



**THE BELIZE WILDLANDS PROJECT:  
ECOSYSTEM AND CULTURES  
SUMMER 2017  
JUNE 24 - AUGUST 6**

**ACADEMIC SYLLABUS**

**Faculty:** Ed Boles, PhD

**Contact Hours:** We will be traveling, living, working, and learning together continuously throughout the course. During this time we will have formal lectures, scheduled field expeditions, and plenty of opportunities for small group or one-on-one meeting times to discuss specific assignments, group issues, personal challenges or concerns, or any other matters. Please do not hesitate to request individual meetings if and when needed.

**Class Meetings:** This Wildlands Studies Project involves seven days per week of instruction and field research, with little time off during the program. Faculty and staff work directly with students 6-10+ hours a day and are available for tutorials and coursework discussion before and after scheduled activities. Typically, scheduled activities each day begin at 8am, with breaks for meals. Most evenings include scheduled activities, including guest lectures, structured study time, night data gathering walks, and workshops. When in the backcountry or at research field stations, our activities may start as early as 5am or end as late as 10pm (e.g., for wildlife observation). It is necessary to be flexible and able to accommodate a variety of class times.

**Course Credit:** Students enrolled in Wildlands Studies Projects receive credit for three undergraduate courses. These three courses have distinct objectives and descriptions, and we integrate teaching and learning through both formal learning situations (lectures and seminars) and field surveys. Academic credit is provided by Western Washington University. Extended descriptions follow in the course description section of this syllabus.

1. **ESCI 437A, Environmental Wildlands Studies (5 quarter / 3.35 semester credits)**  
Field-based course studying the environmental problems affecting the natural and human-impacted ecosystems of our study region, including the role of human interactions.
2. **ESCI 437B, Environmental Field Survey (5 quarter / 3.35 semester credits)**  
Field-based course conducting on-site examinations and analyses of environmental problems affecting wildlands and wildlife in our study region.
3. **ESCI 437C, Wildlands Environment and Culture (5 quarter / 3.35 semester credits)**  
Field-based course involving on-site research in our field location, studying the relationships among cultural groups and the environment. Using region- and culture-specific case studies, students assess historical and current cultural and environmental uses of wildland and/or wildlife communities. Course examines outcomes of environmental policies and wildland/wildlife management, including both sociological and natural consequences.

**Readings:** A Course Reader of required and recommended readings has been established for this project, a digital version of which will be provided to students in advance of the project via Dropbox. Students are responsible for bringing personal copies with them, either electronic copies on a tablet/laptop, or printed copies (easiest to print and have bound). These readings will be supplemented with field guides and textbooks which will be available for students to use throughout the class.

## **Contents of this syllabus:**

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### **I. Project Overview**

Although Belize is a small country of less than 9,000 square miles (approximately the size of New Jersey) with a population of less than 350,000, it is incredibly rich in biological, environmental and cultural diversity. Over half of the land is still forested, though development is occurring at a rapid rate. The territorial waters include over 1,000 small islands or “cayes,” the majority of the Mesoamerican Barrier Reef and the associated marine ecosystem complex, including an unexplored open ocean area within its Exclusive Economic Zone. Being located in the Central American Isthmus, Belizean fauna and flora contain species from both continents of the Western Hemisphere, and as a part of the old British Empire, many plants and some animals from the old world tropics are also well established. Belize is in the Silva Maya, the largest remaining forest area in Latin America outside of the Amazon Basin. Belize is home to three major bird migration flyways and it is a vital component of the Mesoamerican Corridor System.

Belize is a unique country in many ways. Arguably, it is one of the most ethnically diverse countries in the world on a per capita basis, with over twenty-five major ethnic groups. It has the lowest population density and the second highest population growth rate of any country in the Western Hemisphere. It is undergoing rapid changes imposed by internal and external pressures that affect not only its social structure and economy, but also its vital ecosystems upon which everything depends. With a history of exploitation and development, a growing movement toward protection, conservation and management of the diverse environmental systems has been an on-going, evolving process for over half a century – impressive for a country born on September 21, 1981. Now, as the next wave of development washes over the country in the form of corporate farms and international real estate brokerage firms, impacts of globalization and global climate change further complicate the environmental challenges faced by Belize. We will be witnessing many of these issues as we travel through the country, aiming to understand them from different perspectives, and exploring strategies and solutions that allow for both conservation and development.

During our program, we will explore many different settings and ecosystems, including dry to moist tropical forests, savannas, mangrove swamps, seagrass beds, coral reefs, and the edge of the deep blue Caribbean Sea. We will be observing and interacting with a myriad of plants and animals, learning about their biology and ecology. We will also get to meet the people, representing many blended cultures that compose modern day Belize, and gain an understanding of their histories, customs, economy, politics, daily activities, and challenges of life in a tiny developing country.

In addition to ecology, we will focus on food production systems from mechanized farming to slash and burn plots, and consider the environmental effects of each production system. We will visit several Mayan archaeological sites, gaining understanding of their populations and food production strategies, and comparing land use over the centuries. We will examine Belize’s fishing industry, and interview fishermen to get their opinions as to the future of this trade. As students of environmental change and impacts, we will also take a close look at the tourism industry, the most important income generator for the country today; discussing its social, economic, and ecological consequences. Throughout our studies, we will participate in field monitoring efforts, compiling our observations, thoughts, and ideas to better understand the interconnectivity between people and their diverse ecology, as well as many plant and animal species. Our findings will be tempered by the input of local experts,

including educators, scientists, foresters, fishers, hunters, and community leaders. We will also relate our findings to our home culture and reflect on the challenges we all share during this age of rapid change.

We will approach our academics through multiple formats. In addition to regular lectures, discussions and field activities, we will use task-focused teams to resolve proposed challenges. This is a very important component of conservation, management, and cultural adaptation to our changing world. Further, you should come to class prepared to participate in discussions and ask questions/contribute information. Additionally, there will be micro-lectures scattered throughout each day, topics dependent on the advantages of the setting and interesting creatures we encounter during our field studies.

You are expected to attend all lectures, field trips and lab sessions, and to actively participate in discussions. In the field you will be assessed on your attentiveness, ability to demonstrate skills, careful collection of data and completion of data sheets, responsibility for personal and group safety/security, and respect for the local fauna and flora around you. Our academic experience emphasizes teamwork; your willingness to engage in group work will be reflected in your participation grade.

### **A Word about Electronics**

This is an opportunity to unplug and step away from the electronic technology that dominates, dictates, and documents our modern lives. And we will often ask you to do this. At the same time, electronic tools are now an intricate part of our lives as well as our environmental assessment and research tool box. A smart phone, tablet or small laptop, with camera, Google Earth, GPS, sound recording, data storage, and internet connection make these tools essential for recording and sharing experiences, conducting rapid ecological assessments, measuring many environmental parameters, and generating documents to documentaries. Because such devices can be valuable tools, especially when housed in waterproof cases, and can augment learning in many different ways, we would suggest that you bring one small electronic device. However, you are asked to use your technological devices as tools, not as entertainment. And please only consider bringing your device if it is small, light and you don't mind the extra care and attention it demands in an outdoor environment (consider sand or moisture). It is your responsibility to use it wisely so it does not become a distraction to yourself, interfere with the group dynamic or become a hazard. Equally, be mindful not to flash it around so as to advertise that you have valuables in your tent. Your challenge will be to find that balance, using your electronic device to enhance your experiences, not distract you from such opportunities to connect with the incredible world around you.

## **II. Learning Objectives**

These topics will be addressed through classroom lecture and discussion, course readings, field activities, visits with local experts, exposure to ongoing research, backcountry excursions, and field research projects. The program generally progresses from faculty-led instruction in the beginning (more lectures and readings) to student-led critical evaluation, analysis, and synthesis near the end. Our overarching goal is to have students leave the course not only with extensive knowledge about Belize and the region, but also broader skills and understanding of ecological and social sciences that allow students to critically evaluate information in other settings in their future lives and careers. On completion of this program, students should have working knowledge of and firsthand experiences with:

1. ***The ecosystems of Belize, including flora, fauna, microbiota, the ecological processes and services they facilitate, ecological succession and interconnectivity from mountain ridge to open ocean, and the continual dynamics of landscapes and seascapes.*** We will follow the path of water through landscapes and seascapes, envisioning and experiencing the global to local hydrologic cycles that sustain life and climate, sculpt the landscape, and interconnect ecosystems throughout the Earth. We will examine the living organisms, those diverse interworking components of ecosystems, as we immerse ourselves within their environments. We will consider the adaptability and resilience of life within dynamic environments.
2. ***The primary influences that geology, topography, hydrology, climate, and regional to global changes have on natural systems.*** Viewing our terrestrial and coastal zone ecosystems from a watershed perspective, from the headwaters of the Mountain Pine Ridge and Cockscomb Basin to river mouths and

barrier reef, we will be able to see the successional changes in morphology and geology. We will focus on the movement of water, that continual medium of chemical and physical processes, through soil, rock, aggregates, aquifers, streams, rivers, estuaries, seas, and oceans. The roles of water in the formation of atmosphere and local to global heat absorption, transfer and release, will be discussed as we witness local patterns. The current era of global climatic change will be examined in context to Belize, the region, and the world.

3. ***Local to global threats to Belize's ecosystems and biodiversity, conservation challenges and strategies, and continual change.*** Personal observation and interaction with nature will be supplemented with a series of lectures that build on several themes (interconnectedness, ecosystem services, community-based collaborative environmental stewardship) and field activities, lab exercises, assigned readings, group discussions, taxonomic literature, guide books, and journal assignments will also be incorporated. Emphasis is placed on integration of theory with practice through hands-on learning activities. Conservation threats and management challenges, ecosystem services and the protection of biodiversity, and community groups and individuals that promote positive actions will be identified and discussed at each site visited. Our global situation will be linked to economics, politics and human nature as we collectively work to identify solutions and chart a way forward.
4. ***The cultural, political, and management history and effectiveness of various management approaches to conservation in Belize.*** We will meet and talk with educators, community leaders, food producers, and local residents of Belize who may offer diverse perspectives on ecosystem conservation and sustainability. Through informal interviews we will record the perspectives of people from diverse backgrounds. You will be keeping and sharing a cultural dictionary with words and terms from each culture we experience. In a series of assignments, we will ask you to summarize your personal and collective findings, drawing upon the numerous technical articles, guest lecturers, site visits, and internet sources to support your conclusions.
5. ***Designing a field research/assessment project, collecting field data, managing, synthesizing, and presenting interpretations of this data to peers and faculty, both in writing and in presentation.*** Each student will be challenged to pose a research question triggered by an observation, select an appropriate and simple method to test that question, conduct a field trial that will yield data that can be analyzed and from which a conclusion may be drawn. The topic each student chooses may address a social science or natural science question. It will involve a review of pertinent literature, submitting a short proposal, implementing a field effort to gather data using appropriate methodologies, analyzing and drawing conclusions from that data, making recommendations, and presenting information and conclusions to others through visual/oral and written formats. The skills learned in this project are transferable to other fields (and to future careers): working well within a group; taking and using feedback; managing, synthesizing and interpreting information; presenting interpretations in oral presentation and in written form (not more than 10 printable pages); exposure to the vagaries of tropical research.
6. ***Basic understanding of the various field techniques used to study ecology, sociology, and archaeology.*** Students are introduced to and learn to apply current methods for studying and assessing wildlife, plant communities, freshwater systems, marine systems, and social systems firsthand, contributing to the construction of ecology and conservation tables.
7. ***Critical reading, discussion, evaluation and use of current technical and academic literature in ecology, conservation biology, and social science.*** Each student will be responsible for reading multiple articles, with these papers being the focus of group discussions and critical evaluations. In addition, each student will also review at least two technical documents related directly to individual interests or research, and present key points in discussions.
8. ***Basic theoretical concepts of conservation vs. preservation, compositionists vs. functionalists, sustainable development vs. development, environmental sustainability vs. environmental exploitation, cultural rights vs. cultural exploitation, community based economies vs. globalization, and the practical applications of these concepts in conservation and human development.*** By reading both popular and academic literature, think tank discussions, interviews, lectures and other sources, students will encounter

these dual and often conflicting concepts, and be able to recognize how their consequences play out in the lives of Belizeans, with reflections on our own society. The process of growing awareness will be examined in journal entries, assignments, and summaries.

9. ***Field observation skills, including methods for documenting and sharing findings in multiple formats.*** Development of observational and descriptive skills that are essential to the practice of good science is a continual part of this course. As students learn the names and ecology of the organisms we encounter they will begin to understand and describe the connectivity of ecosystems through species interactions. Students will be challenged to make ecological observations of landscapes, recognizing the species and functional guilds involved, and patterns and processes they help facilitate. Students will be encouraged to use a wide range of techniques to record information (field sketches, species descriptions, photographs, assessment data, personal ideas and reflections, etc.), and present findings and insights to the group.
10. ***The diversity of cultures and lifestyles among the people of a small developing country within a rapidly changing world.*** Ongoing discussions will identify and examine similarities and differences between Belize and the United States, and between Belize and the United Kingdom, Central American countries, and Caribbean island states. These experiences will challenge students to confront and analyze their own cultural and lifestyle patterns from outside of their home country setting.

### III. Course Descriptions

We teach these three courses in an integrated format in the field. However, students will receive transcript credit for the following three courses, as introduced on page 1:

#### **ESCI 437A, Environmental Wildlands Studies (5 quarter / 3.35 semester credits)**

Field-based course studying of environmental problems affecting the natural and human-impacted ecosystems of Belize, including the role of human interactions. This course will introduce students to the ecology and biodiversity of tropical ecosystems (pine forests, dry to moist tropical forests, neo-tropical savannas, wetlands, riparian forests, mangrove forests, seagrass and coral reefs) found in Belize; explore the geological and topographical succession, and hydrological and genetic interconnectedness of these ecological units; review and evaluate the ecological impacts that humans impose on these systems; and learn effective conservation strategies for addressing these impacts.

*Experiences/Activities:* Students will examine firsthand the flora and fauna of Belize, observing and learning the ecological relationships within and among communities, participating in natural history investigations, and conducting rapid ecological assessment exercises while also viewing these same ecosystems from Google Earth perspectives in order to gain an appreciation of tropical ecosystem types and their interconnectedness. Students will compare and contrast several models of forestry (clear cutting, selective logging, rotational logging, non-wood products), agriculture (milpa farming, industrial farming, agro-forestry), and mining (aggregates, rock quarrying, dolomite, gold, oil) ongoing in Belize. While traveling to different ecosystems, students will meet local people and learn about traditional uses and present-day attitudes toward the biological and ecological diversity of Belize. We will use field guides, scientific literature, direct field observations, ecological assessments, and local experts to build our collective knowledge of Belizean biodiversity and ecology. Students will gain experience in using field guides and taxonomic keys to identify organisms, take detailed and high-quality field notes during observational exercises, and use this information to formulate interesting questions that lend themselves to investigation through the scientific processes.

*Outcomes:* Students will be able to recognize and differentiate among many different ecosystem types, recognize how different successional ecosystems, from mountains to deep oceans, are interconnected through the hydrologic cycle, and extrapolate these concepts to the ecological landscapes of their homelands. They will better understand the ecological roles and impacts of different human societies and their relationships to their environments; recognize the importance of protecting biodiversity, keystone species, engineering species, and top predators; evaluate mechanisms of landscape to seascape interconnectivity that provide those ecological functions so vital to all life; and develop a deeper personal relationship with the natural world through their experiences in Belize.

**ESCI 437B, Environmental Field Survey (5 quarter / 3.35 semester credits)**

Field-based course focusing on field survey methods, on-site biodiversity analysis and assessment as part of individual and group research on environmental issues. Students will investigate a research question, conduct data collection, analyze and present findings to the class. Further, as a group, we will investigate a number of research/conservation questions to gain a basic understanding of the principles of conservation biology; learn assessment and research methods used by natural resource managers and field researchers to evaluate the health of an ecosystem or landscape; gauge effectiveness of intervention, protection, and restoration strategies; and pursue answers to ecological questions through the investigative scientific process.

*Experiences/Activities:* Through hands-on experience with land managers and researchers, students will learn ecological field techniques to assess and study tropical species and ecosystems. Further, students will utilize current technology for assessment and research. Based on ecological principles, field investigations will teach students to formulate appropriate and testable research questions, design experiments and/or observational strategies to collect data, analyze and draw conclusions from data, and report and present findings. Methodologies used in this effort are typically those used in rapid ecological assessment protocols based on simple statistical relationships and standardized observation techniques that are transferrable to environmental agencies in other parts of the world.

*Outcomes:* Students will gain experience and skills in field observation, assessment, and research; collection and analysis of data; and sharing and discussing results and practical applications. During the process of maintaining sightings lists, students will become familiar with the use of field guides, taxonomic keys, and catalogues. They will experiment with different ways to record observations, using sketches, descriptive text, specimen collection and curation, mapping, and photography. Presentations will provide valuable experience in speaking before an audience of peers, designing presentations, submitting field reports, and compiling studies into a technical paper that includes abstract, introduction, methods and results.

**ESCI 437C, Wildlands Environment and Culture (5 quarter / 3.35 semester credits)**

Field-based course studying the relationships among cultural groups, their environment, and conservation practices. Using region- and culture-specific case studies, students assess historical and current cultural and environmental uses of wildland and/or wildlife communities. Course examines outcomes of environmental policies and wildland/wildlife management, including both sociological and natural consequences. This course provides an introduction to the major ethnic groups (Yucateca and Mopan Maya, Q'eqchi', Kriol, Mestizo, Garifuna, East Indian, Lebanese, Mennonite, Taiwanese, Mainland Chinese, North American, European, and regional Hispanic) found in Belize. These different cultures, including their histories, perspectives, social standing, economic involvement, political agendas, traditional and modern use of natural resources, and the environmental challenges they confront will be examined in order to gain an understanding of their relationship with their environment.

*Experiences/Activities:* Interactions with the cultural groups encountered will allow students to become familiar with local people through casual conversations to ethnographic interviews, providing opportunity to gain insight into the cultures, histories and perspectives of this multi-cultural nation. Students will become aware of and question many of the social, economic and environmental issues with the objective to better understand how this shapes people's understanding of, and relationship to, their rapidly changing environment. Students will learn the economic uses of natural resources (crops, spices, medicines, building materials, etc.) and compare the cultural differences in farming practices. Each student will record words and their meanings in each inter-cultural exchange, collectively contributing to a group language dictionary as we interact with different cultural groups. Students will examine the cultural, social, economic and environmental advantages and impacts of the tourist industry. When visiting various archaeological sites, students will become familiar with the achievements and culture of the Ancient Maya civilization and the research methods used by archeologists to study them through time. Students will present readings and lead class discussions on a number of cultural topics specific to each culture.

*Outcomes:* Students will gain experience in conducting interviews with people from many different cultures, working through communication barriers. They will become familiar with the archaeological, anthropological, and environmental field work required. Students will review cultural literature on Belize, from Ancient Maya to modern day, and be able to compare published findings with their own personal experiences. Each student will

also develop, research, and write a field research project, as well as maintain a detailed journal of the experiences that informed her or his report.

#### IV. Assessment

The following is an overview of the academic requirements for the program. Some of the assignments are continuous throughout the program, such as field journals, taxonomic tables, and participatory discussions, and will be reviewed by the instructor as announced. Other requirements have set due dates, such as quizzes, presentations, and exams. Due dates are subject to change in response to unplanned events and circumstances. Assignments, exams, and presentations are scheduled to allow sufficient time for preparation. Final grades for each of the three courses will be determined as indicated below.

Course Number	Assessment Item	Date due	Percent of grade
ESCI 437A	Daily Field Journal - ecology notes, sightings, observations ...	On-going	20
	Ecosystem Descriptions	On-going	20
	Participatory Discussions/Think Tanks	On-going	20
	Taxonomic Ecology Tables	On-going	20
	Final exam	August 3	20
ESCI 437B	Daily Field Journal - survey planning, implementation, results	Ongoing	20
	Field Assignments	On-going	15
	Short Field-based Project	As announced	20
	Quizzes (3)	As indicated	15
	Participatory Discussions/Think Tanks	As indicated	10
	Midterm exam	July 14	20
ESCI 437C	Daily Field Journal - social/cultural notes, observations ...	On-going	20
	Final Research Paper	August 4	20
	Ethnographic Interviews	On-going	20
	Language dictionary	August 4	10
	Participatory Discussions/Think Tank	As indicated	10
	Oral Presentations (2) (10 each)	Midterm/ final	20

#### Daily Field Journal - Applies to all three courses

The field journal is a very important component of this program that helps to hone observational and descriptive skills, encourages thought and reflection, provides a record of your experiences, and is invaluable when writing reports. A journal is very different from a lecture **notebook** (you will want a separate notebook for lecture notes). Developing the habit of keeping a detailed field journal is a basic and essential practice for all field and research oriented professionals. Journal entries should be a daily activity, and occasionally journals will be handed in to the instructor for review. You will mark your best entry pertaining to each of the three courses that you prefer the instructor to read. Those marked entries will be read in detail and the rest of the journal scanned through and spot checked. If you have entries that you would rather not be read, then fold those pages and secure them with a paper clip.

The field journal is a key grade component for all three courses and should be regarded as an academic and professional undertaking throughout the program. Journals include field observations, thoughts and ideas related to field activities, drawings, maps, tracings, rubbings and other information you consider relevant. Develop the habit of making entries in your journal while you are at the site, or very shortly afterwards. If you skip a day or two and then go back and try to remember what you observed, thought, or felt at the time, you will likely miss many important details. Below are points to consider when keeping a field journal.

- Selection of the right journal is important. You do not need to spend a lot of money, but find something that meets your needs. Hard cover, stitched, and conveniently sized to fit in a cargo pocket or day pack pouch, but not too small to restrict writing and sketching (smaller than 8.5" x 11" and larger than 3" x 5"). You can cover your journal in a plastic jacket to protect it from the weather and wear and tear, or invest in a waterproof notebook.
- Write and draw in your journal neatly, make rubbings or tracings of leaves, and rubbings of textures; strive to keep your journal in good shape, but expect some stains and wear as this is a field journal.
- Record an **observation checklist** in either the first or last page that you can refer to, ensuring your capture all of the information that typically comprises the first part of the written description.
- Record a list of standard questions you ask during an ethnographic interview beneath your observation checklist.
- Enter date and time, using a 24-hour clock format (e.g., 1330 for 1:30 pm).
- Give the location (with arrival and departure time) right below the date and time.
- Give route traveled to get to the location if it is not an obvious area to find, including a sketched map if necessary.
- Describe weather (include temperature, wind, precipitation type, cloud cover, etc.) and river stage and conditions if it is near a stream or river.
- Describe habitat/vegetation type present (woodland, grassland, wetland, etc.).
- At the end of your narrative, list wildlife species, rock types, or other natural elements observed.
- List name, at least first name, description (major ethnic group, sex, approximate age) of anyone you are interviewing.
- Record your general observations, comments and reflections, using complete sentences.
- Make any sketches and drawings that may be helpful, remembering that your objective is to record information rather than produce art; add notes or comments on your drawings to help capture details.
- Consider writing on the front of the pages and using the back of the pages to draw.
- Record the digital number of each photograph you take at the site.
- Paste helpful maps in your field journal.

### Journal Grading Criteria

- **Orienting information present** (date, time, location) provided on all entries, even those occurring on the same day.
- **Consistent entries**, with minimal time gaps occurring.
- **Organized**, with information being accessible, consecutively dated entries, and a table of contents (leave first few pages blank for this purpose, with the first page being for your name and contact information if lost) so that select assignments can be found quickly.
- **Neat and Legible**, so that anyone else can easily read (or grade) your journal.
- **Detailed Observations**, with descriptions being accurate and clear.
- **Invested Effort**, showing care in compiling your journal and with improvements being seen over the program time frame.
- **Complete**, with good descriptions, drawings, maps, species lists, and other necessary components expected in a good field journal.

## **ESCI 437A, Environmental Wildlands Studies**

### **Daily Field Journal**

Give a daily record of your travel and experiences during the six week field study, including basic descriptions of habitat types visited, distances traveled and approximate travel time, and important details along the route. Describe any activities, observations, experiences and the names of persons with you if it is just a small group, and the roles individuals played in the experience. Ideally, an entry should only take about 20 or 30 minutes, depending on the circumstances. Be careful not to get too engrossed in writing that you miss important observations.

Keep a list of all wildlife that you notice, and if you cannot identify the organisms, give a brief description. If you do not have a field guide handy for birds, a quick sketch with arrows pointing to key features and notes on color may be enough to help you identify the bird later. If you are in the water and using a slate to record sightings, you will want to rewrite this information into your field journal once you are back on land. If you have no way to record fish, corals, or other organisms you are seeing, then you will want to consult the field guides as soon as you return while your memory is fresh. At some sites we may be doing 20 minute observations in pairs and building lists of observations. You will be contributing to the development of a complete taxonomic list (plant, mammals, birds, reptiles, amphibians, fishes, insects, arachnids, etc.) by ecosystem type that will be maintained for the duration of the program. Use the field guides and local experts available to help in identifications, giving local and taxonomic names.

### **Ecosystem Descriptions**

We will be encountering many different habitat types, biomes, and aquatic ecosystems during our travels. We will be compiling descriptions of each type of system. Components of these descriptions should include the following:

- Terrestrial, aquatic, or semi-terrestrial
- General morphology or topography
- Primary geological characteristics
- Predominant soil type, sediment type
- Physical description
- Climatic description
- Major producer species
- Major wildlife species, or major characteristics of dominant wildlife
- Human exploitation and impact

### **Participatory Discussions**

These are topic-based discussions that everyone is expected to contribute to by adding information, posing important questions, offering observations, questioning points that may not be clear or accurate, offering constructive criticism, and/or providing alternative viewpoints. Think tanks are open planning and strategy sessions where everyone offers suggested solutions or strategies to a problem or collectively seek an explanation for the topic being examined. These sessions are often times for active note taking.

### **Taxonomic Ecology Tables Contributions**

Collectively we will be compiling a taxonomic list for terrestrial, freshwater, and marine organisms we encounter. Organisms will be added to an electronic table, initially in paper, that is arrayed phylogenetically, each line (representing a species or taxon) will include a columned checklist of habitat types where found, trophic position, and status (common, uncommon, rare, endangered). Each person adding an entry will also have a place to put their initials. Number of entries and accuracy of information will be noted during evaluations.

### **Final Exam**

This is a comprehensive exam with a range of challenges including short answer and essay questions, diagram labeling, data analysis, situation analysis, and solution recommendations. Use of technical terminology is essential in addressing questions and challenges. The exam will draw heavily from specified reading materials. Even though this is an ESCI 437A exam, you will find yourself drawing from what you have learned in all three courses. It should

take between 2-3 hours to complete the exam if you are prepared. It will be given during the last few days of the course.

### **ESCI 437B, Environmental Field Survey**

#### **Daily Field Journal** (same journal you will be keeping throughout the course)

Journal entries pertaining to environmental field survey and assessment methodologies will include notes taken during project activities, detailed descriptions of those activities, data collected, lists of any specimens collected (the instructor holds a collection permit for select organisms and some specimens will be retained) during these efforts, observations on effectiveness, descriptions of observational techniques and sampling strategies demonstrated by guest lecturers, diagrams of field gear or sample designs. When you submit your journal for review, you will mark the pages pertaining to ESCI 437B. Colored sticky notes and paper clips will be available within our group office supplies for your use, or you may elect to bring your own marking devices.

#### **Field Assignments**

There are a total of five field assignments, the first two being very quick and should be submitted prior to arriving in Belize. The assignments are geared to reinforce principles of tropical ecology covered in the course as well as provide students with the opportunity to take on responsibilities for playing key roles in documenting field efforts. Each field activity will require a field report and each student will be required to take responsibility for completing and submitting one of those reports. A field report form will be made available to fill out in detail, capturing all of the information topics that should appear in a completed report. A signup sheet will be circulated and each student will select one of the field activities for which he or she will be writing and submitting a field report as outlined in the form.

Each student will select either Assignment 4a or 4b for one of the field efforts in which we will be engaged. A sign-up sheet will also be circulated for these job duties and students can sign up for a job responsibility at any time during the program, but the first one to sign up for a particular project will assume that particular job target. Each of the assignments in 4a and 4b will contribute to the field reports that will be compiled for each effort, meaning that 2 to 3 students will ultimately be contributing to each field report developed. Specific details and formats will be made available early in the course so that all students know and understand the procedures. These are all group-based projects and everyone will be engaged and making contributions to each other's activities. All assignments are listed in the table below. Due dates will be announced for each field effort as the program progresses.

ASSIGNMENT	POINTS	SUBJECT	DAY DUE
Assignment 1	5	Student Questionnaire	Pre-departure
Assignment 2	5	Biography	Pre-departure
Assignment 3	15	Individual field report form	TBA
Assignment 4a	15	Captioned photographs/paragraphs	TBA
Assignment 4b	15	Habitat descriptions and rapid evaluation	TBA
Assignment 5	10	Draft document review/sign-off	TBA

#### **Quizzes**

There will be three short-answer quizzes focused on questions regarding field sampling methodology, procedures related to activities we will be involved with, and data management. Quizzes ensure that you understand the concepts behind our field efforts as we progress. Quizzes will be announced during the program.

#### **Mid-Term Exam**

This exam will occur in the middle of our program and will focus on field assessment and survey techniques, the philosophy of sampling, advantages and shortcomings of different sampling methodologies, complex vs. simple statistical analysis, contributions and challenges of taxonomic research, strategies and complications of environmental research, extrapolation of lab experiments to the field, and other relevant topics. The exam will consist of a combination of definitions, labeling of illustrations, short-answers and short essay questions.

## **Participatory Discussions**

See description above in ESCI 437A.

## **Short Field-based Project**

Each student will sign up for one of the following project topics, with each project area accommodating 2 to 3 students. A sign-up sheet will be circulated during the beginning of the program so that each person knows her or his project from the beginning and can participate in accumulating materials at the first opportunity. All students will be involved at some point in all of these project areas, but those select students who have taken responsibility for completion of each project will be charged with pulling together the final deliverable. Projects include:

- **Freshwater Macroinvertebrate Survey** - cumulative data for all of the collections and observations made throughout field efforts, assisted by the instructor.
- **Freshwater Vertebrates Survey** - cumulative data for all freshwater field efforts, and interviews of local experts.
- **Terrestrial Insect Survey** - cumulative data for all sheet work, involving general comparison among sites.
- **Riparian Trees and Aquatic Plants Survey** - photo-documentation of species encountered with dates and locations, identifications based on available taxonomic keys.
- **Marine Fishes Taxonomy and Ecology Table** - maintained for all snorkel efforts while on Tobacco Caye and compiled from all student and instructor observations.
- **Marine Invertebrates Taxonomic and Ecology Table** - maintained for all snorkel efforts while on Tobacco Caye and compiled from all student and instructor observations.
- **Composite Bird Sighting List** - includes all birds sighted (with place, time, and location) during entire program.

## **ESCI 437C, Wildlands Environment and Culture**

### **Daily Field Journal**

These journal entries will pertain to personal cultural observations and encounters made during program activities, with detailed descriptions and information on circumstances and setting for each entry. When you submit your journal for review, you will mark the pages pertaining to ESCI 437C.

### **Ethnographic Interviews**

A minimum of 6 ethnographic interviews will be conducted from a range of Belize's many cultural groups. The interviews can be on any topic of interest or can be a formal part of data collection for the research project. In the case of interviews for the research project, student must have faculty approval of their chosen interview format and questions. Interviews should be a minimum of 20 minutes. The six ethnographic interviews include: Mopan Maya, Kekchi Maya, Mestizo, Garifuna, Creole, and one of the following: Mennonite, East Indian, Ex-Patriots and other groups encountered during travels.

### **Language Dictionary Contributions**

Students are expected to maintain a language dictionary for each of the cultures that we'll be encountered during the program. A minimum of 30 words and/or phrases per group is required. The Five language dictionaries include: Mopan Maya, Kekchi Maya, Mestizo (Spanish), Garifuna, and Creole.

### **Oral Presentations**

Each student will be expected to make a 15 minute presentation of selected topics of cultural significance that will be mutually agreed upon with the instructor. These presentations are meant to allow students to practice their presentation skills while at the same time teach their peers about content matter and report to community members what they have learned. The presentations should be detailed and clear to allow learning and synthesis with the rest of the course.

## V. Grading Scheme

To convert final grade percentages to letter grades for each course that will appear on your transcript, we will use the following grading scheme:

Letter grade	Percentage
A	92.5- 100+
A-	90.0- 92.4
B+	87.5- 89.9
B	82.5- 87.5
B-	80.0- 82.4
C+	77.5- 79.9

Letter grade	Percentage
C	72.5- 77.4
C-	70.0- 72.4
D+	67.5- 69.9
D	62.5- 67.4
D-	60.0- 62.4
F	< 60.0

## VI. General Reminders

*Academic Integrity* is as relevant in this field course as it is at your home institution. Plagiarism, using the ideas or materials of others without giving due credit, cheating, or putting forth another student's work as your own will not be tolerated. Any plagiarism, cheating, or aiding another to cheat (either actively or passively) will result in a zero for the assignment. Cases of academic dishonesty may be reported to your home institution.

*Assignment deadlines* are established to promote equity among students and to allow for ample assessment time from faculty before other assignments are due or other activities are to occur. Therefore, deadlines are firm and late work will receive at a minimum a 10% loss of grade points for each day they are late. If you believe that extenuating circumstances have prevented you from completing your work on time, make sure to discuss this with the relevant faculty as soon as possible, and certainly before the work is due.

*Participation and attendance* are crucial throughout this project. Because of the demanding schedule and limited time, all components of the program are mandatory (unless indicated) and missing even one lecture can have a proportionally greater effect on your final grade. Hence, it is important to be prompt and prepared (i.e., with required equipment) for all activities.

Students with special needs should meet with the lead instructor as soon as possible to discuss any special accommodations that may be necessary.

## VII. Academic Schedule & Course Content

This schedule is meant to be a general guide. We will adhere to it as far as is practical, and indeed many of our reservations are already set. However, this is a field course and there will always be changes, mostly minor ones, which may have to be made as we progress. In the event of such changes, you will be advised and adjustments in our activities will be made accordingly. Sometimes changes may be implemented to take advantages of unforeseen opportunities that would be of benefit to us, or to be able to accommodate a guest lecturer. However, expect to cover course content during our time together.

## Academic Itinerary

### DAILY SCHEDULE, OBJECTIVES, READINGS, TESTS

**Comment:** This course set will move rapidly and will require that you start out with some prior knowledge and a few skills. One critical component of this course is cultural interaction. Read the suggested materials to get a good idea of how an ethnographic interview process works, a prime way of getting information from folks we meet along the way. This will be described in more detail once you arrive. Ecological interconnectivity, biodiversity, and habitat complexity are other important themes. Conservation, eco-tourism, and natural resource use are constant issues in this tiny, very international country. The principle methodology behind our travels, with a focus on general, as well as specific areas, falls under the umbrella of rapid ecological assessment (REA), a slowly standardizing process of evaluation that is being used in many areas of the world. Agricultural systems will be a prime focus of our comparative sweep through Belize. The reading material below provides introductions to these topics.

**Reading and Reference Material:** Boles 2005 *The Belize Situation* (dated, but still valid, just skim through this one and check out anything relevant to you); Boles 2014 *Rapid Ecological Assessment Workbook* (good general discussion of watershed ecology, contains information on some of the methodologies we will be using, skim through and read what may be of interest); Balmford et al. 2012 *What conservationists need to know about farming*, Spradley 1979 *Asking Descriptive Questions*.

#### Day 1- Saturday, June 24 - Monkey Bay, Mile 31.5 George Price Highway

Settle into Monkey Bay and brief welcome to Belize, group introductions, and orientation to field program, the three courses, and health and safety issues.

#### Day 2- Sunday, June 25- Monkey Bay

**Objectives:** Lectures and meetings will provide an ecological framework and landscape model that we will build on as we move through the country. Forays into the savanna and looking at savanna ecology will provide a great similarity to Mountain Pine Ridge ecosystems and a significant contrast to tropical forest ecosystems. The Belize Zoo, representing only Belizean animals, will give us a close encounter with the wildlife that will be all around us in the bush, but often not seen.

**Reading and Reference Material:** Antonelli Sanmartin 2011 *Why are there so many plant species in the Neotropics?*; Kellman 2002 *Nutrient retention by savanna ecosystems*; Laughlin 2002 *Flora of pine savannas of Monkey Bay Wildlife Sanctuary*.

#### Day 3 - Monday, June 26 - Monkey Bay

**Objectives:** We will be making observations of any new human impact activities we find, conducting macroinvertebrate sampling focused on detritus mats and leaf packs, and ultimately compiling a float report with photos, introducing concepts of REA as we conduct those activities in the field.

#### Day 4 - Tuesday, June 27 - Monkey Bay

**Objectives:** River bank introduction lecture/discussion on principles of conservation biology, research/assessment methods, and community-based management discussions.

#### Day 5 - Wednesday, June 28 - Monkey Bay

**Objectives:** We will be comparing savanna areas around the Tropical Education Center with areas around Monkey Bay. In particular, we will be visiting a savanna riparian forest and experiencing the transition zone between riparian forest and open savannah (we will be going through other sharp transition zones during our travels). We are also going to focus on aquatic macroinvertebrate communities inhabiting phytothalamata, plants that hold water.

**Reading and Reference Material:** CEPF 2005 *Mesoamerican hotspots-Northern Mesoamerica*; Meerman Wilson 2005 *Belize National Protected Areas Policy and System Plan*; Miller et al. 2001 *Defining common ground for the Mesoamerican Biological Corridor*; Srivastava Vellend 2005 *Biodiversity-Ecosystem functions basic principles*.

#### Day 6 - Thursday, June 29 - Bermudian Landing

**Objectives:** Experience a community-based protected area that supports research, learn firsthand about the Creole culture within the lower Belize River Valley, conduct ethnographic interviews.

**Reading and Reference Material:** Horwich 1998 *Effective solutions for howler conservation* (history); Marsh Loiselle 2001 *Recruitment of howler fruit trees northern Belize*.

### Day 7 - Friday, June 30 - Bermudian Landing

**Objectives:** Build on the understanding of a riparian forest, its overall ecology, the ecological services provided, and its potential economic value.

**Reading and Reference Material:** DeCamps et al. 2004 *Riparian zones-Where biochemistry meets biodiversity in management practices*; Parker 2008 *Riparian and wetland trees of Belize* (list made from Parker 2008 *Trees of Guatemala*, reference list); Pitcher Kellman 2002 *Tree diversity in small riparian tropical forest fragments in Belize*; Treves et al. 2005 *Tourist impacts on the behavior of black howling monkeys (Alouatta pigra) at Lamanai, Belize*; Wyman et al. 2010 *Examining the linkages between community benefits, place-based meanings, and conservation program involvement: A study within the Community Baboon Sanctuary, Belize*.

### Day 8 - Saturday, July 1 - Bermudian Landing

**Objectives:** We will learn how villagers drew their subsistence from the natural environment historically and how that compares to today (food, medicine, building materials, etc.). We will examine how ecotourism is affecting the village economically and socially. Is it a sustainable industry? We will learn about tilapia and the effects of this fish on the ecosystem.

### Day 9 - Sunday, July 2 - Crooked Tree

**Objectives:** Our focus is experiencing the ecology of this incredible wetland system, understanding the cultural adaptations of people to wetland living, resource utilization, and co-management of this natural resource of national significance. We will also get more on the tilapia story.

**Reading and Reference Material:** Baker 2003 *Maya wetlands ecology and pre-Hispanic utilization of wetlands in northwestern Belize*; Cameron et al. 2011 *Savanna ecosystems map of Belize 2011-Technical report (reference, with vegetation map of Belize)*; Carballo-Avilez 2009 *Crooked Tree Wildlife Sanctuary Pride Campaign-Final report (good background on Crooked Tree and active NGOs)*; Darwin Initiative No Date *Savannas of Belize-The lowland savanna*; Mecsek et al. 2009 *Biological activities as patchiness driving forces in wetlands of northern Belize*; McGarth 2008 *Belize-Bird migrants and Crooked Tree*.

### Day 10 - Monday, July 3 - Crooked Tree

**Objectives:** This is a day of examining conflicting resource use and management objectives, and the challenges of resolving those differences. Pay attention to the relationships between BAS and fishers, conservation ecologists and ranchers, local culture and tourist culture.

### Day 11 - Tuesday, July 4 - Crooked Tree

**Objectives:** Conducting interviews will be a prime focus, as well as exploring the village and making observations. We will also explore the larger issues of sovereignty, the threat of Guatemala toward Belize, and the occupation of Belize by foreign militaries.

### Day 12 - Wednesday, July 5 - Crooked Tree

**Objectives:** We will be focusing on GoogleEarth©2016-2017 as a research tool, discussing applications to many areas of study. We will make ecological comparisons between different savanna areas and look at the differences in economic activities between sites visited. We will also introduce the use of taxonomic checklists.

**Reading and Reference Material:** Goodwin et al. 2013 *A checklist of the vascular plants of the lowland savannas of Belize, Central America*.

### Day 13 - Thursday, July 6 - San Ignacio Town

**Objectives:** We will view a number of situations that will be discussed in upcoming lectures, including foreign corporate agriculture (something new outside of citrus and bananas), become familiar with the Belize Department of Agriculture, visit a key farming community in Belize, one that provides most of the dairy, corn, beans, eggs, poultry, and beef locally consumed. Exposure to Mennonite culture, seeing both the mechanized Mennonites and some of the traditional Mennonites who come to Spanish Lookout to trade. We will also be getting to know the Mestizo town of San Ignacio. This will be an opportunity to acquire ethnographic interviews that will be discussed in later meetings.

#### Day 14 - Friday, July 7 - San Ignacio Town

**Objectives:** Our stay in San Ignacio will expose us to a modernizing Mestizo culture and opportunities for ethnographic interviews. The real focus of this day is the Ancient Maya, with a visit to two Maya sites.

**Reading and Reference Material:** Chase and Garber 2004 *Archaeology of the Belize River Valley*; Turner 2010 *Unlocking the ancient Maya and their environment: Paleo-evidence and dating resolution*; Beach et al. 2005 *Impacts of the ancient Maya on soils and soil erosion in the Central Maya Lowlands*; Kirke 1980 *Prehistoric agriculture in the Belize River Valley*.

#### Day 15 - Saturday, July 8 - San Ignacio Town

**Objectives:** We will discuss one of the central energy issues in Belize, hydroelectricity—economic benefits, foreign investors, profit margins, environmental consequences, future plans. We will explore a riparian forest and visit a facility that is focused on helping to maintain one of the signature riparian animals of Belize, the green iguana. We will learn about wildlife rehabilitation and breeding programs on-going in Belize.

#### Day 16 - Sunday, July 9 - Mountain Pine Ridge

**Objectives:** We will be climbing in elevation and seeing a change in ecosystem types from tropical forest to upper elevation pine forest on Mountain Pine Ridge. We will be comparing this system to the savannas we experienced in the lowlands.

**Readings and References:** Bridgewater et al. 2006 *Chamaedorea (Xate) in the greater Maya mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product*.

#### Day 17 - Monday, July 10 - Mountain Pine Ridge

**Objectives:** We will be comparing and contrasting MPR forest and tropical deciduous forests, within an area where these systems are patch-worked together. We will also be looking at geology and talking about how it determines soil and vegetation types found. Our macroinvertebrate sampling will give examples of those organisms so important in the detritus processing in streams and rivers, and composition will be compared to previous efforts.

#### Day 18 - Tuesday, July 11 - Mountain Pine Ridge

**Objectives:** We will be comparing and contrasting the economics and ecological impacts of different energy projection systems in Belize, describing sub-surface watershed components affected by dams and wetland drainage, and exploring seeps, small wetland areas of the headwaters, and headwater streams.

**Reading and Reference Material:** Beck et al. 2012 *Environmental and livelihood impacts of dams: Common lessons across development gradients that challenge sustainability*; Boulton et al. 2010 *Ecology and management of the hyporheic zone: Stream-groundwater interactions of running waters and their floodplains*.

#### Day 19 - Wednesday, July 12 - TREES

**Objectives:** We will be exposed to tropical forest ecology and explore tropical forests on the TREES property. We will also be looking at the recovery of disturbed areas (old orchards).

**Reading and Reference Material:** Chazdon 2003 *Tropical forest recovery: Legacies of human impact and natural disturbance*; Day 1996 *Conservation of Karst in Belize*; Lewis et al. 2013 *Conservation of tropical forests: Maintaining ecological integrity and resilience*; Vitousek and Sanford 1986 *Nutrient cycling in moist tropical forests*.

#### Day 20 - Thursday, July 13 - TREES

**Objectives:** Our focus is detritus processing in streams and discussing the importance of riparian forests as filter systems of the landscape and as the nutrient source for streams, rivers, and coastal zones. We will also be working in Dry Creek identifying fish and macroinvertebrates. We will improve understanding of the importance of amphibian and reptile conservation efforts and the significance of that work.

**Reading and Reference Material:** Fang 2010 *River continuum and flood-pulse: Exploring ecological and hydrologic concepts in riparian-wetland*; Lorion Kennedy 2009 *Relationships between deforestation, riparian forest buffers and benthic macroinvertebrates in neotropical headwater streams*; Seavy et al. 2009 *Why climate change makes riparian restoration more important than ever: Recommendations for practice and research*.

<b>Day 21 - Friday, July 14 - TREES</b>
<b>Objectives:</b> We will examine karst geology and ecology in more detail, including a cave system and a karstic stream that surfaces at a sump where the overhead cave ceiling had collapsed long ago, before it disappears underground again.
<b>Day 22 - Saturday, July 15 - TREES</b>
<b>Objectives:</b> This day will be devoted to agriculture within the Hummingbird area, focusing both on subsistence family farming and commercial farming, as well as a support industry that traces back to the Ancient Maya.
<b>Day 23 - Sunday, July 16 - Cockscomb</b>
<b>Objectives:</b> We will be visiting a Garifuna village and an adjacent Creole village. While at Hopkins Village there will be opportunities to conduct quick ethnographic interviews.
<b>Day 24 - Monday, July 17 - Cockscomb</b>
<b>Objectives:</b> The main focus will be on the wildlife of the area. We will also be noting key plant species and families in the area and comparing observations with what we have seen at TREES.
<b>Day 25 - Tuesday, July 18 - Cockscomb</b>
<b>Objectives:</b> We will be investigating the geology of granite outcropping and the karstic and sedimentary landscape around the mountain range. Our hike will pass through a rather abrupt transition zone between moist to dry tropical forest and pine ridge forest. You also have a great opportunity to get an ethnographic interview in with some of the rangers.
<b>Day 26 - Wednesday, July 19 - Cockscomb</b>
<b>Objectives:</b> We will be describing transition zones, geology, hydrological units, and other features we find along the way, as well as sampling pristine streams encountered along the way. Our trek will be GPS mapped and key points described. The insect work at the sheet should reveal creatures we would not see otherwise, and noted specimens photographed (no collections from the sheet).
<b>Day 27 - Thursday, July 20 - Cockscomb</b>
<b>Objectives:</b> We will get an insight into the impact and ecology of fire disturbance in tropical forests. We will also be sampling tropical forest headwater streams and be able to compare results with previous efforts at other sites.
<b>Day 28 - Friday, July 21 - Ya'axché Conservation Trust</b>
<b>Objectives:</b> We will be learning about community-based conservation efforts, community empowerment, and projects that are on-going and that have been accomplished by Ya'axché. In particular we will be learning about running a tropical tree nursery and discussing projects to increase tree production and forest restoration in Belize. This will include a discussion on the seed collection side of the industry, and other groups where tree nurseries have been established.
<b>Day 29 - Saturday, July 22 - Ya'axché Conservation Trust</b>
<b>Objectives:</b> We will be discussing the importance of disturbance and succession in maintaining high biodiversity within tropical forests. We will also be discussing how human impact compares to natural disturbance, examining slash and burn agriculture under low and high population densities, and mechanized agriculture as practiced in Belize. We will also discuss options to make mechanized agriculture more sustainable.
<b>Day 30 - Sunday, July 23 - Punta Gorda Town</b>
<b>Objectives:</b> We will be doing a survey of the fruits and vegetables available in the local market and compare with what we found in San Ignacio. When meeting with local NGO leaders, we will have the chance to gain insight into some of the conservation activities on-going in southern Belize. We will also get to know a blackwater coastal creek and discuss its ecology.

### Day 31 - Monday, July 24 - Punta Gorda

**Objectives:** Our main objective is to get to know PG better and to develop a deeper understanding of conservation.

**Reading and Reference Material:** Huitric 2005 *Lobster and conch fisheries of Belize: a history of sequential exploitation*.

### Day 32 - Tuesday, July 25 - Laguna Village Camping

**Objectives:** We want to learn as much about the village, the local culture, and food production as we can.

**Reading and Reference Material:** Amiguet et al. 2005 *A Consensus Ethnobotany of the Q'eqchi' Maya of Southern Belize*; Campbell Anaya 2008 *The Case of the Maya Villages of Belize: Reversing the trend of government neglect to secure indigenous land rights*; Atran 1999 *Managing the Maya Commons: The Value of Local Knowledge*.

### Day 33 - Wednesday, July 26 – Laguna Village

**Objectives:** Lecture on Aguacaliente Swamp/Lagoon system and the importance of the lagoon system to the village.

### Day 34 - Thursday, July 27 – Laguna Village

**Objectives:** We will be learning firsthand about the community governance within the Q'eqchi' culture and the larger Maya cultural issues of land rights and food security for the future, recent adaptations of these peoples to their changing lifestyles as international cultural influences arrive in their village, and the rocky history of co-management of the Aguacaliente Wetland.

### Day 35 - Friday, July 28 – Laguna Village

**Objectives:** We will be learning firsthand about the traditional medicinal and seasoning plants that have been used for hundreds to thousands of years. We will also be discussing the local citrus and banana industries. We will also be conducting stream work.

### Day 36 - Saturday, July 29 - Tobacco Caye

**Objectives:** Our overall objective is to discuss and demonstrate the linkages between terrestrial and marine ecosystems through watersheds that feed coastal zones. We will also be building a sighting list/ecology tables for each snorkel effort and discussing the use of sighting lists in monitoring.

**Reading and Reference Material:** Boles 2009 *Marine fishes sighting list-New Mexico State University March 2009*; Burke Sugg 2007 *Hydrologic modeling of watersheds discharging adjacent to the Mesoamerican Reef*; Cooper et al. 2007 *Coastal Capital: Belize- The economic contribution of Belize's coral reefs and mangroves*; Smith 2007 *Neuston, microlayers and surface films: Science at the air-water interface*.

### Day 37 - Sunday, July 30 - Tobacco Caye

**Objectives:** We will be focusing on the important functions of mangroves and grassbeds in maintaining ecological integrity of tropical coastal systems. We will continue to build the sighting/ecology tables from our snorkel efforts. We will also begin the process of consolidating our findings from our ethnographic interviews.

**Reading and Reference Material:** Cho, 2005 *Marine protected areas: A tool for integrated coastal management in Belize*; Feller 2002 *The role of herbivory by wood-boring -insects in mangrove ecosystems in Belize*; Mumby et al. 2004 *Mangroves enhance the biomass of coral reef fish communities in the Caribbean*; Murry et al. 2002 *Mangroves of Belize Part 1. Distribution, composition and classification*.

### Day 38 - Monday, July 31 - Tobacco Caye

**Objectives:** This begins our first exploration of the ecological complexity and importance of coral reef systems and the interconnection of reefs (and all coastal zone ecosystems) with terrestrial ecosystems through watersheds. We will be examining plankton as the dispersal system and interconnecting nutrient pathway among the entire coastal zone and even open ocean systems.

**Reading and Reference Material:** Burk Sugg 2006 *Hydrologic modeling of watersheds discharging adjacent to Mesoamerican reefs*; Land 2000 *Plankton coupling on a Caribbean fringing reef*; Gibson et al. 1998 *Coral reef management in Belize: an approach through integrated coastal zone management*; Mora Sale 2002 *Are populations of coral reef fish open or closed?*; Rogers 2011 *Coral bleaching and disease should not be underestimated as causes of Caribbean coral reef decline*.

<b>Day 39 - Tuesday, August 1 - Tobacco Caye</b>
<b>Objectives:</b> We will focus on open ocean processes and how that ties back into coastal zone systems and the contribution that coastal zone systems make to the open ocean. Our discussion will include deep benthic communities as well. We will continue building our sighting/ecology tables.
<b>Day 40 - Wednesday, August 2 - Tobacco Caye</b>
<b>Objectives:</b> Our attention will be directed to understanding how humans are threatening the state of health of not just coastal zone ecosystems, but of the global marine systems. We will also be specifically focusing on indicators of reef stress as we snorkel. We will continue to add to our sightings/ecology tables and to consolidate our ethnographic findings. <b>Reading and Reference Material:</b> Aronson et al. 2002 <i>The 1998 bleaching event and its aftermath on coral reefs in Belize</i> ; Arrivillaga 2007 <i>The Mesoamerican reef ecoregional assessment: Setting priorities for marine conservation</i> ; Brown-Saracino et al. 2007 <i>Spatial variation in sea urchins, fish predators, and bioerosion rates on coral reefs of Belize</i> ; Diedrich 2011 <i>Cruise ship tourism in Belize: The implications of developing cruise ship tourism in an ecotourism destination</i> ; Healthy Reefs for a Healthy People 2010 <i>Mesoamerican Reef report card</i> .
<b>Day 41 - Thursday, August 3 - Tobacco Caye</b>
<b>Objectives:</b> We will be discussing the big issue of global warming and its impact on the marine systems of the world, as well as the terrestrial tropical ecosystems. <b>Reading and Reference Material:</b> Gilman et al. 2008 <i>Threats to mangroves from climate change and adaptation options</i> ; Huitric 2005 <i>Lobster and conch fisheries of Belize: A history of sequential exploitation</i> .
<b>Day 42 - Friday, August 4 - Monkey Bay</b>
<b>Objectives:</b> Time for studying for the exam or taking care of any last minute efforts needed to consolidate ethnographic information.
<b>Day 43 - Saturday, August 5 - Monkey Bay</b>
<b>Final Exam</b> - The Exam will take about two hours and can be taken wherever you find a comfortable spot away from the others. Instructor will make the rounds during the exam to answer any answer questions relevant to exam instructions, and will be available throughout the exam period.
<b>Day 44 - Sunday, August 6 - Back Home</b>
Departure for airport by Monkey Bay bus.

## VIII. Reading List

### References and Required Readings:

Three texts are required for these courses, and references will be made to select chapters of each text based on activities scheduled for each day. In addition, many other references listed below will be available electronically and a Course Reader will be provided via Dropbox. These readings include selections from academic primary literature, technical reports, book chapters, environmental impact assessments and planning documents as well as a couple of articles from media sources. If you are traveling with a field-durable laptop or tablet, you can acquire and upload these documents for use while you are in Belize. If you are not planning to bring an electronic device that will allow you access to digital information, you should print and bind the primary documents, as indicated by a red asterisk beside the lead author's name, and any other articles that are of particular interest to you. There is a wide range of information represented in these courses and each of us tends to specialize in one or a few areas of interest, perhaps becoming the group "expert" for a particular area of knowledge. In addition to the materials listed here, we will be carrying a mobile library of field guides and other relevant books with us as we travel.

**Required Texts:**

Besides the reading materials listed within each day in the itinerary, the following three text books are required readings:

Bridgewater, S. 2012 *A Natural History of Belize: Inside the Maya Forest*.

Honeth, M. and M. Loubieres 2014. *Tropical Marine Ecology: a field guide to Belize*.

Wainwright, Joel 2008. *Decolonizing Development: Colonial Power and the Maya*. Wiley-Blackwell.

**Other Readings and References:**

Amiguet, V. T, J. T Arnason, P. Maquin, *et al.* 2005. *A Consensus Ethnobotany of the Q'eqchi' Maya of Southern Belize*. *Economic Botany* 59(1): 29–42.

\*Antonelli, A. and I. Sanmartin. 2011. *Why are there so many plant species in the Neotropics?* *Taxon* 60(2): 403-414.

Atran, S. 1999. *Managing the Maya Commons: The Value of Local Knowledge*. *Ethnoecology: Situated Knowledge Located Lives*: 191–214.

\*Balmford, A., R. Green and B. Phalan. 2012. *What every conservationist should know about farming*. *Proceedings of the Royal Society Biology Series* 279: 2714-2724.

Blake, J. 2002. *Developing a New Standard-setting Instrument for the Safeguarding of Intangible Cultural Heritage: Elements for Consideration*. UNESCO.

Beach, T., N. Dunning, S. Luzzadder-Beach, D. E. Cook and J. Lohse. 2005. *Impacts of the ancient Maya on soils and soil erosion in the Central Maya Lowlands*. *Catena*. Available online at [www.sciencedirect.com](http://www.sciencedirect.com).

\*Beck, M. W., A. H. Claassen and P. J. Hundt. 2012. *Environmental and livelihood impacts of dams: Common lessons across development gradients that challenge sustainability*. *International Journal of River Basin Management* 2012: 1-20.

Boles 2005 *The Belize Situation (unpublished, available from instructor)*.

Boles 2014 *Rapid Ecological Assessment Workbook (unpublished working draft, available from instructor)*.

Boles 2009 *Marine fishes sighting list - New Mexico State University March 2009 (unpublished, available from instructor)*.

Boulton, A. J., *et al.* 2010. *Ecology and management of the hyporheic zone: Stream-groundwater interactions of running waters and their floodplains*. *Journal of the American Benthological Society* 29(1): 26-40.

Bridgewater, S. G. M., *et al.* 2006. *Chamaedorea (Xate) in the greater Maya mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product*. *Economic Botany* 60(3): 265-283.

Burke, L. and Z. Sugg. 2007. *Hydrologic modeling of watersheds discharging adjacent to the Mesoamerican Reef*, Analysis Summary-December 1, 2006. World Resources Institute. 30 pages.

Cameron, I. D., N. Stuart and Z. A. Goodwin. 2011. *Savanna ecosystems map of Belize 2011: Technical report*. Darwin Initiative Project 17022, University of Edinburgh, Edinburgh.

Campbell, M. S, and S. J Anaya. 2008. *The Case of the Maya Villages of Belize: Reversing the Trend of Government Neglect to Secure Indigenous Land Rights*. *Human Rights Law Review* 8(2): 377.

Carballo-Aviles, O. 2009. *Crooked Tree Wildlife Sanctuary Pride Campaign Final report*. Belize Audubon Society.

Critical Ecosystem Partnership Fund. 2005. *Mesoamerican hotspot-Northern Mesoamerica*. Improving Linkages Between CEPF and World Bank Operations, Latin America Forum, Rio de Janeiro, Brazil, January 24-25, 2005.

Chase, A. F. and J. F. Garber. 2004. *Archaeology of the Belize River Valley in historical perspective*. 14 pages.

- \*Chazdon, R. L. 2003. *Tropical forest recovery: Legacies of human impact and natural disturbance*. Perspectives in Plant Ecology, Evolution and Systematics 61(1,2): 51-71.
- Cho, L. 2005. *Marine protected areas: A tool for integrated coastal management in Belize*. Ocean and Coastal Management 48(2005): 932-947.
- Cooper, E., L. Burke and N. Bood. 2007. *Coastal Capital: Belize - The economic contribution of Belize's coral reefs and mangroves*. WRI Working Paper, World Resource Institute, Washington DC. 53 pages, Available online at <http://www.wri.org/publications> .
- Day, Michael. 1996. *Conservation of Karst in Belize*. Journal of Caves and Karst Studies 58: 139-144.
- \*DeCamps, H., et al. 2004. *Riparian zones-Where biochemistry meets biodiversity in management practice*. Polish Journal of Ecology 52(1): 3-18.
- Drew, J. A, and A. P Henne. 2006. *Conservation Biology and Traditional Ecological Knowledge: Integrating Academic Disciplines for Better Conservation Practice*.
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