



TUTORIAL 1: Overview of Socio-environmental Synthesis

Learning Goals:

- Explain why addressing environmental problems requires both natural and social science perspectives.
- Explain why a systems perspective is important for studying environmental problems.
- Summarize what the process of socio-environmental synthesis involves and why this research approach is important.

What is Socio-environmental Synthesis?

Our planet is home to 7 billion people, a population growing upwards of 8.3 - 10.9 billion people by 2050. At the same time, rapid globalization has profoundly changed the way we live: We are moving and travelling faster and further than ever before, and the ways in which we interact with information and each other have been transformed by digital technologies. As a result, distances are being traversed with greater ease and speed, not only by people, but by natural resources, food, goods, ideas, information, animals, and diseases. The implications of this connectivity and movement are only beginning to be understood. We live in a globalized world that is vibrant, exciting, and dynamic, but it is also a world that is increasingly crowded, stressed and competitive with 7 billion people striving to meet their many needs and wants.

To meet these needs and desires, humans depend on the natural environment for several kinds of natural resources or “natural capital”: we need clean water, air, plants for food and medicine, animals for food and companionship; energy resources such as coal, oil, and gas— for transportation, manufacturing, and agriculture; timber for building materials, and paper products. And now, there is demand for rare earth metals- elements found in most high tech gadgets like our ubiquitous cell phones.

As we harvest, process, and use these natural resources- through farming, fishing, drilling, mining, fracking, clear-cutting, traveling, etc. - we’re also shaping and impacting the environment and the ecosystems where these resources are found. In many cases, we change them in ways that become problematic for humans. For example, because the world’s oceans provide critical food supplies for many people, fishing is common the world over. However, the ability of the ocean ecosystem to continue providing fish is limited by overfishing. Similarly, as the world’s population grows and increasingly adopt Western lifestyles, the demand for energy grows. With that demand comes increasing incentives for mining coal, extracting oil, and other such practices. However, the extraction of oil and coal impacts the ecosystems where they are found, and contributes to water and air pollution, impacts human health (e.g. due to toxic contaminants), and threatens wildlife (e.g. due to oil spills and altered habitats). While humans have always faced environmental problems, the scope of these problems has increased as the abundance of our natural resources diminish, demands rise, and our world grows increasingly connected.

The impact of humans on the earth’s systems is now so great that many scientists refer to the age we live in as the “Anthropocene”. As this impact has grown, views on the relationship between people and nature have changed. Once dominant views of nature as something to be tamed and exploited for our



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benefit or as something to be preserved as untouched wilderness have been challenged and expanded to include views of nature as important resources for humans (i.e. ecosystem services) or as integrated socioecological or socio-environmental systems (Mace, 2014). This most recent view of humans and nature as integrated socioecological systems is a fundamental perspective of **socio-environmental synthesis (S-E synthesis)**.

As a research and problem-solving approach, **S-E synthesis** focuses on understanding connections between humans and nature and emphasizes the importance of understanding them from a systems perspective. It is a process that brings together multiple, and often disparate, disciplines relevant to the problem at hand to create new insights and discoveries by integrating existing knowledge, data, and methods from these disciplines. Ultimately, it is about helping to inform decisions for addressing the great challenges we face: daunting socio-environmental issues like climate change, deforestation, environmental justice, water pollution, and the loss of biodiversity.

Key Concepts of Socio-environmental Synthesis

The following four related ideas are fundamental to socio-environmental synthesis:

- 1) Socio-environmental problems involve complex interactions between humans and the environment, and addressing such problems requires perspectives from both the natural and social sciences.
- 2) Systems perspectives are necessary to understand socio-environmental problems.
- 3) Transdisciplinary approaches that engage natural and social scientists and decision makers in collaborative research are needed to develop better understanding of the complex interactions within socio-environmental systems.
- 4) The process of synthesis research emphasizes the distillation or integration of data, ideas, theories, or methods, and often utilizes computational approaches, models, and tools.

Concept 1: *socio-environmental problems involve complex interactions between humans and the environment, and addressing such problems requires perspectives from natural and social sciences.*

“There’s no question that the most important concept [for students] to learn is that all environmental problems are social problems. They are so tightly coupled that you can’t really understand environmental problems without understanding social dynamics, the social context, and the ways in which the environment influences people and vice-versa.”

-Dr. Margaret Palmer, Executive Director of
the National Socio-Environmental Synthesis
Center (SESYNC)



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As human influence on the earth continues to expand, we have reached a point where we can say that all environmental problems are really socio-environmental problems. To make better decisions about managing the complex environmental problems we face, we need to understand not just how the environment functions, but also how human systems function and how environmental and human systems interact and influence each other. Understanding these complex dynamics and interactions is the main goal of the socio-environmental synthesis research approach.

A socio-environmental problem: A closer look at the example of coral reefs

Coral reefs are diverse and complex ecosystems that are home to a great diversity of plants, animals, and microbes. Coral reefs are also extremely valuable to the coastal communities that surround them. However, an estimated 75% of the world's coral reefs under threat (Burke, Reyter, Spalding, & Perry, 2011). There is much to lose both in terms of natural biodiversity and in terms of the economic and socio-cultural benefits that coral reefs provide to humans.

To understand why coral reefs are threatened and why this problem is so complicated, we need to consider coral reefs as an integrated socio-environmental system. But first, we will describe how coral reefs function as a natural system and as a social system.

Coral reef - the natural system

Ecosystems are communities of living organisms and biophysical components of the environment that interact with each other to form a system (for more about systems, see Tutorial 2). The coral reef ecosystem is built by coral polyps, small animals that have zooxanthellae, a photosynthetic algae, living inside them.

In this mutually beneficial, symbiotic relationship, the polyps provide the zooxanthellae with a protective environment, CO₂ for photosynthesis, as well as important nutrients like nitrates and phosphates. In turn, the zooxanthellae produce several things that the polyps need, like oxygen and glucose, and other molecules needed for corals to produce calcium carbonate skeletons.

As colonies of reef-building coral polyps expand and produce more skeletons, the reef grows. This reef then becomes a habitat for a great diversity of organisms, including many species of tropical fishes, sea turtles, sharks, rays and marine mammals.

In the coral reef ecosystem, biophysical factors such as sunlight, water clarity and temperature, which are influenced by the climate, are also critical. For coral polyps to be healthy and to continue growing, the water they live in needs to be clear so that sunlight can reach the zooxanthellae for photosynthesis. Most corals also require water temperatures within a narrow range of 23-29 degrees Celsius to thrive¹.

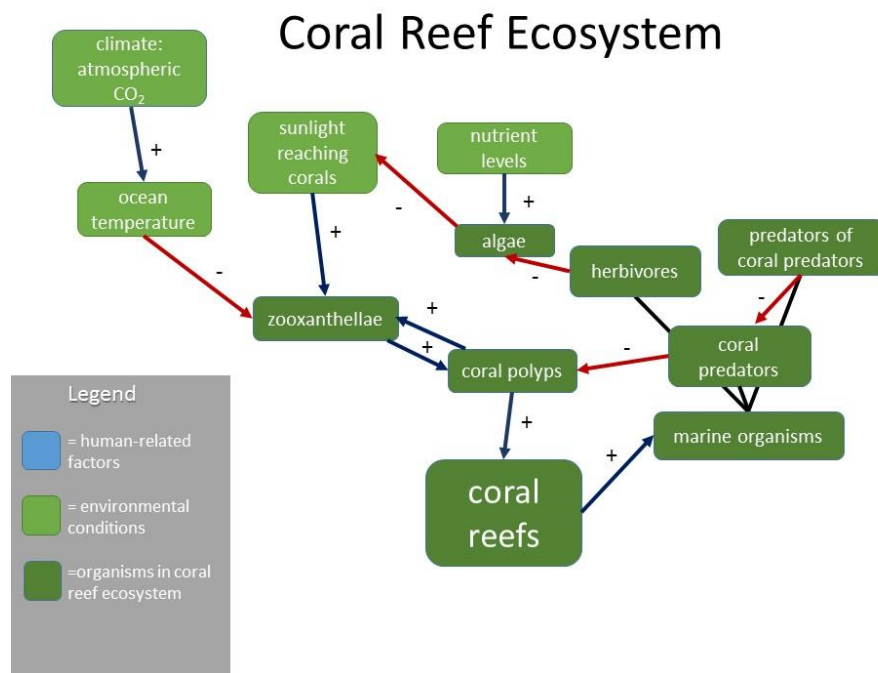
¹ http://www.coris.noaa.gov/about/what_are/

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This delicate balance can be upset when water temperatures reach beyond this temperature zone for some time, resulting in coral bleaching. In waters warmer than 29 degrees, the zooxanthellae in many coral species die, leaving behind white, or “bleached”, corals. This natural threat to coral reefs is greatly influenced by the changes in the earth’s climate, which in turn influences ocean temperatures. Increases in carbon dioxide levels in the earth’s atmosphere is also decreasing pH levels in the oceans and thus creating more acidic waters. This change in pH leads to ocean acidification, which can negatively affect marine organisms, particularly shelled organisms like corals and sea urchins, and also contributes to coral bleaching.

Other natural threats to coral reefs include strong storms (hurricanes and cyclones), and predators, such as sea stars, fish, barnacles, crabs, and snails. While a certain level of predation can be absorbed by the coral reef without problem, extreme cases of predation can be devastating. For example, outbreaks of crown-of-thorns starfish have been known to devastate coral reefs (e.g. 90 % of the corals in the Fagatele Bay National Marine Sanctuary in American Samoa were destroyed during an outbreak.²)

The concept map below (For more about concept maps, see Appendix below) represents some of the connections between parts of the coral reef ecosystem. The direction of the arrows indicate the direction of cause and effect, and the sign/color of the arrows indicate whether the relationship between the two parts is positive or negative. For example, rising nutrient levels causes algae to grow (blue/positive arrow). However, as algae grows, sunlight is blocked from reaching the corals (hence red/negative arrow)



² http://oceanservice.noaa.gov/education/kits/corals/coral08_naturalthreats.html



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Coral reef - the social system

In nearly all coral reefs, there are local communities that benefit from the coral reefs in multiple ways. The spectacular beauty and biodiversity of the coral reefs attracts tourists who love to snorkel and dive in the reefs' waters. As more tourists flock to such areas, money also flows into the local communities and industries that support these recreational activities, and thus, local economies become intertwined with the coral reefs, as do the regional and global industries associated with tourism. With the growth of tourism in coral reef areas, there is also associated growth in the local population and tourist infrastructure like housing and roads. With more people, there is also more pollution and waste.

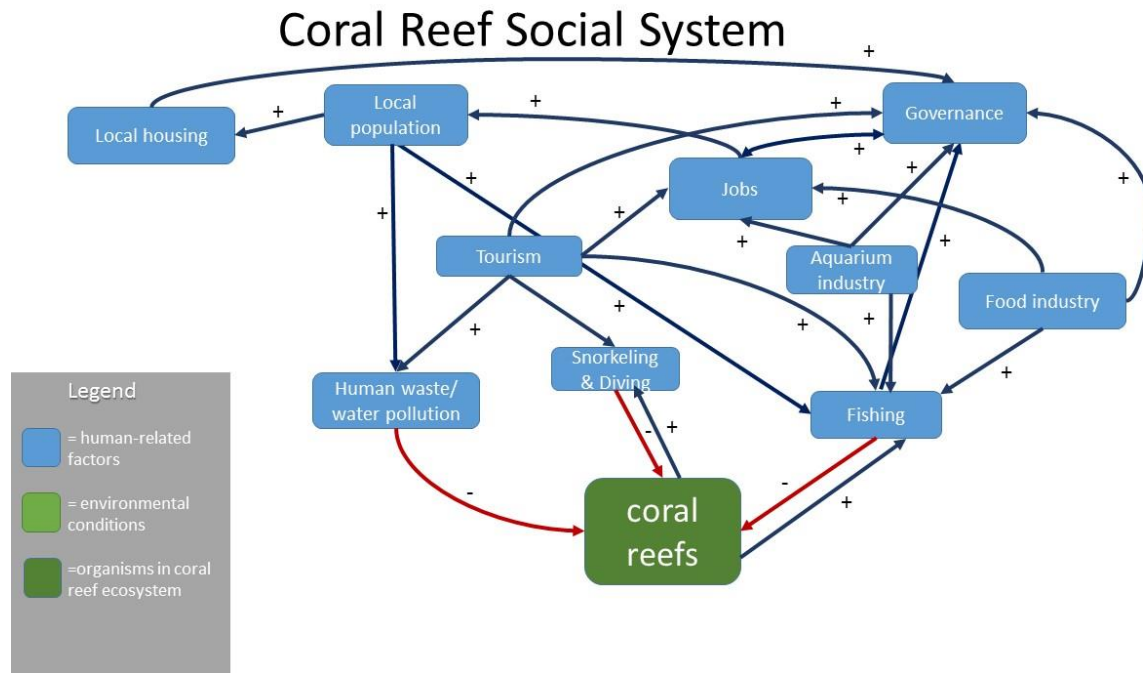
Coral reefs also provide a substantial food source for both local communities and people worldwide. Over 1 billion people depend on fish from coral reefs for sustenance³, and the fisheries that have developed to meet these needs have become an important source of livelihood in many communities. For many, particularly local fisherman in rural areas, fishing in the coral reefs is a critical source of both income and food. In addition to being fished for food, coral reef fish are prized for their beauty and collected for the aquarium trade worldwide. Often, because of the economic incentives, fishers increase their fish catches by using explosives and poisons, destructive fishing practices that also damage coral reefs.

The value of coral reefs to humans goes beyond the marine life within them. Local communities are also dependent on coral reefs to provide protection; reefs form barriers and encourage the growth of seagrasses and mangroves that together protect coastlines from storms, and erosion.

While many of the benefits that humans obtain from coral reefs can be quantified, some values cannot be summed up in a dollar amount. Yet they are no less important. The tremendous biodiversity of the coral reefs is in and of itself extremely valuable in terms of natural history and untapped potential (e.g. medicines), and for philosophical or moral reasons. For many, there is an inherent value in the existence of coral reefs, one that relates to the concept of "biophilia", the instinctive connection between humans and nature. For many communities that depend on coral reefs, the reefs and their inhabitants have powerful symbolic and cultural meaning.

The concept map below represents some of the connections between parts of the coral reef social system. Concept maps are working hypotheses- visualized ideas- of how concepts, or in this case parts of a system, are related.

³ <http://coralreef.noaa.gov/aboutcorals/values/fisheries/>



Coral reef decline- a socio-environmental problem

Of course, the coral reef ecosystem and the coral reef social system are not separate. If we consider the problem of the decline of coral reefs, we see that it is truly a socio-environmental problem.

But it's a socio-environmental problem not just because it's a problem for both nature and humans. It's a "socio-environmental" problem because of the way the natural and human factors are connected or "coupled."

To illustrate, consider the factors that are causing coral reefs to be threatened. One factor is overgrowth of algae close to the water's surface. For coral polyps to be healthy and to continue growing, sunlight must be able to penetrate through the water to allow photosynthesis to occur in zooxanthellae. When water column algae grows, sunlight is blocked, photosynthesis is inhibited, and coral growth slows. Benthic algae (algae that grows on the sea floor) also inhibits coral growth by competing with corals for space.

Algae growth is an environmental factor that negatively influences coral reef health. But this factor is also influenced by humans. Normally, corals live in nutrient poor waters, but humans can change this by doing things like emptying septic tanks into the waters, which introduces a sudden influx of nutrients into the waters. When this happens, algae thrive, which in turn has a negative impact on the coral reefs. With the growth of local populations and the number of tourists in the area, this problem is exacerbated. However, decline in coral reef health will in return lead to declines in tourism and fishing industries, and potentially the number of people as tourists go elsewhere and locals migrate in times of scarce food and job opportunities. Furthermore, as coral reef health declines, so does the population of



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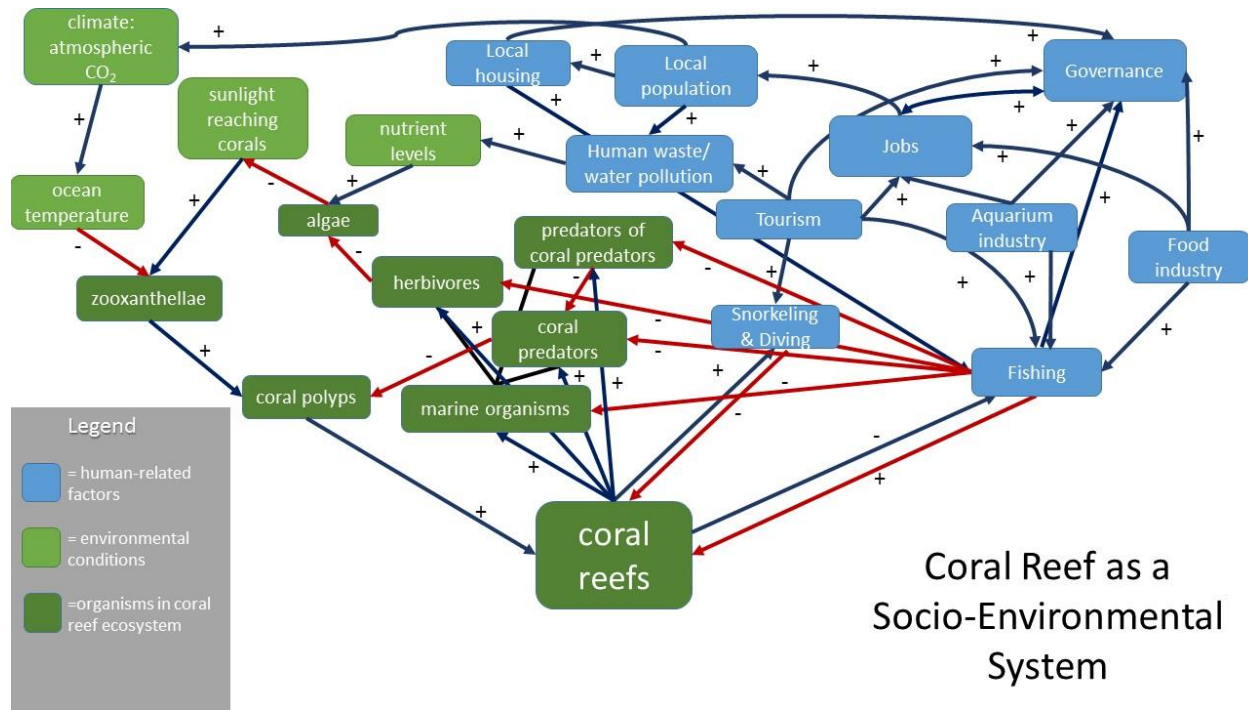
algae-consuming herbivores, like parrotfish, in the coral reef ecosystem; without these algae-consumers helping to reduce the amount of algae, the algal growth problem is exacerbated. People, algae, and corals are coupled in this system because of the way they influence each other.

Another factor in the decline of coral reefs are rising ocean temperatures. Most corals thrive in a narrow temperature range: 23-29 degrees Celsius is optimal. But when water temperatures reach beyond this zone for some time, coral bleaching often occurs. Here again, this environmental factor is linked to human activity: rising ocean temperatures are linked to climate change, which is in turn influenced by human activities on a global scale.

In some places, the Philippines and Japan for example, coral reefs have been threatened by growing populations of predators who feed voraciously on the coral polyps. But this natural threat too is likely linked with human activity: one hypothesis for the growth of this predator population is that the natural predators that normally keep the starfish population in check have been fished by humans. However, these same fishing communities are also impacted by the decline in fish populations caused by growth in the numbers of voracious starfish.

These are less obvious connections between human and natural factors affecting coral reefs. Humans also directly impact coral reefs through destructive fishing practices- like blast fishing, cyanide fishing, or trawling, marine pollution, and irresponsible tourism and recreation. However, as discussed before, humans have a lot to lose if coral reefs die, and for many, the consequences, including loss of livelihoods and food sources, can be dire. Yet humans contribute to this loss in numerous ways. This contradictory behavior hints at why problems like these are called “wicked” problems. Wicked problems are “wicked” because they are complex, dynamic, ill-defined, and extremely difficult or impossible to solve. Judging by the large number of organizations from different sectors that are devoted to coral reef conservation, one thing is clear: protecting coral reefs and governing human activities that impact them is an exceedingly complicated task and a very wicked problem. Looking at the concept map below, we can visualize some of this complexity:

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Even with this incomplete picture of a coral reef system, we can already see that the solutions are not simple. Given the complexity of this problems and others like them, how can we develop a solution? What do we need to learn and know? How do we approach this problem?

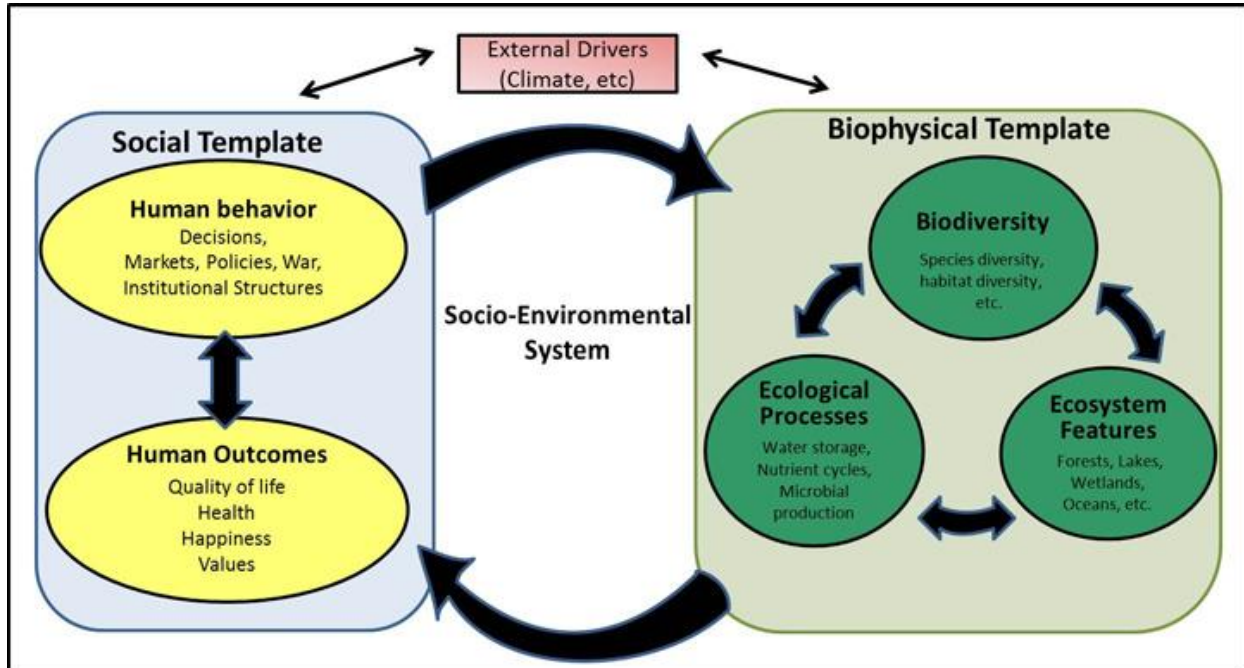
Concept 2: systems perspectives are necessary to understand socio-environmental problems

To begin, we need to look at this problem from a systems perspective. We need to understand how the components of a system interact and produce a pattern of behavior. As we just described, there are many ways in which the social components and natural components of the coral reef system interact. Although we can look at the subsystems (i.e. the coral reef as an ecosystem or the coral reef as a social system) independently, we must consider a coral reef as a socio-environmental system to really understand the dynamics and behaviors influencing coral reef health. Such knowledge is in turn necessary to develop effective policies and management practices. By bringing a systems perspective to this problem, we can get a better sense of why we see certain behaviors or patterns (This is discussed further in Tutorial 2.)

The conceptual diagram below was created by SESYNC to explain a socio-environmental system. The diagram outlines the categories of S-E system parts and illustrates their relationships: Factors that are related to the social system are described within the 'social template', and biophysical characteristics of the system are categorized under the 'biophysical template'. As the diagram illustrates, there are interactions between elements within each template and between the social and biophysical templates.

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These feedbacks and interactions between the parts of the system are the critical features which determine how the system behaves.



This diagram can help us see why it is important to consider coupled interactions between the human and natural dimensions of the coral reef S-E system. Specifically, if we are interested in fishing practices of a local community near a coral reef, we would need to understand all the factors that influence this human behavior in this community. The diagram above can be helpful in guiding our questioning. To begin, we can quickly recognize the influence of factors related to human outcomes on this human behavior: people fish to feed themselves and their community (health) and to earn income (quality of life, happiness). Perhaps less obvious are the influence of “values” and the cultural dimensions and normative aspects of this issue. For example, some may also fish because fishing is deeply embedded in their culture and/or identity: They fish because it is who they are and what they love to do. Others may have different set of values and priorities: Some may fish as a matter of practicality and habit, and may willingly change their livelihoods when presented with viable alternatives. Values clearly have a critical impact on human behaviors, yet how they factor into decisions is often difficult to understand. This underscores the importance of social science in understanding S-E systems.

Fishing practices are also influenced by the health of the coral reefs. For example, dwindling fish populations may influence decisions to use destructive fishing practices to increase their catch, and/or stimulate new policies to regulate such practices. These decisions, in turn, feedback to influence fish populations. For example, damaging the reef structure decreases the amount of habitat available for fish, causing further declines in fish populations. The total size and stability of these fish populations is also influenced by many biophysical factors, including ecological processes such as nutrient cycles and



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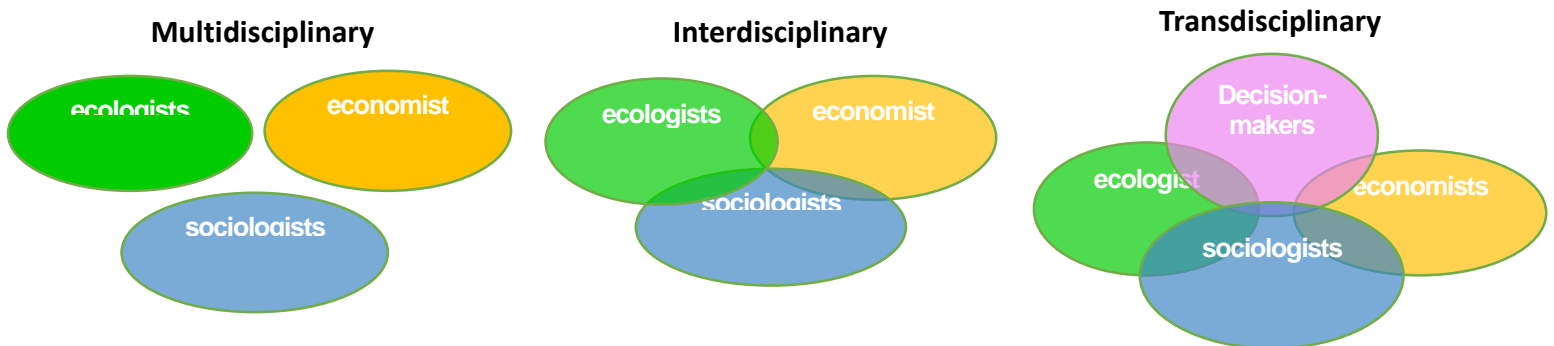
algae growth, and ecosystem features such as the habitats created by coral reefs. Considering this conceptual diagram and the coral reef concept map above, the degree to which the biophysical factors and social factors are linked should be apparent. Considerations of these linkages and feedbacks is critical for understanding the dynamics and behaviors of socio-environmental systems.

Concept 3: Transdisciplinary approaches that engage natural and social scientists, and decision makers in collaborative research are needed to develop better understanding of the complex interactions within socio-environmental systems.

“I’ve always thought that we shouldn’t be thinking about disciplines. We should be thinking about questions. Asking an interesting question that matters to society ... if we have a very good question that we need answers to, then we should bring in whatever disciplines that are needed to answer the question. If you do that honestly, in my view, you are almost inevitably going to have to bring in both the natural sciences and the social sciences to answer the question.”

-Dr. Emilio Moran, John A. Hannah Professor, Department of Geography, Center for Global Change and Earth Observations, Michigan State University

To understand socio-environmental systems and to develop solutions to S-E problems, it should be apparent now that insights from both the natural and social sciences are required. However, S-E synthesis emphasizes not only the inclusion of these fields (multidisciplinary research) but also the integration of insights from multiple fields that are the hallmark of interdisciplinary and transdisciplinary research.





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Moreover, because of the critical role of decision-makers in developing and implementing solutions to S-E problems, an interdisciplinary approach is not sufficient if the research results are not useable or understandable by decision-makers. Because of the importance of producing **actionable** results- results that can inform decisions- **transdisciplinary** research is an important facet of the S-E synthesis approach. Although definitions of transdisciplinarity vary (Stokols, Hall, Taylor, & Moser, 2008), we adopt the definition of transdisciplinarity that not only emphasizes the degree of integration and synthesis as interdisciplinarity does, but also adds a focus on problem-oriented research with the inclusion of stakeholder groups in the co-development of research questions. For example, a transdisciplinary team studying coral reefs might include natural and social scientists from academia, government organizations and non-profits, as well as policy makers, fishermen, or tourism industry representatives. Transdisciplinary work is further delineated by distinctions between consulting transdisciplinary and participatory transdisciplinary work. In **consulting transdisciplinarity**, collaboration between researchers of different disciplines and between researchers and practitioners (some use the term “stakeholders”, but “practitioners” is preferred as a more neutral term) occurs, but the degree of involvement from participants outside academia is limited. The researchers shape the research and consult others when needed. **Participatory transdisciplinarity**, however, attempts to overcome this limitation and involves researchers and practitioners at all stages of the research, and focuses on the co-development of research questions and methods.

Whether done by individuals or in collaborative teams, interdisciplinary and transdisciplinary work requires bridging disciplinary divides and integrating theories, ideas, and methods from across the disciplines. Doing this kind of work requires an additional set of competencies, particularly when working in teams. In particular, interdisciplinary and transdisciplinary work requires: 1) effective communication skills, 2) understanding of and respect for different [epistemologies](#) (i.e. theories of the nature and limits of knowledge), and 3) understanding and reconciliation of methodological differences, mismatching scales and units of analysis.

An emphasis on actionability and transdisciplinarity reflects and reminds us of the critical motivation for conducting socio-environmental synthesis research: we face “wicked” environmental problems- defined as urgent, ill-defined, complex, dynamic, public and often intractable problems- that will have profound consequences for many. How we address these problems now will determine the severity and extent of the consequences. The promise of socio-environmental synthesis research is that it will help us determine better ways to address these problems.

Concept 4: The process of synthesis research emphasizes the distillation or integration of data, ideas, theories, or methods, and often utilizes computational approaches, models, and tools.

Synthesis research is common in many disciplines (e.g. (Cooper, 2009; Kemp & Boynton, 2011; Rodrigo et al., 2013), and generally involves the integration of methods, concepts, and knowledge either within or across disciplines. Integration is a “process by which ideas, data and information, methods, tools, concepts, and/or theories from two or more disciplines are synthesized, connected, or blended” (Repko, 2012). To many, integration is the goal of interdisciplinary and transdisciplinary work, without which the



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work would be more appropriately described as multidisciplinary. Integration is also a critical component of S-E synthesis:

Socio-environmental synthesis “involves distilling or integrating data, ideas, theories, or methods from the natural and social sciences. This approach may result in new data products, particularly ones that address questions in new spatial or temporal contexts or scales, but may also involve evaluating textual or oral arguments, interpreting evidence, developing new applications or models, or identifying novel areas of study.”⁴

S-E synthesis is not a singular method: rather, it is a flexible and broad research approach that can be practiced in many different ways. S-E synthesis involves a constellation of methods that share a common approach of bringing together existing information to uncover new patterns, mechanisms, and insights.

With the increasing prevalence of large databases and computational advances, many S-E synthesis research projects focus on integrating or distilling multiple datasets and utilize data-intensive research methods. Other common approaches to S-E synthesis research includes the development or application of computational models; for example, models are often created to simulate and predict the dynamics and behavior of a particular S-E system. S-E synthesis research can also include qualitative approaches. For example, a SESYNC-funded project is studying the problem of overfishing by studying fishers learning exchanges using methods including focus groups and interviews. The project’s synthesis approach is a comparative analysis of different exchanges around the world to identify the elements of the learning exchanges that lead to conservation outcomes.⁵

REFERENCES

Burke, L., Reytar, K., Spalding, M., & Perry, A. (2011). *Reefs at Risk Revisited*. Washington DC. Retrieved from <http://www.wri.org/publication/reefs-risk-revisited>

Cooper, H. (Duke U. (2009). *Research synthesis and meta-analysis: a step by step approach (applied social research methods)* (Fourth., pp. 1–280). Thousand Oaks, CA: SAGE Publications, Inc.

Kemp, W. M., & Boynton, W. R. (2011). Synthesis in Estuarine and Coastal Ecological Research: What Is It, Why Is It Important, and How Do We Teach It? *Estuaries and Coasts*, 35(1), 1–22. doi:10.1007/s12237-011-9464-9

Mace, G. M. (2014). Whose conservation? *Science*, 345(6204), 1558–1560. doi:10.1126/science.1254704

⁴ <http://www.sesync.org/glossary>

⁵ <http://www.sesync.org/learning-exchanges-lexcell>; <http://www.sesync.org/video-learning-exchanges-for-conservation>

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Mobjörk, M. (2010). Consulting versus participatory transdisciplinarity: A refined classification of transdisciplinary research. *Futures*, 42(8), 866–873. doi:10.1016/j.futures.2010.03.003

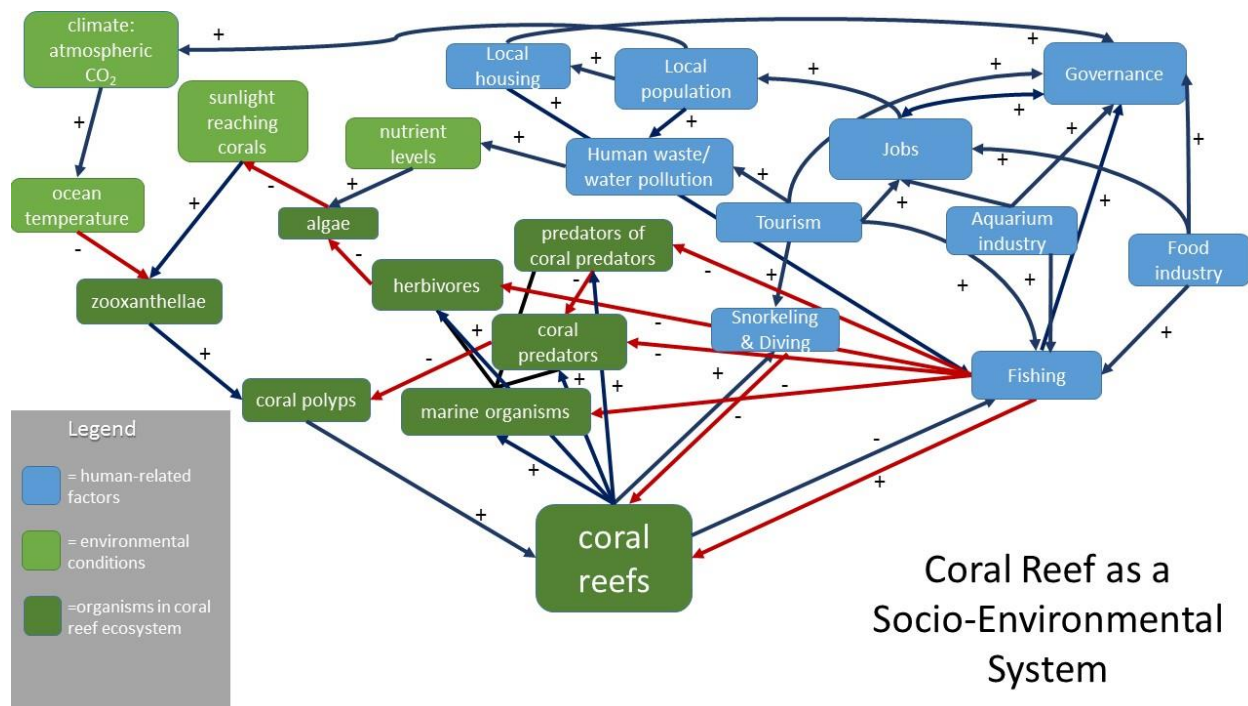
Repko, A. F. (2012). *Interdisciplinary Research Process and Theory* (p. 544). SAGE Publications, Inc.

Rodrigo, A., Alberts, S., Cranston, K., Kingsolver, J., Lapp, H., McClain, C., ... Wiegmann, B. (2013). Science incubators: synthesis centers and their role in the research ecosystem. *PLoS Biology*, 11(1), e1001468. doi:10.1371/journal.pbio.1001468

APPENDIX

What is a Concept Map?

A concept map is a basic tool that helps to visually organize knowledge and highlight relationships, interactions, and connections between the concepts. They are used in a variety of ways and in different settings. One common way is in the classroom. They are used to help students understand how ideas and concepts relate to each other and to help students see the overall picture of a particular topic. For example, the concept map below shows some of the key factors in the decline of coral reefs.



Concept maps can also be used by students to demonstrate their understanding of a topic, and by teachers to assess student learning gains.



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Outside the classroom, concept maps are commonly used by researchers, across the natural and social sciences, to help develop research questions. While it can be used by individuals, it is particularly appropriate for use by research teams and groups; it can help individuals think more clearly together as a group and manage complex ideas. In this case, concept mapping- or “mental mapping” or “concept webbing”- is a very structured and facilitated process with specific steps aimed at articulating ideas as a group. Concept mapping in this context also involves multivariate statistical methods that analyze individual inputs to create a group product. This analysis and mapping procedure requires the use of specialized computer programs.

Here, we’ll focus on concept maps as they are used for student learning.

Creating a concept map:

To create a concept map, begin with the topic or question you are interested in. For the example above, the focal question was “What is causing the decline of coral reefs?” Next, brainstorm a list of concepts and ideas that are related to this topic. Write these concepts out in brief phrases or words.

If you’re doing this on paper, Post-It notes are helpful; place one concept per note. If you are using a computer application (I used Powerpoint, but there are many free online sites where you can create concept maps), place concepts in a box.

Table 1. Examples of concept map tools

Tool name	URL for tool
C-Map	http://cmap.ihmc.us/
Mental Modeler	http://www.mentalmodeler.org/
Bubbl.us	https://bubbl.us/

As you look at your list, you may notice obvious ways to categorize the concepts. Some concept maps may add color-coded groupings to communicate additional ideas, but this is not required of all maps.

Think about how to arrange your concepts so the most important concepts are closest to the topic and concepts that are related to each other are also closer in physical proximity.

Next, add lines and words that explain how the concepts relate to each other. Concepts should be related to each other using connecting words that explain the relationship between the two concepts in the context of the overall topic or question. This is where you will be challenged to think about the relationships between concepts, and you may realize new connections that you had not initially thought about.

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For example:

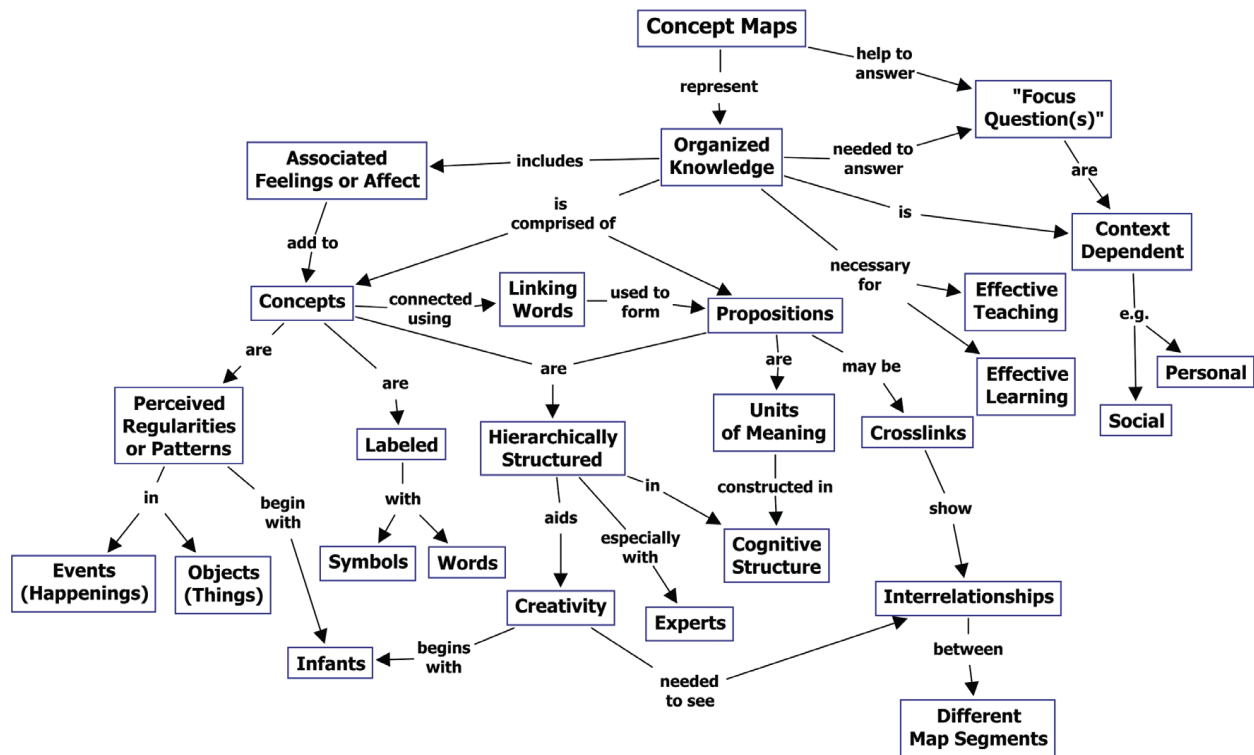


Figure from Novak, J.D. and Canas, A. Theory Underlying Concept Maps and How to Construct and Use Them. Available at: <http://cmap.ihmc.us/docs/theory-of-concept-maps>

These are just guidelines. Concept maps are visual tools to help you organize and present your understanding of a topic. There is no one right answer, and maps will differ. But a good concept map gives you a good idea of how concepts are related and should provide a complete overview of the topic.

Also remember that the structure of the concept map will differ depending on your topic. For some topics, you will see a hierarchical structure. For others, a radial structure might be more appropriate.

One note to end with: getting used to creating good concept maps will take a little practice and will require you to think carefully about the relationships between concepts.

References:

Novak, J. D. & A. J. Cañas, The Theory Underlying Concept Maps and How to Construct and Use Them, Technical Report IHMC CmapTools 2006-01 Rev 01-2008, Florida Institute for Human and Machine Cognition, 2008, available at:

<http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>



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This body of work is nicely summarized by Dr. Douglas Luckie at Michigan State University:

<https://www.msu.edu/~luckie/ctools/>

A detailed tutorial is available on the IHMC website:

<http://cmap.ihmc.us/docs/ConstructingAConceptMap.html>

Research Methods Knowledge Base online textbook by William M.K. Trochim, Cornell University:

<http://www.socialresearchmethods.net/kb/conmap.htm>

Developing Concept Maps

<http://serc.carleton.edu/introgeo/assessment/conceptmaps.html>

Classroom Assessment Techniques- Concept Mapping

<http://www.flaguide.org/cat/conmap/conmap1.php>



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