Toward Social-Ecological Systems (RMES 510)

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Purpose

At the core of many environmental issues are intertwined social and ecological processes that drive changes for both ecological systems and human communities at multiple scales. The multiple causes of environmental problems have long troubled traditional academic approaches because social and ecological systems have generally been studied separately. Increasingly, interdisciplinary socio-ecological approaches are being developed in order to consider these processes together, providing important insights regarding the complex dynamics of diverse and interlinked processes operating across temporal and spatial scales. This course investigates both disciplinary and interdisciplinary approaches that are important to understanding connections and linkages across social and ecological realms. This will include exposure to several case studies, and also to fields of study, their key constructs, and their methods that focus on coupled systems and the integration of socio-ecological perspectives. Attention will also be paid to the evaluation of perspectives where such integration does not yet occur and why this matters. Students will leave the course with an understanding of (i) how these interlinked systems and dynamics function (or are dysfunctional), (ii) how existing policies, economic incentives, governance regimes, behaviors (individual and collective), and preferences affect these systems and processes and (iii) how new policies and institutions might learn from available research to better promote sustainable trajectories.

Learning Objectives and Outcomes:

By the end of the course, all students should be able to do the following:

1. Synthesize from the literature a dozen key concepts and processes from the natural and social sciences that are necessary for understanding ecological and social dynamics and their intersection in environmental problems;
2. Identify and describe major approaches that help to integrate social and ecological, or human-natural systems, dynamics, or understandings;
3. Analyze the strengths and weaknesses of different approaches, including how they may help navigate environmental change;
4. Analyze and express what purposeful socio-ecological change might entail, and understand how such changes might be engineered or fostered through policy, management, or other interventions;
5. Communicate key elements of the politics and policies (formal and informal) behind 'purposeful' changes and the implications of these for just governance, institutions and outcomes;

6. Describe several of the major critiques of 'systems' perspectives, including difficulties associated with bounding the system, and 'compartmentalized' and fragmented understandings of complex interrelated processes;
7. Propose interventions that address multi-scale dynamics and processes (ecological, evolutionary, social), uncertainties, and communicate these in the context of important debates;
8. Describe the criteria for systems to be complex and adaptive (including the difference between biological and physical systems); and, conversely, what it might mean for social and governance systems to be 'adaptive'.
9. Analyze the ramifications of this complexity and adaptive nature for causal understanding (including the roles of linearity and context specificity), prediction, and management (including feedbacks and unintended consequences).
10. Apply the above understanding of systems—and of social, ecological, and social-ecological dynamics—to case studies;
11. Explain the relevance of debates related to culture, values, preferences and behaviors for social-ecological problems, including the difficulties of fostering/engineering change in these realms (e.g., difficulties in scaling up or down from the individual and group levels; the role and critiques of common models of preferences and behaviors, including utility maximization).

Course Description

The course will cover the building blocks for systemic/dynamic understanding of social-ecological systems, with two weeks spent on the biophysical perspectives and two weeks on social perspectives. We will then move to integrative social-ecological approaches and consider what these include and attend to, and what remains sidelined. Using case studies, we will ground these lessons in diverse contexts. Students will also work in interdisciplinary teams for final projects, which can be more research-oriented or more practice-oriented.

Course Policies

As per university requirements:

Attendance

Following university regulation, regular attendance is expected of students. Students who neglect their academic work and assignments may be excluded from the final examinations (note: there are no exams in this course). Students who are unavoidably absent because of illness or disability should report to their instructors as soon as they are able.

The University accommodates students with disabilities who have registered with the Disability Resource Centre. The University accommodates students whose religious obligations conflict with attendance, submitting assignments, or completing scheduled assignments. Please let the instructors know in advance, preferably in the first week of class, if you will require any accommodation on these grounds. Students who plan to be absent for varsity athletics, family obligations, or other similar commitments, cannot assume they will be accommodated, and should discuss their commitments with the instructor before the drop date.

Late Assignments

When exceptional circumstances will prevent you from completing an assignment on time, you may request an extension and it will be granted where possible and appropriate. In the absence of a granted extension, a 5% reduction of grade will be assigned for each day an assignment is late beyond the required due date.

Academic Dishonesty

Please review the UBC Calendar "Academic regulations" for the university policy on cheating, plagiarism, and other forms of academic dishonesty. Students should retain a copy of all submitted assignments (in case of loss) and should also retain all their marked assignments in case they wish to apply for a Review of Assigned Standing. Students have the right to view their marked examinations with their instructor, providing they apply to do so within a month of receiving their final grades. This review is for pedagogic purposes. The examination remains the property of the university.

Schedule

Week 1. Sep 4: Social-Ecological Systems (SES): What Are They, and Why Study Them?

Introduction to the course content, structure, and purpose. Introductions to course professors and fellow students, including our various research and learning goals. A mini-lecture on the history of social-ecological systems thinking and its possible application to contemporary environmental issues; and discussion of relative foci/strengths and omissions/weaknesses.

Learning Objectives:

1. Trace a rough history of academic mindset on SES
2. Initial understanding of strengths, limits, and foci or SES
3. Understand well the overall semester goals

Readings:

Mandatory:

Pp. 1-30 in Berkes, F., J. Colding and C. Folke, Eds. (2003). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge, UK, Cambridge University Press. http://books.google.ca/books?id=Joh0_7X5DHMC

Rockström, J., W. Steffen, K. Noone, et al. (2009). "A safe operating space for humanity." Nature **461**(7263): 472-475. http://dx.doi.org/10.1038/461472a

Hardin, G. (1968). "The tragedy of the commons." Science **162**(13 December): 1243-1248. http://www.jstor.org/stable/1724745

Ostrom, E., J. Burger, C. B. Field, R. B. Norgaard and D. Policansky (1999). "Revisiting the commons: Local lessons, global challenges." Science **284**(5412): 278-282. http://dx.doi.org/10.1126/science.284.5412.278

Optional: Liu, J. G., T. Dietz, S. R. Carpenter, et al. (2007). "Complexity of coupled human and natural systems." Science **317**(5844): 1513-1516. http://www.sciencemag.org/cgi/content/full/317/5844/1513

Questions for Thinking Through Readings:

1. When considering Berkes *et al.*, and given your existing knowledge, what kinds of ecological processes or considerations are glossed over or 'assumed' and/or what kinds of social phenomena are considered and not?
2. How is the concept of resilience operationalized in Berkes *et al.*, and what exactly is being made 'resilient' in response to 'what'?
3. Should we be thinking of SES with respect to resilience only, or should other 'goals' be just as primary?
4. How would your own characterization of Hardin's argument differ from Ostrom *et al.*'s, if at all? Which, if any, of Hardin's points to you see as *unnoticed* in Ostrom *et al.*'s treatment?
5. Hardin uses a local-scale example to get us thinking about the fact that 'certain forces/conditions' lead to 'certain ends'. Which of these forces/conditions appear compelling to you for other problems at local and nonlocal scales?
6. In what contexts do Ostrom and colleagues' insights most apply, and where might they fail and why? For which kinds of goods/resources, with what kinds of resources and users?

7. Ostrom *et al.*'s 'institutional rules' have, fairly or not, often been taken up as a "check list" of traits that make for good institutional governance. What are the implications of this for understanding social behaviour as it might play out and what appears particularly absent in that list in of rules in any case? Why might these insights have been reduced to a checklist in any case?
8. Rockström *et al.* compels us to think about scales at many levels; to what extent are social, ecological or SES principles captured in the analysis? (There is no pre-formed list of such principles—feel free to identify them as you go.)

Week 2. Sep 11: Social-Ecological Systems: Theory and Practice

** *Relevant lecture: Nathan Bennett, IRES: 12:30 on Tue Sep 9 in AERL 120* **

Key Concepts:

Vulnerability, resilience, social networks, panarchy, and adaptive governance

Questions for Thinking Through Readings:

1. What distinguishes a fast from a slow variable and how are both sets treated in the SES literature? [Folke et al. 2004]
2. How has the SES literature dealt with thresholds – how are thresholds conceptualized and operationalized? [Folke x2, Holling]
3. How does the definition of boundaries affect how we should think about the response diversity of social systems, and what does this mean for thinking about SES? [Leslie and McCabe]
4. Holling's panarchy thesis tries to address where in the adaptive cycle opportunities present themselves – where are these and what properties in the system render some opportunities possible?
5. Can we and should we think of institutions as responsive or adaptive, and what makes them so (or not)? [Folke et al. 2005]
6. Reflecting critically on Holling's article: How much and what kind of evidence is presented in support of adaptive cycles? Of panarchy? How prevalent should we expect such dynamics to be, and how regular a procession through phases of the adaptive cycle?
7. In what circumstances might it be preferable to manage for transformability rather than resilience? [Walker et al.]

Readings:

Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson and C. S. Holling (2004). "Regime shifts, resilience, and biodiversity in ecosystem management." Annual Review of Ecology Evolution and Systematics **35**: 557-581 http://arjournals.annualreviews.org/doi/abs/10.1146%2Fannurev.ecolsys.35.021103.105711

Folke, C., T. Hahn, P. Olsson and J. Norberg (2005). "Adaptive governance of social-ecological systems." Annual Review of Environment and Resources **30**(1): 441-473. http://www.annualreviews.org/doi/abs/10.1146/annurev.energy.30.050504.144511

Holling, C. S. (2001). "Understanding the complexity of economic, ecological, and social systems." Ecosystems **4**(5): 390-405. http://link.springer.com/article/10.1007/s10021-001-0101-5

Leslie, P. and J. T. McCabe (2013). "Response diversity and resilience in social-ecological systems." Current anthropology **54**(2): 114. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4028135/ *only* 114-129. [note page limit here]

Walker, B., C. S. Holling, S. R. Carpenter and A. Kinzig (2004). "Resilience, adaptability and transformability in social-ecological systems." Ecology and Society **9**(2). http://www.ecologyandsociety.org/vol9/iss2/art5/

In class activities: Tweeting basics

Week 3. Sep 18: Ecological and Evolutionary Building Blocks: Patterns, Processes, Scales, Systems, and Surprises

Learning Objectives:
Identify key concepts from ecology and evolutionary biology as applied to particular SES contexts, which provide critical understanding of the issue and the pertinent SES dynamics.
Course-level: 1, 8, 9

Readings:
Levin, S. A. (1992). "The problem of pattern and scale in ecology." Ecology **73**(6): 1943-1967. http://www.jstor.org/view/00129658/di960347/96p0058p/0
Levin, S. A. (2000). "Multiple scales and the maintenance of biodiversity." Ecosystems **3**(6): 498-506. http://dx.doi.org/10.1007/s100210000044
Levin, S. A. (2005). "Self-organization and the emergence of complexity in ecological systems." Bioscience **55**(12): 1075-1079. http://dx.doi.org/10.1641/0006-3568(2005)055[1075:SATEOC]2.0.CO;2
Spencer, C. N., B. R. McClelland and J. A. Stanford (1991). "Shrimp stocking, salmon collapse, and eagle displacement." BioScience **41**: 14-21. http://www.jstor.org/stable/1311536
Vitousek, P. M. (1990). "Biological invasions and ecosystem processes: towards an integration of population biology and ecosystem studies." Oikos **57**: 7-13. http://www.jstor.org/stable/3565731
http://en.wikipedia.org/wiki/Natural_selection
http://en.wikipedia.org/wiki/Nature_versus_nurture

Questions for Thinking Through Readings:
1. What are the implications of Levin 1992 for the study of SES as spatially and temporally bounded entities? What are the implications for the demonstration of cause and effect in such systems?
2. Re: Levin 2005, What makes a system complex? What distinguishes a complex *adaptive* system from a complex one? Which is more predictable? What is the atmosphere (just complex, or complex adaptive)? The biosphere?
3. Re: Levin 2000, If the Earth's biophysical processes were more regular and predictable, would you expect that pre-human conditions would have featured more or less biodiversity?
4. If you could express the single-most important general insight from Spencer *et al.*, pertinent to all ecosystem managers, what would it be? How predictable were the events described? How predictable in general are the outcomes of species introductions?
5. Ecological models frequently assume that many elements of the geochemistry of ecosystems are constant, with ecosystem interactions layered on top of these 'slow variables'. Are such assumptions true? Should models make such assumptions?

In class activity:
1. Group problem-solving, based on readings

Week 4. Sep 25: Some Ideas about 'How Things Work Socially' Given Environments and Environmental Risk

Guest lecture: Terre Satterfield, IRES

Key Concepts:

Environmental Values; Meaning and Landscapes; Thinking about Risks: Social Structure and Risk; Cultural and Social Capital; Structural Power, Identity and Agency.

Readings:

Basso, K. H. (1996). Wisdom Sits in Places: Landscape and Language among the Western Apache. Albuquerque, NM, U. New Mexico Press. Chapter 2, "Stalking with Stories", pp. 37-70. url

Lin, N. (2001) Social Capital: A Theory of Social Structure and Action. Cambridge University Press, Theory and Research, Ch2 pp. 19-28 url

Satterfield, T. and L. Kalof (2005). Environmental values: An introduction. The Earthscan Reader in Environmental Values. L. Kalof and T. Satterfield. Sterling, VA, Earthscan**:** xxi-xxxiii. url

Slovic, P. (2010). The Feeling of Risk: New Perspectives on Risk Perception, Earthscan. http://books.google.ca/books?id=63oCQ1BFk8wC Chapter 2, url to come

Watts, M. (2001). Petro-violence: community, extraction, and political ecology of a mythic commodity. Violent environments. N. Peluso and M. Watts. Ithaca, NY, Cornell University Press**:** 189-212. http://books.google.ca/books?id=efcw5qe7mygC&source=gbs_navlinks_s url

Optional:

Kahan, D. M., E. Peters, M. Wittlin, P. Slovic, L. L. Ouellette, D. Braman and G. Mandel (2012). "The polarizing impact of science literacy and numeracy on perceived climate change risks." Nature Climate Change **2**(10): 732-735. http://dx.doi.org/10.1038/nclimate1547

Slovic, P. (1992). Perceptions of risk: Reflections on the psychometric paradigm. Social theories of risk. S. Krimsky and D. Golding, Praeger**:** 117-152. url

Slovic, P., D. Zionts, A. K. Woods, R. Goodman and D. Jinks (2011). Psychic numbing and mass atrocity. The Behavioral foundations of Public Policy. E. Shafir. Princeton, NJ, Princeton University Press**:** 126-142. http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=1809951 url

Questions for Thinking Through Readings:

1. Why distinguish between values and valuation? What kind of values do you think are relatively stable and not easily changed versus those less or much less so? Do environmental goods have value, yes or no? [Satterfield & Kalof]
2. What are some of the means by which people move within, organize themselves socially, resist, or find purchase against the constraining social structures within which they live? [Lin, Watts]

OR What is the difference between 'cultural' versus 'social' capital? What are the implications of each for thinking about resilience or resilient communities or social groups? [Lin, Watts]

3. How do people (in this example, Cibecue Apache) 'inscribe' themselves on human landscapes and what are the implications of this for how we think about the physical world? [Basso]
4. How do people view risk? How does the perception of risk change given (a) the attributes of the risk object itself (e.g., a particular hazard), (b) the attributes of the person perceiving the risk, (c) the way in which risk information is communicated, (d) the scale of the risk? [Slovic, Slovic, Kahan]
5. What is meant by the resource curse, what are some implications for how systems of power at different scales can operate to benefit from resource wealth, and how might the organization of identity work in or as against such social structures? [Watts]

In class activities:

1. Group problem solving, based on readings

2. Read one page problem description, propose solutions based on your knowledge of the 'human dimensions' of the problem posed

Week 5. Oct 2: Ecological and Evolutionary Building Blocks: Populations, Services, and Impacts

Learning Objectives:
Identify key concepts from ecology and evolutionary biology as applied to particular SES contexts, which provide critical understanding of the issue and the pertinent SES dynamics.
Course-level: 1, 8, 9

Readings:
Adger, W. N., H. Eakin and A. Winkels (2008). "Nested and teleconnected vulnerabilities to environmental change." Frontiers in Ecology and the Environment **7**(3): 150-157. http://dx.doi.org/10.1890/070148
Caughley, G. (1994). "Directions in conservation biology." Journal of Animal Ecology **63**: 215-244. http://www.jstor.org/stable/5542 (accessible parts only)
Daily, G. C., S. Alexander, P. R. Ehrlich, et al. (1997). Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems. Issues in Ecology. Ecological Society of America. Washington, DC**:** 1-18. http://www.esa.org/science_resources/issues/FileEnglish/issue2.pdf http://www.esa.org/science/Issues/
Dias, P. C. (1996). "Sources and sinks in population biology." Trends in Ecology & Evolution **11**(8): 326-330. http://www.sciencedirect.com/science/article/pii/016953479610037 9
Luck, G. W., G. C. Daily and P. R. Ehrlich (2003). "Population diversity and ecosystem services." Trends in Ecology & Evolution **18**(7): 331-336. http://dx.doi.org/10.1016/S0169-5347(03)00100-9

Questions for Thinking Through Readings:
1. How feasible has it been or might it be to add much more theory to Caughley's declining population paradigm? How feasible has it been or might it be to link empirical evidence to such theory?
2. In what concrete ways does/did the ecosystem services framework (Daily et al. 1997) add to the previous study of natural resources? (Aim for three.)
3. What is a population 'sink' (Dias 1996) and how might these lead astray conservation practice? How might we avoid inadvertently focusing on protecting sink habitats?
4. Luck et al. (2003) propose that 'population diversity' is in many cases more pertinent for conservation than species diversity. Do you agree? In what ways is such a notion of population diversity parallel to species diversity, and in what ways does it differ?
5. How would you define a 'teleconnection' (Adger et al. 2008)? One might argue that this idea has already been well primed by a (chronologically) earlier reading from weeks 3 and 5—which one strikes you as having done such priming, and why?

In class activities:
1. Group problem-solving, based on readings
2. Group formation for final projects

Week 6. Oct 9. Some Ideas about How "Things Social" Change or Fail to Change

Guest lecture: Jiaying Zhao, IRES?

Key Concepts:

Markets and Incentives, Learning and the Knowledge Deficit Hypothesis; Behavioural Practice and Change; Nudge and Choice Architecture; Institution of Governance and Policy Change

Readings:

Allum, N., P. Sturgis, D. Tabourazi and I. Brunton-Smith (2008). "Science knowledge and attitudes across cultures: a meta-analysis." Public Understanding of Science **17**(1): 35-54. http://pus.sagepub.com/content/17/1/35.abstract

Fehr, E. and A. Falk (2002). "Psychological foundations of incentives." European Economic Review **46**(4-5): 687-724. http://www.sciencedirect.com/science/article/pii/S0014292101002082

Heal, G (1999) Markets and Sustainability. *The Science of the Total Environment* 240:75-89 http://www.sciencedirect.com/science/article/pii/S00489697990031 49

Kahan, D. (2010). "Fixing the communications failure." Nature **463**(7279): 296-297. http://dx.doi.org/10.1038/463296a

John, P., G. Smith and G. Stoker (2009). "Nudge nudge, think think: Two strategies for changing civic behaviour." The Political Quarterly **80**(3): 361-370. http://dx.doi.org/10.1111/j.1467-923X.2009.02001.x

Shove, E. (2010). "Beyond the ABC: climate change policy and theories of social change." Environment and Planning A **42**(6): 1273-1285. http://www.envplan.com/abstract.cgi?id=a42282 https://blog.itu.dk/hest/files/2012/10/shove_abc.pdf

Optional:

Agrawal, A. (2001). "Common property institutions and sustainable governance of resources." World Development **29**(10): 1649-1672. http://www.sciencedirect.com/science/article/pii/S0305750X01000638

Levine, J., K. M. A. Chan and T. Satterfield (submitted). "From rational actor to efficient complexity manager—exorcising the ghost of Homo economicus with a unified synthesis of cognition research." Ecological Economics.

Questions for Thinking Through Readings:

1. In what sense do markets fail to accommodate for the supply, demand or extirpation of environmental goods and services? [Heal]
2. What kind of market incentives motivate whom and why? [Fehr]
3. What features of governance institutions appear to be most important when thinking about 'managing the commons'? Describe a few human behaviours, social contexts or environmental problems that theories of governing the commons cannot or does not address?
4. What is meant by the knowledge deficit hypothesis? Is it over-stated, understated, or simply applicable to certain ways of anticipating human behaviour?
5. Why think about practices that drive behaviour instead of the values that drive behaviour? What becomes possible or not if we do so?

In class activities (handouts of describe cases will be provided):

1. Given the problem described, how might information provision be modified were one to accept the premise that the 'knowledge deficit' is a fallacy? Is true?

Week 7. Oct 16: The Missing Links – SES and its uptake of social and ecological constructs?

Guest: Jordan Tam

Key Concepts:

Adaptive capacity; Thresholds, Shocks, and regime shifts; Ecosystem Services, Dependency; Socio-political difference and inequality; environmental justice; Capabilities approach; entitlements

Readings:

Adger, W. N. (2006). "Vulnerability." Global Environmental Change **16**(3): 268-281. http://www.sciencedirect.com/science/article/pii/S0959378006000422

Engle, N. L. (2011). Adaptive capacity and its assessment. Global Environmental Change, 21(2), 647-656. http://www.sciencedirect.com/science/article/pii/S0959378011000203

Henrich, J. and N. Henrich (2010). "The evolution of cultural adaptations: Fijian food taboos protect against dangerous marine toxins." Proceedings of the Royal Society B: Biological Sciences **277**(1701): 3715-3724. http://rspb.royalsocietypublishing.org/content/277/1701/3715.abstract

Kesebir, S., D. H. Uttal and W. Gardner (2010). "Socialization: Insights from social cognition." Social and Personality Psychology Compass **4**(2): 93-106. http://dx.doi.org/10.1111/j.1751-9004.2009.00245.x

Westley et al. 2002 "Why systems of People and Nature are not just Social and Ecological Systems". In Panarchy, Chapter 4, Gunderson (ed). url

Questions for Thinking Through Readings:

1. Are we trying to understand systems or are we trying to understand dynamics so as to better anticipate change? How might it help understand SES to NOT think about people as systems? [Westley]
2. Vulnerability means to captures the predilection to or consequences of system change; how are these understood (well or poorly) in the SES literature? [Adger]
3. How is adaptive capacity understood, and fostered, and what are the risks associated with such? [Engle]
4. On your travels, a villager advises you not to eat a certain food, and you are on the fence about whether to heed this advice. You ask her how she came to this information. If she answers that she learned it from her mother, would that make you more or less inclined to follow the advice than if she learned it from an unrelated woman, and why? [Henrich]
5. Imagine a scenario in which an ecosystem change might prime people differently, causing ripple effects on socialization. What feedback effects might this cause in the social-ecological system? [Kesebir]

In class activities:

1. Brainstorming a list of recommendations for revising SES.
2. Brainstorming a list of problem types not amenable to SES.

Week 8. Oct 23: Incremental Change and Big shocks (that do or do not lead to big change)

Guest: Rebecca Witter – Relocating people outside parks and protected areas

Key Concepts, Incremental Change:

Thresholds; nonlinear dynamics and uncertainty; chronic disasters; corrosive communities; contamination and community stigma

Readings, Incremental Change:

Bromet, E. J., J. M. Havenaar and L. T. Guey (2011). "A 25 year retrospective review of the psychological consequences of the Chernobyl accident." Clinical Oncology **23**(4): 297-305. http://www.sciencedirect.com/science/article/pii/S0936655511005334

De'ath, G., K. E. Fabricius, H. Sweatman and M. Puotinen (2012). "The 27-year decline of coral cover on the Great Barrier Reef and its causes." Proceedings of the National Academy of Sciences **109**(44): 17995-17999. http://www.pnas.org/content/109/44/17995

Jackson, J. B. C., M. X. Kirby, W. H. Berger, et al. (2001). "Historical overfishing and the recent collapse of coastal ecosystems." Science **293**(5530): 629-638. http://www.jstor.org/stable/3084305

Picou, J et al. 2004 Disaster, Litigation and the Corrosive Community *Social Forces 82 (4): 1493-1522.* http://sf.oxfordjournals.org/content/82/4/1493.abstract

Key Concepts, Big Shocks:

Relocation of human populations; the social aftermath of natural disasters; large species mortality and extirpations; multiple attractors and the effects of disturbance vs. invasives

Readings, Big Shocks:

Caves, E. M., S. B. Jennings, J. HilleRisLambers, J. J. Tewksbury and H. S. Rogers (2013). "Natural experiment demonstrates that bird loss leads to cessation of dispersal of native seeds from intact to degraded forests." PLoS ONE **8**(5): e65618. http://dx.doi.org/10.1371%2Fjournal.pone.0065618 (*Open access*)

Freudenburg, W. et al. 2008 Organizing Hazards, Engineering Disasters? *Social Forces* Volume 87 (2): 1015-1038. http://sf.oxfordjournals.org/content/87/2/1015.short http://www.stevenpicou.com/pdfs/community-impacts-of-the-exxon-valdez-oil-spill.pdf

Turner, N. J. and K. L. Turner (2008). ""Where our women used to get the food": cumulative effects and loss of ethnobotanical knowledge and practice; case study from coastal British Columbia." Botany **86**(2): 103-115. http://dx.doi.org/10.1139/B07-020

Optional Readings

McCune, J. L., M. G. Pellatt and M. Vellend (2013). "Multidisciplinary synthesis of long-term human-ecosystem interactions: A perspective from the Garry oak ecosystem of British Columbia." Biological Conservation **166**(0): 293-300. http://www.sciencedirect.com/science/article/pii/S0006320713002784

Picou et al. 2009 Community Impacts of the Exxon Valdez Oil Spill: A Synthesis and Elaboration of Social Science Research. In *Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska.* (Braund & Kruse, eds). MMS OCS Study Number 2009-006.

Pringle, R. M. (2005). "The Nile perch in Lake Victoria: local responses and adaptations." Africa **75**: 510-538.

Vitousek, P. M., L. R. Walker, L. D. Witeaker, D. Mueller-Dombois and P. A. Matson (1987). "Biological invasion by *Myrica faya* alters ecosystem development in Hawaii." Science **238**(4828): 802-804. http://www.sciencemag.org/content/238/4828/802.short

Questions for Thinking Through Readings:

1. What are some of the basic characteristics of technological disasters for human communities?

2. What are the implications of technological disasters for how we think about or should think about resilience?
3. Would you consider Great Barrier Reef coral cover to be a story of incremental change, big shocks, or both? Why? [De'Ath]
4. What does a historical analysis of coastal ecosystems suggest about the causes of decline? How does it differ from the understanding suggested by a-historical analyses (just based on the recent past)? [Jackson]
5. As an impact of bird loss due to the brown tree snake, Caves et al. focus on the possible slowing of restoration of degraded forests; do you foresee other possible consequences for tree populations, which may have non-linear effects in the long-term (hint: think metapopulations)? Please describe how these might come about.

In class activities (tba):

1. Case study selection and group discussion
2. Group problem solving, based on readings

Week 9. Oct 30: Systems Thinking and Interventions

Note: Project status updates presented in class

Key Concepts and In Class Activity:

Intervention points; effects of events on policies; compensating interventions; planning recommendations to mitigate vulnerability

Readings:

Heath, C. and D. Heath (2010). Switch: How to Change Things When Change Is Hard. New York, Crown Publishing Group. (at least Chapter 1) http://books.google.ca/books?id=QgzBqhbdlvUC

Meadows, D. (2009). "Leverage points: Places to intervene in a system." Solutions **1**(1): 41-49. http://thesolutionsjournal.anu.edu.au/node/419

Olsson, P., C. Folke and T. P. Hughes (2008). "Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia." Proceedings of the National Academy of Sciences of the United States of America **105**(28): 9489-9494. http://dx.doi.org/10.1073/pnas.0706905105

Jaffe, A; Newell, R; Stavins, R. 2005 A tale of two market failures: Technology and Environmental Policy. *Ecological Economics.* **54**(2-3): 164-174. http://www.sciencedirect.com/science/article/pii/S0921800905000303

Kahn, M 2007 Environmental Disasters as Risk Regulation Catalysts? The Role of Bhopal, Cherynoble, Exxon Valdez, Love Canal, and Three Mile Island in Shaping US Environmental Law. *Journal of Risk and Uncertainty.* **35**(1): 17-43. http://link.springer.com/article/10.1007%2Fs11166-007-9016-7

Optional: Lawton, J. H. (2007). "Ecology, politics and policy." Journal of Applied Ecology **44**(3): 465-474. http://dx.doi.org/10.1111/j.1365-2664.2007.01315.x

Questions for Thinking Through Readings:

1. Can you identify an example of an attempted social-ecological interventions that was (a) well-designed, and (b) poorly designed according to Heath & Heath's suggestions? Please explain these two interventions briefly, and their design successes (a) or flaws (b), with explicit reference to *Switch* strategies. (It could also be one attempted intervention, with both successes and flaws.)
2. Working with the two interventions above, what leverage points were targeted? Please identify and explain, using Meadows' typology.

3. How do the strategies adopted by the Great Barrier Reef Marine Park Authority align with the strategies of Heath & Heath and leverage points of Meadows? In this consideration, do you see opportunities for potentially promising interventions that Olsson *et al.* do not discuss?
4. To what extent can it be argued that 'shocking events' or acute shocks are catalysts for policy change, given the evidence provided.
5. What kind of market interventions do you suggest might be most useful for reducing emissions and how might we evaluate the success of policies, in general?

Optional Readings

Ban et al. 2013 A Socio-ecological approach to conservation planning: embedding social considerations. Frontiers in Ecology and Environment. http://www.esajournals.org/doi/full/10.1890/110205

Oreskes, N. (2004). "Science and public policy: what's proof got to do with it?" Environmental Science & Policy **7**(5): 369-383. http://www.sciencedirect.com/science/article/B6VP6-4D1DMSM-1/2/27f603a63195e253b17e756088a43e9c

Meadows, D. H. (2001). "Dancing with systems." Whole Earth **Winter 2001**. http://www.sustainer.org/pubs/Dancing.html

In Class Activities

1. Characterize several different points of possible intervention in systems
2. Articulate a possible plan for such an intervention in various contexts
3. Where appropriate, consider the problem of compensation and the relative importance of different losses.
4. TBA

Week 10. Nov 6: Workshop Case Study Progress and Dilemmas

Week 11. Nov 13: Student Case Study Presentations, Part 1

Week 12. Nov 20: Student Case Study Presentations, Part 2, Course Wrap-Up

*We will try to extend the course time this week, to allow for all presentations, a wrap-up and celebration!

Assignments

Overview

This course will be run as a graduate-level seminar. This means that reading, critical responses, and discussion are essential to the success of the course and your own learning. You *absolutely* should have completed all readings before coming to class.

Your grade for the course will be determined as follows:

Weekly responses to readings	20%
Tweeting about readings, relevant current events	10%
Journal	10%
Case Study Proposal	7%
Case Study Presentation	15%
Case Study Paper	30%
Class Participation	8%

Assigned readings may change slightly throughout the semester, but all readings will be finalized and each week's reading list made available at least two weeks prior to the due date.

Assignments Schedule

- Various weeks: Short Written Submissions Addressing Readings
- Various weeks: Tweeting
- Oct 9: Case Study Proposal Due
- Nov 13, Dec 20: Case Study Presentation
- Dec 4: Final Case Study Paper Due

Weekly Responses to Readings

All students will be asked to write responses to questions about the week's readings. These questions are intended to aid and gauge your reflections about the readings in relation to the class material: we will generally not ask what the authors said, as we're more interested in your perspectives on and syntheses of that content. Questions will be distributed via email or Connect to other class members at latest the day before the class—by Wednesday noon. The emphasis here is demonstrating briefly that you have read the readings and done some related thinking that you can shape this into a concise response to particular questions, not that you can compose an eloquent essay. Answers should be <100 words, prefaced with the question (full wording). See the rubric below.

Responses to Readings Rubric

	Levels of Achievement		
Criteria	**No credit**	**Half marks**	**Full marks**
Answer (for each Q)	**0 Points** No responses; responses far too short, without explanation; or responses don't address question	**2.5 Points** Responses too short or too long; responses don't reflect readings.	**5 Points** Responses of appropriate length and reflect readings, showing comprehension and some reflection.

Tweeting

One of the themes of this course is the crucial need to transfer technical knowledge from experts in one field to other experts, involved stakeholders and decision makers. Such communication can differ

starkly from the typical academic paper, which partly explains the dearth of effective communication on resource management and environmental issues to date. Accordingly, one crucial skill to be gained in this course is writing for and connecting with selected academic and practitioner communities. The most concise and networked form of such communication is Twitter, and this platform offers three key underappreciated benefits for academics (see http://chanslabviews.blogspot.ca/2014/07/3-ways-tweeting-will-improve-your-reach.html). The key components here are (1) seizing the attention of your audience, and (2) conveying complex concepts effectively in simple terms.

The assignment is (A) to tweet weekly (i) about one or more of the course readings (perhaps using #hiddengem or #OBG, for "oldie but goodie", and #SocEcoSys) (≥1 tweets/week); and (ii) about current events or the general topic of the week, connecting to ideas regarding social-ecological systems or dynamics (using #SocEcoSys) (≥1 tweet/week). I will introduce our use of these hashtags in a CHANS Lab Views blog post, and perhaps we can start a new trend of tweeting about ideas of substance (rather than merely uber-current events).

Part (B) is to retweet or modify-tweet (MT) three of the tweets from the rest of the class, each week (≥3 tweets).

Of the 10% of the course grade for tweeting, you will get 1% for each week for ten weeks, using the rubric below. I will grade your tweets after two weeks, after six weeks, and at the end. For each week (beginning Tue 5pm), I will grade the first relevant tweets (please use the hashtags above to guide me).

Getting Started with Twitter

If you're unfamiliar with Twitter, it may seem daunting. Trust me, you can learn this quickly—I know plenty of technophobes who have. Five steps: 1: Create a Twitter account. 2: Download Tweetdeck (Twitter's official desktop app). 3: Read a quick-start guide, like this one. 4: Follow me (@KaiChanUBC) so I can direct-message you. 5: Add a column in Tweetdeck for #SocEcoSys, so you can see tweets from the class.

Tweeting Rubric

	Levels of Achievement		
Criteria	**No credit**	**Half marks**	**Full marks**
Each Tweet (0.5 marks)	No tweets related appropriately to SES; tweet is rude, inflammatory, or represents a fundamental misunderstanding of events and/or readings.	Tweet is somewhat related to SES; tweet may be confusing or potentially misleading.	Tweet is clearly related to SES; tweet is clear, elegant, catchy (possibly with a graphic), and appropriate for events and/or readings; tweet connects to resources (weblinks) and to other Twitter conversations as appropriate (e.g., using hashtags).

Journals

Social-ecological system ideas are foundational to understanding how things work (or don't) and how to intervene to effect change, but they also tend to be abstract and intangible. This intangibility works directly against their 'stickiness', so lots of these great ideas never find purchase in real-world applications. I found this to be the case in the first version of RMES 510 as "Towards Social-Ecological Systems", and consulted accessible pedagogical literature. Other instructors have found it very helpful for students to put themselves in the position of real-world characters who are faced with realistic quandaries.

To facilitate this role-playing for concreteness (and stickiness), I'd like to introduce four characters. All four are taking RMES 510 as early- or mid-career professionals, while also working. As they encounter

the ideas in the course, I'd like you to imagine scenarios that they could realistically encounter that would allow them to act on their learning. These can be problems that have long needed solutions, opportunities waiting to be realized, etc.

Sarah Astprof is an assistant professor in a related field (you pick, perhaps based on your own background). She has an interest in social-ecological dynamics, and her research systems have clear examples of such dynamics. She would like to study, and potentially engage with, these dynamics but has lacked the foundation to do so.

Joe Ngoing is a staff member in an NGO responsible for helping to direct NGO campaigns. Like Sarah, Joe has a background that touches up either social or ecological subsystems, but not the full picture (you pick the specifics). He suspects that resilience and/or particular social-ecological dynamics might help him in his work, but he's not sure how.

Gary Bureaucrantz works in the public sector, perhaps as a policy analyst (or director, or assistant deputy minister). He has been out of school for a while, but he's recently been introduced to the idea of social-ecological dynamics and systems, and it resonates. He's curious, and eager to shake things up.

Xiaoping Bigbux is working as a consultant or in industry overseeing something related to environmental assessment, corporate social-environmental responsibility, or some other sustainability aspect. Unlike what her name suggests, she has never been in it for the money, but rather to effect change from within the capitalist engine that she feels certain has a major role to play in the sustainability of our resources and our planet. She too is eager to learn more about social-ecological dynamics and systems, with the notion of applying it to her work.

Every second week, please write a 250-500 word entry that answers the following question, "What would Xxx Yyyyy think about concepts W and Z? How might the new understanding change his/her actions?" (where concepts W and Z come from either or both of the two weeks of material). Write in first person (you *are* Xxx Yyyyy), and specify who you are. Please have fun with this. You don't need to stick to the four characters above—you can change their names, create new ones, change your 'identity' from week to week, write your journal entries as stories, etc. In each case, you'll be graded five times (for 2 marks each) using the following rubric. The key point here is to consolidate your own learning.

Journals Rubric

	Levels of Achievement		
Criteria	**No credit**	**Half marks**	**Full marks**
	0 Points	**1 Point**	**2 Points**
Entry	Entry represents a fundamental misunderstanding of concepts, concept is unrelated to readings from the two weeks, or entry is wholly impersonal and/or unclear.	Entry is vague, impersonal, or it seems to misrepresent the concept in question or largely misses the point, and/or entry is confusing or unclear.	Entry is concrete. It reflects an understanding of the concept and how it could change a person's thinking and be incorporated into practice. Creative and clear.

Case Study Project Guidelines

The goal of this assignment is to apply your thinking as it has developed over the course of the seminar to an analysis of a particular social-ecological problem. In essence, your team will be a consultant to some decision-maker or practitioner.

Too often, policy and management are focused on short-term outcomes, striving for efficiency via social *or* ecological dynamics assumed to be rational, linear and stationary (unchanging over time).

This is also true for problems that are obviously rooted in deeply integrated complex adaptive systems, whose dynamics are strongly non-linear and changing. For such problems, blindness to these social-ecological dynamics can be the difference between disastrous and desirable futures. Resilience, adaptive capacity and/or transformability may be more appropriate goals. And yet, pinpointing needed changes and communicating these is no mean feat, given the complexity of the subject matter and the jargon we academics rely on to understand it.

The purpose of this project is to do just that: pinpoint, explain, and justify needed changes to law, policy, or practice for a decision-making client (in NGOs, government, business, etc.).

Possible Topics

We want this project to be useful to you, and to relevant decision-makers, so please choose a site of special interest or significance to you. Also, we hope that in cases where this is possible, you will go as far as to establish contact with these decision makers, as soon as you settle on a problem/area (indeed, you may wish to choose your focus problem/area in part based on your conversations with decision makers). Conversations with decision-makers where possible will help guide the scope, focus, and structure of your analysis. When not possible, you will need a proxy for contact with a decision maker—e.g., contact with someone who doesn't have decision authority but knows the site well and this can be supplemented in turn with 'grey literature' (planning documents, reports and meeting minutes, etc.). I have been in contact with a suite of possible 'clients', but you can also pursue your own. If you need help with this, please let us know as soon as possible.

A Subset of Initial Ideas for Case Studies (more to come, and please add your own)

1. Enbridge Northern Gateway Pipeline
2. Exxon Valdez, a quarter century later
3. Remediating the Hanford Superfund Site
4. Hurricane Katrina and its Aftermath
5. The City of Vancouver, and e.g., transformation to the "Greenest City"; or vulnerability to disasters
6. The Great Bear Rainforest, and the Ecosystem-Based Management agreement
7. The West Coast of Vancouver Island, and e.g., sea otter reintroduction
8. The arid Southwest USA: forest fires, water shortages, and/or dust storms
9. Offsetting impacts on biodiversity and ecosystem service: gateway to real norm change, or a tool for industrial apologists?
10. Howe Sound, and scheming for rejuvenation (Better & Wilder)

The Analysis

Your case study analysis should make the case for these needed changes in an accessible and compelling manner. It should include (1) a **characterization** of the problem/site as well as (2) an **assessment** of its current challenges and dynamics both ecologically and socially (and social-ecologically), and should close with (3) **recommendations** for management or other intervention. While we will not ask you to follow a specific format, your case should include content along the following lines:

- Include a succinct presentation of primary details of the site including historical context, ecological issues and dynamics (uniqueness, significance, role in larger-scale processes, etc.), major users, human interests, threats and pressures–local and non-local, governance structure of relevant region or nation state as pertains to the problem. Also highlight and explain any major points of scientific or social controversy, and relevant law or policy prescriptions (e.g., CITES, national endangered species legislation, etc.). Finally, include a brief assessment of the implications for local or national income, wages, or livelihoods (and, where applicable, to human concerns outside the nation).

- Provide a clear framework or theory as to why any evident problems or improvements have changed or escalated over time **or** why a particular problem evolved as it did. Your explanation should clearly rely upon class material but may also draw upon other ideas to elaborate or contest core findings or assumptions in the seminar literature.
- In your assessment, pay special attention to social-ecological interactions and feedbacks (including ecosystem services and processes by which ecological change may trigger social change/consequences and vice versa; also including interactions and feedbacks that may be purely social or ecological). Identify any such interactions that may be overlooked in management, policy, or discourse, especially from the perspective of your intended audience. To the extent that any existing social-ecological interactions or feedbacks are at risk, do your best to prioritize these.
- Convince the reader and your class colleagues (re: the presentation) that the explanatory framework you used to analyze your case is appropriate (i.e., that your criteria for evaluating the current status and/or future prospects are sound and the 'best' way to understand the case).
- Provide some compelling arguments as to what changes in management and/or governance or monitoring practices should occur, and defend these as sensible from an ecological, social, or social-ecological perspective. Feel free to borrow recommendations from others, but acknowledge sources comprehensively and pay special attention to insights and recommendations that are novel, especially from a social-ecological perspective.
- Present all in a visually accessible way with **graphics**, a **table of contents**, an **executive summary**, and any other elements appropriate and useful to your audience.

Case Study Components

This project has three components. Final papers should be fully referenced and standard term length, that is, 18-25 pages double spaced (max 7000 words). Presentations should be treated as a 'dry-run' for your paper and should be structured such that you are able to maximize feedback from seminar participants. *You may choose to deviate from the assignment criteria somewhat if and when a particular kind of analysis strikes you and if and when you have cleared that option with either Kai or Terre.*

Proposal: In ≤1000 words, explain and justify your chosen problem, and lay out the structure and content of the paper. Describe the approach that you will use (including the steps you will take), and refer to some of the literature that you will consult. Please also describe your plan for ensuring that it will be considered appropriately by the decision makers in question (ideally you would already have established contact).

Please only have one member from your group submit the assignment, which you should do so as a Word document (or pdf), where the filename includes each of your names and your project's short title (e.g., "NGP").

Grades: one mark each for the following (a total of 7):

- Brief problem description
- Brief problem definition (put some bounds on scope and scale, etc.)
- Report structure
- Proposed content
- Proposed steps/approach
- Preliminary literature
- Plan to connect with the report's audience/decision-makers

Presentation: In ≤30 minutes, present your initial findings in the areas outlined above. Presentations are intended as 'dry-runs' to get valuable feedback from the instructor and peers. Please share presentation time equitably. Marks will be deducted for going over time.

Paper: In ≤7000 words (including figures, tables, and all text except references and supplementary appendices), present your findings. Papers should be fully referenced according to the

style of your choice. Exceptions to the word limit will be considered if requested a week or more in advance of the deadline, based on discussions with your decision-maker contacts.

Assembling Your Team

This is intended to be a **team** effort. As in every case with social-ecological systems, the relevant expertise is distributed among different people, and you should learn from these others. We prefer teams of 3-4 but will consider proposals with different numbers and will adjust grading expectations accordingly. Teams will receive the same grades on all components except for the delivery component of the presentation, as it is assumed that you will make use of your reviewing skills to improve your partner's contributions. Exceptions to the policy of equal grades will be considered only if requested *by all parties together at the due date*.

Presentation Grading Rubric

Category	**Excellent** (90-100%)	**Good** (74-89%)	**Adequate** (65-73%)	**Inadequate** (<65%)
Opening/intro (1)	Clearly, quickly established the focus of the presentation, gained audience attention.	Established focus by the end of the intro, but went off on a tangent or two. Gained audience attention.	Audience had an idea of what was coming, but the intro did not clarify the main focus.	Little or no intro, or intro unfocused such that audience did not know the speaker's main focus.
Clarity & Organization (2)	Main points clearly stated and explained; well thought out background; logical, smooth organization.	Main points clearly stated; background adequate; logical, smooth organization.	Main points must be inferred by audience; background adequate; audience can follow presentation, but holes are evident.	Presentation jumped among disconnected topics. Main points unclear.
Content (5)	Content presented and analyzed in an interesting, knowledgeable, logical way. Key points clearly expressed and integrated with logical links. Presented appropriate & useful, forward-thinking insights.	Content presented and analyzed in an interesting, knowledgeable, way. Key points clearly expressed and integrated with logical links. Presented appropriate insights.	Content presented in an interesting way. Some key points linked, but others "hanging". Presentation lacked clear synthesis and insight.	Content patchy. Lacked specific important information. Little effort to synthesize key points.
Style/Delivery (2.5)	Audience could see & hear presentation clearly, appropriate eye contact, gestures, and language. Effective pauses and verbal intonation. Graceful transitions.	Audience could see & hear presentation clearly, appropriate eye contact, gestures, and language. Some pauses, verbal intonation, and transitions effective.	Audience could see & hear presentation. Presentation poorly timed. Speaker expressed hesitation or uncertainty.	Presenter spoke to the screen or mostly to one person in the audience. Difficult to hear/understand. Poorly timed.
Visual Aids (2)	Well-selected, well-placed images and text. Figures were explained to clearly support ideas presented without extraneous info.	Well-selected images and text, not always well-placed. Figures clearly support ideas presented. May have some extraneous info.	Chosen images extraneous to presentation or marginally support presentation. Too much extra detail.	Chosen images and text marginally useful and poorly ordered. Too much extra detail. Limited connection to topic.
Summary (1)	Conclusions clearly stated. Summary integrated main points and brought the presentation to a logical & effective close.	Conclusions clearly stated. Summary integrated main points and brought the presentation to an appropriate close.	Summary shown but poorly explained by speaker. Audience has to summarize for themselves.	Summary non-existent or very abrupt. Lack of synthesis.
Addressing questions (1.5)	Questions handled with confidence and in a knowledgeable way. Speaker clearly	Questions handled in a knowledgeable way but with some hesitation. Speaker clearly	Speaker made a strong effort to answer questions, but lacked depth of knowledge	Speaker lacked answers to obvious questions the audience would be likely to ask.

	demonstrated further depth of knowledge than just the information in his/her presentation.	demonstrated further depth of knowledge than just the information in his/her presentation.	beyond what he/she already presented.	Speaker struggled to link answer to content of presentation.

Paper Grading Criteria

Content (24)**:**

- ***Context*** *(representation of)* (5): how well you explain the issue and the relevant threats, policies, stakeholders, and how it all comes together.
- ***Data*** *(identification and representation of)* (5): the quality of the data you've marshalled (or, where good data are not available, the quality of your search for data as you describe it, your evaluation of that data, and your description of the kind of data you would want/need) for the relevant natural and social science.
- ***Analysis*** (9): the quality of your analysis of the data (their implications and limitations) and the integration across disciplines for a synthetic understanding of the relevant ecosystem services; use of course materials.
- ***Recommendations*** (5): the creativity and appropriateness of your recommendations (in light of the data & analysis); justification of these.

Style (6)**:**

- ***Layout*** (3): clarity, aesthetics, layout, outline (e.g., a table of contents is helpful, as is an executive summary), organization.
- ***Visual aids*** (3): balance of materials for different styles of learning (e.g., visual vs. verbal), clarity and relevance of figures and tables.

Class Participation Grading Rubric

Task Description: Students will participate actively in class, thereby contributing to their own learning and to that of their peers.

	Excellent (80-100%)	**Competent** (60-80%)	**Needs work** (<60%)
Content	Asked and answered questions as appropriate, showing reflection and synthetic understanding.	Asked and answered questions only rarely, or frequently but superficially or obliquely.	Contributions were very rare and/or superficial or off the mark.
Delivery/ Group-Fostering	Respectful, clear, constructive questions and answers. In group activities, fostered timely and effective collaboration.	Respectful questions and answers. Group participation was generally passive (not attending to timely completion of the task).	Questions and answers were sometimes unclear, or not constructive or respectful. Group participation tended to be disruptive.