

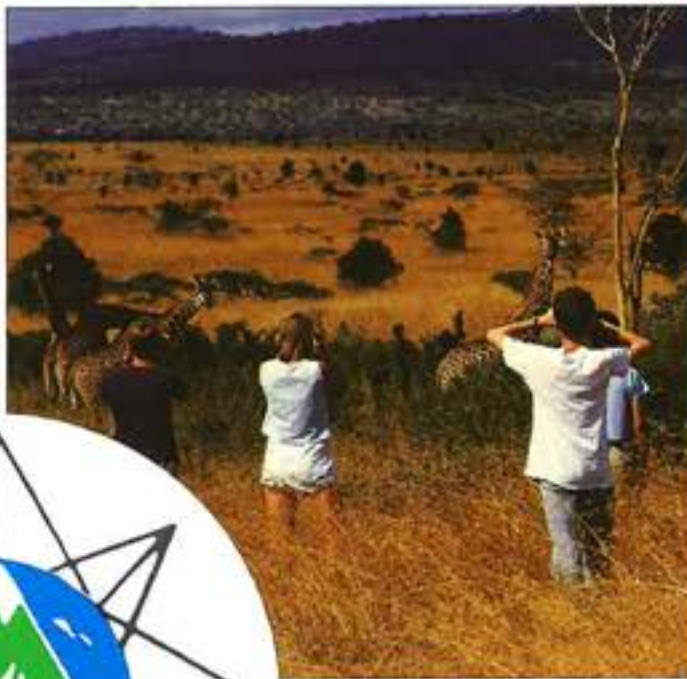
The School for Field Studies

1991-92 Course Catalogue

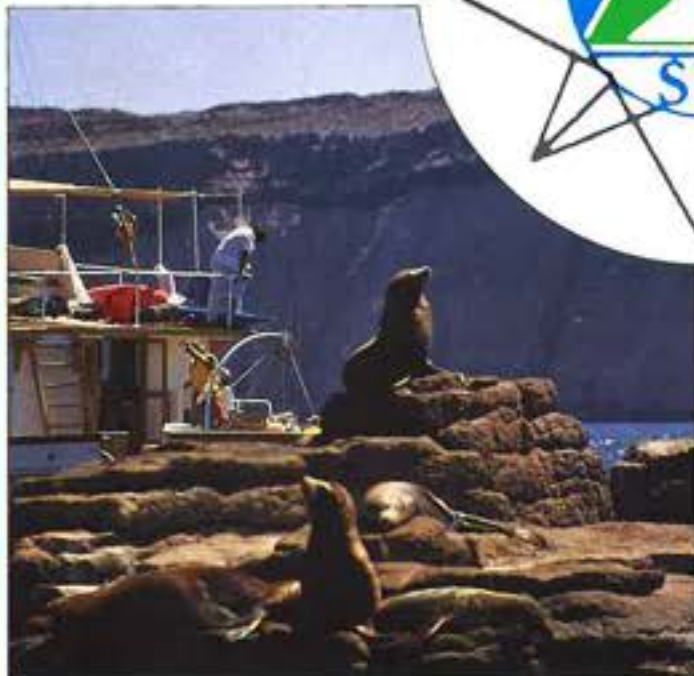
Environmental
Field Training and
Research Programs
Around the World



Center for Rainforest Studies-Australia



Center for Wildlife Management Studies-Kenya



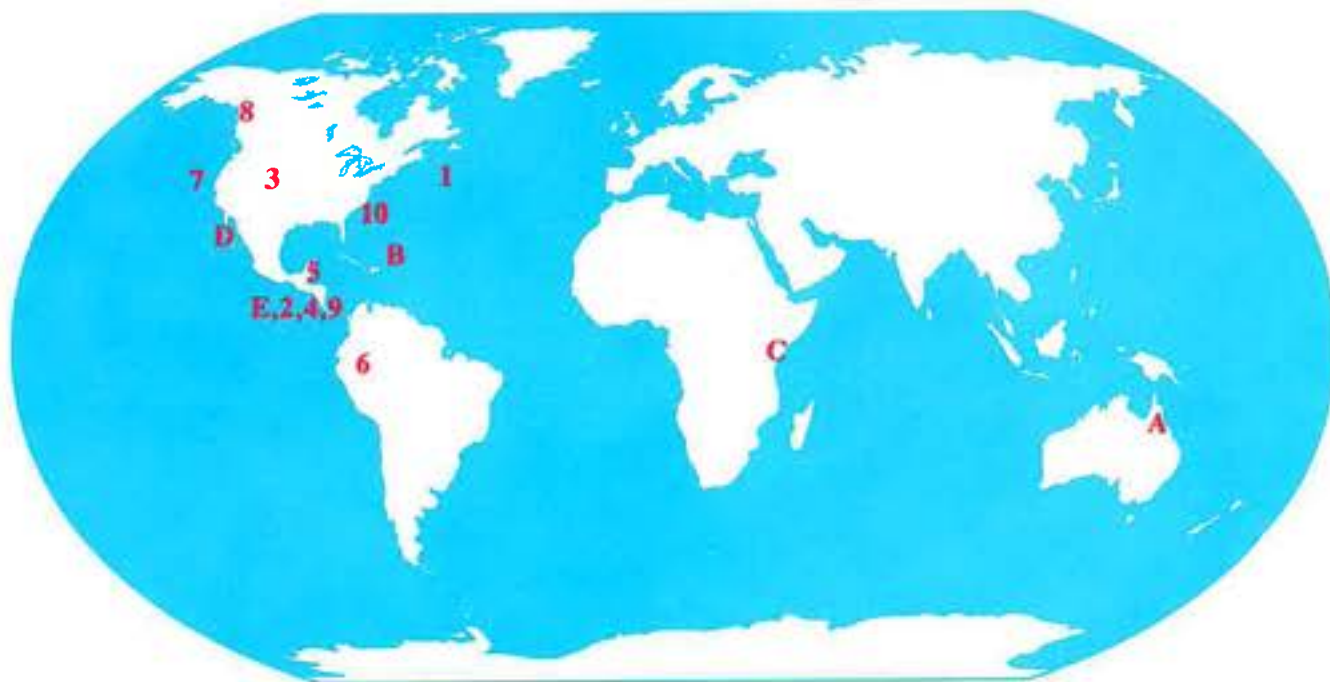
Marine Mammal Studies Program-Mexico



Center for Marine Resource Studies-Caribbean

The world is your classroom

1991-92 Curriculum



About The School for Field Studies p. 2-5;36-43

About SFS	p. 2-3
Curriculum	p. 4
Faculty	p. 5
Academic Credit, Research Papers	p. 36
Processes, Requirements, Tuitions & Costs	p. 37-38
Reference Form	p. 39-40
Application	p. 41-42
SFS Organization	p. 43

A. Center for Rainforest Studies p. 6 - 9

Site: AUSTRALIA
 Fall and Spring Semester Programs:
Biogeography: Patterns of Ecological Diversity
 Summer Course: (June 28-August 9)
Tropical Deforestation: Threats to Biological Diversity

B. Center for Marine Resource Studies p. 10 - 14

Site: TURKS AND CAICOS ISLANDS, CARIBBEAN
 Fall and Spring Semester Programs:
Marine Ecology and Management
 Summer Courses: (June 18-July 17; July 24-August 22)
Mapping Marine Ecosystems
Coral Reef Management

C. Center for Wildlife Management Studies p. 15-19

Site: KENYA
 Fall and Spring Semester Programs:
Wildlife Ecology and Management
 Summer Courses: (June 18-July 17; July 24-August 22)
Wildlife Management
Study in Symbiosis: Humans and Honeyguides

D. Marine Mammal Studies Program p. 20-22

Site: BAJA, MEXICO
 Fall and Spring Semester Programs:
Marine Mammal Biology and Conservation

E. Center For Sustainable Development Studies p. 23-24

Site: COSTA RICA
 Fall and Spring Semester Programs:
Studies in Sustainable Development

Summer Satellite Courses p. 25 - 35

Session I: June 18-July 17; Session II: July 24-August 22

1. Humpback Whale Ecology	p. 26
North Atlantic	
2. Primate Ecology and Conservation	p. 27
Costa Rica	
3. Landscape Ecology	p. 28
Colorado	
4. Ecology of Endangered Sea Turtles	p. 29
Costa Rica	
5. Tropical River Ecology	p. 30
Belize	
6. Ethnobotany	p. 31
Ecuador	
7. Ecology of Harbor Seals	p. 32
Puget Sound, Washington	
8. Ecology of Bald Eagles	p. 33
Alaska	
9. Tropical Cloud Forest Ecology	p. 34
Costa Rica	
10. Biology and Behavior of	p. 35
Bottlenose Dolphins	
North Carolina	

A Letter from the President

Dear Reader,

Thank you for your interest in The School for Field Studies. Right away, let me tell you that our courses are not for everyone. Nor are they only for students majoring in environmental sciences or those who seek a career in that area.

But if you want to learn about (and see) more of the world... understand how your own decisions affect the environment... challenge yourself, physically and mentally... make a real difference in how the world manages its natural resources... SFS may be ideal for you.

In fact there may be no better way to achieve your goals than to spend a semester or summer with SFS.

You see, I began SFS 10 years ago with several of our Trustees to do one thing: give bright, talented students—no matter what their academic focus or career aspirations—a unique opportunity to study environmental problems firsthand, contribute immediately to their solutions and carry a heightened awareness of environmental issues to the world.

Today, there seems to be no lack of environmental interest. People recycle. Governments are moving to limit some pollutants. "Green consumer" is the latest marketing buzzword.

But fundamental environmental crises won't be solved just because people recycle cans. Preserving ecosystems, balancing development and conservation, finding ways to manage and maintain wildlife and marine resources—these problems have been growing for years. Finding the answers will require time, commitment, and a thorough understanding of these very complex issues.

SFS offers you a way to take the time, make the commitment, and gain an understanding of the issues. In return, you will be richly rewarded. You'll work with others who share your desire to contribute. You will have the opportunity to obtain a practical education in the best possible laboratory—the real world. In the end, when your course of study is successfully completed, you will have a sense of achievement and a deeper understanding of the complex aspects of the environmental issues facing us today.

If our curriculum intrigues you, I urge you to apply soon because enrollment is limited. And don't let financial concerns stop you. Scholarships and loans are available.

The challenge awaits you. We invite you to accept.

Sincerely,

Jim Elder
James L. Elder, Jr.
Founder and President





About SFS

What The School for Field Studies Does.

SFS provides motivated young people—from secondary schools, colleges and universities nationwide, and from a variety of academic backgrounds—with an action-oriented, experience-based education in environmental issues. At the same time, students are able to make immediate contributions toward sustainable management of natural resources.

In doing so, we seek to make tomorrow's leaders more environmentally literate, aware and able to recognize the environmental effects of how they choose to live.

Since our founding in 1980, we have given more than 3,500 students a unique opportunity to conduct hands-on field studies and research addressing some of the most critical environmental issues facing the world. SFS is the largest private educational institution exclusively offering courses and fieldwork for undergraduates in the increasingly important field of conservation biology.

In an SFS program, you'll be face-to-face with the issues.

Rainforests don't fit under a microscope. Giraffes don't graze in a test tube. That's why SFS courses don't take place in a classroom. We'll take you to the best possible laboratories for environmental studies, the actual ecosystems where problems are occurring. This provides dramatic, real-life illustrations of the issues that can only be imagined through lectures and textbooks. We provide an educational experience which fully integrates theory and practice.

SFS operates five Centers where you can participate in 13-14 week **semester programs** (part of ongoing, year-round studies). Most Centers also offer month-long **summer courses**. These campuses include:

- The Center for Rainforest Studies in Australia
- The Center for Marine Resource Studies in the Caribbean
- The Center for Wildlife Management Studies in Kenya
- The Marine Mammal Studies Program in Baja, Mexico
- The Center for Studies in Sustainable Development in Costa Rica (scheduled to open in 1991)

SFS also operates 10 **satellite sites** at environmental "hot spots" around the world. At these sites, you can spend a month examining a critical problem, such as loss of biodiversity, in the context of a traditional academic discipline, such as ecology.

For SFS students, the rewards can far exceed academic credit.

You will have an opportunity to learn.

We will teach you how to approach a problem, how to formulate and test a hypothesis. You will work within a team, building on strengths and compensating for weaknesses to reach a common goal. You'll gain skills in research methodology, teamwork, outdoor living and a scientific discipline—a breadth of training unmatched by any other program.

In short, you'll tackle and solve serious problems under real-life conditions. Many former students tell us the skills learned here stay with them, helping them to succeed in school, in their careers, in their lives.

You will have the opportunity to contribute.

The research that results from your work will become part of databases and management reports for use by wildlife officials, government organizations and other environmental agencies. You can make a unique, personal contribution to science and humanity.

You'll have opportunities rarely available to undergraduates.

For science majors, SFS is a chance to obtain field training before graduation. For students with little or no scientific background, but interested in a career as a field scientist, SFS is a unique way to see what it's really like. For those simply intrigued by environmental issues, SFS is a practical way to study them.

You will have the opportunity to live where few others are allowed to go.

Our courses address timely and sensitive issues. Much of our work is carried out in spectacular places—game ranches, pristine coral reefs, rainforests—that provide dramatic illustrations of the issues under study. Access to these areas often requires special permits not available to the public.

You can establish lasting friendships.

A strong comradery builds among team members as you share daily challenges—setting up camp, cooking, tackling a tough aspect of the research—and as you share thoughts at the end of each day. The experiences you share as you work toward a common goal form the basis of friendships that endure over the years.



SFS students have the opportunity to conduct hands-on research on real world issues. Here team members radio-track elk while investigating the return of plant and animal species to Mt. St. Helens. (Photo: Gary Braasch)



Of course, you'll receive college credit.

Upon successful completion of an SFS program, all students receive credit through Northeastern University. For information on academic credit and a partial list of over 150 colleges and universities who accept/award credit for SFS programs, please see page 36.

Academics and personal growth go hand in hand in an SFS course.

Academic study, research and the development of practical skills are the three components of any SFS course. Though separated here for the sake of clarity, these components are integrated within the course structure.

Academics

Though we utilize many traditional methods of instruction (lectures, seminars, assigned readings, critical reviews of current research papers, presentations, papers and exams), we constantly seek creative ways to enhance learning through hands-on experience and direct application. For instance, a marine species identification exam is given underwater, with living examples; in one Resource Management course, the "midterm paper" is an Environmental Impact Statement.

Research

It is here that the opportunity arises for you to make a personal contribution to science and—because of the kinds of issues addressed—to humanity.

You will engage directly in real-world problem solving across a wide range of questions: how to control loss of species diversity... feed an expanding world population... strike a balance between development and preservation. While taking part in team research efforts, you will also have the opportunity to test out the career of a field scientist by designing and carrying out a directed research project, either independently or in a small group.

A few of our current research projects include the effects of human activity on whales and seals; the variability in giraffe feeding behavior on a Kenyan wildlife ranch; the ecology of pharmaceutical plants growing in Amazonian Ecuador.

Practical skills

Students routinely receive training in field methodology. Field techniques, which may include training in SCUBA, tracking, censusing, capturing, mapping, wilderness living and a dozen other skills, are also presented. You will gain experience in teamwork and cooperative problem solving.

Team building is the essence of the SFS experience.

SFS teams range from 15 students and two faculty on a month-long course to 30 students and three to four faculty for semester programs.

SFS students come from public and private high schools, colleges and universities. They major in everything from science to liberal arts. They come from across North America and from many foreign countries. They're as young as 16 and as old as 25-26. **About 25% receive SFS financial aid** (see page 38 for financial aid information). The one thing that everyone shares is a desire to learn more about the natural world.

As an SFS team member, you are actively involved in all aspects of our research and day-to-day living. In fact, with so much to accomplish in the limited time available, there is little time for individual ventures. This team approach to learning and problem solving is at the heart of the SFS educational philosophy; it is one of our greatest strengths.

Working with people from many different backgrounds, under demanding

conditions, you will learn a lot about yourself, how you relate as a member of a team, how you adapt to new people and surroundings. Students often say they learn as much about themselves as they do about the environment. To us, that means the program works.

You provide the enthusiasm, we provide the experience.

Since one of our goals is to introduce students to field training methodology not found in most traditional classroom settings, SFS program participants do not need previous camping experience, field training or a science background.

Summer courses are designed at a college introductory level. However, our low student to faculty ratio and interactive teaching approach let us adjust course pace and content to suit the needs and levels of the team. While most summer students have completed one or more college level biology or ecology courses, talented and motivated students with a high school biology background have had comparable academic success. SFS summer students must be 16 years of age or older and must have completed their junior year of high school.

SFS semester programs require successful completion of one college level ecology or biology course. Applicants to semester programs must be at least 18 years of age.

In all cases, the Admissions Committee carefully screens students to insure that they have the potential to contribute to and be successful in an SFS program.



"I expected some of the awkwardness of getting to know new people, and envisioned the silence that is present in a group that doesn't know what to say to each other. There was not a trace of that, only an air of eagerness and excitement."

David John Cornet, Olmstead Falls, OH—Cleveland State University (Photo: Jim Elder)

SFS Semester Programs

Each SFS semester program enrolls 24-30 students in a series of four rigorous, carefully designed courses. Courses are linked by a common focus on the flora, fauna, and human populations comprising the critical ecosystem under study. These must be considered together in any plan to evaluate or preserve natural habitats and wildlife populations. This link is explicit in the Directed Research course. Within this capstone course, students integrate all coursework with independent or small group investigations focused within key environments.

You will complete the equivalent of 21 quarter hours (approximately 15.5 semester hours) of college study through a series of four courses. Courses include approximately 30 hours of formal lecture/discussion sessions. Courses may have reading assignments, written and oral evaluations, laboratory and field projects, and many periods of informal discussion. The structured portion of the field project totals at least 16 hours per week. The nature of the program is such that learning often takes place in impromptu settings in addition to the formal lecture periods; thus the figures listed above are minimum contact hours.

Faculty

Semester programs are usually taught by a Field Director, three faculty, and one or more teaching assistants. This insures an unusually low student to faculty ratio. Faculty members and the Director will hold an advanced degree and have substantial teaching and research experience at the program location. (See page 5 and individual Center Sections for current list of faculty).

Schedule

The semester programs are 13-14 weeks of intensive study. A series of lectures and group discussions will supplement training in field research and laboratory analysis. Field trips to wildlife parks or reserves, visits to local villages, and occasional sightseeing in the major towns and cities of the area are scheduled as an integral component, usually totalling 2-4 weeks of the program.

Courses are taught six days a week, with one day free for recreation. A mid-term break of 3-4 days usually occurs between weeks six and seven, when students may be free, for the only time during the program, to travel on their own.

Applicants to semester programs must be at least 18 years of age and have successfully completed at least one college level biology or ecology course (preferably a laboratory course).

SFS Summer Courses

Month-long summer courses (8 quarter credits) depart in June and July. Teams are usually comprised of 15 students, two faculty and a teaching assistant or intern. You can expect a complete, intense learning experience, exposing you to issues that will engender thought and reflection long after your course has ended.

Schedule

Activities are planned seven days a week and usually ten to twelve hours every day with one or two breaks during the course.

Phase One: Introduction

- general discussion of expectations and individual introductions
- outdoor skills and safety training
- explanation and history of the research project
- initial exploration of the site

Phase Two: Lectures and Field Work

- faculty presentations on general comparative ecology, ecosystem organization, environmental issues, local histories and peoples



"This course has allowed me to design and carry out an independent research project, giving me a solid background in field techniques and confidence in my abilities."
Edward Slingerland, Toms River, NJ—Princeton University
(Photo: Tom Kleinert)

Preparation

SFS faculty prepare a detailed syllabus for each program. The syllabus contains academic and research objectives, required and recommended reading lists, and a course schedule, as well as information on the site, necessary personal equipment and medical information. Students may be assigned pre-course readings and will be expected to complete these assignments before the start of the course. A faculty member will contact each student prior to the course to discuss his/her participation in the program. SFS Admissions Counselors are available to answer or refer pre-course questions.

Evaluations

Faculty will conduct oral and written evaluations of students based on classwork, field work, examinations, papers, presentations and other aspects of the course. Students will be requested to evaluate both their course and their faculty. Upon successful completion of the course, students will receive a grade card from Northeastern University (or from SFS if the student attends an SFS Affiliate School) and may then request a transcript from the Northeastern Registrar (see pages 36 and 37 for additional information).

"Overall, an incredible, informative, intense, irreplaceable experience."

Laurie Wetherbee, Rochdale, MA—
Rensselaer Polytechnic Institute

- topical lectures on course material
- overview of research problem, design and data collection
- student critique of scientific papers
- description of scientific method, research methodology, field tools and techniques, successful hypothesis testing
- field data collection
- field trips as appropriate

Phase Three: Implementation of Directed Research Projects

- continuation of data collection; lectures/discussions
- lab work, data processing and analyses
- independent directed projects

Phase Four: Conclusion

- presentation of group findings and independent projects
- integration of research results to date: practical applications
- written examinations, group discussions
- faculty evaluation of students
- student evaluation of faculty and course

Applicants to summer courses must be at least 16 years of age and have completed the junior year of high school. They should also have successfully completed a minimum of a high school biology course. Most applicants to summer courses have completed a college level biology or ecology program.



SFS faculty are special people. Selected for their extensive teaching and field experience, knowledge of research and strong inter-personal skills, they are carefully chosen from hundreds of applicants worldwide. Complementing their strong backgrounds in the sciences are a broad range of skills and

experiences that qualify them to lead SFS courses. Research conducted by members of our faculty has resulted in hundreds of published scientific articles documenting research funded by National Geographic, NATO, the National Science Foundation, U.N.E.S.C.O., and the EPA. The success of SFS programs

in effectively challenging you intellectually, physically and socially, and in building your self-confidence and self-reliance, can in large measure be attributed to our outstanding faculty. (Please see individual Center sections and page 25 for additional faculty information.)

Faculty Profile Dusty Becker



Dusty Becker's (left) commitment to conservation has provided inspiration for many SFS students. (Photo: Tom Kleinert)

Senior Faculty: Primate Ecology and Conservation/Costa Rica

Education: B.S. (Secondary Science Education) University of Virginia, 1977

M.E.S. (Environmental Studies) Yale School of Forestry and Environmental Studies, 1984.

Ph.D. Candidate (Zoology) University of Alberta

Teaching Experience: Birmingham, Alabama Public Schools, Peace Corps, Kenya; The School for Field Studies: Wildlife Management Course/Kenya, Reintroduction of Endangered Species/Switzerland; University of Alberta

Field Research: Alberta, Canada: Reproductive physiology and ecology of red squirrels.

Athi-Kapiti Plains, Kenya: Behavioral studies of wild ungulates on a game ranch.

Samburu Game Reserve, Kenya: Mother-infant behavior of Grevy's Zebra.

Other Professional Experience: Researcher/writer for the Royal Society for the Protection of Birds, Great Britain. Natural History Tour Leader, Kenya.

Published: Articles by Ms. Becker have appeared in over a dozen publications including *British Birds*, *Journal of African Ecology*, and *Appalachia*. She has presented papers at conferences in the U.S., U.K. and Kenya.

Personal: A veteran SFS faculty member, Dusty's versatile talents and evolving interests have taken her to SFS programs in Switzerland, Kenya, and now Costa Rica. Dusty enjoys carpentry, writing, canoeing and scuba diving. She is a committed conservationist who spends a considerable amount of her free time giving talks on the environment to young people. Dusty's guitar and fiddle playing have enlivened many SFS campsites after a long day in the field.

Faculty Profile Bill Laurance



Bill Laurance's (shown here with a rainforest marsupial) enthusiasm has sparked his students to join him on pre-dawn forays into the rainforest. (Photo: W. Laurance)

Director: SFS Center for Rainforest Studies/Australia

Education: B.S. (Biology) Boise State University, 1982; Ph.D. (Zoology) University of California at Berkeley, 1989.

Teaching Experience: Boise State, UC Berkeley, University of Queensland

Field Research: Idaho: Ecology of desert or forest small mammals, birds and reptiles.

Baja, Mexico: Ecology of small mammals.

Queensland, Australia: Impacts of rainforest fragmentation on small mammals.

Tikal Forest Reserve, Guatemala: Ecology of tropical raptors.

Other Professional Experience: Internship, Jersey Wildlife Preservation Trust, England.

Summer employment at four U.S. zoos and wild animal parks.

Director, Boise State University Conservation Group.

American Society of Mammalogists Conservation Committee.

Head of delegation to IUCN General Assembly, 1988.

Winner of American Society of Mammalogists Award, 1989.

Published: Articles by Dr. Laurance have appeared in over two dozen technical and popular publications including *Wildlife Conservation*, *Biological Conservation*, *Conservation Biology*, *Journal of Mammalogy*, *Australian Mammalogy*, and *Heritage Australia*. In addition, Bill has been awarded over \$30,000 in research grants from organizations including the National Science Foundation and the World Wildlife Fund.

Personal: Bill has been actively involved in wildlife conservation issues in the USA, Mexico, Guatemala, the Philippines, Papua New Guinea and Australia. He is a published photographer and enjoys hiking and birdwatching, all of which are easily facilitated at the Center for Rainforest Studies. Bill's favorite sports are tennis and swimming.

Center for Rainforest Studies

Site: North Queensland,
AUSTRALIA

Curriculum:

Semester Program

**Biogeography: Patterns
of Ecological Diversity**

Summer Course:

**Tropical Deforestation:
Threats to Biological
Diversity**

Staff:

Field Director: William
Laurance, Ph.D., University of
California/Berkeley (Zoology).

Resident Faculty: Tony Cummings,
M.E.S., Yale University (Environ-
mental Studies).

Additional Faculty to be announced.

Site Manager: Colin Matthews,
Ph.D., University of Bath, U.K.
(Plant Pathology).

Facilities: The Center is located in North Queensland, on 153 acres of secondary growth forest and rainforest on the Atherton Tableland. A farmhouse serves as our Administrative Center, complete with lecture hall, modern kitchen facilities, refrigeration, washing machines, a small library and periodicals collection, and computer center. Students live in one of four dormitory cabins on the property. Faculty housing is now under construction. The nearest town is Yungaburra, approximately 12 miles from the Center.

Tropical rainforests are complex ecological arenas within which intricate evolutionary scenarios have been unfolding for over 100 million years. The tropical forests that span northern Queensland are the most diverse in all Australia and are inhabited by the greatest diversity of wildlife found anywhere on the continent. The greatest concentration in the world of primitive flowering plants—thirteen of the known original nineteen families—are found here in an area botanists claim to be a "priceless world heritage."

When Australia was cut off from the rest of the world by its separation from South America and Antarctica over 60 million years ago, it became isolated from the mainstream of mammalian evolution. A unique evolutionary pattern arose. Instead of the dominance of placental mammals found elsewhere in the world, marsupial (pouch-bearing) mammals—kangaroos, possums and bandicoots—evolved. Australia's isolation, coupled with the lack of a major human presence and the absence of other predatory animals, allowed the survival of bizarre evolutionary phenomena—the egg-laying, milk-producing, furred, duck-billed platypus, the strange spiny anteater, and the air-breathing lungfish which crawls about mud flats on its fins.

As a consequence of the exceptionally high incidence of endemism—the evolution of species found nowhere else on Earth—the botanical and faunal riches of this area are irreplaceable. North Queensland rainforests have been subjected to an array of intensive land uses in the past century—deforestation for agriculture, logging, and mining. Most of



"Never had I seen anything so unique: a land so lush and full of life in some parts, so harsh and desolate in others. As we climbed in altitude, the moisture began to gather in the air and the fields around us loomed into towering, thick rainforest."
Jessica Jay, Williamstown, MA—Mt. Greylock H.S.
(Photo: Chip Isenhardt)

Australia's remaining rainforests are protected as a World Heritage site. We will conduct our research in protected areas and in a number of drastically modified habitats, as we attempt to assess the impacts of human activities on the unique rainforest biota. SFS students have a rare opportunity to participate in research on this "frontier of ecology." Semester participants will explore the extent to which endemic species—such as birds, possums and various marsupials—can serve as indicators of biological disturbance. Summer participants will focus upon a specific conservation problem such as assessing the impacts of rainforest fragmentation on native plants and animals.

Research focus

Given the realization that rainforests worldwide are being felled, logged, burned and altered at astonishing rates, our research focuses on understanding the ecological processes and communities that characterize intact rainforests and which may be lost as the forests are destroyed or modified. A second goal is developing strategies for regenerating and rehabilitating formerly degraded tropical communities. These topics have direct relevance for rainforest conservation in a world which will probably lose much of its rainforest during the next few decades.



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Center for Rainforest Studies-AUSTRALIA



The Center's 153-acre property is comprised of a mosaic of logged rainforest, rainforest regrowth, and cleared pastures. Our research attempts to illuminate the composition of plant and animal communities in these modified habitats. We will also study assemblages of species in "corridors" of regrowth vegetation along streams; similar corridors may be used to provide avenues for animal migration between isolated forest fragments and nature reserves. Finally, we are investigating the use of "key indicator species" such as lemuroid ringtail possums and Lumholtz's tree kangaroos, birds such as the logrunner, and other species to indicate the "health" of the rainforest ecosystem.

Site

The Cape York Peninsula of far northern Queensland has the greatest biological, climatic, and social diversity in all of Australia. Jutting some 400 miles toward New Guinea from the rest of the continent, it separates the Coral Sea from the Gulf of Carpentaria. A narrow strip of Australia's largest remaining tropical rainforest runs down to the water along the shoreline fringed by the magnificent 1,200 mile long Great Barrier Reef.



"I have never felt so attuned to the matter I was studying. In a traditional classroom, the material ends when the book is closed. In the rainforest, it lived and breathed and rustled and photosynthesized all around me like a big, fantastic machine."
M.K. Crabb, Richmond, KY—University of Massachusetts

Living and Working Conditions

Be prepared for wet weather, especially during the wet season from January to May, when rainfall may average 400 mm/month. Rainfall and thunderstorms occur sporadically during other times of the year. The dry season months of September through December are often quite warm, with temperatures in the 80's and low 90's. We conduct field work at all times of the year, regardless of the weather.

The SFS Center for Rainforest Studies is located on 153 acres on the Atherton Tableland, a mid-elevation plateau, and provides ready access to rainforest and drastically modified habitats on and adjacent to our property. On our frequent forays into the rainforest, we may encounter over 500 spe-

cies of canopy trees and equally diverse animal communities including pandemon wallabies, lorikeets and cockatoos, tree kangaroos, pythons, and dragon lizards. Massive flights of flying foxes (huge bats) can darken the evening skies in coastal areas. Streams wind their way through dense, lush vegetation and occasional waterfalls fill the air with the persistent hum of crashing water.

Students live dormitory-style in large, modern cabins surrounded by forest, and can expect to be awakened by a "dawn chorus" of myriad birds and the hopping and scurrying sounds of wallabies and other small animals. Fresh fruits, vegetables, fish and meat are readily available in nearby Yungaburra to embellish our culinary endeavors.



Center Director Bill Laurance introduces students to a face monitor, a huge lizard found in the Queensland rainforest.
(Photo: Jennifer Taylor)



The Center for Rainforest Studies, called "Warrawee"—'you are welcome here' in the local Aboriginal tongue, is located on 153 acres of rainforest and secondary growth forest.
(Photo: Mark Noble)

Financial Aid is available.
Please see page 38.



Semester Program-Center for Rainforest Studies-AUSTRALIA

Semester Program:

Biogeography: Patterns of Ecological Diversity

Site: Center for Rainforest Studies—
AUSTRALIA

Course Titles and Numbers:

Introduction to Exotic Ecosystems

(BIO 1825)

Principles of Resource Management

(BIO 1845)

Cultural Ecology (SOA 1304)

Directed Research (INT 1191)

Departure Point: Cairns, Australia

Program Dates:

September 10 - December 13, 1991

February 1 - May 5, 1992

Through four distinct but interrelated courses, we will investigate the biological, political, economic and historical issues that must be considered in determining strategies for rainforest conservation.

Introduction to Exotic Ecosystems provides the ecological background to understand the tremendous diversity of Australian tropical ecosystems. We will focus to a large extent on the rainforest, but field trips to mangrove forests and coastal reefs will enrich our studies.

Lecture topics will include the ecology, evolution, taxonomy, and natural history of rainforest animals, as well as rainforest ecology, biogeography and conservation. Field activities will include spotlighting for animals at night, live-trapping small mammals, mist-netting birds, dawn choruses (identifying bird calls), bird watching, trapping terrestrial and aquatic insects, and measuring forest vegetation.

Concepts developed in the preceding course will be applied to real-life problems in **Principles of Resource Management**. Case studies emphasize the ecological impacts and yield optimization of tropical forestry, and include field trips to Queensland logging sites. Focusing on problem solving skills—environmental impact assessment, forest surveys, the design and management of nature reserves—this course will be applicable throughout the world. Resource

management policies in developing nations will be presented, with particular emphasis on multiple land use, sustainable development and inter-cropping strategies.

The relationship of humans to the environment in which they live will be explored in **Cultural Ecology**. We will specifically examine human cultures and societies inhabiting the tropical rainforests in Australia, Melanesia and Southeast Asia, both from a historical and current perspective. We will identify specific perceptions about the environment and ways in which local peoples use the environment to make a living. Comparisons between aboriginal and non-aboriginal approaches to natural resource use will be emphasized. Field trips to meet local people will be an important component of this course. **Cultural Ecology** will provide us with an understanding of the complex considerations that must be addressed in developing policies regarding the conservation of tropical rainforests.

In **Directed Research**, we will develop skills needed to address crucial ecological questions emphasizing modern scientific methods. The formulation of testable hypotheses, sampling strategies, data analysis, as well as written and oral presentation of findings will be discussed. With faculty consultation, students will devise and implement an original research project designed to address a cutting-edge problem in rainforest ecology. Special emphasis will be placed on assessing the impacts of deforestation, habitat fragmentation and selective logging on Australian wildlife. Likely topics include censusing of bird and mammal populations in secondary vegetation and forest fragments, assessing the habitat requirements of critical "indicator species" such as logrunners, rodents, and shrew-like antechinus, and determining the utility of "corridors" for wildlife dispersal. We will present our findings in a public meeting before interested local residents. Government scientists are also often in attendance.



"I felt so small next to all the gigantic trees and fields of grass several feet high. No space was wasted; plants grew all over and around one another creating webs of shade and mystery."

Dina Strachan, Brooklyn, NY—Harvard/Radcliffe College
(Photo: Chip Isenhardt)

**The School
For Field Studies**



Tropical rainforests are the Earth's most ancient, most diverse, and most ecologically complex communities. Covering only 7% of the planet's land surface, tropical rainforests may sustain half the world's plant and animal species. These ancient forests are being burned, logged, fragmented and overhunted on a scale that lacks historic precedents. At current rates of deforestation, two-thirds of the Earth's rainforests will disappear by the year 2000, leading to the likely extinction of up to 600,000 species.

SFS students will set out from the Center for Rainforest Studies near Yungaburra to investigate two of the most dire threats facing tropical rainforests; habitat fragmentation and selective logging. Questions we will seek to answer include how are marsupials—colorful possums, tree-kangaroos, shrew-like antechinus—impacted by fragmentation? How does logging alter the rainforest's structure and microclimate?

Our first days will pass quickly as we orient ourselves to the intricacies of the 100-million-year old rainforest. At first glance, we can't help but notice the canopy of tree crowns towering 60 meters above and the vines and epiphytes (rootless, attached "air plants") streaming about us. The faculty become our guides, teaching us how to see beyond the obvious into the web of life that

makes up the rainforest ecosystem. Beyond learning how to identify and measure the extraordinary plant and animal life found here, we will work to understand how it develops.

Lectures by faculty and guests will address rainforest ecology and tropical resource management. We will compare and contrast different forest types with special emphasis on identifying centers of tropical endemism. Field techniques necessary for conducting biological surveys may include vegetation transects, quadrat measurements, canopy and forest floor cover estimates, mist-netting birds, live-trapping small animals, and spotlighting animals at night.

In the second half of the course, we will apply these skills while conducting individual directed research projects on the ecology and restoration of degraded tropical forests. We will compare plant and animal communities in regenerating forests of varying ages to those found in primary rainforest. Topics will include questions such as which bird and mammal species can survive in disturbed vegetation and which are most easily lost? How does the microclimate of degraded forests differ from intact rainforest? Which vertebrate species can use "corridors" of regrowth forest along streams for dispersal?

Summer Course:

Tropical Deforestation: Threats to Biological Diversity

Site: Center for Rainforest Studies—AUSTRALIA

Purpose: to investigate impacts of deforestation, habitat fragmentation and selective logging on tropical forest biotas; to document the effects of intensive land uses on Australian marsupials, birds, reptiles and amphibians.

Course Number: BIO 1841

Departure Point: Cairns, Australia

Dates: June 28 - August 9

During the final days of the course, we will compile the results of our directed research projects. Our findings will be summarized in a "rainforest symposium" which may be presented before park managers, government scientists and interested local residents.

Note: This course will be six weeks in length allowing us to take greater advantage of the vast research opportunities at the Center for Rainforest Studies. Students will receive 10 quarter credits from Northeastern University for the successful completion of this program.



SFS students caring for an orphaned bandicoot, a small rainforest marsupial.
(Photo: Bill Laurance)

**The World
Is Your Classroom**

SFS gratefully acknowledges the Archer Daniels Midland Company, processors of agricultural products, for their support of this course.



Center for Marine Resource Studies

Site: South Caicos Island,
BRITISH WEST INDIES

Curriculum:

Semester Program:

**Marine Ecology and
Management**

Summer Courses:

**Mapping Marine Ecosystems
Coral Reef Management**

Staff:

Field Director: Mark Towne,

M.L.A., University of California/
Berkeley (Environmental
Planning).

Resident Faculty: William Alevizon,
Ph.D., University of California/
Santa Barbara (Marine Ecology,
Ichthyology).

Additional Faculty to be announced.

Summer Course Faculty:

Lori Buckley, Ph.D. candidate,
American Museum of Natural
History (Vertebrate Zoology).

Kathleen Sullivan, Ph.D., Scripps
Institute of Oceanography, Univer-
sity of California/San Diego
(Marine Biology).

Additional Faculty to be announced.

Facilities: The SFS Center for Ma-
rine Resource Studies is based in a
former hotel on the southern edge of
South Caicos Island. From its perch
atop a small bluff, the Center over-
looks clear Caribbean waters and
offshore cays as well as the town of
Cockburn Harbor. The main Center
facility has a large, brightly muraled
classroom/dining area, a kitchen,
laboratory and study areas. There are
14 residence rooms, each with a bath
and an often necessary large ceiling
fan. We are fully equipped for ma-
rine operations with a private dock to
support our boats and a dive shop
with a commercial SCUBA com-
pressor. A rainwater cistern supplies
water, which is a most precious
commodity here. One of our goals at
the Center is to introduce as many
renewable and sustainable resource
options as possible.

Background

The Turks and Caicos Islands and
their surrounding Caribbean waters offer us
an unparalleled classroom/laboratory in which
to study marine resource issues. Here one
finds one of the last remaining pristine ref-
uges for inshore marine life. Throughout the
Caribbean, tourism and development are ex-
erting extreme pressures on the linked and
delicate coastal ecosystems. If the Turks and
Caicos area is to escape the detrimental envi-
ronmental effects brought on by the increased
tourism, population growth and urbanization
now being evidenced in other parts of the
Caribbean, studies that will lead to manage-
ment plans for conserving precious marine
resources must be initiated without delay.

The Turks and Caicos Islands were
once the world's largest exporter of conch
and an important exporter of lobster; both
shellfish are important as local food sources.
South Caicos has been the Island's most
important port for the local fishing industry.
This industry, once the economic mainstay of
the area, has reported that catches of both
conch and lobster have dropped drastically in
recent years. The depletion of the fishery is
of major concern, with impacts on employ-
ment, nutrition and social structure.

Growth and development present
three primary threats to the local coastal
ecosystem. These are: 1) the direct impacts
of overfishing and destructive fishing prac-
tices, 2) the direct impacts of tourism, and 3)
the general impacts of the increased pollution
and waste disposal that accompany increases
in human populations. Confounding the rela-
tively simple relationship between human
population size and environmental stress, is
the issue of a culture attempting to move from
a simple artisanal lifestyle toward a more
wasteful and inefficient lifestyle characteris-



*"I cannot say enough about the beauty of the
underworld. What made it even better was that, by
the second week, I was able to identify the majority
of corals and fish"*

Thomas Angelicola, Waterbury, Ct—Northeastern
University (Photo: Chris Neelus)

tic of urbanized, industrialized western soci-
eties. The possible negative ecological ef-
fects of these processes are magnified in
island communities because of limited lo-
cally produced resources and options for waste
disposal. The relatively high cost of obtain-
ing resources and/or disposing of wastes off
island make it much more expensive to sup-
port a western lifestyle on a remote island
than in a continental setting. Yet today,
inhabitants of these islands seek to make
these changes in order to be able to compete
for the highly valued tourist dollars on which
their fragile economies heavily depend.

Faculty and students at the SFS
Center for Marine Resource Studies at South
Caicos are in a unique position to influence
the policies and decisions that will ultimately
influence the course of growth and develop-
ment here. The local government has ac-
tively solicited our input in such areas as
basic resource assessment, resource manage-
ment strategies, and training in fisheries en-
hancement methods. In providing these re-
search data and recommendations, we may
have the opportunity to help guide the pro-
cesses in such a way that the Turks and
Caicos might become a model for other de-
veloping Caribbean island nations.





Research Focus

Our research efforts will explore the potential for sustainable development on South Caicos through the development of the Admiral Cockburn Land and Sea National Park. When fully established, this park will offer opportunities for ongoing use of the marine habitat for the benefit of the residents. Our studies will assist the park managers in identifying ways that local needs can be met, on an ongoing basis, without the destruction or degradation caused by overuse or other harmful practices.



In our first year at South Caicos, SFS students and faculty identified over 60 species of corals and 150 species of fish on the nearby reefs. (Photo: Tim Stout)

We will consider the impact of hotels on water quality, marine life and island infrastructure, and investigate the ways in which a marine park can survive tourism. What are the appropriate levels of use for diving, boating and other water-based recreation? Parks may also provide a means to restore the areas' badly depleted commercial fisheries. Should parks have controlled fishing for lobster, conch and other species? Should they be set aside entirely as a source of replenishing stock for more heavily fished areas nearby? Can artificial means—such as the construction of special habitats in which fish and lobster find refuge—be employed to increase the fishery?

Finally, we need to consider the consequences that may arise from the creation of the Park and an increase in tourism and fishing success. What will be the economic impacts on the area? One hotel is currently under construction. Will there be additional hotels, diving and charter operations, marinas, etc? What services (solid waste disposal, roads, waste water treatment, fresh water supplies) will be required? We will assist in baseline resource assessment and establishment of a resource monitoring program in conjunction with these efforts.

**The World
Is Your Classroom.**

Site

The Turks and Caicos Islands lie at the southern most edge of the Bahamas chain, approximately 100 miles north of Haiti. The islands represent the surface exposure of two vast platforms, the Turks Bank and the Caicos Bank. The two banks plunge some 7000 feet into the deep ocean abyss, making the area a world class diving site. In addition, a vast shallow bank area, averaging 10 to 12 feet deep, stretches for nearly 60 miles. With expansive seagrass beds and scattered coral heads, this area is highly productive and is the source of the area's premiere shellfish product, Queen Conch. A five minute boat ride from our base provides access to shallow expanses of turquoise waters or to the deep blue of the open sea.

Most of the residents of South Caicos live in Cockburn Harbor, a small fishing port and the only town on the island. In the face of the declining fish catch, almost half the island's residents have moved in recent years. The town, which has very limited shopping facilities, is the site of the island's only industry, three small fish processing plants.

In order to develop viable resource management strategies, we must understand local perceptions regarding resource use and potential impacts of conservation. The Center's close proximity to town allows us frequent interaction with local residents, also known as "Belongers". (Photo: Jim Elder)

Living and Working Conditions

A true tropical climate prevails here with hot (90's) days and warm (80's) nights. Temperatures range from the 70's to 80's in the winter months. The strong, steady trade winds off the ocean help keep the site comfortable and insect free throughout most of the year. Ocean temperatures range from the 70's to 80's. Much of our data will be collected via SCUBA and snorkeling. Most dives will be in waters under 20 feet deep although we will try to visit the drop off for deeper dives during each program.

We will utilize locally produced seafood as much as possible; basic staples (rice, beans, fruits and vegetables) will be provided via regular shipments from the U.S.



From its perch atop a small bluff, the Center looks out over clear blue waters with nothing but open ocean all the way to the African coast. (Photo: Jim Elder)



Semester Program:

Marine Ecology and Management

Site: Center for Marine Resource Studies, CARIBBEAN

Course Titles and Numbers:

Tropical Marine Ecology
(BIO 1824)

Principles of Resource Management (BIO 1846)

Cultural Ecology (SOA 1305)

Directed Research (INT 1191)

Departure Point: South Caicos Island

Program Dates:

September 10 - December 13, 1991

February 1 - May 5, 1992

Through a four course sequence, SFS semester students will investigate first-hand the scientific, economic, political and historical issues involved in managing marine resources in the Caribbean. These courses are designed to enhance our understanding of and contribution to a plan for sustainable development of South Caicos Island through the establishment of the Admiral Cockburn Land and Sea National Park.

Tropical Marine Ecology will orient us to the marine environment and provide an overview of the biology of the major groups of organisms. The distribution and diversity of marine organisms in response to their environment will be explored. Fundamentals of reproductive strategies and population growth will be presented. The classic principles of ecology are discussed and applied to the tropical environment using field work to illustrate local examples. Mutualism, competition, predation and succession will be studied with respect to how these interactions structure marine communities. Nutrient cycling, energy flow and organization of the major coastal communities including pelagic, seagrass, mangrove and reef systems will be discussed. Field and laboratory work will be integrated with the Directed Research course; students will have the opportunity to learn the essentials of underwater data collecting, computer-aided data analyses and report writing. The field work will include supervised snorkeling and

SCUBA exercises designed to investigate the distribution and interactions of near-shore marine organisms.

The relationship of humans to the environment in which they live will be explored in **Cultural Ecology**. We will focus on the human cultures and societies inhabiting the islands in the Caribbean from both a historical and current perspective. We will discuss cultural perceptions about the environment and ways in which local peoples use the environment for making a living. Comparisons between approaches to natural resource use among the different socio-cultural groups who inhabit the Caribbean will be emphasized. In addition, we will explore the social and environmental impacts of tourism and other externally prompted economic developments in the Caribbean. Field trips to meet with local people will be an important component of this course. Cultural Ecology will provide us with an understanding of the complex considerations that must be addressed in developing policies regarding the conservation of marine environments.

In **Principles of Resource Management** we will develop an in-depth understanding of marine resource utilization and conservation by reviewing resource use in the coastal zone and conservation strategies to reduce or avoid impacts from resource utilization. Our goal will be to understand sustainable development in the context of marine resources utilizing case studies from around the world with a close examination of issues in the Turks and Caicos Islands. We will explore conservation strategies including coastal land-use planning, fisheries man-

agement, aquaculture, environmental impact assessment and marine park design. Our focus will be on the optimum design for the proposed national park and adjacent coastal development so that local needs are met while ecological processes and environments are maintained in their near pristine condition.

The **Directed Research** component of our program will complement our over-all objective of quantifying the impact of fisheries and tourism on the Island ecosystems. The opportunity to integrate perspectives developed in the preceding courses becomes evident here as students work with faculty to design independent projects from coordinated parts of the overall research effort. The initial part of the course will introduce field identification of organisms, experimental design and field methods. Workshops will be presented on computer-aided data analyses and statistical methods. Students may choose from research topics in marine ecology, resource management or cultural ecology. Sample projects include the role of human-induced stress on the diversity and structure of coral reef and seagrass communities, changes in conch distribution and abundance, and coastal zone management. Results will be presented orally to the group and to guest speakers at a seminar and also will be submitted to local government officials.

Note: Students must be certified in SCUBA prior to the program. Please contact the SFS Admissions Office for assistance in arranging certification. Students must provide their own SCUBA equipment except weights and tanks, which may be rented on-site.



After studying coral reef management, I found myself really caring about what is happening to the reefs. Never in my academic career have I found myself wanting to learn all I can about a particular subject."

Thomas Angelicola, Waterbury, CT—Northeastern University

(Photo: Shaun Bennett)

**The School
For Field Studies**



Because much—over 70%— of the earth's surface is covered by water, many people have harbored the mistaken notion that the ocean is a vast, almost limitless, resource readily available for human use. Ocean resources are just as vulnerable as the land to exploitation, pollution and disturbance, and scientists have not developed the sophisticated means of assessing potential impacts to marine ecosystems that are available to monitor changes in terrestrial ecosystems. Resource managers dealing with marine ecosystems worldwide need affordable, reliable means to monitor changes in shallow-water marine habitats. Satellites have been used to monitor habitat changes, but in most instances, the cost of these transmissions is prohibitive and satellite imagery cannot always provide the resolution needed for evaluating habitat degradation. One promising alternative involves combining aerial photography and a computer-based modeling system to produce high-resolution habitat maps on a biologically-meaningful scale. In order to develop this remote sensing technique scientists will need to rely on accurate ground truthing to identify species of benthic invertebrates, seagrasses and algae that make up discrete optical fields.

Resource managers in the Department of Fisheries for the Turks and Caicos Islands, confronted with a declining conch and lobster fishery as well as development from an expanding tourism industry, are eager to implement policies that will protect the islands' remaining resources. This summer, at the request of the Department of Fisheries, SFS students will have the opportunity to test the effectiveness of using remote sensing techniques to map the marine habitats surrounding South Caicos and East Caicos Islands. Questions we will seek to answer in order to assess the effectiveness and potential for widespread use of remote sensing include: What invertebrates and fishes make up the discrete communities on the Caicos Bank? What animals do we expect to find together? Can we predict the inhabitants we will find in a specific habitat? Can remote sensing be used to detect changes that result from human impact or storms to monitor nearshore environments?

Looking out the window of the plane as we approach South Caicos, the waters below us appear as a patchwork of varying shades of blue and green. This mosaic effect is caused by the variety of marine habitats—seagrass beds, sandy shoals, coral reefs, rocky

platforms and mangrove swamps—that surround the island. Prior to the start of the course, the faculty will have taken aerial photographs of our study area. Each student will be given a map, based on these photographs. With the exception of black lines used to outline the habitats appearing in the aerial photographs, the maps will be blank.

Our first task will be to refine our snorkeling and SCUBA skills, and to learn how to read and use the maps. Individual team members will be assigned specific territories and we will then proceed to "ground-truth" these maps. Using snorkeling and/or SCUBA, we will survey assigned areas to determine their characteristics and inhabitants and whether or not they are accurately represented on our maps. In order to conduct an accurate census, it will be necessary for us to learn to identify all of the brightly colored fish and invertebrates we find within our transects.

We will start most days with field work, usually snorkeling to survey near-shore habitats. Mid-day lectures will address invertebrate biology, community ecology, remote sensing and statistics. Afternoons will be devoted to additional field work and will provide students with an opportunity to work on individual or small group directed research projects. Potential projects include an assessment of the distribution of sponges or the locations of hard and soft corals on the Caicos



Using snorkeling and SCUBA in the clear turquoise waters off our Center, we will identify all the fish and invertebrates we encounter in our efforts to ground-truth data provided by aerial photographs. (Photo: Shaun Bennett)

Summer Course: *Mapping Marine Ecosystems*

Site: Center for Marine Ecosystem Studies, CARIBBEAN

Purpose: to test the potential of using remote sensing techniques to map the marine habitats surrounding South Caicos and East Caicos Islands; to produce high-resolution habitat maps on a biologically-meaningful scale to assist resource managers in identifying habitats suitable for nurturing lobster and conch populations and habitats potentially impacted by proposed development on South Caicos Island.

Course Number: BIO 1847

Departure Point: South Caicos Island

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

Bank, comparisons of collection techniques and a study of which territorial fish are associated with specific habitats?

Each day we will enter data recorded during fieldwork onto our maps and into a computer. Once we have collected sufficient data, we can determine if similar habitats are homogeneous. Do all seagrass or mangrove habitats contain the same inhabitants and, if not, how do they differ? We can then build statistical models that will help us predict the composition of other similar habitats. In the future, resource managers can utilize remote sensing as a quantitative means of measuring and/or predicting impacts of fishing or development.

This summer, we expect to complete habitat descriptions for 1,000 square meters of seagrass beds, coral reefs, sandy shoals and mangrove channels. Our data will be presented to the Department of Fisheries resource managers for use in identifying habitats most suitable for nurturing juvenile populations of lobster and introducing conch, and habitats potentially impacted by proposed development on South Caicos Island.

Note: SFS will assist students in Session I to become SCUBA certified. Students in Session II must be SCUBA certified prior to the course. Students must provide their own SCUBA equipment except weights and tanks, which may be rented on-site.

**All courses
carry college credit.**

Summer Course:

Coral Reef Management

Site: Center for Marine Resource Studies, CARIBBEAN

Purpose: to investigate the effects of natural and human disturbances on coral reef structure and function; to develop and maintain monitoring programs to detect and prevent these stresses from causing a loss of diversity in this fragile ecosystem.

Course Number: BIO 1805

Departure Point: South Caicos Island

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

Coral Reefs comprise one of the most beautiful, diverse and highly specialized ecosystems on earth. Thousands of species of plants and animals exist side-by-side on Caribbean reefs where they display a fascinating variety of adaptations that enable them to survive in this highly competitive environment. For example, the protruding mouth of the butterfly fish enables it to feed on algae in cracks not accessible to other species. Similarly, the parrotfish's scraping jaws are an adaptation that allows it to graze on the algae on coral skeletons.

Unfortunately, human activities are affecting coral reef ecosystems worldwide at an alarming rate. Local impacts such as boat damage, diver damage and dredging, for instance, can cause long-lasting impacts to coral reefs. Regional impacts may be even more critical to the long-term health of these ecosystems. Such impacts include sedimentation as a result of coastal deforestation, thermal pollution, salinity changes, oil pollution, and eutrophication resulting from nutrient overloading. Recovery of disturbed coral reefs may take anywhere from several decades to several centuries.

The coral reefs at South Caicos Island are in nearly a pristine condition. Diving into the clear turquoise waters, where visibility averages 100 feet, one is amazed at the beauty and variety of fish and invertebrate species. In our first year at the site, SFS students and faculty identified over 60 species of corals and 150 species of fish on the

nearby reefs. Much of this diversity is the result of the variety of reef types found at South Caicos including fringing, patch and deep reef habitats. Partly as a result of this reef diversity, the area in and around our Center has been proposed as Admiral Cockburn Land and Sea National Park as part of the fledgling national park effort of the Turks and Caicos Islands government.

Coastal development at South Caicos, however, could significantly affect these coral reefs. Potential impacts from such development include the dredging of reefs, sedimentation, and diver and boat damage. If such impacts are to be minimized, it is imperative that the structure of the local reefs be understood and that the reefs be monitored after development begins. These data are critical if environmental impacts are to be accurately assessed and effective management plans are to be developed.

Our course will examine the potential impact of coastal development at South Caicos and the role of the proposed national park in light of lessons drawn from similar case-studies worldwide. We will spend the first two weeks of the program learning the basic ecology of the coral reef in order to

understand the structure of the ecosystem and the processes that shape that structure. Faculty lectures will emphasize marine ecology and will include oceanography, invertebrate and vertebrate zoology, and the distribution and function of coral reefs. During the second half of the course, we will focus on coral reef management strategies and lectures will address human impacts on coral reefs, coastal zone management, and the role of marine parks in coral reef conservation.

"My interests and goals weren't matched to my financial situation and I felt I might not be able to afford a course. I kept in touch with SFS, and with their help, I was able to participate."

Dave Stemper, Minneapolis, MN—
University of Minnesota

Our field research will focus on the community structure of the coral reef in Cockburn Harbor and the proposed Admiral Cockburn Land and Sea National Park. Our first step will be to learn the identities of all of the organisms on the reef. Second, we will learn how to measure the reef environment using quadrats and transect tapes. Our goal is to describe the base condition of the coral reef ecosystem so that impacts can be accurately assessed and management plans developed for coastal development and the proposed park. Dive teams will gather baseline data on fishes, corals, other invertebrates and algae. Students will also partake in directed research projects focusing on reef organisms of particular interest to the individual.

We will spend the final days of the program analyzing our data in the Center's computer facility and writing up our findings as independent research papers. These papers will be presented to resource managers in the Turks and Caicos government for use in coral reef management.

Note: SCUBA certification will be offered to non-divers in Session II for a fee of \$150. Students in Session I must be SCUBA certified prior to the course. Students must provide their own SCUBA equipment except weights and tanks, which may be rented on-site.



"This course provided me with a chance to learn by thinking and by doing, not just listening and watching. I could spend long hours discussing issues with professors and peers on a one to one basis. I find this setting infinitely better than sitting in a musty lecture hall."

Patrick Zoellner, Lansing, MI—University of Michigan
(Photo: Olaf Ehrenstrom)



Background

It is a time of high drama on the plains of Kenya. This land of enormous physical beauty—from the rugged scar of the Great Rift Valley and its soda lakes teeming with pink flamingos, to the vast savannas and escarpments approaching Mount Kenya—is becoming a vulnerable and worried land. With one of the highest population growth rates in the world and a rapidly developing economy, Kenya provides a dramatic illustration of conflicting priorities of preserving land, protecting wildlife, and feeding people.

Population and economic growth have placed severe pressures on the rapidly diminishing natural habitats needed to sustain Kenya's irreplaceable wildlife herds. The increasing need for meat, in particular, has led to extensive ranching of beef cattle. These cattle varieties, however, were originally developed in countries with abundant water, a commodity in short supply in Kenya. Several biologists have proposed what, at first glance, seemed a radical solution: the practice of game ranching. In game ranching, populations of native species of ungulates (hoofed mammals) are strictly managed in a protected environment and periodically cropped to be served as food.

Substituting native wildlife species for domestic cattle offers an ecological alternative that lowers water and energy demands, and when properly managed, may allow more protein production per acre than crop farming in East Africa, potentially leading to increased food production. Yet game ranching itself may pose ecological threats. How do harvested populations differ

from natural herds? Only carefully coordinated research including population and habitat studies will provide the answers.

Mankind must find a way to satisfy the needs of both wildlife and humans on shared land, rather than assuming that the presence of one excludes the other. SFS students will have the unique opportunity to become directly involved in this dilemma.

Our research is part of a continuing analysis of the ecological viability of game ranching. Results of our research will be integrated with ranch management analyses, assisting the Kenyan government and outside conservation agencies to monitor the effectiveness of mixed species ranching as a wildlife management and conservation tool.

Site

The enormous variety of wildlife in Kenya occupies an equally remarkable variety of terrain. Herds of antelope, buffalo, giraffe, and zebra graze in the expansive savannas as lions, cheetahs, leopards and other large carnivores prowl in the bush. The lush mountain forests to the west are home to duikers, bushbucks, forest hogs and colobus monkeys as well as a large number of impressive birds. In the Great Rift Valley, believed to be the ancestral home of the modern man, hippopotami bathe in lakes shared with white pelicans and pink flamingos.

Significant areas of the country have been set aside as national parks and game reserves where native flora and fauna thrive with little human interference. These settings provide the rare opportunity to witness the complex interrelationships of climate, physiography, vegetation, and animal life.



SFS students in Kenya will examine the pros and cons of game ranching, a promising experiment that may address both the conservation of native ungulate species and provide a sustainable means of feeding the people of Kenya.

(Photo: Geoff Levner)



Center for Wildlife Management Studies

Site: Athi-Kapiti Plains, KENYA

Curriculum:

Semester Program
Wildlife Ecology and Management
Summer Courses
Wildlife Management Study in Symbiosis: Humans and Honeyguides

Staff:

Field Director: Richard Ruggiero, Ph.D., Rutgers University (Wildlife Ecology and Management).

Resident Faculty: Susan Cooper, Ph.D., University of Witwatersrand, R.S.A., (Ecology).

Tolumbaye Tadingar, Ph.D., University of Nebraska (Range Science).

Summer Course Faculty: Hussein Isack, Ph.D., Oxford University (Zoology).

Facilities: "International Wildlife Ranching and Research, Ltd.", the site of our Center, consists of 81 square kilometers of fenced rangeland on the Athi-Kapiti Plains. The Center is approximately 40 kilometers southeast of Nairobi. Accommodations are in thatched "bandas" and/or walled tents beneath thatched roofs. Additional facilities include a kitchen area, outhouses, solar water heater, gravity showers, and a dining/lecture/library building. We will sleep on foam mattresses at the Center and on foam pads while on safari. We will have access to the Ranch's laboratory and slaughterhouse. There is no electricity at the Center.



Center for Wildlife Management Studies-KENYA

Our base of operation will be "International Wildlife Ranching and Research, Ltd.", established by Dr. David Hopcraft, as an experimental game ranch. Here, a variety of large mammal populations are protected, carefully monitored and ranched. Situated approximately 40 kilometers southeast of Nairobi on the Athi-Kapiti Plains, the ranch consists of laboratory facilities, a slaughterhouse, a small library, and 81 square kilometers of protected and fenced savanna where wildebeest, giraffe and gazelle roam freely.

Research focus

The success of wildlife ranching depends on whether wild ungulates can be maintained on limited areas under a regular cropping regime. In our ninth consecutive year of research in Kenya, we will assist in analyzing criteria that are crucial to game ranch management.

For example, how much woodland habitat does a large population of giraffes need to sustain optimal growth and reproduction? What is the best way to control weeds and improve rangeland quality? How can cattle herders benefit from the presence of wildlife on their ranches? We are seeking answers to these questions at our Center for Wildlife Management Studies.

Living and Working Conditions

Although located near the equator, Nairobi enjoys a year round climate similar to that of a New England September. Nights are cool and chilly, days are warm to hot.

Located in its own isolated setting on the ranch, with the Ngong hills to the north and Mount Lukenya dominating the eastern horizon, our SFS basecamp includes a permanent dining/lecture hall, library, outhouses and open air showers. When in camp, our accommodations will be thatched huts called "bandas" and walled tents suspended in the shade beneath thatched roofs. On off-ranch field expeditions, we will pitch hiking tents.

"I was, to be honest, a little scared to delve into science because I feared I might not do well. I wanted to conquer this fear and break down self-created barriers. I felt an SFS course, with immediate, hands-on learning, would be an exciting way to do this."

Tom Meier, Lake Geneva, WI—Lake Forest College



Reconstructing a skeleton helps us to understand structure and function. "A biologist who only learns from a book can never be called a true biologist. Had I not gone, I'd still be that narrow-minded person thinking she could go on and study mammals and nothing else." Blanca Simmons, Fullerton, CA—California Polytechnic Institute (Photo: Sandra Taylor)



"If I were to summarize the most powerful thing about my SFS experience it would be this immersion. No other learning experience could compare." M.K. Crabb, Richmond, KY—University of Massachusetts (Photo: Louise Matthews)



One of the most severely affected populations in Africa, Kenya's elephants, have experienced a drastic decline in numbers in recent years. We will examine this crisis in conservation on field trips and during guest lectures by prominent elephant researchers. (Photo: Rich Ruggiero)

**The School
For Field Studies**



This 13 week semester program is designed to allow students to compare aspects of game ranching with the management of preserved herds while studying the theory of wildlife ecology. Through a series of three interrelated academic courses, complemented by a capstone course, Directed Research, we will seek to learn about organisms, habitats, peoples and cultures of East Africa; to understand the ecology of East Africa; and to increase our awareness of the philosophical, social and economic justification for various conservation strategies.

Wildlife Biology will provide us with the means to study and understand wildlife populations and habitats in East Africa. We will emphasize techniques and strategies to assess wildlife habitat status and will study the requirements of native large game species with the aim of providing suggestions for their management. We will examine the effects of human disturbance and domestic livestock as well as the ability to formulate sound conservation and management policy with the overall aim of optimizing productivity while maintaining biodiversity. The lecture component of this course will be complemented by laboratory and field exercises on the Ranch and directed observation in several national parks and reserves in Kenya. Our field work will include bird and mammal observation, identification techniques and methods for analyzing and classifying vegetation. The digestive anatomy and physiology will be demonstrated at the Ranch slaughterhouse and laboratory, and the practical aspects of the harvesting of game species will be discussed. We will explore some of the current controversies in wildlife conservation, and discussions of the global implications of conservation issues will help us focus our understanding of wildlife biology and management.

Population and Community Ecology is our second core course and is designed to provide us with the information and conceptual background to understand the underlying ecological principles of the East African ecosystem. We will focus on fundamental processes and the inter-relationship of the biotic and abiotic components of the system. Lectures, field observations, required readings and seminars will help us examine the theoretical underpinnings of the other courses in our curriculum.

**Financial Aid is available,
Please see page 38.**

Cultural Ecology will introduce us to the cultural, economic and geographic factors which affect life in East Africa. We will build a theoretical basis for the study of human culture by drawing on principles from human ecology and ecological anthropology. Ethnographic examples of selected adaptations will be studied in the classroom and in the field during trips and safaris. We will examine the present day status of East Africa in light of these concepts. Our location and field trips afford us an excellent opportunity to view certain aspects of the transition from traditional subsistence agriculture and pastoralism to a modern economy. We will discuss the global implications of this change while emphasizing its ecological aspects.

Directed Research, the program's capstone course, builds on the other three courses. A thorough research training begins with how key questions are formulated as experimentally testable hypotheses. Lectures are limited to scientific methodology—experimental design, sampling procedure, basis statistics, and the interpretation and communication (graphic, written and oral) of research findings.

Actual field research, consisting of group projects, begins during the third week of the semester. Teams of two to six students will either continue studies begun during previous semesters or conduct new research. Topics of key interest have been identified by SFS faculty in conjunction with other experts in the field of wildlife conservation and management in Africa. Directed research

Semester Program: *Wildlife Ecology and Management*

Site: Center for Wildlife
Management Studies, KENYA

Course Titles and Numbers:
Wildlife Biology and Management
(BIO 1821)
Population and Community Ecology
(BIO 1823)
Cultural Ecology (SOA 1306)
Directed Research (INT 1191)

Departure Point: Nairobi, Kenya

Program Dates:
September 10 - December 13, 1991
January 14 - April 15, 1992

projects are designed to provide data and analyses of actual ecological and management questions of relevance to on-going programs on the Ranch and throughout East Africa.

We will conduct field work on the 30 square mile ranch which supports both domestic livestock and native wildlife. The ranch and its slaughterhouse enable us to carry out a wide variety of research projects, which may range from behavioral ecology to prescribed fire experiments. Most studies apply to practical management concerns of rangeland and wildlife biologists.



SFS students studying in the classroom banda on the ranch. "I wanted to test my ability to survive in a more simple and a totally unfamiliar environment. Life in Hamden, Connecticut seemed so very different from life in Kenya. What would it be like to live with outhouses and without electricity?"
Rachael Feldman, Hamden, CT—University of Connecticut
(Photo: Jenee Colton)



Summer Course: *Wildlife Management*

Site: Center for Wildlife
Management Studies, KENYA

Purpose: to compare the population dynamics, carrying capacity and economic potential of large mammals (antelope, giraffe and zebra) in hunted populations and in national parks; to assess the long term implications of game ranching as a wildlife management technique.

Course Number: BIO 1806

Departure Point: Nairobi, Kenya

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

Rising early each morning, we will begin a busy day with breakfast and some camp chores, followed by either lectures or field exercises. On days that include research time, we will travel by foot or by landrover to our research sites. Our studies call for extensive monitoring of vegetation and field conditions as well as long, sometimes arduous, observations of wildlife species including zebra, antelope and giraffe. Our research activities will address questions including: Does cropping adversely affect the social organization and breeding success of antelope? What is the economic potential of various species? What is the diversity of incidental species affected by game ranching (e.g. scavengers)? What is the recovery rate of areas overgrazed by cattle and how are these areas utilized by game?

In order to answer these questions, we will need to develop our research skills, including behavioral sampling techniques, large mammal censusing techniques and how to conduct surveys of vegetation composition. Faculty and guest lecturers will provide us with the necessary background to begin our research. Lectures will introduce us to the general principles of ecology, animal identification and social organization, game ranching and management techniques, plant and herbivore interactions and techniques for estimating rangeland productivity.

The Ranch's weekly cropping operations provide our research teams with unique opportunities, and the slaughterhouse and laboratories offer numerous research possibilities. Parasite load, carcass condition and composition, and other physical observations can be made here.

We will initiate small group field research projects early in the course. Potential topics for directed research include giraffe feeding ecology and carrying capacity, behavior and social organization of the fringe-eared oryx, fleeing distance and cropping protocol for various species on the Ranch and surrounding ranches and wildlife areas, and management of cattle bomas.

Field trips outside the Ranch will take us to some of the more spectacular areas of Kenya. These trips may include visits to Lake Nakuru to examine the effects of the surrounding human population on one of Africa's greatest national parks, the Maasai-Mara Reserve to witness the massive concentrations of game and to examine the Maasai and wildlife interactions here, or Nairobi National Park to compare the ecology of a semi-fenced national park with that of International Wildlife Ranching and Research, Ltd. We may also hike up nearby Mt. Lukenya

to take a first-hand look at some of the factors affecting raptor conservation or visit the bustling Friday market at Machakos to interact with the local people in a thriving agricultural area. Other possible day trips include the National Museum of Kenya and the Olorgesailie National Monument, a prehistoric archaeological site.

"The measure of the success of SFS should not be the degree to which they increase interest in science per se, but the degree to which they help each of us define our appropriate roles as global citizens and protectors of a fragile planet. By this latter measure, I think they are enormously successful."

Claudia Polsky, N.Y., N.Y.—
Harvard/Radcliffe College/
Fulbright Scholar



When thinking of Kenya, one often has visions of giraffe, zebra, lions and elephants. Kenya is also home to many spectacular bird species including raptors such as the one that Simon Thomsett is showing to Center Director Rich Ruggiero.
(Photo: Wendy Haugh)



The world is shrinking—not in size but in terms of cultural diversity. Cultural erosion is an ongoing worldwide phenomenon, and in Kenya, a developing country with one of the world's fastest growing populations, cultural changes are taking place at a phenomenal pace. One casualty of these changes may be the unique relationship that has evolved between humans and one species of bird, the Greater Honeyguide (*Indicator indicator*). The Honeyguide has evolved a remarkable behavior of guiding man to wild bee colonies so that the bird can acquire beeswax. It is the only known bird in the world to evolve such a mutually beneficial cooperation with humans.

In many regions of Kenya, the use of honey as a sweetener or medicine has diminished, and the brewing of alcohol from honey and other substances is now illegal. Traditional nomadic communities are finding other ways to acquire food now that the hunting of wild animals is illegal. And children, who once would have herded livestock and been thus introduced to the activities of the honeyguide, are now enrolled in schools. In some areas honeyguides have already lost their ability to respond to humans.

SFS students will travel to rural Kenya to study this imperiled relationship. How have economic and social development impacted the relationship between humans and honeyguides? What are the consequences for birds whose beneficial cooperation with humans is facing a breakdown in inter-specific communication? If honeyguides require beeswax for survival, how do they obtain it in this new situation?

We will meet in Nairobi and proceed to our site in Sololo. Sololo is located in the northern arid region of Kenya, approximately 700 km from Nairobi. Here, in picturesque surroundings bordered by mountains, professional honey hunters search for the wild honey still used by the nomadic Boran people who inhabit the area.

The 18 species of the Honeyguide family are thought to be the only entirely brood parasitic family of birds in the world. The female lays her eggs in the nest of other species of birds and leaves the care of her young in the "hands" of foster parents. We

will monitor breeding activities at nests of potential hosts for evidence of brood parasitism, for attempts of female honeyguides to deposit eggs, and for interactions between the honeyguide and potential foster parents.

The Honeyguide's feeding habits are no less bizarre. In the nest of its host, the young bird starts out being insectivorous. At some unknown time and triggered by an unknown mechanism, the honeyguide starts to feed on bee products. Honeyguides require help from humans to access this source of food and consequently have evolved a complex symbiotic relationship with humans. We will design experiments using nestlings to determine the ontogeny of behaviors and whether the behavior is innate or learned. Students will search for, locate and follow honeyguides on their own and with professional honey hunters.

Lectures will address the land-use throughout Kenya, the ecology, physiology and behavior of birds, territorial behavior, animal communication, and symbiosis. We also will discuss aspects of human activities and pressures which promote the existence or disappearance of human-honeyguide relationships. Students will conduct a directed research project which may address such questions as do honeyguides lead other animals such as the Honey badger to bee colonies? What is the relationship between guiding calls of young adult honeyguides and the food begging calls of nestlings? Our results will be shared with interested parties at the Museums of Kenya and the Wildlife Clubs of Kenya.

Summer Course: *Studies in Symbiosis: Humans and Honeyguides*

Site: Sololo, KENYA

Purpose: to study the Greater Honeyguide (*Indicator indicator*), its symbiotic relationship with humans, changes occurring in its natural habitat and the long-term implications for its survival in Kenya; to investigate cultural and economic factors affecting human populations which may have an impact on the Honeyguide and its survival.

Course Number: BIO 1840

Departure Point: Nairobi, Kenya

Course Dates:

Session I: June 17 - July 16

Session II: July 24 - August 22

Our basecamp will consist of tents erected outside of Sololo at the foot of Borolle Mountain. We will have access to a dining/library/lecture building as well as latrines. Our light will come from kerosene lanterns and, while the supply is restricted, we will have water for drinking and showers. Day-time temperatures will be very warm and dry, nights relatively cool. Our travels to and from Sololo will take us through a variety of Kenyan landscapes. We can expect to glimpse some of the numerous wildlife species—giraffe, elephant, lion, cheetah and zebra—found here. On our travels through rural areas, we may spend a day visiting local Boran people in Marsabit or fishing communities at Lake Turkana and Baringo.



SFS students on this program will have the unique opportunity to work with professional honeyhunters in their search for the wild honey still used by the nomadic Boran people. This incredible cultural and scientific adventure is beyond the reach of ordinary tourists. (Photo: Rich Ruggiero)



Marine Mammal Studies Program-MEXICO

Marine Mammal Studies Program

Site: La Paz, Baja California Sur, MEXICO

Curriculum:

Semester Program
Marine Mammal Biology and Conservation

Staff:

Field Director: Lorayne Meltzer, M.Sc., California State University (Teacher Education and Natural Science).

Resident Faculty: Joel Barnes, M.Sc., Humboldt State University (Resource Management Education).

Julie Eliason, M.A., Humboldt State University (Biology).

Luis Bourillon, B.S., Universidad Nacional Autonoma de Mexico, Mexico City (Biology).

Mary Strong, Ph.D., Temple University (Anthropology).

Site Manager: Henk Nienhuis, M.Sc., State University of Leiden, The Netherlands (Marine Biology).

Facilities: The SFS Marine Mammal Studies Program is currently based out of a small hotel just outside the city of La Paz, at the southern end of the Baja California peninsula. Our site allows us excellent access to the nearby Bay of La Paz where over 20 species of whales and dolphins have been sighted. Our facilities consist of three, large, dormitory style rooms, as well as access to small lecture rooms, a kitchen and dining/commons area. In addition to the small field library and computer room at the site, our affiliation with the Universidad de Baja California Sur allows us access to the university's small library. When the weather allows, many of our lectures will be presented in the field. We will make several trips into nearby La Paz to enjoy the cultural opportunities of the city. We will camp in tents during our trips to wilderness areas.

Background

It has been said of Baja that "few places exist today where nature proceeds so unhindered with its own agenda." Increasing resource requirements, spurred by Mexico's exponentially increasing population, may soon pre-empt this agenda. The waters surrounding Baja—the Pacific Ocean and the Sea of Cortez (also known as the Gulf of California)—are among the most productive marine ecosystems on earth. Benign climate, historically undisturbed habitats and the presence of marine upwellings—unusually rich sources of plankton—provide ideal conditions for the area's remarkably diverse marine mammals and their prey. However, with increasing demand and technological capability, humans and marine mammals are becoming competitors for the same food and habitat resources, threatening fundamental portions of the marine food web.

The rich waters adjacent to Baja support large populations of whales, dolphins, sea lions, porpoises, and seals. These waters provide a habitat for an unusually large resident population, while numerous other animals migrate—often thousands of miles—for the seasonally abundant food supply and protected warm waters necessary for reproduction.

*SFS gratefully acknowledges
The Island Foundation
for their start-up funding
of this Program.*



"Participating in a field course such as this is a fantastic opportunity for any undergraduate considering marine science as a career. This is a chance usually reserved for graduate students."
Tracy Farmer, East Pepperell, MA—Smith College
(Photo: Steve L. Swartz)

Schools of anchovies, shrimps, sardines and numerous species of gamefish drawn to these waters are the targets not only of Mexican fishermen, but also sportsfishermen from all over the world. Overfishing is driving fish resources to ever increasing lows, presenting the threat of a diminished food source and the loss of dependent species from their habitats.

For centuries the Baja peninsula was nearly inaccessible. 1973 marked the opening of a highway from its U.S. border to the tip of the cape. A steadily increasing influx of tourists portends mixed results. Monies derived from tourism can be directed to conservation efforts to protect this irreplaceable ecosystem, which will no doubt be additionally stressed by their presence.

The Government of Mexico has a long history of wildlife conservation and a strong interest in protecting marine mammals. Unfortunately, funds for marine mammal research are severely limited. Through a cooperative agreement with the University of Southern Baja California, and by working with the Mexican Society for the Study of Marine Mammals, SFS students will have an opportunity to make a significant contribution to future management policies as we consider the status of marine mammal populations here. Through our on-going presence, SFS can document the changing demographics of marine mammals at constant sites over several years. These baseline data can provide much needed information on changes in the utilization of coastal waters by

**The School
For Field Studies**

Marine Mammal Studies Program-MEXICO



marine mammals as these animals are caught in the growing struggle over use and management of the region's natural resources.

Site

Jutting south 800 miles from its border with California, Mexico's Baja peninsula separates the Pacific Ocean and the Gulf of California. Its mountainous landscape is speckled with a desert garden of thorny cacti. The Pacific coastline is marked by occasional saltmarshes and lagoons, widely separated by miles of sandy dunes. The rockier coastline of the Gulf and the plethora of adjacent islands provide an ideal nesting site for numerous bird species including brown pelicans, brown boobies, terns, blue footed boobies and Heerman's gulls.

Human presence is noticeably absent here. The few large cities and resort areas are separated by miles of rural coastline dotted with small fishing villages. Nearby waters teem with fish including anchovies, sardines, brightly colored king angelfish, moorish idols, black marlin, sailfish and sharks.

Resident populations of marine mammals include California sea lions, bottlenose dolphins and Bryde's whales. These waters also comprise key migration routes of gray whales, blue whales, fin and humpback whales.

Research Focus

In order to manage human activities for the benefit of both humans and marine mammals, it is essential that we understand the natural history and habitat requirements of each species (including humans) within the Bay of La Paz. Our field work will directly contribute to and support ongoing work of Mexican scientists concerned with conserving the marine mammals around the southern peninsula. We will document the seasonal abundance and distribution of marine mammals in and around La Paz Bay, focusing on both resident and migratory species. Key questions addressed by our research include: How do occurring species differ in their patterns of prey and habitat use? To what extent does increased boat traffic impact whale and seal activity patterns? What are the energy requirements and feeding success rates of brown pelicans? We will use photo-identification to study individual variations in movement and behavior.



The Baja Peninsula boasts several dynamic and beautiful desert environments. Our studies will include some desert ecology, focusing on the unique interface between desert and marine ecosystems.

(Photo: Lorayne Meltzer)



"In what other classroom can you listen to a lecture about sea lions and observe a sea lion pop up in the water behind the lecturer?" Mark Clements, Plymouth, IN—Butler University (Photo: Steve L. Swartz)

Travel and leisure are key elements of the economy of Baja California. Assisting Mexican scientists in assessing marine mammal occurrence and the impact of increased human disturbances will help guide future programs to increase tourism and devise policies and strategies that will preserve the natural resources of the region.

Living and Working Conditions

La Paz, the capital of Southern Baja, California, is the largest city on the peninsula with a population of over 100,000 people. Our base camp will be situated in an old hotel on La Paz Bay. Our simple living accommodations will be supplemented with a field computing facility, a darkroom, lecture and study space, and a small field library. We will have kitchen facilities and will cook for ourselves.

The site provides easy access to an extraordinary array of marine mammals in nearby crystal clear waters surrounded by rocky cliffs and sandy beaches. The city of La Paz, and all it has to offer, is accessible by a short boat ride.

**All courses
carry college credit.**



Semester Program-Marine Mammal Studies Program-MEXICO

Semester Program: **Marine Mammal Biology and Conservation**

Site: La Paz, Baja, MEXICO

Course Titles and Numbers:

Marine Mammal Biology
(BIO 1816)

*Resource Ecology and
Management* (BIO 1822)

Cultural Ecology (SOA 1307)

Directed Research (INT 1191)

Departure Point: La Paz, Baja,
Mexico

Program Dates:

September 10 - December 13, 1991

February 1 - May 5, 1992

This 95 day semester program consists of four courses designed to allow students to explore the scientific, economic, social and historical issues involved in the conservation and protection of marine mammals.

Marine Mammal Biology will provide the foundation of our semester's work. This course will provide an overview of the biology of the five marine mammal groups—cetaceans, pinnipeds, sirenians, polar bears and otters—concentrating on cetaceans and pinnipeds. Lectures will cover the evolution, systematics, social and behavioral ecology, anatomy, physiology and adaptations to marine environments of marine mammals. We will also discuss the history of marine mammal/human interactions, touching on the animals' ecological role in the past and present. Our research will focus on cetaceans and the California sea lion, and how they interact with the human population in the area. Guest lecturers will include leading marine mammal biologists from the area who will share their recent research experiences and ideas.

Resource Ecology and Management will complement Marine Mammal Biology in that we will continue to use pinniped and cetacean examples in our discussions of resource use and management. In Resource Management, we will expand our view to

consider conservation and resource management issues more generally as we integrate concepts of marine ecology with the needs of managing marine resources. We will consider problems created by the often conflicting demands of resource use and conservation as well as how conservation policies are made on both local and global scales. The course will review the management of complex ecological communities and ecosystems. Techniques of data collection and analysis will be introduced during laboratory sessions.

In **Cultural Ecology** we will consider how cultural perceptions often conflict with resource conservation and management. The relationship between the people and how they view or use resources is rooted in cultural and historical traditions. Growing human populations usually stress terrestrial ecosystems. In Baja, while climate limits the capacity of the environment to support populations, the expanding industries of commerce, fisheries and tourism can accommodate populations above the normal "ecological" carrying capacity of the resources. Consequently, the local ecosystem suffers gradual degradation. We will examine the structure of the societies of Baja and of Mexico, and how the history of agriculture, fisheries, commerce and tourism shaped those structures. We will also discuss

current politics and consider major industries, their impact on the local economy, culture and environment (especially marine resources).

In **Directed Research** students will have the opportunity to integrate perspectives developed in the previous courses as we design independent research projects focusing on the behavior and ecology of marine mammals in the wild. These projects will support ongoing research by Mexican scientists through the University of Southern Baja California. Students will be exposed to how to identify key questions, and to transform them into testable hypotheses. We will then develop the technical skills of research including statistics, behavioral observation, data collection and analysis, and marine mammal identification at sea, to test these hypotheses. Finally, we will work on the communication of research results. Potential projects include creating a photo-identification catalog of whales and dolphins, determining distribution patterns of whales in the Bay of La Paz, examining special relationships of bottlenose dolphin, and assessing whether vigilance behavior of sea lions is affected by group size and approach.



We will utilize boats such as the one above to gain access to the over 20 species of resident and migrating marine mammal species that have been recorded in the nutrient rich waters surrounding the Baja peninsula. (Photo: C. Shannon Goob)

**The School
For Field Studies**

Center for Studies in Sustainable Development: COSTA RICA



Background

Sustainable development, defined as the management of resources so that they may yield the greatest benefit to present generations while maintaining their potential to meet the needs of future generations, is thought by many to be one of the few viable, long term conservation strategies for implementation on a global scale. Historically, the conservation movement has sometimes floundered, in part because of the "total preservation" attitude of its advocates, and the implication that conservation and economic development are incompatible. Theories underlying sustainable development propose that development and conservation are, in fact, mutually dependent, rather than mutually exclusive.

Site

Costa Rica presents some very special opportunities for case studies of the challenges of sustainable development including some examples where progress has already been achieved. These include protection of forested watersheds while developing hydroelectric power; the establishment of conservation regions for the protection of biological diversity, indigenous peoples, and the culture of regional communities; control of disease; development of sustainable agricultural practices; and restoration of native ecosystems.

Costa Rica, translated "rich coast", was discovered and named by Christopher Columbus in 1502. Similar in size to West Virginia, Costa Rica is bordered by Panama and Nicaragua as well as the Pacific Ocean and the Caribbean Sea. Costa Rica has not had an army since 1948, and has a strong democratic history. While approximately 12% of Costa Rica's land is protected as national preserves, outside of these parks deforestation continues at an alarming rate. In the face of the highest per-capita debt in the world, "Ticos", as Costa Ricans call themselves, are addressing their country's environmental problems with a commitment and creativity rare among developing countries.

Costa Rica's cloud forests, rainforests, mountain plains and lowland jungles are home to over 6,000 species of plants—including over 1,200 varieties of orchids. The iridescent Blue morpho is just one of over 500 species of butterflies found here; total insect species number in the thousands. And, while the elusive quetzal is considered by many to be the area's most spectacular bird, Costa Rica is home to over 850 bird species including scarlet macaws, toucans and hummingbirds. Drenching rains—up to 300 inches per year—foster large expanses of rainforest that provide refuge for howler monkeys, capuchins, and three-toed sloths. Much of the plant and animal life exists in the uppermost reaches of the rainforest where the canopy towers more than 150 feet above the forest floor.

Temperatures and rainfall vary, coastal temperatures average 75 degrees and may fall to below freezing in the central mountains where peaks rise to 12,000 feet. During the rainy season, usually from May to November, it is rainy along the coast but the heaviest rain falls in inland mountain ranges. Dry, tropical forests can be found in the northwest, near Guanacosta. Condensation, rather than precipitation, provides the moisture necessary to sustain the unique flora and fauna found at the Monteverde cloud forest.



The fact that "Ticos", as Costa Ricans call themselves, are addressing their country's environmental problems with creativity and commitment may ensure the availability of critical resources for the next generation. (Photo: Jane Marcus)

Center for Studies in Sustainable Development

Site: COSTA RICA

Curriculum:

Semester Program:
Studies in Sustainable Development

The SFS Center for Studies in Sustainable Development in Costa Rica is scheduled to open in September 1991. Here, students can take advantage of an unusual opportunity to gain first-hand knowledge of the challenges posed by the search for sustainable development strategies under conditions of limited resources. Direct observation of the challenges of natural resource protection in developing countries is vital when considering the role that developing countries must play in future international environmental agreements.

Studies in Sustainable Development will be offered at the intermediate level and applicants must complete a college level ecology course prior to participating in this semester program. Background in one of the following areas would enable students to maximize this opportunity: environmental studies, international development or Latin American studies.

Program Dates:

September 10 - December 13, 1991
February 1 - May 5, 1992

Course Titles:

Conservation Biology of Tropical Ecosystems
Social and Political Systems of Costa Rica
Sustainable Development Directed Research

The SFS Center for Studies in Sustainable Development is the result of cooperative effort between The School for Field studies and a Consortium of schools including Brown University, the University of Michigan, and Allegheny, Colby, Dickinson, and Middlebury Colleges. A portion of the spaces in each semester are reserved for students from Consortium Schools. Interested students should contact the SFS Admissions Office for further information.



Center for Studies in Sustainable Development: COSTA RICA

located on the continental divide in the central mountains. To the southeast, near the border with Panama, La Amistad Park hosts a population of jaguars and pumas. The country seemingly "tilts" toward the Pacific, and the sloped terrain is etched by swift rivers, several of which have been harnessed to power electric plants. Magnificent beaches fringe both coasts, and some of the largest known nesting beaches for sea turtles are found here. Costa Rica's rich botanical and faunal diversity is fostering the development of a significant tourist industry. Many Ticos support themselves through agriculture, especially the growing and harvesting of sugar, bananas and coffee. Cattle graze on inland slopes while the coasts are the sites of productive fisheries. There is some manufacturing, usually utilizing products from the rainforest. San Jose, the capital, is a bustling, modern city.

Program of Study

The study of Costa Rica's effort to protect their environment and to deal with the challenges of sustainable development will be presented as a series of case studies on particular issues and problems. Students will spend a period of time learning first-hand about the scientific and social aspects of the issue, and the efforts of the Costa Rican people to address their need for development and protection of their environment. These cases will then be used to address the broader issues of sustainable development in developing countries and the changing role of both the U. S. and the U. N. in working with these countries to achieve their objectives.

The overall themes of the curriculum will be to understand: what scientific information is necessary to achieve programs that support sustainable human systems, how different development issues are unavoidably interrelated, and how solutions are shaped by the existing political and cultural conditions. Specific case studies that may be investigated include:

- *The success of community-based reforestation projects and the use of community forests to support furniture production for export.*
- *Design and management of the buffer zone for La Amistad International Park.*
- *Baseline studies of the proposed Boruca Hydroelectric project.*
- *Land-use and economic transition in Golfito in the wake of the departure of the United Fruit Company.*

Emphasis will be placed on having students directly involved with the communities affected by the issues, and engaged in projects that involve monitoring conditions over extended periods of time.

Our case study approach necessitates that material be presented in an integrated fashion by faculty teaching as a team rather than breaking the curriculum into discrete courses. We will therefore integrate our studies of conservation biology, agroecology, hydrology, soil science, mineralogy, economics, political science, social planning and organization, and Latin American culture. For the purpose of awarding academic credit, these subject matter comprise the necessary components for the following courses:

Conservation Biology of Tropical Ecosystems will explore the natural mechanisms by which biodiversity is maintained. We will study patterns of interactions among biological components of a tropical ecosystem to understand the factors controlling diversity, scarcity and ecosystem health, and how biodiversity can be protected from human disturbance.

Social and Political Systems of Costa Rica examines the human history of Costa Rica. Costa Rican democracy will be compared with that of the United States, particularly with respect to the formation and enforcement of resource

policies. The high literacy rate, relatively good economic situation, and other special features such as lack of an army, will be examined and contrasted to other Central American countries. We will explore the historical and contemporary cultural composition of Costa Rica, giving attention to ways in which Costa Ricans perceive their natural resources and the conservation/exploitation of these resources.

Sustainable Development will examine the essential elements for designing and implementing sustainable rural development efforts. We will consider projects in agriculture, forestry, and energy production as well as fisheries, "ecotourism", and small scale manufacturing. The role of local people as well as that of the government and private national and bilateral aid agencies will also be covered.

Directed Research will enable students to undertake an original project reflecting one or more of the case studies, examples of which are described above. The group will choose a field research topic addressing a conservation, social, or welfare issue and will develop research objectives and design data collection with faculty supervision. Each project will be presented in a paper and in a public meeting to which local residents and/or development professionals will be invited.

Living and Working Conditions

We are currently considering a variety of site options, and expect to locate our center in the southern pacific region of Costa Rica in the Coto Brus Valley, most likely in or near the town of San Vito. We will occasionally travel to other areas of the country to investigate specific problems relating to issues studied in the Coto Brus area. For at least the first year of the program, it is expected that we will lease a site. Base accommodations will be rustic, but comfortable and will likely include a lecture/dining hall, library and computing center.

Costa Rica has a tropical climate. We can expect moderate temperatures and fairly regular rain showers, especially in the late spring. A great variety of foods are available in Costa Rica including beef, chicken, fish, fresh fruits and vegetables. Students will prepare their own meals when at our site.

A knowledge of Spanish will prove very useful as many Costa Ricans do not speak or understand English. Students are encouraged to take a course in Spanish prior to arriving in Costa Rica. Our program will incorporate a period of intensive language instruction upon our arrival at the Center, however this will not substitute for a working knowledge of the language.



Before it was settled, virtually all of Costa Rica was covered by forest. Today that area has been reduced to less than 35%. While over 10% of the country's land is preserved in parks and reserves, outside of these parks deforestation continues at an alarming rate. (Photo: Chip Isenhardt)

Introduction to Summer Satellite Courses



Satellite Courses

In addition to conducting research at the five SFS Centers described in the preceding pages, SFS is keenly interested in having the flexibility to mount shorter-term research efforts at environmental "hot-spots" worldwide. To this end, we offer students the opportunity to participate in 30-day summer courses at ten satellite sites around the globe. The academic rigor of satellite courses is equal to that of summer courses offered at our Centers.

SFS sites are chosen in large measure for their dramatic illustrations of the issues under study. Satellite sites allow us to take advantage of unique research opportunities such as those presented by the oil spill in Price William Sound, Alaska or the proposed development of ski areas in Colorado. SFS research activities at these sites may take place over one to as many as five or six years. As is true for our Center-based programs, all research results are shared with concerned local agencies and resource managers for use in developing management policies.

Because of the shorter duration of summer courses and the fact that, in most

cases, weather conditions during this period are less severe, our housing requirements are more flexible. Satellite courses offer us the opportunity to be more mobile and to move our camps, if necessary, to access the best research sites. In most instances, our accommodations for satellite programs are in tents or rustic cabins. Our curricular design for these programs fosters an intense immersion in the ecosystem under study.

1990-91 Satellite Course Faculty (Partial List)

Constance Becker, Ph.D. Candidate
(Zoology)
University of Alberta

Brad Bennett, Ph.D.
(Biology)
University of North Carolina

Scott Carroll, Ph.D. Candidate
(Ornithology)
University of Utah

Peter Dutton, M.Sc.
(Ecology/Biology)
San Diego State University

Molly Morris, Ph.D.
(Environmental Studies)
Indiana University

Keith Rittmaster, M.Sc.
(Environmental Management)
Duke University

Charles Schaadt, Ph.D.
(Evolutionary Ecology)
McGill University

Donna Stockrahm, Ph.D.
(Zoology/Wildlife Ecology)
Ohio State University

Larry Underwood, Ph.D.
(Zoology)
Pennsylvania State University

Patrick Kangas, Ph.D.
(Environmental Engineering Sciences)
University of Florida

1991 SFS Summer Satellite Sites



1. Ecology of Bald Eagles
Alaska
2. Ecology of Harbor Seals
Puget Sound, Washington
3. Ethnobotany
Ecuador
4. Landscape Ecology
Colorado
5. Biology and Behavior of Bottlenose Dolphins
North Carolina
6. Tropical Cloud Forest Ecology
Costa Rica
7. Primate Ecology and Conservation
Costa Rica
8. Ecology of Endangered Sea Turtles
Costa Rica
9. Tropical River Ecology
Belize
10. Humpback Whale Ecology
North Atlantic

SFS Alumni are happy to share their experiences with you. Call the Admissions Office for details.



Summer Course-Humpback Whale Ecology-NORTH ATLANTIC

Summer Course:

Humpback Whale Ecology

Site: NORTH ATLANTIC

Purpose: to understand how distribution and density of endangered humpback whales (*Megaptera novaeangliae*) are related to the occurrence of fish stocks; to contribute to ongoing studies of the density and distribution of large whale species; to further document the life history, reproductive success and association patterns of the identified whales in the Gulf of Maine.

Course Number: BIO 1804

Departure Point:

Boston, Massachusetts

Course Dates:

Session I: June 18-July 17

Session II: July 24- August 22

Each summer, hundreds of humpback whales return from breeding grounds in the Caribbean to the food-rich banks of the Gulf of Maine. In a three to four month period, they must build up a thick coat of blubber to carry them through a period of fasting during their long migration to winter breeding and calving grounds in the Caribbean.

The factors that determine the distribution and movement patterns of humpback whales on the summer feeding grounds have never been clearly understood. As their numbers increase, there have been concerns about disturbances associated with whalewatching vessels, the potential impact of increased commercial fishing, and the effects of oil exploration. Four years ago, humpbacks all but abandoned the once heavily used Stellwagen Bank in the northern Gulf of Maine. SFS surveys supported speculations that they were using an area southwest of Cape Cod more heavily. In 1989, the whales returned to Stellwagen Bank. Recent proposals have been made to use this area as the release site for waste water from nearby metropolitan communities.

SFS studies of humpback whales over six years have tracked changes in distribution throughout the Gulf of Maine, added to an ongoing catalog of individually-identified whales, and documented behaviors associated with feeding episodes. Further effort is needed to determine the habitat re-

quirements and use patterns of humpbacks, to help clarify the degree of recovery of this species, and the implications of recovery for future management policies. Our research will focus on questions such as how are humpbacks distributed relative to food supplies? To what extent are whales able to communicate food availability to other whales? How closely are whale distribution patterns associated with movements of sand lance? What impacts are boats having on whale behavior?

Our first week will be spent at a campsite on Cape Cod, near the Massachusetts coast, preparing for our time at sea. Faculty will address the anatomy and physiology of whales and dolphins, the life cycle of the humpback whale, marine food webs and humpback feeding patterns, and techniques for identifying cetaceans. We will cover as much of the lecture material as feasible to enable us to spend every available moment at sea watching our spectacular and unpredictable subject of study—the humpback whale.

Much of the next three weeks will be spent aboard a sailing schooner where we will divide into watches that rotate throughout the day and night. Our research day begins at sunrise. Once we sight whales, we will record their location, number, general activity and direction of movement, as well as general sea and weather conditions. Research activities will include censusing of humpbacks and other species of great whales along pre-determined ship transects, measuring ocean characteristics in areas differing in whale density, and photo-identifying individual humpback whales. We will document

behaviors, particularly with respect to social interactions among groups of feeding whales. We also will note the type and occurrence of boat activity during our observation periods. Students' directed research projects may focus on long-term associations among individually identified whales, documenting differences in behavior among calves, sub-adults and adults of different size and sex.

"Students with field experience such as this not only have an edge in landing that interesting job; once hired, they are more capable of carrying out their research opportunities."

Dr. Harry O. Haakonsen, Coordinator,
Environmental Studies, Southern
Connecticut State University

The final days of the course will find us back on the mainland processing data and preparing our reports and papers. Our results will be sent to the National Marine Fisheries Service, while our fluke photographs will be sent to a central repository of identified whales at the Center for Coastal Studies in Provincetown.

Life aboard the schooner will be close at times; efficient use of space is an important element of a ship's sailing capacity. We will share watch rotations and clean-up chores. A willingness to be a cooperative team member is especially important on a sailing ship; things go smoothly only if everyone does his or her share.



"All of a sudden a whale would change direction and come towards us and follow us ... then it would raise itself out of the water just to look at you. And you're trying to say wow and take data at the same time ..." Beth Grieff, Beaver Dams, NY—Mt. Holyoke College (Photo: Ben Baxter)

The School
For Field Studies



Fifty percent of all known primate species are endangered or threatened according to listings compiled by the International Union for the Conservation of Nature (IUCN). On a global scale, the single most serious threat to primates is the loss of undisturbed tropical forest habitat.

Costa Rica has a strong record of setting aside protected lands—over 10% of the country's land is set aside in national parks and reserves. However, outside of the national parks in Costa Rica, primate populations are experiencing a rapid loss of habitat as their range is fragmented and transformed into agricultural systems. There are few exceptions to this pattern of deforestation and those that exist have been poorly studied. Recently, growing numbers of private landowners have been maintaining tropical forest patches with the aim of attracting both amateur and professional ecologists as paying visitors. These private forest reserves may provide a sustainable framework for the conservation of several species of neotropical primates.

The Curu National Wildlife Refuge was established in 1984, by private owners, with the intention of combining sustainable agriculture with wildlife conservation, ecological tourism, and environmental education. Curu offers a rich diversity of plant and animal life and is home to two species of monkeys. The mantled howler monkey (*Alouatta palliata*) and the white-faced capuchin (*Cebus capucinus*), can both be readily spotted on and near trails throughout the reserve.

Our research will focus on the habitat use and the population biology of the mantled howler and white-faced capuchin. Questions we will seek to answer include how do these species use trees? What is their diet choice? How can conflict between these monkeys and human agricultural systems be reduced? What are the ecological correlates of howler monkey troop size, home range and demography? We will add to initial habitat descriptions and population censusing begun by SFS research teams at Curu in 1990. Our compiled research results and census data will be sent to the IUCN Primate Specialist Group and presented to the managers of the Curu Reserve.

After meeting at the airport, we will spend the first night in San Jose. The next morning, we will travel west to Puntarenas, a coastal town on the Gulf of Nicoya. Here we will board boats that will take us to Curu, located on the tip of the Nicoya peninsula. The Curu reserve is owned by the Schutt-Valle family, who will be our hosts.

During our first days at Curu, we will attempt to identify age and sex classes of howlers and capuchins, to become familiar with the reserve's trail system, and to become skilled in censusing and data collection techniques. With the help of faculty, by the end of week one, each student will have selected and initiated a directed research project. Potential projects include an investigation of howler troop size and composition in deciduous and evergreen tropical forests, agricultural crop-use by capuchins, and diet differences in both species.



"It is very different collecting data on monkeys that are running from you or throwing twigs at you than it is collecting data on rats that are in a Skinner box!"
Christy Freeland, Charlotte, NC—University of North Carolina (Photo: Dusty Becker)

Summer Course: *Primate Ecology and Conservation*

Site: Curu National Wildlife Reserve,
COSTA RICA

Purpose: to study the ecology and behavior of two species of New World monkeys, mantled howler monkeys (*Alouatta palliata*) and white-faced capuchins (*Cebus capucinus*), to understand how they use their environment in order to develop management plans to promote their survival, in the face of ongoing deforestation, on both public and private land.

Course Number: BIO 1808

Departure Point: San Jose,
Costa Rica

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

During the second and third weeks of the course, our days will begin at dawn with field work. Most days will be spent collecting data in the forest, while others will be punctuated by faculty lectures on topics including biogeography, primate social organization, and tropical rainforest conservation. In the late afternoon and evening, we will have time for study and opportunities for relaxation including beachcombing and swimming. Occasional trips to the nearby village of Paquera, as well as an overnight field trip to Cabo Blanco Natural Reserve (Costa Rica's first national park) will provide us with a broader appreciation of natural resource management as well as a perspective on Costa Rican culture. The last week of the course will be spent compiling data in preparation for oral and written presentations of our research results.

Visits to the nearby beach will provide a temporary respite from the heat and humidity. Our accommodations consist of rustic beach cottages. Meals will be served "Tico"-style (traditional Costa Rican fare) and we will all pitch in to help with daily chores.

Financial Aid is available.
Please see page 38.



Summer Course-Landscape Ecology-ROCKY MOUNTAINS

Summer Course: *Landscape Ecology: Designing Parks for Preservation*

Site: ROCKY MOUNTAINS,
COLORADO

Purpose: to determine the quality and size of ecological land units needed to preserve species diversity and conserve populations of bighorn sheep, American elk, mule deer, black bear, and other mammals in the Rocky Mountains; to initiate the development of a biological preserve system for Colorado to support and protect the state's wildlife.

Course Number: BIO 1800

Departure Point: Denver, Colorado

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

The remote San Juan Mountains represent one of America's most outstanding natural areas. Here, where snow-capped mountain peaks jut skyward from green-forested valleys, elk, mule deer and the solitary black bear roam at will. This area forms one of the last intact fortresses of vast wildlife diversity in the continental U.S. Planned land-use changes throughout the southern Rockies are leading to concern that competing interests will result in a rapid loss of wildlife habitat in the San Juans. In order to protect the diversity of species that naturally occur in threatened primary wildlife areas, biologists and resource management officials must know where, how large, and "natural" key areas should be to sustain wildlife diversity and abundance.

We will document the vegetation type and topography of habitats for large mammal species such as bighorn sheep, mule deer, elk, and bison. We will record the presence of these animals and attempt to determine if habitats in which the animals do not occur could support introduced populations. Special efforts will be made to identify unique or critical environments (old growth forest, undisturbed riparian habitats, areas of high berry productivity). Study areas will be selected on the basis of factors such as current use, proposed development or conservation efforts, or indications of potential as wildlife habitat. Our findings will be of use in answering critical questions such as How much development can be interspersed with natural

systems of a region? How seriously will the current system be impacted by proposed land-use changes?

The San Juan Mountains lie to the north and east of Mesa Verde National Park and the Southern Ute Indian Reservation, along the Colorado-New Mexico border. They extend from sagebrush habitat below 8,000 ft., to high peaks over 14,000 ft. Following our arrival, we will familiarize ourselves with the San Juan area through maps and aerial photos and move on to establish our first base camp. We will survey areas on the Western slope of the Front Range to determine types and distribution patterns of selected wildlife and then carry out systematic transects to map vegetation associated with the presence of identified species. We will note the features of greatest importance in those areas associated with particular distributions of large mammal species.

We will carry out directed research projects based on our interests and observations. There are many important questions to be addressed such as How suitable are landscape units for endangered species such as grizzly bear, wolverine, lynx and black-footed ferret? What is the potential for restoring free-roaming bison to the area? Do public

land-use values threaten the pristine qualities of this region? Our research results will be presented to the U. S. Forest and U. S. Fish and Wildlife Services in order to build support for preservation of this vital area.

Faculty lectures will address the vegetation and habitat types of the southern Rockies, the natural history and ecology of native species, conservation biology and

"I worked out the arrangements. I paid for it. I flew there alone. I did it myself. This is the type of independent experience I needed at this point in my life."

Laurie Sanders, Cheshire, CT
Smith College

theories of biogeography. Training in the use of landscape mapping systems and aerial photo interpretation will be provided. At the end of each day, as we relax around a glowing campfire, we will informally consider topics that may range from cultural differences in land ethics to personal views about conservation and wildlife protection.

Weather conditions will range dramatically from mid-day heat to nighttime cold. While it will be generally warm and dry at lower elevations, we can expect afternoon thundershowers, particularly along the higher mountain slopes. Our base camps will be comprised of durable lightweight tents and outdoor equipment, facilitating our ability to create secondary camps as needed. We will prepare our food over campfires, and share camp chores.



Vegetation sampling in the Colorado Rockies. "When I signed up for the course, I was expecting to find fourteen scholastically intense researchers and me. As I talked to the other students, I found people with a variety of interests. They weren't all bio majors, there were economics and liberal arts majors, and the ever present undecided majors."
Timothy Jon Van Norman, El Paso, TX—Washington State University
(Photo: Donna Stockrahm)

**The School
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Summer Course-Endangered Sea Turtles-COSTA RICA



Sea turtles are among the largest living reptiles, ranging in size up to 900 kg. Surprisingly little is known about these animals, since they spend the majority of their lives at sea. Their habitat ranges from Labrador to South Africa, and includes warm and cool waters. The sex of hatchling sea turtles is not determined by genetics, but by the temperature at which the eggs are incubated. In sea turtles, low incubation temperatures produce males and higher temperatures produce females.

Sea turtles face a growing number of environmental threats, many of them of human origin. Worldwide, their nesting areas are being altered or destroyed by development, they face capture by fishermen, and adults and eggs on or near beaches are exposed to the threat of poaching. Additional problems include survival of hatchlings through the vulnerable first years at sea and nest failure due to predators, parasites, and physical processes such as seawater washout.

SFS students will return to the beaches at Tortuguero for a second year to study the biology, ecology and conservation of several species of turtles that use these beaches on the northeastern coast of Costa Rica. Our research will have three foci. First, we will assist the researchers and volunteers of the Caribbean Conservation Corporation (CCC) in their efforts to tag and measure nesting green turtles and to record nest locations. We will help to add to an existing database on green turtle behavior, distribution, population size, and migration. We will accompany CCC nightly tagging teams or

will be assigned our own patrol area. The presence of researchers on the beach is thought to be a deterrent to potential poachers.

Second, we will seek to answer questions including: What effects do the physical characteristics of the nests of both green turtles and leatherback turtles have on the hatchlings that emerge from those nests? What are the thermal characteristics of the nesting beach? What hatchling sex ratios might we expect given these thermal characteristics? How do current sex ratios compare with those of previous years?

Our third project will involve an investigation of the effects of human activities on nesting behavior. There is concern that the increasing numbers of tourists present on the beaches at night may disrupt nesting. Our study will provide data which may help the National Park Service to make appropriate management decisions for these beaches.

After meeting in San Jose, we will travel by bus and boat to our site just outside the small town of Tortuguero. Tortuguero is surrounded by lowland wet tropical forest, much of which has been cleared in recent years for agricultural use. The area is populated by a mixture of native Costa Ricans ("Ticos") and Nicaraguan refugees.

We will divide into three research teams with two teams patrolling the beach each night. Students will be introduced to field research skills including tagging, censusing, conducting thermal measurements, recording nesting activities and physical characteristics. Because the majority of our data collection must be done at night when

Summer Course: *Ecology of Endangered Sea Turtles*

Site: Tortuguero, COSTA RICA

Purpose: to investigate the ecology and behavior of endangered sea turtles including the green turtle (*Chelonia mydas*), and the leatherback turtle (*Dermochelys coriacea*); to investigate the beach at Tortuguero used by several species of turtles in order to recommend management policies that will protect the nesting habitats of these endangered species.

Course Number: BIO 1842

Departure Point: San Jose, Costa Rica

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

females come shore to lay their eggs, our days will be devoted to lectures, studying and documenting evidence left on beaches from any turtle activity from the previous evening. Faculty and guest lectures will address the taxonomy, natural histories and life histories of turtles, concepts of population and physiological ecology as they apply to sea turtles, nesting biology, temperature dependant sex determination, and the conservation of sea turtles. Students will have the opportunity to conduct individual or small group directed research projects. Potential projects include effects of moon and tides on nesting green turtles, mean sand temperature variations by zones, a theoretical sex ratio for green turtles or leatherback turtles, or the effects of transplanting nests on rates of predation.

During the final days of the program, we will compile and analyze our data for use in oral presentations of our research. Our results will be shared with the CCC to enhance their longterm efforts here, as well as with the Park Service for use in developing area management policies.

Our base will be in cabins just outside of Tortuguero. Boats will be used as our primary form of transportation on the river and connecting canals. The weather here is hot, humid, and often rainy. While the thought of swimming can be enticing, especially in the midday sun, the presence of sharks in the area forces us to limit our water ventures to knee deep wading. We will schedule our days as best we can to accommodate recovery from any lack of sleep brought on by evening patrols.



If they survive the many perils and predators facing them as hatchlings, female turtles are thought to always return to the beaches where they were born to lay their eggs. Thus, habitat protection is essential to this already endangered species. (Photo: Susan Barvanek)

**Financial Aid is available.
Please see page 38.**



Summer Course-Tropical River Ecology—BELIZE

Summer Course: *Tropical River Ecology*

Site: BELIZE

Purpose: to describe the structure and function of a tropical river ecosystem in order to evaluate the "health" of the river and indirectly its watershed; to develop recommendations for river conservation to protect rivers from the impacts of land-use changes.

Departure Point: Dangriga, Belize (We will meet in Belize City and fly to our site as a group.)

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

For many Americans, a description of a tropical river might include adjectives such as mysterious, exotic, and even romantic, as one conjures up scenes of Bogart and Hepburn on the African Queen. In reality, tropical rivers do present us with a mystery as relatively little is known about their diversity, structure and function. The lack of research and management focus devoted to tropical rivers is somewhat surprising given the significant role many of these rivers play in the history, commerce, and agriculture of the countries through which they flow. In many cases, rivers are more severely stressed than any other ecosystem.

Belize, with the lowest population density and lowest relative deforestation rate of all Central American countries, offers an excellent site for the study of tropical river ecology. Since the environment has suffered less human impact than most other neotropical countries, the Belizian ecosystems retain much of their ecological value. At the same time, the rivers of Belize have had more use than other systems through commerce, fishing pressure and pollution, and effective management and conservation of river systems is critical to Belize's future prosperity.

This summer, SFS students will have the opportunity to help unravel some of the mystery surrounding tropical river systems as we study and inventory the Sittee River at three critical points along a 10-mile stretch of its route to the sea. The Sittee River, which flows for approximately 30 miles from the Maya Mountains of central Belize to the Caribbean Sea, has served as a main "highway" since the days of early Mayan civilization. Questions we will seek to answer include: How does the ecosystem structure and function differ as the river changes from a freshwater stream to a mainly saline/sea water

system? What is the metabolism of the river? To what extent have land-use patterns changed the river, and how can the river be managed to prevent degradation?

We will meet at the airport in Belize City and fly as a group to Dangriga. From Dangriga, we will travel by bus to our site at Possum Point, a biological field station on the banks of the Sittee River. Introductory lectures by faculty will introduce concepts of aquatic ecology to prepare us for field work. Much of our time will be spent in or on the river. For most of our field work, we will break into three groups to facilitate our sampling, which will take place primarily at three locations along the river. Possum Point will serve as our middle river sampling site, and we will travel upstream to a freshwater site and downstream to the mouth of the river in motorized boats.

Once a week, we will develop diurnal oxygen curves for all three sites in order to understand the metabolism of the river. This information can yield important indications of the overall health and performance of the ecosystem. In order to understand community structure, students will utilize snorkeling and seine netting to sample fish and macroinvertebrates and to assess in-stream habitats. The fact that no taxonomic keys exist for identifying species in inland tropical rivers is just one indication of how little attention has been focused on this ecosystem. Therefore, it may not be possible for us to identify, to the species level, all of the invertebrates we collect. We can expect to encounter a range of species on our collecting forays, from anemones, crabs and shrimp at the mouth of the river to insect larvae, snails and crayfish in the freshwater upstream. The presence of specific indicator taxa as well as the diversity of species will be used to assess water quality, which will be related to the condition of the watershed as a whole.

In the latter stages of the course, we will compare data collected from the Sittee River with samples collected during field trips to a more polluted river such as the Belize River, or to mountain streams in the Jaguar Preserve. Additional lecture topics, including the natural history of Belize, taxonomy, biodiversity, energy budgets, elements of water chemistry, the role of floodplain swamps, and the role of the Maya in land-use changes, will prepare students to undertake directed research projects. Potential projects include the role of terrestrial crabs in land-water interactions, aquatic feeding by birds, or floodplain vegetation analysis. If time permits, we will also visit nearby Mayan ruins to gain greater insight into the extensive use of rivers by early Mayans.

At the end of the course, we will compile written and oral reports with recommendations for viable river conservation strategies. Our reports will consider the utilization of buffer strips, corridor preserves, in-stream and floodplain habitat restoration and other options. This data will be submitted to government resource managers, the Belize Audubon Society and the Programme for Belize.

Our camp at Possum Point will be rustic but comfortable. We will sleep in platform tents along the river. A large screened building will offer protection from insects and serve as our lecture room and dining hall. Kerosene lamps will light our picnic tables for nighttime study. We can expect warm and humid weather with frequent showers. We will look to the river for food, recreation and transportation, and can expect almost daily encounters with Belizians as they make their way along this aquatic highway. Brightly hued flowers, birds and butterflies provide splashes of color along river banks shrouded in lush green vegetation.



We will travel up and down the Sittee River in boats and dug-out canoes to unlock some of the long-standing mysteries of tropical rivers. (Photo: Pat Kangas)

**The School
For Field Studies**

Summer Course-Ethnobotany: Uses of Plants-ECUADOR



The greatest storehouse of information about human use of tropical plants resides not in university libraries, but in the oral traditions of indigenous peoples who have used these plants for centuries. The Runa or Quijos-Quichuas of Ecuador have lived along the Rio Napo for hundreds of years. Like other Amazonian people, they adapted to the forest and now depend on it for their survival. From the rich, tropical vegetation they find food, shelter, clothing, medicine and most everything they need to survive. Long-practiced agricultural and hunting strategies of native people often have been ecologically sensitive and sustainable.

At present, both the people and the forests are undergoing rapid change. Twenty hectares of tropical forests are cut every minute. Cultures are eroding at an equally alarming rate. Ethnobotanical data, dependent on both the people and the plant species, are being lost even faster.

"Probably the most important thing I learned was that buying a t-shirt is not going to 'save the rainforest'. By this I mean things are not as simple as they seem."

Heidi Schultz, Southbury, CT—Drew University

herbarium specimens from the primary rainforest including canopy species, understory shrubs and trees and herbaceous plants growing in soil and on the limbs and trunks of trees. As we collect plant specimens used by the indigenous people, we also will document the diversity of the plant life in this region. These herbarium specimens will be prepared for identification and analysis at our base camp using standard botanical field techniques. Our results will contribute to an ongoing research program sponsored by the New York Botanical Garden's Institute of Economic Botany on the plant resources of Amazonian Ecuador.

Faculty lectures will discuss the cultural history of the indigenous people of Ecuador, uses of plants by indigenous peoples, and the taxonomy and physical adaptations of major plant groups. Additional lectures will cover the biochemistry of plant alkaloids, the isolation and concentration of active plant products, ethnobotanical and anthropological methods, and the problems and potential of rainforest development.

During the second part of the course, we will apply what we have learned to date as we travel in motorized canoes to villages and towns along the Rio Napo. Students will continue to work with faculty assistance on directed research projects. Previous projects have examined medical uses of traditional

Summer Course: **Ethnobotany: Uses of Plants by Native Peoples**

Site: ECUADOR

Purpose: to identify and collect plants used by indigenous peoples in Ecuador's Amazon Basin for medicine, food, construction, hunting and rituals; to help document the rapidly disappearing ethnobotanical knowledge of the lowland people known as the Runa.

Course Number: BIO 1801

Departure Point: Quito, Ecuador

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

crops, economic potential of novel species, management of agricultural fields, and the uses of plants in home construction.

The verdant greens of the rainforest are fostered by drenching rains—in this area up to 6 meters annually. Days are often clear and warm, while nights can be cool. Our base camp at Jatun Sacha will provide simple but adequate accommodations complete with a spectacular view of the snow-capped Andes rising in the distance.



SFS students visiting a Quichua family in the Ecuadorian rainforest. "To be listening to a lecture on botany and to be able to reach over to the 'classroom wall' and grab a handful of the subject matter was tremendous. It's here, I remember thinking. It's real."

(Photo: Brad Bennett)



Summer Course-Ecology of Harbor Seals-PUGET SOUND

Summer Course: Ecology of Harbor Seals

Site: San Juan Islands, PUGET SOUND, WASHINGTON

Purpose: to census the population of pacific harbor seals (*Phoca vitulina richardsi*) in northern Puget Sound; to monitor and understand the impact of human activities, especially boating and fishing, on seals; to help predict the potential impact of an oil spill on seals.

Course Number: BIO 1809

Departure Point: Friday Harbor, Washington

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

The pacific harbor seal (*Phoca vitulina richardsi*) is widely distributed in temperate and arctic waters of the Northern Hemisphere. The total population of harbor seals from California to Alaska has been estimated at over 300,000 animals, so the population is not in immediate danger of extinction. Seals, however, are subject to disturbances at their breeding grounds. They haul-out on sandbars, rocks and beaches where females give birth to a single pup from mid-June until August. Mothers nurse their young on or near shore for a period of 4-6 weeks, and during this time, vulnerable seal populations are highly concentrated at breeding rookeries. Additional threats are posed by fishermen who consider seals to be a nuisance as well as competition for the salmon and shellfish catch. Finally, the shallow waters frequented by harbor seals are also the habitat of orca, the largest member of the dolphin family. Orca are often known as "killer whales" due to the fact that they are the world's largest predator of warm-blooded animals. Marine mammals are their preferred prey.

Previous SFS teams have conducted research on the population dynamics of harbor seals in Glacier Bay and in Prince William and Puget Sounds. This summer, SFS students will return to Puget Sound to continue research begun in 1989 on the ecology and behavior of the harbor seal population here. In addition to censusing the population in order to determine if the number of seals here has changed, we will seek to answer the following questions: What is the pupping rate of seals in our study

area and how does this number compare with previous data? What factors influence haulout and bolting behaviors? What are the impacts of vessel traffic on seal behavior?

After meeting in Friday Harbor, we will travel together to our site on Spieden Island in the San Juan archipelago in north-west Puget Sound. The San Juan Islands consist of 172 islands situated between Vancouver Island, Canada and the U.S. mainland. Some of the islands have a regular ferry service but the majority are reached only by private boats. Puget Sound boasts relatively protected and very productive waters. These attractions, coupled with the area's spectacular beauty, have made the area a favorite vacation spot. There is also considerable commercial fishing in the area.

Spieden Island's 500 acres will serve as our research base. From high bluffs overlooking the rocky coastline we have a clear view to several neighboring islands including Sentinel Island, a favorite haulout site for seals. After setting up our tent camp, we will begin our observations. In addition to seals, we can expect to see Stellar's sea lions, orcas, numerous seabirds and possibly a small population of river otters that are unusual in that they have taken to a marine habitat. Faculty lectures will introduce us to pinniped biology and behavior, the ecology of Puget Sound, global threats to biodiversity, field research methods, community ecology and population growth models.

Students will use binoculars, spotting scopes and photography to collect data. We will conduct both boat and land-based surveys of human and seal use of the area. Utilizing behavioral observation methods,

students will participate in long watches of seals on beaches to quantify numbers and behavior on land. Habitat analyses will provide us with information on habitat requirements for the population. This data can help us to determine how a seal population might be affected in the event of an oil spill. After they have been trained in the use of theodolites, students will measure the response of hauled-out and swimming seals to boat traffic. In addition, students will have the opportunity to conduct individual or small group directed projects. Potential project topics include mother-pup behavior of hauled-out seals, the effects of tide, boats and weather on bolting behavior, and seal behavior during the molting period. While our goal will be to divide each day between lectures and research, our actual schedule will often be determined by the weather.

During the final days of the course we will compile our data and present our findings in oral presentations. Our census data will be presented to the Washington State Department of Wildlife and to the Whale Museum on San Juan Island. Data on the impacts of boats on seals will be shared with the Cascadia Research Group for use in their long-term studies of seals in Puget Sound.

Spieden Island is privately owned. We will camp in tents and use the main lodge for lectures, studying and for meals. Whenever possible, lectures will be held in the field. The weather here varies and we can expect overcast, fog and rain interspersed with days of spectacular sunshine. The beautiful views and abundant marine life will provide diversion during the long hours we spend counting and observing seals.



One of the goals of our research in Puget Sound will be to better understand the potential impacts of an oil spill on harbor seals. (Photo: Gary Miller)

Summer Course-Ecology of Bald Eagles-ALASKA



Populations of bald eagles have been nearly eliminated throughout most of the United States as their habitats, once constituting some of the most spectacular wilderness areas of the world, have been decimated. In southeast Alaska, however, many thousands of bald eagles remain. The SFS study site near the Eagle River is in the midst of the most dense breeding population of bald eagles in North America. Here, adults spend the summer feeding on herring and spawning salmon while newly-fledged young test their wings in the Alaskan summer skies.

"I've gone from a raving environmentalist to a raving environmentalist who can present an issue clearly, factually, calmly, and with a sense of direction for correcting or solving a problem. I'm more able to integrate the us and them syndrome and move people toward cooperation and problem solving."

Annie Farris, Woody Creek, CO
University of Colorado

Our research focuses on important issues for bald eagle recovery plans in other parts of the United States. Biologists need to understand the ecological characteristics of undisturbed bald eagle populations in order to determine whether a previously decimated population has recovered fully. Previous SFS courses have provided the U.S. Forest and Fish and Wildlife Services with important data on the vegetation associated with preferred nesting and perch trees. This summer, we will continue to characterize nesting and perch trees utilized by bald eagles, and will investigate habitat characteristics between the U.S. Forest Service's 100 meter radius buffer zone around eagle nests versus a proposed 0.5 km use area. Our study area, located approximately 30 miles north of Juneau, is relatively undisturbed and will serve as a control for data collected in the more disturbed areas nearer Juneau.

Sea kayaks will serve as our primary means of transportation to access our study sites. In the distance, white peaked mountains rise above endless stands of coniferous forest, while Alaskan wildlife ranges freely through the woods and waters we will call home for a month. Black bears, deer, porcupine and field mice abound in the forest, while the near-shore waters are home for humpback whales.

After establishing our base camp and becoming familiar with the study area, we will review safety measures and practice using compasses and topographic maps. Our field research will begin with kayak trips along the shore as we acquire the difficult skill of spotting eagle nests. Where possible, tracking tagged eagles with the aid of radio-telemetry equipment may help us to delineate areas used by bald eagles. When nests are located, we will use spotting scopes and binoculars to observe the occupants without disturbing them. Our research will help to determine the critical area required to adequately protect bald eagles and their nests.



"One thought kept coming back to mind, how many people would never see this part of the world, feel the wonder of it, and sadly, not understand the importance of preserving it for all of us."
Linda Thompson, Centerville, MA—Greenfield Community College
(Photo: Penny Jeffers)

Summer Course: *Ecology of Bald Eagles*

Site: Eagle River, ALASKA

Purpose: to study the ecology and behavior of nesting and newly fledged bald eagles (*Haliaeetus leucocephalus*) in Southeast Alaska; to quantify foraging and reproductive success; and to expand the ecological database required for management of eagles in Southeast Alaska and for assessing the successful recovery of populations elsewhere in the United States.

Course Number: BIO 1803

Departure Point: Juneau, Alaska

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

Faculty will introduce topics including Alaskan ecosystems, bird taxonomy, and the natural history of the bald eagle. Additional lectures on principles of ecology, population dynamics, physiology, statistical methods and resource management will occur throughout the course. Techniques of observation and data collection will be demonstrated prior to beginning field research.

In addition to the group research project, we will undertake directed study independently or in small groups. Past topics have included observations of bald eagle vocalizations, the study of tidal effects on foraging behavior, temporal differences in foraging activity and perch-site preferences. Our results will be presented to the U. S. Fish and Wildlife Service, Forest Service and Alaska wildlife management personnel.

Our campsite requires us to practice minimum-impact camping. We will leave little behind but our footprints. The weather will be cool and often rainy. Wilderness and safety training will be important aspects of the course in preparing us for the remoteness of the site, the presence of cold water, and the proximity of black and brown bears.

Summer Course-Tropical Cloud Forest Ecology-COSTA RICA

Summer Course: *Tropical Cloud Forest Ecology*

Site: Monteverde, COSTA RICA

Purpose: to document the diversity of plants and insects in mature and regenerating cloud forest; to explore the interactions between plants and animals that generate biodiversity; and to examine rural cultural and economic factors that lead to deforestation or forest conservation.

Course Number: BIO 1807

Departure Point: San Jose, Costa Rica

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

The World Conservation Strategy calls rainforests the "most exuberant celebration of genetic diversity on Earth." Of the estimated 4 to 5 million species of plants and 10 to 30 million species of insects on earth, the majority exist only in rainforests. Only a small fraction of these have been described. The tropics and subtropics contain only 7% of the earth's land surface but possess 50-80% of all living species. Just as scientists are beginning to unveil their secrets, rainforests are being destroyed at a rate of 25-50 acres a minute.

Before it was settled, virtually all of Costa Rica was covered by forest. Today that area has been reduced to less than 35%. Little is known about the process of forest regeneration. What happens to the biological integrity of a tropical forest when its area is significantly reduced? How is regeneration of plant diversity affected by size of disturbance and distance from mature forest? To what extent does restoration of animal diversity depend on regeneration of plant diversity? How does reduction of diversity in disturbed areas affect interactions between animals in regenerating patches? We will begin to answer these questions by documenting abundances of key species of plants and animals found in the primary forests and in secondary growth areas.

Monteverde, our base, is located in northwestern Costa Rica. Just above Monteverde the crest of the continental divide is covered with cool wet cloud forest. To

the east verdant wet forests extend down to the Atlantic lowlands; to the west drier seasonal forests cover the slopes of the Pacific side. With this unique combination of wet and dry forest, Monteverde supports an exceptionally high diversity of plants, mammals, birds and insects. We will study this diversity in the Monteverde Cloud Forest Reserve, a private preserve that attracts many biologists.

Our research will focus on a fundamental aspect of biodiversity: interactions between forest plants and the animals that eat, pollinate and disperse them. We will assess species composition, species richness and relative dominance of trees in regenerating and mature forest areas. We will then measure diversities of insects in these areas. Insects are critical to the maintenance of plant diversity due to their critical role in pollination. They are thus useful indicators of community integration. Ongoing projects will examine pollination of flowers and bird dispersal of seeds in the context of forest regeneration, as well as the dispersal behavior of an insect pest of pastures that, by reducing forage quality, is responsible for the clearing of forests to replace pastures in this area.

Lectures will focus on the nature and conservation of tropical biological diversity. Faculty will discuss species interactions, community and ecosystem dynamics, nutrient cycles, succession, and plant and animal identification. Also emphasized will

be causes of habitat destruction, economics of reforestation, and principles of natural resource management. Integral to the program is a series of classes that examine land use by Central American inhabitants, including historical, political and social roles. During these classes we will visit local fincas and interview Ticos (as Costa Ricans call themselves). Our interactions with local people will help us gain a greater understanding of the difficult decisions involved in conserving tropical resources while attempting to promote improvements in the quality of life for people in tropical regions.

Faculty-directed student research projects may include topics such as a comparison of epiphyte loads in forest and pasture trees, seed dispersal by birds in regenerating areas, or pollination biology of a flower species.

We will live in rustic cabins and work in a remarkable range of ecosystems: one of the most luxuriant cloud forests in the New World tropics, remote premontane moist forests, and low-land deciduous forests. Tall trees dripping with epiphytes and a large array of animal life—including howler monkeys, sloths, toucans, and spectacular butterflies—create an unforgettable tropical world. Temperatures at these locations vary from cool and wet at higher elevations to hot and muggy at lower elevations. Rain showers are short but frequent.



Documenting key plant species at Monteverde... "I yearned for the opportunity to apply my knowledge in the real world, not just in the laboratory where results are often known before the experiment has even begun."
Larry Boles, King, NC—University of North Carolina
(Photo: Tom Kleinert)

Financial Aid is available.

Please see page 38.

Summer Course-Dolphin Biology and Behavior-NORTH CAROLINA



From June 1987 to March 1988, unprecedented numbers of dolphins began washing up dead along beaches that fringe the eastern United States. While the cause of this die-off remains unknown, a red tide and/or marine pollution are thought to be at least partially responsible. It is clear that the die-off has now ended and our challenge is to see if, and how, the population will recover. Research conducted by SFS teams indicates that the calving rate has doubled over previous years and the percentage of calves may be returning to previous rates. This may represent a healthy response to the die-off. Surprisingly, the number of dolphins encountered in the Cape Lookout National Seashore estuary during survey transects has not changed significantly. Fishermen have reported seeing fewer dolphins further offshore than in previous years, so perhaps more animals have moved inshore in order to reproduce and rear their young.

Previous SFS research has identified preferred habitats for specific dolphin activities such as feeding, travelling and socializing. We have tracked the movement of pods in order to understand movement and residence patterns. The Beaufort area is becoming increasingly subject to the pressures of tourism, development, and a nearby expanding shipping port. In addition, the waters surrounding Beaufort support a large commercial fishing industry. Our research will provide important baseline data to help environmental managers understand how development and specific human activities

affect aspects of dolphin biology, behavior, movement patterns and residence times. Our results will be made available to the National Marine Fisheries Service, Duke University Marine Lab, the North Carolina State Aquarium, and a number of local agencies who have expressed interest in our work.

Individual dolphins are identified by the scars and notches on their dorsal fins. We will use dorsal fin photography to verify resights of individual dolphins. This process, called photo-identification, is also used on the flukes of humpback whales, the dorsal fins and saddles of killer whales, and on many other cetacean species. We will continue to photograph the animals to understand short term movements and social affiliations, and long term residence times. Additional data will be collected on environmental parameters (temperature, water depth, salinity, tidal state, etc.), the presence of other species (fish and birds), and the presence of and reactions to human activities such as fishing, boat traffic and development.

All our field data collection will be made from small boats and land observation posts. Weather permitting, we will spend approximately 6 hours on the water daily. Each time groups of dolphins are approached, team members will begin pre-assigned tasks of photographing dorsal fins, recording data on behavior, location and habitat characteristics. Notes on group composition and social activities will be made. We will use hydrophones to record changes in echolocation clicks and whistles associated with ob-

Summer Course: *Biology and Behavior of Bottlenose Dolphins*

Site: Beaufort, NORTH CAROLINA

Purpose: to document through observation and photo-identification the social ecology, movement patterns, and pod composition of bottlenose dolphins (*Tursiops truncatus*) in the estuarine and coastal waters around Beaufort, NC; to collect population data to understand how dolphins are responding to the catastrophic die-off in 1987; to expand upon an existing catalog of identified dorsal fin photographs for comparison with other researchers in the Southeast.

Course Number: BIO 1802

Departure Point: New Bern, North Carolina

Course Dates:

Session I: June 18 - July 17

Session II: July 24 - August 22

served behaviors. Shore-based spotting teams will use binoculars and spotting scopes to monitor activity in pre-determined areas.

Lectures will cover marine mammal taxonomy and evolution, cetacean anatomy and physiology, sensory and communication systems, whaling, and cetacean environmental issues. Material on quantitative analysis, cetacean research techniques and general principles of ethology will also be presented. Each team member will participate in a directed project that may address questions on pod composition and size, calf percentage, daily movement patterns, percentage of identifiable animals in pods, and variations in acoustic patterns. As time and opportunity permit, we may visit nearby marine labs, aquaria, and government agencies.

We will live in a large house on Core Banks Island, approximately a half mile from the beach. The weather on the island is hot, humid and sometimes breezy, and insects can be a nuisance. We will prepare our own meals and share in housekeeping chores, highlighting our evenings with occasional barbecues on the beach.

An SFS teammember uses a hydrophone to listen to the dolphins. "The first time I saw a pod of dolphins, I forgot to breathe. They were so graceful, sliding in and out of the water, yet so powerful slapping the surface with their flukes. The excitement never abated, and the last time I saw the dolphin was as awe-inspiring as the first time."

Melanie Wilkins,
Delmar, DE—Gettysburg
College
(Photo: Jim Elder)



All courses
carry college credit.



Academic Credit and Research Papers

Academic Credit

All SFS participants are registered at Northeastern University in Boston, which accredits all SFS courses. The only exceptions are students from SFS Affiliate Schools (see * below). Semester programs incorporate four courses and carry a total of 21 quarter credits in biology, sociology/anthropology and independent study. Month-long summer courses carry 8 quarter credits in biology. Many students have arranged to receive credit directly through their home school. Students should check with their advisor/registrar for more information **before going into the field**. A partial list of the more than 150 colleges and universities accepting/awarding credit for SFS participation includes:

Allegheny College
American University
Amherst College
Augsburg College
Barnard College
Barry University
Bates College
Berea College
Boston College
Boston University
Bowdoin College
Brandeis University
Brown University
Bryn Mawr College
Bucknell University
California Lutheran University
California State College
Calvin College
Carnegie Mellon University
Case Western Reserve University*
Clarion University
Clark University*
Colby College
Colgate University
College of the Atlantic
College of St. Thomas
Colorado College
Colorado School of Mines
Connecticut College
Cornell University
Dartmouth College
Davidson College*
Denison University*
Dickinson College*
Drew University
Duke University
Eastern Michigan University
Emory University
Evergreen State College
Fort Lewis College
Framingham State College
Franklin and Marshall College
Franklin Pierce College
Gettysburg College
Green Mountain College
Guilford College
Hamilton College
Hampshire College
Harvard College
Haverford College
Hiram College*
Humboldt State University
Huntingdon College
Huron College
Indiana State University
Indiana University
Kansas State University
Kent State University
Kenyon College

Lang College, New School for Social Research*
Lewis and Clark College
Macalester College
Mariboro College
McGill University
Merrimack College
Miami University*
Middlebury College
Middlesex Community College
Mitchell College
Mount Holyoke College
Mount Union College
New York University
North Carolina State University
Northern Kentucky University
Northwestern University
Oberlin College
Ohio State University
Ohio Wesleyan University
Oregon State University
Pennsylvania State University
Prescott College
Providence College
Purdue University
Randolph Macon College
Saint Lawrence University
Saint Michael's College
Saint Olaf College
Salem College
Shimer College
Simon's Rock of Bard College
Skidmore College
Smith College
Southern Connecticut State University
Stanford University
Stockton State College
S.U.N.Y. College of Environmental Sciences and Forestry*
Trenton State College
Trinity College
Tufts University
Tulane University
Union College
University of California
University of Cincinnati
University of Colorado
University of Connecticut
University of Iowa
University of Kansas
University of Maine
University of Maryland
University of Massachusetts
University of Miami*
University of Michigan

University of Minnesota
University of New Hampshire
University of North Carolina
University of Pennsylvania
University of Pittsburgh
University of Puerto Rico
University of Rhode Island
University of Southern Indiana
University of Southern Maine
University of Utah
University of Vermont
University of Wisconsin
Vassar College
Villanova University
Virginia Polytechnic Institute and State University
Washington University
Wellesley College
Wells College*
Wesleyan University
Whitman College
William Smith College
Williams College
Wittenberg University
Wofford College
Xavier College
Yale College

* SFS Affiliate School



"From the very start, SFS demanded that we step out of our comfort zone and do things that we weren't used to doing. The first night we cooked on a portable Coleman stove, and set up and slept in tents." Lucia Whitman, Brookline, MA—Brookline H.S. (Photo: Phillipa Richards)

Selected Research Papers Resulting from SFS Field Courses

Biogeography: Patterns of Ecological Diversity, Australia, 1990
LAURANCE*, W.F.

Rainforests in the Land Down Under. *Wildlife Conservation Magazine*, July/August:26-45, 1990.

LAURANCE*, W.F., and E. YENSEN

Predicting the impacts of edge effects in fragmented habitats. *Biological Conservation*, Vol. 55, 1990.

PUTZ*, F.E.

Growth habitats of climbing palms (*Calamus* spp.) in North Queensland rainforest. *Australian Journal of Botany*, 1990.

Endangered Monkeys: Social Ecology of Stumptail Macaques, Mexico, 1989

JOLLY**, D.W. and D.R. RASMUSSEN*

Differences in competitive rates when feeding on natural or provisioned food and when not feeding in the Catemaco troop of stumptail macaques. Presented to the Annual Meeting of the American Society of Primatologists; Davis, CA, July, 1990.

Dolphin Biology and Behavior, Florida Keys and Alabama, 1985, 1986, 1987

HEIMLICH-BORAN*, J., and S. HEIMLICH-BORAN*

Population estimation and seasonal habitat use patterns of bottlenose dolphins (*Tursiops truncatus*) off the Gulf coast of Alabama. Presented at the Seventh Biennial Conference on the Biology of Marine Mammals; December 5-9, 1987.

Center for Wildlife Management Studies, Kenya, 1982, 1983, 1984, 1985, 1986, 1987

STELFOX*, J.B.

Thompson's and Grant's gazelle in relation to seasonal environments and resource use. *African Journal of Ecology*, 24:111-120, 1987.

MADDEN**, D.

Thorns, browsing mammals, and the management of an East African rangeland. Presented at meeting of the Association for Arid Land Studies and Western Social Science Association; Albuquerque, New Mexico; April, 1989.

Marine Ecology and Management, St. John, USVI, 1988-1989

EDMUNDS*, P.J., D.A. ROBERTS*, and R. SINGER*

Reefs of the Northeastern Caribbean I. Scleractinian populations. *Bulletin of Marine Science*, 46(3):780-789, 1990.

* SFS Faculty

** SFS Student

The School
For Field Studies



Requirements for Admission

We are seeking a body of curious students with a thirst for learning and the maturity and personal initiative to make use of our unique educational opportunities. Individuals should exhibit enthusiasm, character, compassion, flexibility and social concern. Also evident should be a demonstrated promise to benefit academically and socially from this experience. The essay in which the student defines his or her motivation for participation is a strong determining factor in the admission process.

Admission to SFS courses is open to eager, motivated students. A strong background in science is *not* required to be a part of an SFS experience. Participants are screened by the Admissions Committee to insure that they are choosing the right course for the right reasons. We encourage students who are willing to commit their emotional, intellectual, and physical energies to working toward a better understanding of crucial environmental issues to join us. We promise a learning experience to last a lifetime.

Applicants for admission are required to submit an SFS application form, a 300 word essay describing their reasons for participating, a \$30 application fee and an SFS reference form. Applicants for summer courses should be at least 16 years of age, and have completed at least their junior year in high school. Applicants who have not entered college must submit a transcript to qualify for college credit. Summer course applicants should have completed at least one biology or ecology course. Semester applicants should be 18 years of age, have completed at least one college-level biology or ecology course and must submit an up-to-date transcript.

For further information regarding admission, please call the SFS Admissions Office at (508) 9277-7777.

Acceptance

Applications for all programs are reviewed on a rolling admission basis, as soon as all required information is received. The Admissions Committee meets on the 1st and the 15th of every month.

Teams fill quickly. We strongly urge students to apply early to join the course of their choice. Waiting lists are maintained for courses that fill early.

All acceptances are contingent upon medical approval. Course syllabi will be sent to all accepted applicants, and course faculty will call all accepted students to discuss their participation in the program.

Academic Credit

All students, except those from SFS Affiliate Schools, receive academic credit for their SFS course from Northeastern University in Boston, Massachusetts. A \$100 non-refundable registration fee is due 10 days after acceptance into the program. All summer courses carry Biology Department credit at Northeastern. Semester students will receive biology, sociology/anthropology and Interdisciplinary course credit from Northeastern. Upon completion of the course, students may request an official transcript from Northeastern University at any time. Over 150 colleges and universities accept or award credit for SFS courses. Applicants should consult their Registrar or the SFS Admissions Office for further details. Students from SFS Affiliate Schools (see page 36) will receive a transcript from SFS and credit directly through their home school.

All SFS courses are approved and assigned course numbers by Northeastern University. As this publication goes to press, several new courses are undergoing the approval process at Northeastern. Course numbers are usually assigned at the end of this process.

Changes

SFS programs are obviously different from travel or adventure programs. We have tried to give accurate portrayals of every program in this catalogue. All course descriptions have been written in consult with a current or past faculty member. However, each project is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Over half of our projects take place in highly regulated and sensitive environments, usually requiring special permits, such as in Kenya and Mexico.
- Some projects depend on the goodwill and generosity of individuals and institutions which lend support.
- Tenuous weather situations, natural disasters or changes in political conditions in another country may require last-minute changes in sites or research plans.

Applicants are advised that these or other variables may require changes before or during a course. Indeed, part of the challenge is in adapting to changing conditions and overcoming the obstacles they may present. In other words, the whales are not always where we want them to be, so please be flexible.

Student Conduct

Participants are expected to conduct themselves in a mature and responsible manner. SFS reserves the right to require any participant to withdraw from any program at any time if the faculty deem the student's conduct to be detrimental to or incompatible with the interest, harmony, comfort, or welfare of the course—including use of alcohol or drugs not authorized by a medical doctor, or uncooperative or disruptive behavior. Should such a decision be made, SFS will notify parents if the student is under 21 years of age and return the student to the point of departure of the course, at which time any and all responsibility on the part of The School for Field Studies will cease.



"Arriving as an unknown, closed-minded, unsuspecting Long Island armchair traveller, I experienced SFS with wide eyes as an intense new world offering rich opportunities for self-challenge in the outstretched arms of instructors and students; I left with a greater self-esteem, world awareness, and very special friends."

Michelle Weideman, Melville, NY—Union College
(Photo: Stephanie Clapes)

Responsibility

In organizing and managing these courses, The School for Field Studies (SFS), its agents, employees, and staff give notice that they act solely on behalf of and for the benefit of the participants, on the express agreement that SFS shall not be liable, financially or otherwise, for non-performance or unsatisfactory service; for injury to persons including death; for loss of, or damage to property; for accident or delay; and/or for expenses arising from strikes, weather, quarantine, sickness, government regulation, or from any act or omission of its agents or employees, and/or airline, railroad, bus company, automobile rental agency, hotel, or other supplier of service.

SFS reserves the right to refuse any applicant admission to any program if he/she is deemed unsuited for the project for any reason. All courses, fees, and dates are tentative until verified and confirmed in writing by The School for Field Studies.

The School for Field Studies admits students of any sex, religion, race, color, national or ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students of the School and does not discriminate on the basis of sex, religion, race, color, national and ethnic origin in the administration of its educational policies, admissions policies, scholarship loan programs, and other School-administered programs. SFS is an equal opportunity institution.



Processes, Requirements and Costs

Tuitions

(all programs have additional \$100 Registration Fee)

SFS Fall 1991 and Spring 1992 Semester Programs \$8,550

Summer 1991 Courses (30 days)

Wildlife Management/Kenya	\$2,650
Honeyguides and Humans/Kenya	\$2,650
Marine Mapping/Caribbean	\$2,370
Coral Reef Management/Caribbean	\$2,370*
Endangered Sea Turtles/Costa Rica	\$2,230
Tropical Cloud Forest Ecology/Costa Rica	\$2,230
Primate Conservation/Costa Rica	\$2,230
Ethnobotany/Ecuador	\$2,230
Ecology of Bald Eagles/Alaska	\$2,140
Ecology of Harbor Seals/Puget Sound	\$2,110
Humpback Whale Ecology/North Atlantic	\$2,550
Biology and Behavior of Bottlenose Dolphins/No. Carolina	\$2,330
Landscape Ecology/Colorado	\$1,990
Ecology of Tropical Rivers/Belize	\$2,280
Tropical Deforestation/Australia (6 weeks)	\$2,980

*add \$150 for SCUBA Certification fee if necessary

In addition to tuition charges, please also consider the following to determine the total cost of participation:

Transportation and Travel Arrangements: To insure the best possible fares as well as orderly arrival at the site, we work with one travel agency to handle SFS travel. This agent will arrange travel to the course, with any special arrangements students require. Any student not using the SFS agent must have their travel plans approved by the SFS Admissions Office. Specific details will be forwarded upon acceptance. Students are responsible for passport/visa fees as well as all transportation costs to and from the site.

Clothing and Equipment: SFS will provide food, cooking equipment, tents and all scientific and research equipment. Students are responsible for personal gear including sleeping bags, backpacks, clothing, and SCUBA gear (if applicable). Stu-

dents may find they already have much of what they need, and we encourage students to borrow as much gear as possible from friends.

Physical Examination and Medical Insurance: Students must present a completed SFS Medical Form, signed by a doctor, no later than 30 days prior to course departure. All medical forms must be approved by the SFS Medical Committee. Students must be able to meet the physical challenges presented by SFS courses without undue risk. Academically qualified individuals may be disqualified from participating on medical grounds. Students will not be allowed to join an SFS program without proof of up-to-date medical coverage and a signed medical release.

Financial Aid

We are committed to making the SFS experience accessible to everyone who wishes to participate. *Financial aid, in the form of scholarships and/or interest-free loans, is available to qualified students based on need.*

The School receives generous contributions from foundations, corporations and individuals to make this possible. In 1990, over 150 of our participants received financial aid totalling more than \$200,000.

We encourage students who will need financial assistance to request, complete and return a SFS financial aid application as soon as possible. Aid is available by need until funds are exhausted. *Semester applicants may arrange to apply federal financial aid monies toward their tuition in addition to applying for SFS funding.*

For more information on how to qualify for assistance, please call the Admissions Office at (508) 927-7777.

Deposits, Tuitions and Fees

Like other non-profit, tax exempt educational institutions, SFS meets its expenses with a combination of tuition charges and income from grants and donations. Tuition pays for instruction, room and board, and ground transportation during the course. It also includes group equipment, medical supplies, scientific instruments and material. *It does not include transportation to and from departure point.*

A non-refundable deposit of \$350 for summer courses or \$500 for semester programs is due no later than 10 days following acceptance in order to reserve a place in the program. All students will be registered for academic credit with Northeastern University. The non-refundable registration fee of \$100 is due with the deposit. (Deposits and registration fees for financial aid candidates are non-refundable 10 days following financial aid offer. Students must complete and return their financial aid application within 10 days of acceptance to qualify for refund status.)

Full tuition is due sixty days prior to course departure. No student with an outstanding tuition balance will be allowed to participate in the program.

Note: The tuition fees listed in this catalog are based on estimates made a year in advance of departure and involve many variables—currency rate, outside project support, enrollment projections, etc.—all of which may change. The tuition for each program is tentative until confirmed in writing by SFS.

Refunds

Summer courses:

Registration fees are non-refundable and non-transferable. If a student withdraws prior to 15 days before the start of the course, his/her non-refundable deposit may be transferred within 12 months to another SFS course. If a student withdraws 15 days or less before the start of the course, SFS will retain 50% of the course tuition. No refunds are made once the course has begun.

Semester Programs:

Registration fees are non-refundable and non-transferable. Deposits are non-refundable. If a student withdraws more than 30 days prior to the start of the program, SFS will retain 50% of the program tuition; the deposit may be transferred to another SFS program within a 12 month period. If a student withdraws from a course 30 days prior to the program commencement to 14 days after program departure, SFS will retain 75% of the tuition. No refunds are made after the second week of the program or to students asked to leave the program.

**The School
For Field Studies**



REFERENCE FORM

To the Applicant: Please complete the top section of this form and give it to a teacher/ professor or academic counselor who is well acquainted with you.

Under the provisions of the Family Educational Rights and Privacy Act of 1974, you may have the right to review your educational records. The Act further provides that you may waive your right to see recommendations for admission. Please indicate below, by checking the appropriate phrase, whether or not you waive this right.

Applicant Name _____ Social Security # _____

SFS Course _____ Level _____ Dates _____

I waive _____ do not waive _____ my right of access to this recommendation form.

Applicant's signature _____ Date _____

To the Reference: The student listed above has applied to participate in an intensive, environmental field study program offered by The School for Field Studies. Students and faculty work, camp, and live together within remote ecosystems, totally immersed in coursework and research. Field work, research, academics and inter-personal dynamics all pose rigorous challenges that promote growth and learning. Each participant will receive university credit for successful completion of the program.

The applicant need not be a scientist, but must be sufficiently motivated and mature to live and work productively in the setting described above. Your comments, in response to our questions below, would be extremely helpful in our efforts to provide optimal learning experiences for our students. Your comments will be used to evaluate the student for admission and provide information for the faculty on student abilities.

1. How long have you known the applicant? _____ In what capacity? _____

How well do you feel you know the applicant? _____

2. What strengths do you think the applicant will bring to this program?

3. What are the applicant's weaknesses, and how would you expect these to affect his/her performance on this type of educational experience?

(over)



SFS Reference Form

Compared to all of the students you have known, please rate the applicant as indicated below:
(Please circle.)

Applicant Information	Superior (5)	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
current academic performance	5	4	3	2	1
potential academic performance in SFS type of learning situation	5	4	3	2	1
maturity	5	4	3	2	1
sensitivity to others	5	4	3	2	1
judgment capabilities	5	4	3	2	1
flexibility in coping with unpredictable circumstances	5	4	3	2	1
ability to cooperate with others to accomplish group goals	5	4	3	2	1
ability to accept authority, discipline, and structure	5	4	3	2	1

5. If you were the faculty member responsible for teaching this course, would you want the applicant to be a participant? Please explain.

6. If there is any additional data about the participant that you feel we should know, please feel free to make additional comments on this form or attach additional sheets if necessary.

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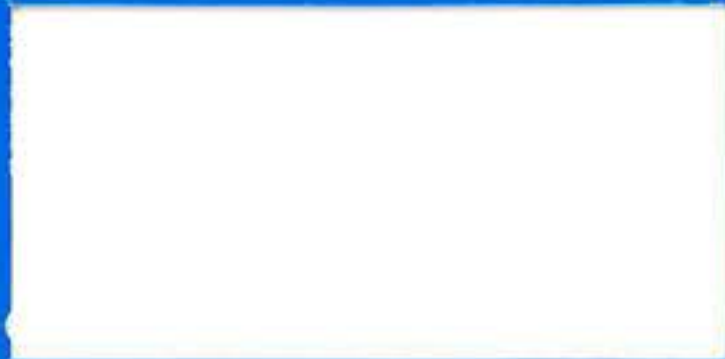
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