Course Description
Coastal and marine ecosystems represent some of the most threatened and most important ecosystems in the world. They play a particularly vital role in carbon sequestration. While most carbon conservation efforts have been focused on terrestrial systems, scientists are increasingly focused on coastal ecosystems due to their superior capacity as carbon sinks for climate change mitigation. Blue carbon ecosystems not only provide key carbon reserves but also shelter coastal populations from floods, house fisheries which offer crucial benefits to local communities, and protect coastal waters from pollutants.

Coastal ecosystem health links directly with marine ecosystem diversity. Interdependent and intrinsically linked, coastal ecosystems provide the nesting grounds for an unquantified array of marine organisms and are a cornerstone for marine ecosystem health and biodiversity. In this course, students divide their time between the Pacific and the Caribbean studying carbon accumulation and preservation as well as exploring marine biodiversity in Panama’s mangroves, wetlands, coral reefs and sea grass beds.

Learning Outcomes
Upon completion of this course, students will be able to:

- Discuss the importance and ecology of blue carbon and marine ecosystems with specific reference to the tropics.
- Describe the relationships among a range of marine organisms both with each other and in the context of climate change.
- Effectively apply methodologies for assessing and measuring blue carbon stocks and tropical marine biodiversity.
- Critically analyze proposals for blue carbon management, restoration and conservation.
Prerequisites
Previous college-level coursework and/or other preparation in environmental studies, ecology, biology, or related fields, as assessed by SIT. This is a science course which is entirely hands-on. Students will spend most of the time in the water and must be able to swim well.

Language of Instruction
This course is taught in English.

Course Schedule
*Please be aware that topics and excursions may vary to take advantage of any emerging events, to accommodate changes in our lecturers’ availability, and to respect any changes that would affect student safety. Students will be notified if this occurs.

Module 1: Introduction
Students will arrive in Panama City and then travel the next day to Bocas del Toro. They will take part in a detailed orientation that provides them with an introduction to Panama’s ecology and conservation efforts, an overview of the program, as well as preparation for health and water safety.

They will also begin their studies of marine ecology and blue carbon. Topics include:
- The importance of coastal ecosystems, role of marine ecosystems in mitigating climate change. Exchanges between the ocean, land, atmosphere.
- Introduction to Panama and Panama’s ecosystems. Marine ecology and bio-diversity in Panama. Pacific/Caribbean-Atlantic differences.
- The possibility and promise of marine ecosystems - the importance of blue carbon.

Module 2: Wetlands - Bocas de Toro, Caribbean
Students will begin their field explorations at the Smithsonian field station in Bocas de Toro, and carry out field work in the San San Pon Sak internationally protected wetlands.

Topics include:
- Introduction to wetlands ecology
- Wetland dendrology
- Wetland biodiversity
- Wetlands and blue carbon
- Research methods for the study of blue carbon

Module 3: Pacific Ocean Mangroves and Coral Reefs – Coiba Island
The Pacific coast of Panama experiences exceptional diversity due to dramatically fluctuating rainfall and climatic variations related to the Humboldt Current and the northern trade winds. The majority of Panama’s 169,700 hectares of mangroves are located on the Pacific coast and have been well-preserved, although they come under increasing pressure from development and climate change. Coral reefs have suffered in particular with El Niño and climate change and have begun to show reduced growth and calcification.
Students will explore mangroves and coral reefs on Coiba Island, a UNESCO protected heritage site. Coiba is also part of the ETPS (Eastern Tropical Pacific Seascape). It is the largest island in Mesoamerica and considered widely to be one of the top 10 diving sites in the world.

Topics include:
- Mangroves: Introduction to mangroves, mangrove biology and ecology, needs and threats. Role of mangroves in coastal protection and fisheries reproduction / role of mangroves as carbon sinks
- Coral Reef systems of the Pacific: Corals and coral biology and reproduction, marine organism diversity and reefs
- Climate change and impacts on coral reefs and coral reef health
- Eastern Tropical Pacific Seascape (Cocos-Coiba-Mal Pelo-Galapagos) and marine biological corridors
- Field methods to measure marine organism diversity, identify coral species, and measure reef health
- Field briefings.

Module 4: Caribbean Coral Reefs and Sea Grass Beds – Guna Yala, Caribbean
Guna Yala is the first indigenous reserve in Latin America and is fully organized under autonomous indigenous stewardship. It boasts one of the best preserved coral reef systems in the Caribbean.

- Seagrass beds: seagrass biology and productivity, biodiversity in seagrass beds, Distribution and adaptation, role of seagrass beds in coastal and other ecosystem protection. Fishery and megafauna support.
- Blue carbon stocks in seagrass beds. Threats to seagrass systems. Field methods for seagrass research.
- Comparative study of biodiversity in coral reefs (compared with field studies in the Pacific (Coiba Island)), including coral species identification, reef organism diversity, and coral reef health.

Sample Readings:
- McLeod, Elizabeth, Chmura, G. L., Bouillon, Steven, Salm, R., Björk, Mats, Duarte,


**Evaluation and Grading Criteria**

**Description of Assignments:**
To be handed out onsite. Students will create a methods field journal of observations, notes, and write-ups related to ongoing methodological practice, data collection, and findings. For each module, students will be assigned a group research project which will include an oral presentation of the project description and research results. Students will also be responsible for two quizzes. Assignments will be graded for attention to detail, adherence to methodological steps, and depth of analysis.

**Assessment:**

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<td>Seagrasses and mangroves quiz</td>
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<tr>
<td>3 Group presentations of field projects</td>
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<td>Methods and methodology field journal</td>
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<td>Participation</td>
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**Grading Scale**

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Expectations and Policies

- **Show up prepared.** Be on time, have your readings completed and points in mind for discussion or clarification. Complying with these elements raises the level of discussion and the quality of the activity for everyone.

- **Put safety first, your own and others.** Being in the water is fun but demands responsibility.

- **Comply with academic integrity policies.**

- **Respect differences of opinion (classmates’, lecturers, local constituents engaged with on the visits).** Conservation policies can provoke passionate responses. You are not expected to agree with everything you hear, but you are expected to listen across difference and consider other perspectives with respect.

Please refer to the SIT Study Abroad Student Handbook for policies on academic integrity, ethics, warning and probation, diversity and disability, sexual harassment and the academic appeals process.

**Disability Services:** Students with disabilities are encouraged to contact Disability Services at disabilityservices@sit.edu for information and support in facilitating an accessible educational experience. Additional information regarding SIT Disability Services, including a link to the online request form, can be found on the Disability Services website at http://studyabroad.sit.edu/disabilityservices.