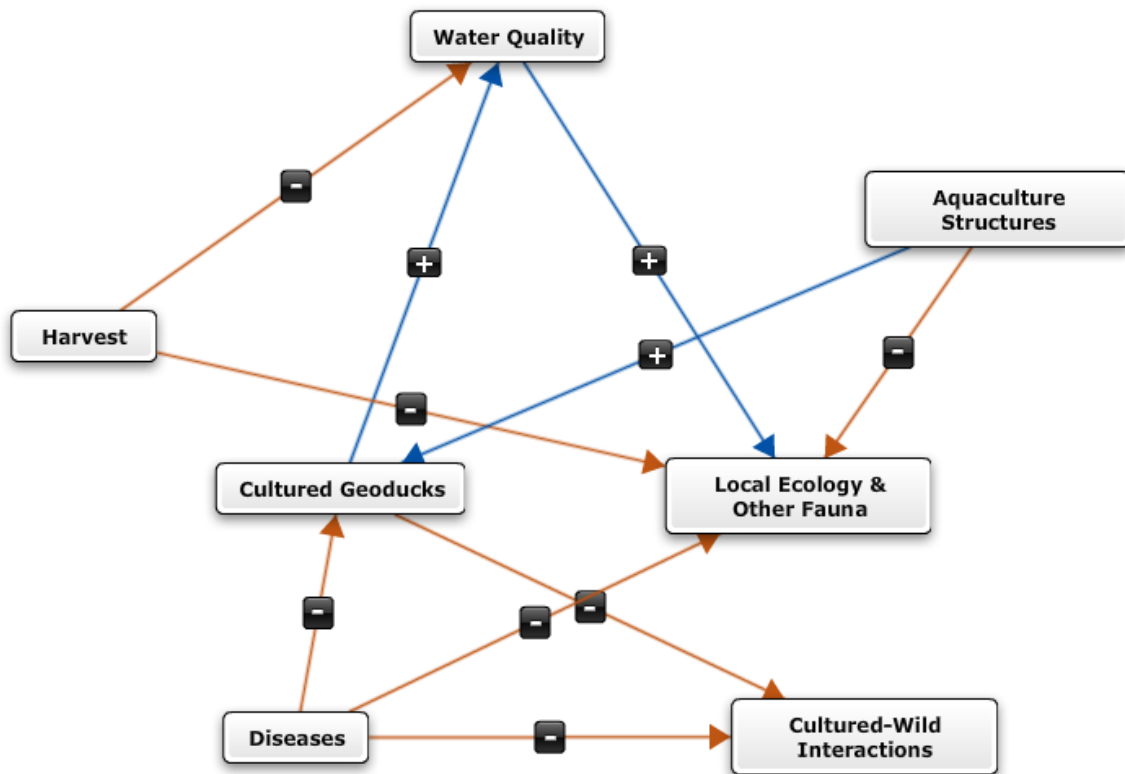


Figure 3: Adult geoducks in a basket after harvest (Source: Washington Sea Grant)

Sub-system Map of the Ecological Component of the Geoduck Aquaculture Case



Connections

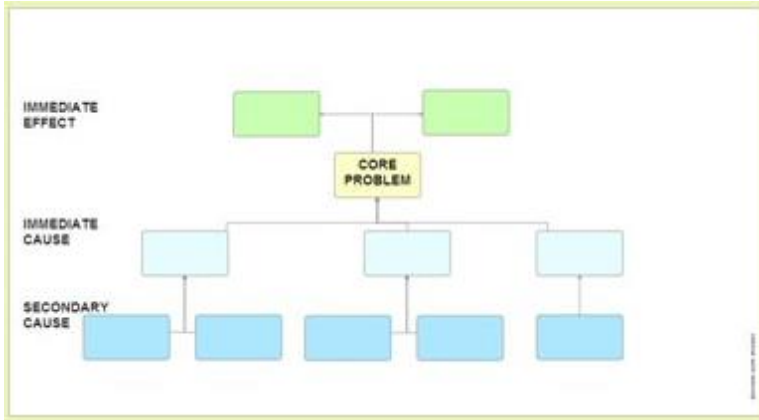
“Cultured geoducks” and “local ecology and other fauna” are placed in the center of the sub-system map with the five key factors making connections to them. Connections between key factors are traced below with non-italic font indicating the factor and italic font indicating the relationship.

- Cultured Geoducks → *improves* → Water Quality
- *Improved* Water Quality → *improves* → Local Ecology & Other Fauna
- Aquaculture Structures → *improves* → Cultured Geoducks
- Aquaculture Structures → *has no impact on* → Resident Macrofauna
- Aquaculture Structures → *negatively impacts* → Transient Macrofauna
- Harvest → *negatively impacts* → Water Quality
- Harvest → *negatively impacts* → Local Ecology & Other Fauna
- Diseases → *negatively impacts* → Cultured Geoducks
- Diseases → *negatively impacts* → Local Ecology & Other Fauna
- Diseases → *negatively impacts* → Cultured-Wild Interactions
- Cultured Geoducks → *negatively impacts* → Wild Geoducks

IN-CLASS GRADED ASSIGNMENT 4: PROBLEM AND SOLUTION TREES

In pairs, you will develop another Problem Tree/Solution Tree analysis for a topic related to geoduck aquaculture of your choosing. Again, you want your problem to be specific enough to be overcome.

1. Core Problem: (2 points)



2. Develop a Problem Tree similar to the problem tree that we developed together as a class (and similar to the figure above). Each “cause: statement needs to be written in negative terms, i.e., how the cause exacerbates the problem. List both immediate causes and secondary causes. (6 points)
3. Develop a Solution Tree similar to the Solution Tree that we developed together as a class (and similar to the figure above). Each “cause” statement needs to be rewritten into positive terms, i.e., how we can overcome the problem. List both immediate and secondary solutions. (2 points)

Grading Rubric for Assignment #4 (Total Points: 10 points)

Criteria	Points	Ratings			
		4	3	2	1
Identify core problem	2	Identifies at core problem significantly different from the example completed in class			Identifies a core problem that is similar to example completed in class
Problem tree	6	Identifies a full range of causes, effects; distinguishes between immediate and subsequent causes; statements are written in negative language.	Identifies many causes and effects; Distinguishes between immediate and subsequent causes; statements written in negative language	Identifies some causes and effects; Doesn't distinguish between immediate and subsequent effects; statements written in negative language	Identifies only a few causes; doesn't distinguish between immediate and subsequent causes; statements are not in negative language.
Solution tree	2	Translates all the negative statement into positive statements			Translates only a few negative statements into positive statements.

WASHINGTON STATE-OWNED LANDS

As we reviewed in class, the Washington Department of Natural Resources is currently considering proposals for a pilot study of geoduck aquaculture on state-owned lands (see http://www.dnr.wa.gov/BusinessPermits/News/Pages/2013_08_02_dnr_announces_trial_geoduck_aquaculture_leases_nr.aspx for a press release and

http://www.dnr.wa.gov/BusinessPermits/Topics/ShellfishAquaticLeasing/Pages/aqr_aqua_geoduck_aquaculture.aspx#purpose for a more in-depth review of the proposal). Part of the reason for this study is a lack of knowledge about geoduck aquaculture and its impact on coastal ecosystems and coastal communities. Fortunately, we have been working on the system map for geoduck aquaculture throughout the semester, and we can apply that knowledge in the framing of possible policy outcomes for the WDNR.

For this assignment, you are taking on the role of an outside socio-ecological synthesis expert who has been asked by the WDNR to explain some of the possible impacts and outcomes of three different proposals for geoduck aquaculture on state lands.

Proposal 1: *Geoduck aquaculture is banned on state-owned coastal lands in Washington.*

Proposal 2: *Geoduck aquaculture is allowed only in Mason County and only in areas in which there is no adjacent residential development or recreational fishing access areas.*

Proposal 3: *Geoduck aquaculture is allowed in all areas in Mason, Jefferson, Pierce and Thurston counties where there are low natural shellfish and eelgrass densities.*

Because each of these proposals is very different and has varying implications for the socio-ecological system, the WDNR could benefit from your analysis of impacts to the system map from these proposals. For each of the three proposals, please complete the following:

- a. Identify five perturbations to the socio-environmental system that could result from this proposal. What causes those impacts? (trace through system map)
- b. Are any components not affected by this proposal?
- c. Would any community groups be supportive of this proposal? Why?
- d. Would any community groups oppose this proposal? Why?
- e. What does the system map show us that could have been missed through looking at just the:
 - i. Ecological impacts?
 - ii. Economic impacts?
 - iii. Socio-cultural impacts?

Proposal 1: Geoduck aquaculture is banned on state-owned coastal lands in Washington.

a. Trace the perturbations through the system map to identify five perturbations to the socio-environmental system that could result from this proposal. What causes those impacts? Trace the perturbations through the system map. (3 points each)

1.

2.

3.

4.

5.

b. Are any components not affected by this proposal?

c. Would any community groups be supportive of this proposal? Why?

d. Would any community groups oppose this proposal? Why?

e. What does the system map show us related to this proposal that could have been missed through looking at just the:

i. ecological impacts?

ii. economic impacts?

iii. socio-cultural impacts?

Proposal 2: Geoduck aquaculture is allowed only in Mason County and only in areas in which there is no adjacent residential development or recreational fishing access areas.

a. Trace the perturbations through the system map to identify five perturbations to the socio-environmental system that could result from this proposal. What causes those impacts? Trace the perturbations through the system map. (3 points each)

1.

2.

3.

4.

5.

b. Are any components not affected by this proposal?

c. Would any community groups be supportive of this proposal? Why?

d. Would any community groups oppose this proposal? Why?

e. What does the system map show us related to this proposal that could have been missed through looking at just the:

i. ecological impacts?

ii. economic impacts?

iii. socio-cultural impacts?

Proposal 3: Geoduck aquaculture is allowed in all areas in Mason, Jefferson, Pierce and Thurston counties where there are low natural shellfish and eelgrass densities.

a. Trace the perturbations through the system map to identify five perturbations to the socio-environmental system that could result from this proposal. What causes those impacts? Trace the perturbations through the system map. (3 points each)

1.

2.

3.

4.

5.

b. Are any components not affected by this proposal? (2 points)

c. Would any community groups be supportive of this proposal? Why? (2 points)

d. Would any community groups oppose this proposal? Why?

e. What does the system map show us related to this proposal that could have been missed through looking at just the:

i. ecological impacts?

ii. economic impacts?

iii. socio-cultural impacts?

ASSIGNMENT #6 - RAPID ASSESSMENT OF SOCIAL-ENVIRONMENTAL SYSTEM

Now that you are all experts in social-ecological systems, it is your turn to demonstrate your knowledge of how these systems work. To do so, you will work in small groups (minimum 3, maximum 5) and use the course materials for the S-E systems to conduct a rapid analysis of a social-environmental system. Your group will be expected to:

- a. Create a system map of the issue, clearly identifying the “decision point” or proposed action
- b. Identify areas/connections in the map that appear to be strong/weak
- c. Identify possible effects if decision is adopted/implemented (using system map)
- d. Identify additional information needed to complete system map, or understand issue more fully

Based on your system map and the identified information, you will develop a 2-3 page white memo that presents this social-environmental system succinctly and critically. See the information from the earlier white memo for more details.

The last two sessions of class, teams will give short presentations (3-5 mins) with class discussion.

Grading Rubric for Assignment #6

Rubric for White Memo

Criteria	Points	Ratings			
		4	3	2	1
Identifying key factors in a sub-system	10	Identifies at least 5 key factors in each component. The list of factors covers the component thoroughly. Information for each of the key factors is well presented.			Identifies at less than 1 key factor in a sub-system. No attention to assignment requirement.
Organization and quality of writing	10	Follows the format requirements. The information organized. The writing is nearly flawless and concise.			No attention to organization and structural requirements. Writing does not meet college-level standards.
Research and additional resources	6	5+ sources of which 2+ are additional sources. In-text citations and References list with correct formatting.			Uses less than 1 source. Missing citations or references.
Use of images	4	Images chosen are great match for topic and help illustrate the points of the memo. Include 2+ images with correct caption and citation.			No images. Missing captions or references.
Sub-system map	10	Includes at least 5 key factors and factors are connected in a meaningful way. The list of connections is complete. Map is organized and prepared with CMAP.			Includes less than 1 key factor and no connections are mapped. The list of connections is missing. No attention to assignment requirement.

Rubric for Presentation

Criteria	Points	Ratings			
		4	3	2	1
Subject Knowledge	2	Demonstrates full knowledge, elaborates upon subject and is able to answer questions.			Does not build upon the subject. Is not able to answer appropriate questions.
Organization and quality content	3	The presentation is logical and interesting.			No attention to organization and structural requirements.
Enthusiasm/ Elocution	2	Demonstrates positive engagement with the presentation and audience.			Does not make eye contact with the audience, Shows little interest in the topic.
Mechanics	3	Presentation slides are clear and easily Grammatically correct.			Spelling or formatting errors throughout presentation.