



THE SCHOOL FOR FIELD STUDIES

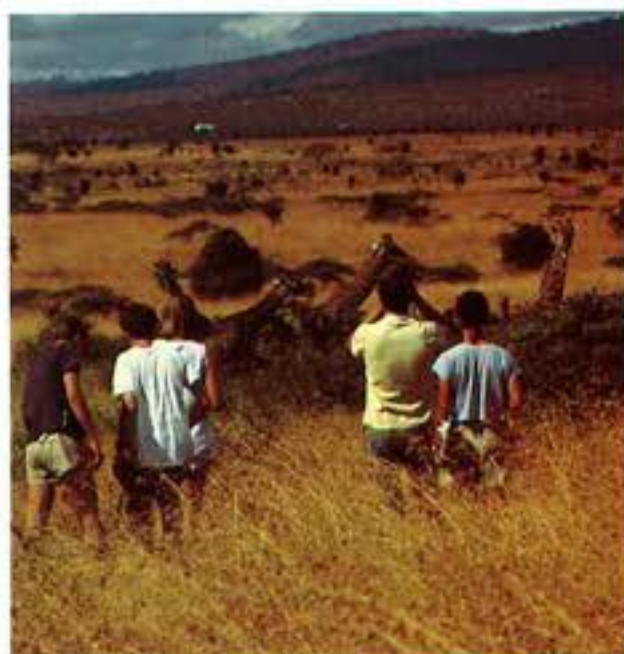
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Center for Rainforest Studies—Australia



Center for Marine Ecosystem Studies—Virgin Islands



Center for Wildlife Management Studies—Kenya

1989-90 Course Catalogue

Semester, Summer
and January

Environmental
Field Training and
Research Programs
Around the World

The world is your classroom



1990 Curriculum

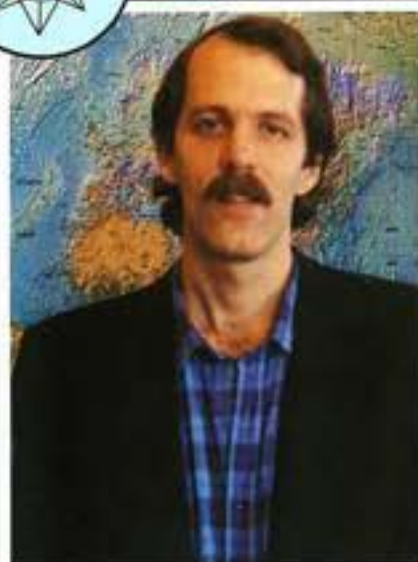


Photo: Barry Canner

The failure of human society to attend to our obligations to future generations is graphically illustrated for us almost daily in the current media coverage of endangered species, polluted air and waters, and barren landscapes where forests once stood. As *Newsweek* magazine pointed out recently, we are grossly mistaken if we think that the global environment is fragile. It is not fragile: what is fragile are those biological conditions necessary to sustain human life.

It is easy to look upon the discouraging environmental situation that past generations are bequeathing to coming generations with a sense of helplessness and frustration. But by doing so, you fail to recognize that this situation presents young people such as yourself with enormous opportunities. Joining the struggle to turn this situation around is a very real chance for you to make a commitment to a global effort which is extremely important, and to thereby find an unparalleled degree of meaning and purpose to your life.

SFS's job in all this is to help you gain a better understanding of environmental issues and the ways in which you can get started toward making your own contribution to their resolution—whatever your chosen profession or occupation may become. But we cannot do more than issue you the invitation.

The world needs you. Listen to what it is saying.

James L. Elder, Jr.
James L. Elder, Jr.
President

P.S. If financial constraints are keeping you from taking this first step with SFS, please call or write one of our Admissions Counselors about SFS financial aid. We are committed to trying to make SFS available to everyone with a sincere interest in participating.

Semesters: June 18 July 24
Fall Spring thru thru
July 17 Aug. 22 Page

Plant Community and Ecosystem Ecology

SFS Center for Rainforest Studies -- Australia					10-
Semester Program:	X	X			12
<i>Biogeography: Patterns of Ecological Diversity</i>					
Summer Course:					
<i>Tropical Deforestation: Threats to Biological Diversity</i>				Intro. June 28-Aug. 6	13
Satellite Courses:					
<i>Ethnobotany: Uses of Plants by Native Peoples -- Ecuador</i>				Adv. Adv.	28
<i>Landscape Ecology: Designing Parks for Preservation -- Rocky Mountains</i>				Adv. Intro.	29
<i>Tropical Cloud Forest Ecology -- Costa Rica</i>				Intro. Adv.	30
<i>Acid Rain: Changing Aquatic Ecosystems -- Adirondack Mountains</i>				Adv. Intro.	31

Wildlife Ecology and Management

SFS Center for Wildlife Management Studies -- Kenya					14-
Semester Program:	X	X			16
<i>Wildlife Ecology and Management</i>					
Summer Course:					
<i>Wildlife Management</i>				Adv. Intro.	17
Satellite Courses:					
<i>Ecology of Bald Eagles -- Alaska</i>				Intro. Adv.	33
<i>Study in Symbiosis: Honeyguides and Humans -- Kenya</i>				Intro. Adv.	36

Marine Biology and Management

SFS Center for Marine Resource Studies -- Virgin Islands					18-
Semester Program:	X	X			20
<i>Marine Ecology and Management</i>					
Summer Courses:					
<i>Coral Reef Management</i>				Intro. Adv.	21
<i>Marine Fisheries: Threatened Tropical Resources</i>				Adv. Intro.	22
Satellite Courses:					
<i>Conflicts in Ecological Management: Sea Turtle Survival -- Greece</i>				Adv. Intro.	32

Animal Behavior and Conservation

Marine Mammal Studies Program-- Baja, Mexico					23-
Semester Program:	X	X			25
<i>Marine Mammal Biology and Conservation</i>					
Satellite Courses:					
<i>Harbor Seals: Dynamics of a Population in Crisis -- Alaska</i>				Adv. Intro.	34
<i>Endangered Monkeys: Ecology of Stumptail Macaques -- Mexico</i>				Adv. Adv.	35
<i>Humpback Whale Ecology -- North Atlantic</i>				Adv. Intro.	37
<i>Biology and Behavior of Bottlenose Dolphins -- North Carolina</i>				Intro. Adv.	38

Sustainable Development

SFS Center for Studies in Sustainable Development -- Zimbabwe					26-
Semester Program:	X	X			27
<i>Studies in Sustainable Development</i>					
Summer Course:					
<i>Sustainable Development</i>				Adv. Intro.	27

How To Use This Catalogue



In an effort to make your selection of SFS programs easier, we have organized the catalogue in the following manner:

SFS offers programs in four curricular concentrations:

- Plant Community and Ecosystem Ecology
- Wildlife Ecology and Management
- Marine Biology and Management
- Animal Behavior and Conservation

SFS has four permanent campus centers where you may choose to attend a 13-week semester program or a 30-day summer course:

- Center for Marine Ecosystem Studies—St. John, Virgin Islands
- Center for Rainforest Studies—Australia
- Center for Wildlife Management Studies—Kenya
- Center for Marine Mammal Studies—Baja, Mexico

SFS offers a wide variety of programs: 13-week semester programs, 30-day summer courses, and 23-day January Term courses at Centers or satellite sites worldwide:

- | | |
|--|----------|
| Semester Programs at Centers | 13-weeks |
| Summer Courses at Centers and Satellites | 30-days |
| January Term Courses | 23-days |

Table of Contents

What is SFS	2-3
Curriculum	4-5
Faculty	6-7
Curricular Concentrations ...	8-9
Center for Rainforest Studies	10-13
Center for Wildlife Management Studies	14-17
Center for Marine Ecosystem Studies	18-22
Center for Marine Mammal Studies	23-25
Center for Northern Studies	26-27
Satellite Courses	28-38
Processes, Requirements, Tuitions and Costs	39-40
Application	41
Organization	43



"Thank you SFS for a 24 hour a day learning experience—from learning how to brush my teeth in the woods to identifying trees and plants to a lecture on lotic systems to making pizza on a Coleman stove—it was a real lesson in immersion."

Kristen Steinmetz, Trenton, NJ-
Haverford College
(Photo: Linda Thompson)



What is SFS?

Since 1980, The School For Field Studies has provided more than 3000 young people with a unique opportunity to conduct hands-on field studies and research addressing some of the most critical environmental issues facing our world today. In just nine years, SFS has become the largest private educational institution exclusively offering courses and fieldwork in the rapidly evolving field of conservation biology. We are pioneering a new form of education which fully integrates theory and practice.

Our field operations span five continents. In addition to our administrative Headquarters in Beverly, Massachusetts, SFS operates five **Centers** at which we conduct long-term, year-round studies. Each Center offers 13-14 week **semester programs** in the fall and spring and month-long **summer courses**. These campuses include:

- The Center for Rainforest Studies in Australia
- The Center for Marine Resource Studies in the Virgin Islands
- The Center for Wildlife Management Studies in Kenya,
- The Marine Mammal Studies Program in Baja, Mexico (planned to open in 1990).
- The Center for Studies in Sustainable Development in Zimbabwe (planned to open in 1990).

In addition, students may choose to attend a month-long course at one of twelve **satellite sites** around the world. Satellite sites offer summer and/or January Term courses. Courses at satellite sites examine a critical environmental problem or issue—such as acid rain—in the context of a traditional academic discipline—such as limnology.

Because rainforests don't fit under a microscope and giraffes don't browse in a test tube, SFS takes students to the best possible laboratories to study environmental issues. Our courses are situated in the midst of ecosystems that provide dramatic, real-life illustrations of what we often only imagine in classroom lectures, making facts and theories come to life in a new way that textbooks can't match.

What does an SFS course cover?

Each SFS course incorporates three integral components. Separated here for the sake of clarity, each component is carefully integrated with the others so that it is hard to distinguish where one stops and another starts in practice.

The academic component includes lectures, seminars, assigned readings, critical reviews of current research papers, class presentations, papers, and exams. While we utilize many traditional methods of instruction, we constantly seek creative ways to learn through hands on experience and direct application. For example, one of our marine species identification exams is conducted 30 feet underwater with living examples; in one of our Resource Management courses, we substitute the production of an Environmental Impact Statement for a midterm paper.

The research component provides a unique opportunity to make a personal contribution to science and humanity. Addressing such issues as how to control loss of species diversity, how to feed an

expanding world population, and how to balance the conflicts between development and preservation, we engage directly in real-world problem solving. The research component also offers you the opportunity to test out the career of a field scientist as you design and carry out a directed research project on your own in addition to contributing to the team research effort. Each course concludes with a final report, many of which have been published in scientific literature (see page 7 for examples). A few of our many current research projects include: the effects of human generated activity on whales and seals, the variability in giraffe feeding behavior on a Kenyan wildlife ranch, and the ecology of pharmaceutical plants growing in Amazonian Ecuador.

The practical component includes training in field methodology, field techniques (which may include SCUBA diving, tracking, censusing, capturing, mapping, wilderness living, or any of a dozen other skills), experience in teamwork and cooperative problem solving, confidence building experiences, and other aspects of personal growth.



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)



How will I benefit from an SFS Course?

- **SFS courses are designed to teach you skills in research methodology, teamwork, a scientific discipline and outdoor living.** No other program offers training in all of these areas. We will offer you training in how to approach a problem, how to form a hypothesis, how to work as a team utilizing each other's strengths and weaknesses to benefit the entire group. You will engage in problem-solving under real-life circumstances. These are valuable, life-long skills you will find useful in careers or directions you choose to pursue in the future.

- **Participation in an SFS course offers you a unique opportunity to make a personal contribution to science and humanity.** All of our research results contribute to data bases and management reports for use by various environmental agencies including wildlife officials, government organizations and park managers.

- **All students may receive college credit for the successful completion of an SFS program through Northeastern University.** Over 120 colleges and universities across the country have accepted/awarded credit for SFS programs. For information on academic credit and a partial list of these schools, please see page 5.

- **A strong network of friendships grows from sharing special experiences and working together toward a common goal.** A sense of camaraderie builds daily as we share tasks—setting up camp, cooking, tackling a challenging aspect of the research or sharing thoughts at the end of a long day.

- **A strong network of friendships grows from sharing special experiences and working together toward a common goal.** A sense of camaraderie builds daily as we share tasks—setting up camp, cooking, tackling a challenging aspect of the research or sharing thoughts at the end of a long day.

- **SFS provides students with field opportunities rarely available to undergraduates.** SFS offers students with little or no scientific background an opportunity to test out the career of a field scientist; students who are science majors the opportunity to acquire field training before they graduate; and students who are simply intrigued by environmental issues a practical means of studying them.

- **SFS courses offer access to spectacular places not always available to travelers and tourists.** Because our courses address timely and often sensitive issues, many of our research sites including game ranches, pristine coral reefs, and rainforests, often require special permits and/or permission not accessible by the general public.

What Background Do I Need to Participate?

We have designed our month-long courses on two levels to accommodate introductory and advanced level students.

Introductory Courses do not require previous field training or a science background. In fact, most students who enroll in introductory courses have not had any previous experience.

Advanced Level month-long courses and all **semester programs** require a minimum age of 18 and successful completion of a college level biology or ecology course, or a previous SFS course.

Who goes on an SFS Course?

Students from public and private high schools, colleges and universities, from science as well as liberal arts majors, and from across North America and many foreign countries have contributed to the success of SFS teams. **Approximately 30% of these students are recipients of SFS financial aid (see page 40 for financial aid information).** Ranging in age from 16 to 26, all share a desire to learn more about the natural world.

SFS team sizes range from 15 students and two faculty on a month-long course to 24 students and four faculty on semester programs.

As an SFS participant, you become an active member of the team involved in all aspects of our research and day-to-day living. This team approach to learning and problem solving is at the heart of the SFS educational philosophy and is one of our greatest strengths. Working with new people from many different backgrounds, under demanding conditions, teaches us things about ourselves, how we relate as members of a team, how we adapt to new people and different environments. Living and traveling together, whether for 30 days or 13 weeks, presents many challenges. As we have a great deal to accomplish in a limited time, there is little time for extended ventures on your own. You will have some time to yourself for personal reflection, however.



The 1987 SFS Acid Rain Research Team: "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: William McComas)



"Everyone had an enormous respect for every part of the environment, even if it wasn't their particular area of interest. Spending time with a group like this is tremendously motivating." Maia Enzer, New York, NY—Union College (Photo: William McComas)



Course Levels

Introductory courses are taught at a college freshman level. They assume little background in the academic discipline and no field work experience. They are open to students who have completed a high school biology course and at least their junior year in high school. Intro courses are designed for people who want initial exposure to field experience in environmental disciplines.

Advanced courses and Semester programs assume completion of one or more of the following:

1. college-level course in an appropriate discipline (biology, botany, ecology, etc.), preferably a laboratory course; or
2. an SFS Intro course or other scientific field experience; or
3. special permission from SFS.

Advanced courses are taught at a more advanced academic level and usually involve mastering more sophisticated data collection and analysis techniques. They are directed toward people who are committed to environmental studies and are seeking experience which will help them make or further career plans.

SFS prepares a detailed **syllabus** for each program. Contained in the syllabus are academic and research objectives, required and recommended reading lists, a course schedule, as well as information on the site, necessary personal equipment, and medical information.

Evaluations

The faculty will conduct oral and written evaluations on the basis of class work, field work, examinations, papers, presentations, and group participation at the midpoint and conclusion of each course. Each student will receive a grade card and may request an official transcript from Northeastern University (see page 5 and 39 for additional information).



"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: Jim Elder)

SFS Semester Programs

Each SFS semester program enrolls 20-28 students in a series of four or five 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 21-22 quarter hours (approximately 16 semester hours) of college study through a series of four or five 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, 3 faculty, and one or more teaching assistants. This insures an unusually low student to faculty ratio, averaging less than 7 to 1. Faculty members and the Director will usually hold a Ph.D. or its equivalent and have substantial teaching and research experience at the program location. (See pages 6-7 for further faculty information).

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 part of the program, usually totaling 2-4 weeks of the program.

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

January Term and Month-Long Summer Courses

SFS January Term courses (4 quarter credits) depart in late December. 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 a one to two day break in the middle of 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.
- 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: Mid-term Evaluation

- faculty evaluation of student progress
- student evaluation of student progress

Phase Four: Implementation of Directed Research Projects

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

Phase Five: Conclusion

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



Academic Credit

All SFS participants are registered at Northeastern University in Boston, which accredits all SFS courses. Thirteen week semester programs that incorporate five courses carry 21-23 quarter credits, month-long summer courses carry 8 quarter credits, and twenty-three day January term courses carry 4 quarter credits. Many students have arranged to receive credit, in most cases in the sciences, directly through their home school or college. A few of the 120 colleges and universities that have awarded/accepted credit for SFS participation include:

American University	Oregon State University
Amherst College	Pennsylvania State University
Augsburg College	Barnard College
Barry University	Prescott College
Bates College	Purdue University
Berea College	Randolph Macon College
Boston College	Saint Lawrence University
Boston University	Saint Olaf College
Brown University	Salem College
California Lutheran University	Shimer College
California State College	Simons Rock College
Carleton College	Smith College
Carnegie Mellon University	Southern Connecticut State University
Clark University	State University of New York
Colby College	Stockton State College
Colgate University	Trenton State College
College of the Atlantic	Tufts University
College of St. Thomas	Tulane University
Colorado School of Mines	University of California
Connecticut College	University of Cincinnati
Cornell University	University of Colorado
Dartmouth College	University of Connecticut
Denison University	University of Iowa
Dickinson College	University of Kansas
Duke University	University of Miami
Eastern Michigan University	University of Maine
Emory University	University of Maryland
Evergreen State College	University of Massachusetts
Framingham State College	University of New Hampshire
Gettysburg College	University of North Carolina
Green Mountain College	University of Pennsylvania
Guilford College	University of Pittsburgh
Hamilton College	University of Puerto Rico
Hampshire College	University of Rhode Island
Harvard College	University of Southern Indiana
Haverford College	University of Southern Maine
Huntingdon College	University of Utah
Huron College	University of Vermont
Indiana State University	University of Wisconsin
Kansas State University	Virginia Polytechnic Institute and State University
Kent State University	Washington University
Kenyon College	Wellesley College
Macalester College	William Smith College
Marlboro College	Williams College
Merrimack College	Wofford College
Miami University	Xavier College
Middlesex Comm. College	Yale College
Mount Holyoke College	
Mount Union College	
Northern Kentucky University	
Northwestern University	
Oberlin College	
Ohio State University	



"I saw the tents, the latrine, the shower (a.k.a. water hose) and thought to myself 'this is going to be a long four weeks.' I was wrong. It would be the shortest four weeks of my life."
Alice Stoffa, Ardmore, OK—St. Mary's College
(Photo: William McComas)

Recent Research Papers Resulting From SFS Field Courses

Plant Community And Ecosystem Ecology Group

Community Ecology, Mount St. Helens

ADAMS*, A.B., and V.H. DALE, 1987

"Vegetative succession following glacial and volcanic disturbances in the Cascade mountain range Washington, USA", In D.E. Bilderback (ed.), Mount Stain Helens 1980 Botanical Consequences of the Explosive Eruptions. Los Angeles: University of California Press. pp. 70-147.

Ecology and National Park Planning, Atacama Desert, Chile

RAEDEKE*, K.J., and J.A. SIMONETTI, 1988.

In press. Food habitats of guanaco in the Atacama desert of northern Chile. *Journal of Mammalogy*.

Hazardous Waste and Coastal Ecology, Chesapeake Bay

JACQUES, L.K. KRISHNAN**, and W. HATCH*.

Calcification of saltmarsh periwinkle shells in pristine and polluted environments. Presented to the 54th Congress of the Franco-Canadian Association for the Advancement of Science. May 14, 1986

Acid Rain, Adirondacks Mountains, New York.

SINGER*, R., D.A. ROBERTS*, and

C.W. BOYLEN, 1983

Biological effects of acidification on small oligotrophic Adirondack lakes. Proceedings of the Second New York State symposium on Acid Deposition. Ithaca, New York.

Marine Biology and Management Group

Coral Reef Ecology, St. John, USVI

BRODY*, M., S.J. MILLER*, M.T. BALBACH**, J.M. EAGLES**, M.L. FINDLEY**, H.C. FOWLER**, F.D. ING**, R.A. MADON**, W.S. MALDONADO**, D.P. REMSEN**, N.A. ROSE**, P. SIPMSON**, and T.R. WHITE**, 1984

Man and the Biosphere: ground truthing coral reefs for the St. John Island Biosphere Reserve. Reports to the Virgin Islands National Park Service.

Sources of Reef Fish Toxins, St. John, USVI

KOHLER*, C.C., D.R. TINDALL, P.C. PHILLIPS*, and S. KOHLER*. 1987

Ecology of Organisms Involved in Ciguatera Poisoning in Great and Little Lameshur Bays, St. John, United States Virgin Islands. Report submitted to United States National Park Service, St. Thomas, USVI

Animal Behavior and Conservation Group

Marine Mammal Biology and Conservation, Glacier Bay and Kenai Peninsula, Alaska.

CALAMBOKIDIS*, J., and G.H. STEIGER**, 1985

Bald Eagle (*Haliaeetus leucocephalus*) consumption of harbor seal (*Phoca vitulina*) placenta in Glacier Bay, Alaska. *Raptor Research* 19:2

CALAMBOKIDIS*, J., B.L. TAYLOR*, S.D. CARTER*, G.H. STEIGER**, P.K. DAWSON*, and L. ANTRIM*, 1987

Distribution and haul-out behavior of harbor seals in Glacier Bay, Alaska. *Canadian Journal of Zoology*. 65:1391-1396

Dolphin Biology and Behavior

HEIMLICH-BORAN*, J., and S. HEIMLICH-BORAN*, 1987

Population estimation and seasonal habitat use patterns of bottlenose dolphins (*Tursiops truncatus*) off the gulf coast of Alabama. 7th Biennial Conference on the Biology of Marine Mammals. Dec. 5-9.

Monkeys, Panama

CLARKE*, M.R., E. ZUCKER*, and R. SCOTT, 1986

Population trends in the howler monkey (*Alouatta palliata*) in Costa Rica. *American Journal of Primatology*.

RASMUSSEN*, D., In press.

Social Ecology and Conservation of Panamanian Tamarins (*Signatus oedipus goffroyi*). *The Nature of Panama*.

Wildlife Ecology and Management Group

Population Dynamics of Endangered Species. Greek islands. HUSBAND*, T.P., P.B. DAVIS*, 1984.

Ecology and behavior of the cretin agrimi. *Canadian Journal of Zoology* 62:411-420

Center for Wildlife Management, Kenya

STELFOX*, J.B. 1987.

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

* SFS Faculty

** SFS Students



(Photo: Dave Jolly)

Faculty Profile Dennis Rasmussen

Director: Endangered Monkeys
Ecology of Stumptail

B. (Psychology) Humboldt University; M.A., Ph.D. (Com-psychology) University of Riverside; Post-Doctoral at Swin College, Cambridge

Research: Humboldt State University of California—California State University; in Tropical Research Institute; University of Wisconsin Research Center.

at: Olive and yellow Baboon zania (with Dr. Jane Good- sexual behavior of Bonnet California Primate Research Tamarin Tamarin Monkey ma.

over a dozen scientific papers in journals including *Behavior*, *Folia Primatologica*, *Primate Journal of Primatology*.

married; 2 sons. Dennis was a N.I.H. Senior National Service Award to study behavior and biology at the Regional Primate Research Center now lives in Madison,



(Photo: Chris Galligan)

Faculty Profile Deborah Roberts

Resident Faculty: Center for Marine Ecosystem Studies/Virgin Islands;

Senior Faculty: Acid Rain: Changing Aquatic Ecosystems/Adirondacks.

Education: B.A. (Biology) Colgate University; M.S., Ph.D. (Biology) Rensselaer Polytechnic Institute.

Teaching and Research: Rensselaer Polytechnic Institute; the Freshwater Institute.

Field Research: Water quality survey of Madison County, NY; EPA sponsored study of small New Hampshire lakes sensitive to acid deposition; water quality monitoring program, Lake George, NY.

Publications: Published over a half dozen research papers and journal articles in publications including *The Canadian Journal of Fisheries and Aquatic Science*, and *Aquatic Botany*.

Personal: Married; Dr. Roberts grew up on a farm in the Adirondacks on the edge of Lake George and is an avid sailor, camper and skier, and an accomplished runner.



(Photo: Kim Kamborian)

Faculty Profile David Neill

Senior Faculty: Ethnobotany: Uses of Plants by Native Peoples, Ecuador

Education: B.S. (Biology) The Evergreen State College; Ph.D. (Biology) Washington University; Post-Doctoral Fellow-Missouri Botanical Garden.

Teaching and Research: The Evergreen State College; Washington University; Peace Corps Volunteer, Nicaragua.

Field Research: Two botanical expeditions to Nicaragua; study of experimental hybridizations of *Erythrina* in Hawaii; tropical research at the Organization of Tropical Studies, Costa Rica; research on rainforest conservation in Ecuador.

Publications: *The American Journal of Botany* is one of several publications printing Dr. Neill's research findings.

Personal: Dr. Neill resides in Quito, Ecuador but spends much of his time at Jatun Sacha, the tropical rainforest preserve he is developing as a research station.

"Our leaders were knowledgeable and questioning scientists who could teach us twenty-four hours a day and still have more to teach."

Day Wilkes, Picayune, MS—Mount Holyoke College

Semester Program:

Biogeography: Patterns of Ecological Diversity p. 12

Summer Courses:

Tropical Deforestation: Threats to Biological Diversity p. 13

Ethnobotany: Uses of Plants by Native Peoples p. 28

Landscape Ecology: Designing Parks for Preservation p. 29

Tropical Cloud Forest Ecology p. 30

Acid Rain: Changing Aquatic Ecosystems p. 31

"The worse thing that can happen during the 1980's is not energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. As terrible as these catastrophes would be for us, they can be repaired within a few generations. The one process ongoing in the 1980's that will take millions of year to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us."

Dr. E.O. Wilson—Harvard University

More species of plants and animals are found in forests than in all other ecosystems combined. There are an estimated 5 to 10 million species on earth; to date less than 2 million have been named. Tropical rainforests are felled on a daily basis for lumber, for roads and buildings, for crops and livestock. Elsewhere, forest plant communities face threats from



(Photo: © Chip Isenhardt)

damming, erosion, and products of industrial societies such as hazardous waste and acid rain. If current rates of disruption and degradation continue, by the year 2000, nearly 20% of all species may be extinct.

Merely protecting these ecosystems is not the answer. Man must find ways to insure their self-renewal.

SFS Wildlife Ecology and Management Programs

Semester Program:

Wildlife Ecology and Management p. 16

Summer Courses:

Wildlife Management p. 17

Ecology of Bald Eagles p. 33

Study in Symbiosis: Honeyguides and Humans p. 36

Earth is the only planet we know that can support life. Growing demands from exponentially expanding human populations are diminishing Earth's life-supporting capacity. Overhunting, overgrazing and overstocking have resulted in loss of habitat for countless species of plants and animals that are critical resources as food and a means of profit in developing and developed countries worldwide.

The World Conservation Strategy defines conservation as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit

to present generations while maintaining its potential to meet the needs and aspirations of future generations." For many, including the over 800 million destitute or impoverished peoples in developing countries who, in their day to day struggle for survival, are compelled to destroy the very resources that can free them from poverty and hunger, this objective has little relevance. In other cases, the needs of one group or species may conflict with those of another.



(Photo: Geoff Levner)

There exists an urgent need, on an international basis, to make informed decisions about land use—based on optimal yield, carrying capacity and maintaining species diversity—that will insure sustainable habitat use. These decisions may result in management plans, or in refuges; all start with an understanding of ecosystem dynamics.



(Photo: Tim Stout)

The World Conservation Strategy suggests that one way to consider living resources is to "regard them as biological capital available for human use. If we use up this capital, it will no longer produce interest: food, raw materials and life-supporting services we need to survive."

Semester Program:

Marine Biology and Management p. 20

Summer Courses:

Coral Reef Ecology p. 21

Marine Parks Management p. 22

Coastal Ecology: Habitat Assessment for Monk Seal and Loggerhead Turtle Recovery p. 34

Because much—over 70%—of the earth's surface is covered by water, many people have the mistaken notion that we have a vast, almost limitless, resource at our fingertips. In reality, less than 0.2% of the earth's oceans are productive, and this resource is just as vulnerable as the land to exploitation, pollution and disturbance.

We are rapidly depleting our "capital." In recent years, overfishing has led to subsequent depletion of fish stocks and a drop in the world's fish catch. Fishing practices and industrial debris have led to death or dismemberment for countless

non-target species including sea turtles, seals, birds and fish, pushing some species close to extinction. Pollution is rendering critical spawning grounds and estuaries uninhabitable.

The research conducted by students at the SFS Center for Marine Ecosystem Studies/Virgin Islands and in SFS marine courses worldwide contributes valuable and necessary data for use in formulating management policies to insure sustainable utilization of these life-supporting resources.

SFS Animal Behavior and Conservation Programs



(Photo: Steve L. Swartz)

Most people are familiar with the plight of the whale. Hunted for over a century, larger species such as the Humpback and Blue whale were initial targets and as they grew scarce, hunters turned to smaller species. Today most whales are protected by an international whaling moratorium and some species are evidencing encouraging population increases.

Semester Program:

Marine Mammal Biology and Conservation p. 25

Summer Courses:

Endangered Monkeys: Stumptail Macaques p. 35

Social Ecology of Spinner Dolphins p. 36

Humpback Whale Ecology p. 37

Biology and Behavior of Bottlenose Dolphins p. 30

But protection isn't enough to guarantee survival for whales and other endangered species. In the century since their numbers flourished, change has been rampant in the whales' habitat. The scenario is much the same for other species facing habitat disturbance. Habitats are lost as critical grazing and mating areas are taken for commercial ventures, crop cultivation, livestock ranching and tourism; as roads bisect migratory routes; as prey are eliminated by competition from domestic species, disease, pollution or man; as animals are exported for zoos and aquaria.

Scientists are uncertain as to the impacts of habitat disruption on behavior, and thus the survival, of many threatened species. Each time a species is lost to extinction, its genetic traits, often adapted over millions of years, are lost as well. While it is critical that we understand the behavior of individual species, it is even more imperative to understand, and then protect, the habitat of these species.

Center for Rainforest Studies

Site: AUSTRALIA

Curriculum:

Semester Program

**Biogeography: Patterns of
Ecological Diversity**

Summer Course

**Tropical Deforestation:
Threats to Biological
Diversity**

*SFS gratefully acknowledges
R.J. Reynolds Industries
for their start-up funding
of this Center.*



Background

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 Asia 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. The degradation of this resource is one of Australia's most critical environmental issues. This is truly a unique area just

now being recognized for its significance. SFS students have a rare opportunity to be at the forefront of the research being initiated here. Semester participants will be among the first researchers to explore the extent to which endemic species—such as birds, possums and various marsupials—can serve as indicators of biological disturbance. Summer participants will continue this work which may eventually lend support to the creation of new protected areas for threatened species.

Research Focus

Rainforests worldwide are subject to losses from logging and from conversion of forests for agricultural purposes. Australia's rainforests are no exception. Our research efforts contribute to an understanding of the ecological processes and communities which characterize intact rainforests and which may be lost as forests are logged or fragmented. Our studies will illuminate the effects of forest

fragmentation as we investigate the possibility that key “indicator” species of marsupials such as Lumholtz's tree-kangaroo and ringtail possums, birds such as the log runner, and other species may be used to reveal the “health” of the rainforest ecosystem. In addition, we will also examine the changes in rainforest species composition and diversity which occur when the ecosystem is stressed by logging and other human induced pressures.



“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)

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 towards 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.

Living and Working Conditions

Be prepared for wet weather. The summer rainy season is November through April, and an average of one meter per month or more of rain can be expected to fall in this period. Frequent rains will be punctuated by intense sunshine. Breezes usually keep the air temperature in the 80's. When the rains are very heavy, we may not be able to get into the forests so our field work may be temporarily postponed in favor of data crunching or field trips to drier areas.



"I learned about subjects I didn't expect to like but enjoyed so much I changed my fall schedule to take related courses."

Jane Payeur, Portland, ME—University of Southern Maine
(Photo: Zadya Lundgren)

Our base is small but comfortable with modern cooking facilities, a library with 3 computers, a small classroom, a dormitory, and appliances to wash and dry our clothes. The living and study facilities are solar-powered. As it is near a small town, with only a few stores, our presence hardly goes unnoticed. Fresh fruits, vegetables, fish and meat should be available in abundance in nearby Yungaburra to embellish our culinary endeavors.

The SFS Center for Rainforest Studies is located on a tract of 153 acres of rainforest contiguous with a large state forest on the Atherton Tableland. Our site is adjacent to the region now being designated as a World Heritage Area. Approximately 30 acres are cleared, 20 acres are secondary growth, and the remaining 100 acres are rainforest. Thus students can literally conduct studies in our backyard.

On our forays into the rainforest we may encounter over 500 species of canopy trees, and an equal number of animal species including the cuscus, pandemelon wallaby, tree kangaroo, lorikeets, 2-foot long forest dragon lizards, and frogs and toads. For example, the entire worldwide populations of the five species of possum we will study can be found within our study area. Flights of up to 2,000,000 flying foxes (which are actually bats) cloud 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.



"This experience should be an integral part of every student's education whether they want to study business or life sciences. We all need to understand you cannot totally separate the worth of a Cervus elephus from yesterday's Dow Jones."

Hau Le, West Jordan, UT—University of Utah
(Photo: Zadya Lundgren)



The Center for Rainforest Studies' campus is located on a 153 acre tract of rainforest contiguous with a large state forest.
(Photo: Mark Noble)

Semester Program **Biogeography: Patterns of Ecological Diversity**

Site: Center for Rainforest
Studies-AUSTRALIA

Courses:

*Introduction to Exotic
Ecosystems*
*Population and Community
Ecology*
Environment and Society
*Principles of Resource
Management*
Directed Research

Departure Point:
Cairns, Australia

Program Dates:
September 11-December 14
February 1-May 6

Through five 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 ecosystems. We will focus to a large degree on the rainforest, but field trips to the savanna "outback" forests as well as coastal mangroves and reefs will enrich our studies.

Lecture topics will include a survey of rainforest plants and animals, historical biogeography, and the evolutionary ecology of rainforests. Many lectures will take place in the field, using the rainforest as a "living laboratory" to illustrate ecological principles. Field activities will include mist-netting birds, live-trapping small mammals, and spotlighting for animals at night.

Building on these foundations, **Population and Community Ecology** will integrate empirical and theoretical issues in contemporary ecology. Emphasis will be placed on factors that constrain the growth and distribution of natural populations, including predation, competition, parasitism and environmental variability. Hypotheses of species diversity and coevolution will be explored, placing special emphasis on the astonishing richness of rainforests. Principles of population genetics, including genetic drift, inbreeding, and the loss of allelic diversity, will be examined. Field topics will include sampling strategies for quantifying the distribution, abundance and diversity of animal populations.

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.

Human's impact upon local, regional and global ecosystems will be examined in **Environment and Society**. Terrestrial, aquatic and aerial modes of pollution dispersal (both from point and diffuse emission sources) will be investigated and illustrated with Australian examples. North American environmental risk perception, policy and pollution control technology will be considered. We will devote special attention to international crises such as deforestation, hazardous waste storage, oceanic pollution and global warming, which span international scales. The political and social context of conservation—and critical differences in the attitudes of undeveloped and developed nations—will be discussed. The design and effective use of environmental impact statements will be highlighted.

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 censuses 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 antechinuses, and determining the utility of "corridors" for wildlife dispersal. We will present our findings in a public meeting before park managers, government scientists and interested local residents.



"I'm glad I took the time and money to take part in an experience most people never have a chance to do. Knowing our data is used for national research and isn't just a 'cookbook lab experience' is really exciting."
Kimberly Kent, Augusta, NJ—University of Maryland
(Photo: Sigfried Musser)

"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

How resilient is the tropical rainforest ecosystem with respect to recovery from increasing logging demand? To address this query, SFS rainforest students will set out from our property in Yungaburra to investigate the land's cleared acreage, secondary growth region and the remaining virgin rainforest. Our first days will pass quickly as we orient ourselves to the intricacies of this 100 million year old rainforest. At first glance, we can't help notice the canopy of tree crowns towering 60 meters above and the vines and epiphytes (rootless, attached "air plants") streaming about us. At this point, our faculty become our guides, teaching us how to see beyond the obvious into the web of life that makes up the rainforest ecosystem. We will learn to look for feeding damage, feces, or even eyes peering from the foliage that indicate the presence of arboreal folivores: the lumholtz tree kangaroo, the spectacled flying fox, the spotted cuscus, and other species of possum.

Beyond learning how to identify and measure the extraordinary plant and animal diversity found here, we work to understand how it develops. What disperses seeds that eventually become towering trees? How many seedlings must be initiated before one actually survives to produce "offspring"? How linked is any one species—whether marsupials or herbivorous insects such as bizarrely sculpted treehoppers—to the occurrence of a particular vegetation type? How do trees physically and chemically defend themselves against naturally occurring disturbances? Building component by component, we begin to assemble a working perception of plant/herbivore interaction.

Lectures by faculty will address biogeographic patterns and the processes by which these diversities are maintained. Plant/herbivore interactions and the responses of both to disturbances (natural and man-induced) will be explored. The concept of critical centers of endemism will be developed for Australian flora and fauna.

Using field technologies including quadrat analyses of vegetational occurrence, timber cruising, mist-netting of birds, and home range mapping, we find there is an order to the complex diversity of life-forms surrounding us. As we census various naturally stressed sites—insect defoliation, fungal attack, tree-falls—we should find that we can predict patterns based on the occurrence of key species within each habitat.



"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)

Summer Course *Tropical Species Diversity*

Site: Center for Rainforest Studies
AUSTRALIA

Purpose: to gain insight into the diversity of plant/herbivore interactions within biogeographically unique ecosystems involving rare host plants and endemic marsupials by identifying patterns of bird and herbivorous marsupials (green and bushy tailed possum, laughing kookaburra, tree kangaroo and fluffy glider) occurrence within habitats disturbed by logging; to begin testing predictions of species recovery from forest disruption.

Departure Point: Cairns, Australia
Course Levels & Dates:

Intro: June 15-July 14

Advanced: July 21-August 19

Armed with our questions and predictions, we will travel to several of the national parks that lie within 40 km of our base. New animal species—laughing kookaburra and fluffy gliders—appear with changes in height of land, soil type or tree composition. Here we also see evidence of the large scale disturbance caused by the newcomer to the rainforest: Man. What is the relation between clearcut area and the diversity of associated plant and animal species? As we conduct replicated transects, we begin to establish whether the presences or absences of key species serve as indicators of the magnitude of disturbance.

In the last few days of the course, we will compile a report from our team research and will share the results with park managers and government scientists.

"If I were approached a year ago and asked about my summer I probably would have smiled and given a general 'good.' This year was different. This summer with SFS, I did something important."

Tim Yarrington, Westfield, NJ—
Westfield High School

"Based on my daughter's experience, I recommend SFS with unqualified enthusiasm. Here is an intellectual challenge, even a spiritual opportunity, to care about threatened environments and learn how to make a difference."

Donald Abbott, Headmaster, Millbrook School,
Millbrook, NY

Center for Wildlife Management Studies

Site: KENYA

Curriculum:

Semester Program

Wildlife Ecology and Management

Summer Course

Wildlife Management

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, 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 seemed a radical solution: the practice of game ranching, in which populations of native species of ungulates (hoofed mammals) are strictly managed in a protected environment and periodically cropped to be used as food.

Substituting native wildlife species for domestic cattle offers an ecological alternative that lowers water and energy demands, and allows more protein production per acre than crop farming in East Africa, potentially leading to increased food production. Yet game ranch-

ing itself may pose ecological threats. How do harvested populations differ from natural herds? Only carefully coordinated research including populations 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.



"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)



"I learned a lot, but most of all, I learned I have the strength to accomplish what I set out to do. Now I have to find a job and my SFS experience has influenced me to go into conservation. I know it's not an easy field to get into but our world is too beautiful to waste. If I can help, I will."

Marguerite Martini, Hillside, IL—Mundelein College
(Photo: Sarah Lamport)

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 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 interrelation-

ships of climate, physiography, vegetation, and animal life.

Our base of operation will be "International Wildlife Ranching and Research, Ltd.," established by Dr. David Hopcraft, a Cornell University graduate, as an experimental game ranch. Here a variety of large mammal populations are protected, carefully monitored and ranched. Situated approximately 40 kilometers south-east 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 regu-

lar cropping regime. In our seventh consecutive year of research in Kenya, we will assist in analyzing criteria that are crucial to game ranch management.

For example, how are plant defenses—such as thorn production—induced following feeding by ungulates? What decisions do giraffes make in selecting foraging locations and preferred plant species? To what extent do the reproductive rates among the ranch's wildlife population vary from year to year?

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 to 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. Two kilometers away is a laboratory. 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.



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: Jack Shea)



"It's inspiring to know that there are at least 16 other people in the world who feel the same way and want to make a difference."
Jafray Phillips, Weston, MA—Amherst College
(Photo: Nelson Holmes)

Semester Program: *Wildlife Ecology and Management*

Site: Center for Wildlife
Management Studies, KENYA

Courses:
Wildlife Biology
*Population and Community
Ecology*
Environment and Society
Cultural Ecology
Directed Research

Departure Point:
Nairobi, Kenya

Program Dates:
September 11-December 14
February 1-May 6

This 13 week semester program is designed to allow students to compare aspects of game ranching with the management of preserved herds as a promising experiment in wildlife management while studying the theory of wildlife ecology. Through a series of four 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 justifications for various conservation strategies.

Wildlife Biology will orient us to the major vertebrate groups of East African savannas through a discussion of their evolution and ecological requirements. Ungulate population biology will be emphasized and the physiological and behavioral ecology of individuals and natural social groupings will be explored thoroughly. The field and laboratory portion of this course will take place at the Ranch and in various National Parks including Masai Mara Game Reserve and Nairobi National Park. This portion will cover field identification of common birds and mammals, classification of social groupings and behaviors, demonstrations of ungulate anatomy and parasitology, techniques for capturing organisms and standard techniques for population sampling. We will also spend a week near 16,000 foot high Mt. Kenya where daily lectures will focus on geomorphology, glaciology, and the various plant and animal species living at different altitudes along the mountains.

Population and Community Ecology is our second core course. Models of population dynamics form the basis for investigating interactions between populations of different species, including competition, predation, parasitism and mutualism. Coevolutionary aspects of these relationships will be discussed with emphasis on plant-herbivore and parasite-host interactions. We will apply many of these theoretical concepts to field situations, making use of a wide variety of plants and animals as subjects for study.

Cultural Ecology will introduce us to the varied cultural heritage of Kenya. We will review the East African evidence for human evolution and concentrate on the traditional cultures of major indigenous small tribes of the area. The social, political and economic impact of the colonial and post colonial era will be examined. Historical relationships between indigenous peoples and their natural resources, particularly land and wildlife, will be explored in depth. The course will consist of classroom lectures and field trips to areas or events of particular cultural interest including Masai villages.

Environment and Society will allow us to synthesize information on wildlife biology, ecological and evolutionary principles and human cultural, political and economic forces into a general understanding of the role of people in the environment and their options for conserving the unique species and environments of East Africa. Our safaris will allow us to examine a number of approaches to land utilization and their

impact on the natural communities of organisms. We will discuss the goals of various conservation programs both globally (such as the World Conservation Strategy) and locally, and justifications for these goals. The course will present options for preservation, from the level of the individual organism to entire ecosystem. Management required at each level will be emphasized. Students will be exposed to elements of environmental impact statements.

Directed Research, the program's capstone course, builds on the other four 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, basic statistics, the interpretation and communication (graphic, written, and oral) of research findings.

Actual field research, consisting of group projects, begins during the fourth week. Six to eight students work together building on previous SFS studies of plant/herbivore interactions in general and of ranch ungulate response to rangeland vegetation in particular. Directed projects allow students to explore key tangents of wildlife behavior, forage plant population dynamics and distributional ecology.

Field work will take place within the 30 square mile Ranch enabling us to conduct studies across a broad spectrum of habitats. The laboratory and slaughterhouse on the ranch will facilitate our investigation of the form and functioning of keystone species.



"Bandas"—thatched roof huts, will serve as our living quarters at the ranch, where we will also have an opportunity to get to know some of the local people who work here.
(Photo: Reed Stewart)

After meeting in Nairobi, we will head 40 kilometers southeast through the rolling savanna to our research site, Wildlife Ranching and Research, Ltd., an experimental game ranch. The ranch spans 81 square kilometers of open savanna, offering habitats to an enormous range of African wildlife, several species of which we are likely to see on our initial approach to our camp.

Arriving at the ranch, we will stow our gear in bandas, the thatched huts that will serve as our homes when we are not conducting off-ranch research. We will begin with discussions on the major wildlife management objectives of the ranch and learn about the cropping methods used here.

Rising early each morning, we will travel either by foot or in landrovers to specific sites in the ranch to begin our field survey. By careful observation we will collect detailed population records for wildebeest, gazelle, zebra, and giraffe. We will also monitor food preference, the ratio of males to females and pregnant females. Though not subjects of our research, we may see cheetahs, spotted hyenas, aardvarks, and warthogs during our days in the field, where the shade of intermittent acacia trees is always a welcome sight.

Each Tuesday night, ranch personnel ride out to conduct their cropping regime. Their return with fresh carcasses provide us with a superb opportunity to study anatomy and morphology firsthand. From stomach content analyses compared to our assessment of local forage availability, we can determine food preferences. With these data, we will conduct a survey of forage plant distribution and the water content of these plants. Advanced course teams will also study evolutionary relationships of the Athi Plain biota from a systematic approach.

An introduction to East African ecosystems, general principles of ecology, ungulate taxonomy and identification, and the principles of game ranching will be provided by faculty and guest lecturers. Faculty will also present advanced lectures on wildlife parasitology, ungulate social systems, the role of parks in wildlife conservation and the economics of game and cattle ranching.

Actual field research, consisting of group projects, begins early in the course. Six to eight students work together building on previous SFS studies of plant/herbivore interactions in general, and of range ungulate response to rangeland vegetation in particular. Directed projects allow students to explore key tangents of

Summer Course Wildlife Management

Site: Center for Wildlife Management Studies, KENYA

Purpose: to compare the population dynamics and water conservation strategies of large mammals (gazelle, giraffe, wildebeest, and zebra) in hunted populations on a game cropping ranch with those of protected populations in national parks; to assess the long term implications of game ranching as a wildlife management technique.

Departure Point: Nairobi, Kenya

Course Levels & Dates:

Advanced: June 15-July 14

Intro: July 21-August 19

wildlife behavior, forage plant population dynamics and distributional ecology.

Research conducted by previous SFS teams determined that species have different abilities to withstand drought and may be affected differently by cropping in wetter and dryer years.

Field trips outside the Ranch will take us to some of the more spectacular Kenyan parks. These may include Lake Nakuru to study flamingo population dynamics; Masai Mara Game Reserve to observe the annual migration of over one million wildebeest; Nairobi National Park to compare our data on species populations with park data, or we may climb Mt. Kenya's Teleki Valley to examine key elevational gradients established by extremely unusual highland plant species.



"Trying to find answers to complicated issues forced me to be more than a camera-happy tourist. My experience gave me a valuable perspective on how my college studies can be applied to the real world."

Day Wilkes, Picayune, MS—Mount Holyoke College

(Photo: Bob Singer)

"Well, to put things in perspective, on my application to John Hopkins Medical School, I was asked to describe the most positive experience of my college career. I chose my SFS course."

Michael Boyle, Gaithersburg, MD—University of Maryland



Center for Marine Resource Studies

Site: St. John, VIRGIN ISLANDS

Curriculum:

Semester Program

Marine Ecology and Management

Summer Courses

Coral Reef Management

Marine Fisheries:

Threatened Tropical Resources

Background

The Virgin Islands and their surrounding waters offer us an unparalleled classroom/laboratory in which to study marine resources. We have the unique opportunity to live and work within the Virgin Islands National Park, the only Biosphere Reserve in the Lesser Antilles. Throughout the Caribbean, tourism and development are exerting extreme pressures on the linked and delicate coastal ecosystems. Even around protected Park waters, there is evidence of damage and loss of vital habitats.



"Now I can go to college more confident that I could happily spend my life doing marine biology."

Brenda Gregory, Reeds, MO—Sarcoxis H.S.
(Photo: Chris Neefus)

Tourism to the Virgin Islands National Park has increased dramatically in the last 10 years. It is estimated that more than 30,000 boats anchor within Park waters each year. This problem is of major concern due to the serious damage caused by the boats in coral and seagrass habitats. A new problem is the increasing number of mini-cruise ships whose anchors may cause even larger scars.

The entire coral reef complex is a hub of productivity amid relatively unproductive tropical oceans. Coral reefs protect shores and harbors from erosion and wave action and provide a spectacle for tourists that has tremendous economic importance in many communities. Coral reefs provide a habitat for over one-third of all fish species, ensuring an important source of protein for humans.

Not only are reef ecosystems limited in size and number, they're extremely fragile. Disturbing one component can disrupt the entire system. Worldwide, the ecosystems are being seriously impacted by oil, sewage, toxic wastes, dredging, development and overfishing. Algal encrusted skeletons of reefs are often all that remain of once productive communities.

Fishing is an economically important industry throughout the Caribbean. Yields from the fishing industry have recently dropped, indicating that local fisheries are being rapidly depleted. Additionally, several species of normally edible fish are being eliminated from consideration as a food source as it is impossible to determine which individual fish carry ciguatera (unusually high levels of toxins which can have lethal effects on

humans who eat these "poisoned fish").

It is essential that management plans dedicated to sustaining what is left of these valuable resources be updated and improved by new research. SFS students can make a significant contribution toward addressing this problem as they census commercially harvestable fish, lobster and conch populations. By analyzing existing policies, and exploring local attitudes toward fishery management, they can assist in developing suitable guidelines for further uses of these valuable resources.

Research Focus

We will focus our efforts on assessing the impacts of sedimentation and anchor damage on marine ecosystems, as well as the population structure of species threatened by over-fishing. Snorkeling and SCUBA diving will be used to conduct our research. Diving for research purposes is markedly different from recreational diving. SFS students can look forward to learning SCUBA techniques with scientists and the opportunity to appreciate and understand the underwater world from a scientific perspective.

Critical areas within the park will be carefully mapped and the structure of the coral communities documented. Students will also have the opportunity to contribute to our long term study of conch populations or investigations of lobster fisheries in the near-shore Caribbean waters. Our results will be utilized by the National Park Service and other resource managers to help determine appropriate future management strategies.



VIERS is a rustic and isolated research station; a short walk brings you to the turquoise waters of the Caribbean or to a mangrove marsh or to an encounter with a herd of wild donkeys.
(Photo: Wendover Neefus)

Site

The Virgin Islands lie at the eastward edge of the Greater Antilles chain of Caribbean Islands. The environments of these tropical paradises vary from lush green forests to dry, desert-like terrain. All are characterized by sandy beaches, mangrove swamps and quiet lagoons created by the extensive coral reefs that usually fringe each island.

The majority of our research will be done on and around the island of St. John. St. John is among the least developed, and many say the most beautiful, of all the Virgin Islands. Because of its relative isolation and lack of development, St. John's resources have not yet been impacted by tourism to the extent suffered by other islands. Not only is this an ideal location in which to conduct our research, our efforts here can help preserve precious remaining resources.

Our home base will be the Virgin Island Ecological Research Station (VIERS). VIERS is a small and rustic field station, several hundred yards from the shores of Lameshur Bay. Owned by the University of the Virgin Islands, VIERS is completely surrounded by miles of undeveloped National Park land, which

lends to the isolation of our site. VIERS has been the site of eight years of SFS research.

From the VIERS dock at the water's edge we will head out daily into our natural laboratory. The clear waters of Lameshur Bay teem with activity. More than 300 species of brightly colored fish have been identified among these reefs. Each species—from the algae eating parrotfish and iridescent blue tang surgeonfish to the nocturnal, crab-eating squirrelfish and yellowtail snapper—plays a vital role in the functioning of the sensitive coral reef ecosystem.

Living and Working Conditions

Arriving at St. John we are confronted with a kaleidoscope of color—turquoise waters, white beaches, lush tropical vegetation—and that's just the view from shore. Set among palm trees only a few hundred yards from the ocean, VIERS provides us with basic living and research facilities including small screened bunkhouses, a dining hall and classroom (none of which are impervious to heat, humidity or small insects), as well as a laboratory and library with computers for our use.

Although quite rustic, the site has electricity and outdoor showers. The mean annual temperature is 79° F, ranging from extremes of 63° F to 95° F. Water shortages are frequent so our showers and general water use may be restricted.

As there are no longer any local agricultural or commercial fishing industries on St. John, we must import all of our food and supplies including fruits and vegetables (when available). This situation offers us a daily reminder of the past mismanagement of island resources. Meals will be prepared by VIERS staff, many of whom can offer insight into the intriguing West Indian culture that abounds around us. SFS students assist with clean-up and other efforts that contribute to camp maintenance.

Note: Students are responsible for providing/renting their own SCUBA equipment.



"I gained something I could never get from a textbook, a deep seated respect for the environment. The beauty of the Virgin Islands did more than impress me visually, it showed me why people are trying to protect the natural resources we have left."

Scott Rice, Virginia Beach, VA—Virginia Tech
(Photo: Chris Neefus)



Semester Program *Marine Ecology and Management*

Site: St. John, VIRGIN ISLANDS

Courses:

Tropical Marine Ecology

Principles of Resource

Management

Cultural Ecology

Directed Research

Departure Point:

VIERS, St. John

Program Dates:

September 11–December 14

February 1–May 6

Through a four course sequence, SFS semester students will investigate firsthand the scientific, economic, political and historical issues involved in managing marine resources in the Virgin Islands.

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 fieldwork 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 essential skills of underwater data collection, computer aided data analysis and report writing. The fieldwork will include supervised snorkeling and SCUBA exercises designed to investigate the distribution and interactions of near-shore marine organisms.

In **Cultural Ecology**, we will study the history, economics, politics and human cultures of the Caribbean and relate these factors to the management and preservation of the marine environment. We will investigate societal development and structure, documenting how the ocean and its fisheries have been incorporated by those insular cultures. Lectures by faculty and guests will illuminate factors underlying recent political and cultural developments, alien-immigration issues and the effects of major industries, such as tourism and oil shipping, on the region's economy and culture. We may conduct limited field surveys within the local communities exploring attitudes regarding fisheries, development, tourism and conservation issues.

In **Principles of Resource Management** we will develop an international focus on sustainable resource use, environmental risk assessment and conservation practice. Critical case studies will introduce effective and ineffective management practices within a variety of arenas including fisheries, forests and other agro-ecosystems. Special attention will be focused on the management of the Caribbean fishery resource and problems

faced by the National Park Service in establishing and enforcing environmental protection policies under various types of park use. We will also consider environmental problem solving on both local and global scales. Economic and biological models for yield optimization, steady state dynamics, diversification/multiple use strategies will be presented. Additional topics for discussion include environmental policy and regulation, cost/benefit analysis, pollution control and biotic reserve design.

The **Directed Research** component of our program will complement our overall objective of quantifying the impact of fisheries and tourism on the National Park ecosystems. The opportunity to integrate perspectives developed in the preceding courses becomes evident here as students work with faculty to design independent projects from well 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. Research topics may include the role of human induced stress on the diversity and structure of reef communities, changes in conch populations size and distribution, the impacts of boat damage on coral and seagrass communities. Results will be presented orally to the group and to guest speakers at a seminar and will also be submitted to the National Park Service.

Note: SCUBA certification will be provided.



Participants in the semester program have a unique opportunity to conduct comparative research during a two-week sail to investigate the coral ecosystems of neighboring islands. (Photo: Deb Roberts)

"The measure of the success of SFS courses 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 later measure, I think they are enormously successful."

Claudia Polsky, New York, New York—
Harvard College

The likelihood that a coral reef community will survive depends on how resources are divided among its component species. Intense competition for the two most vital resources, food and space, has led to a high degree of adaptation or specialization among the coral reef inhabitants. 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.

Our ongoing studies of natural and man-made stresses on coral reef structure and function will continue in the blue waters surrounding St. John. This summer we will focus our efforts on determining the impacts of boat anchor damage on coral communities in both high and low use areas in the park. Reef areas will be carefully mapped to determine the best locations to allow boat anchoring or for moorings to be established. In other areas, both transect surveys and photo surveys will be used to determine the community composition and coral diversity with respect to physical characteristics of a site such as sedimentation rate and water movement. These data can also serve as a baseline for long term studies to detect responses in the reef environment to increased or decreased stress. Questions we will address will include: Are the species and size of coral colonies influenced by sedimentation rate? Can particular areas be designated for boat

anchoring that will result in less damage to coral communities? Which corals are most readily damaged anchors or by divers?

Upon arriving at VIERS, we will spend our first week taking a full SCUBA certification course. Diving into the turquoise waters gives one entry into another world where a spectacular array of fluorescent fish dart between brightly colored corals, sponges and other invertebrates. The first step in our research will be to learn the identities of all of the organisms on the reef. This will involve underwater instruction and slide presentations to learn all of the species' names. Second, we will learn how to measure the reef environment using quadrats and transect tapes.

At the same time we are learning field research techniques, the faculty will introduce the essential theories and facts on how the reef functions. Introductory lectures will focus on oceanography, invertebrate zoology, and the distribution, structure and function of coral reefs. Subsequently, we will discuss nutrient cycling, pollution impacts and the implication of various management strategies. An important component of the course will address the theory and case histories of stress-induced change on coral reefs.

Our data collection will commence with visits to sheltered sites within Lameshur Bay. Using SCUBA and snorkeling techniques, we will survey reef areas and document evidence of disease and diver

Summer Course Coral Reef Management

Site: Center for Marine
Resource Studies
St. John, VIRGIN ISLANDS

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

Departure Point: VIERS, St. John
Course Levels & Dates:

Intro: June 18–July 17

Advanced: July 24–August 22

damage. At this point, our identification skills become essential for accurate data collection. After long periods of underwater observation, we can begin to understand the effects of these stresses in Lameshur Bay. Some of our work will involve repeated surveys in order to determine if there are any changes over time, and to determine if the reefs are deteriorating.

Each student will have the opportunity to undertake a directed research project that will complement our ongoing studies of stress on the reef. Potential topics for student projects include a comparison of the variation in size and abundance among species of coral at various reef sites receiving different sediment loads or an investigation of the extent of damage by boat anchoring in different sites.

Back at VIERS, we will use computer facilities to analyze our data. Each student will summarize their data into a scientific paper which will be combined into a single report on coral diseases, diver damage and stress on the reef. Our results will be presented to resource managers at the National Park Service, and will form part of our ongoing data base which we hope may give insight to monitoring programs on Virgin Islands reefs.

SCUBA Certification will be offered at the Introductory Level for a \$150 fee. Advanced level participants must be SCUBA certified. Note: Students must provide their own SCUBA equipment.



"Everyone works together and there's always someone who is just as exhausted as you who will gladly give you a boost and a shoulder to lean on." Perri Wexler, Dunedin, FL—College of Wooster (Photo: Erin Block)

Summer Course

Marine Parks Management

Site: Center for Marine
Ecosystem Studies
St. John, VIRGIN ISLANDS

Purpose: to quantify impacts of increased boat traffic (e.g., anchoring damage) upon the coral reef and seagrass communities in general and specifically upon the potential sustainable harvest of the Queen Conch; to assist the St. John National Park managers to formulate management plans for such pristine yet threatened ecosystems.

Departure Point: VIERS, St. John
Course Levels & Dates:

Advanced: June 15-July 14

Advanced: July 21-August 19

The conch and lobster fisheries on St. John have become so depleted that the Park Service now prohibits conch fishing entirely, and is considering adding on to the already strict limits on lobster. Additional plans are to limit boating by prohibiting anchoring in the Park, and allowing boats on only limited moorings. These limits will drastically alter currently impacted seagrasses. Resource managers lack the scientific data base necessary to set limits that provide sustainable yields. It is the goal of SFS to provide some of the data required to generate these limits.

How abundant are populations of conch? To what extent does the population size and growth rate vary with location, intensity of fishing pressure, habitat type or physical variables? Anchoring by touring boaters damages turtle grass and coral. How many boaters are too many? How do we set and enforce limits on visits to nearshore waters?

Our first dives from the VIERS dock will enable us to check our SCUBA equipment, sharpen our diving skills, and explore the turquoise waters of Greater Lameshur Bay. On our initial dives we will identify distinctive species of colorful fish and invertebrates that surround us. Many classes will be conducted underwater to enable us to learn the local flora and fauna. Dividing into pairs, we will utilize hand slates while surveying the "coral garden" nearshore to compare species distribution with respect to depth, turbidity, and wave action.

Students will work on three ongoing group research projects: 1) population studies of the Queen Conch, *Strombus gigas*, to determine the maximum sustainable yield of this important fishery, 2) determination of the impact of boat anchoring on growth and distribution of seagrasses, and 3) studies of coral diversity in damaged and unimpacted areas to assess the recovery rate of reef communities from perturbations.

Our first effort will be to map our area of interest, taking measurements using numerous compass bearings. We will then put to use the information we received at the start of the course to identify and count the community of organisms inhabiting our study area. Long dives to carefully document behavior and interactions by conch or fish with other organisms will be brightened by the colorful panorama of marine life before us.

Students interested in anchor damage will identify the anchor of a pleasure boat in Lameshur Bay. When the boat departs they will measure the anchor scar left behind. Frequent measurements over a period of several weeks will allow us to determine if the scar grows or recovers.

Lecture material will cover principles of population growth and control,

reef ecosystem dynamics, resource planning and management theory. Between dives, faculty will present lectures on food chain dynamics, statistical interpretation and the ideals and actualities of fisheries management. Guest lectures—including U.S. Park Service managers—will speak on marine resource management.

Additionally, each student will undertake a specific piece of directed research. Examples of directed research topics include: "Population size and movement of queen conch," and "Colonization of anchor-damaged substrates on coral reefs." As the course draws to an end, students will write up their projects and present them orally to the rest of the group. Written reports will be presented to the National Park Service resource managers who are seeking information such as this to help formulate effective management policies to insure the long-term stability and conservation of the coral reefs while still permitting use by tourists and fisherman.

Note: SCUBA certification is a prerequisite for this course. Students are responsible for providing their own SCUBA equipment.



"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 Zoeller, Lansing, MI—University of Michigan
(Photo: Chris Neefus)

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 that surround 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, man 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.

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, further stressing marine food webs.

For centuries the Baja peninsula was nearly inaccessible. 1973 marked the opening of a highway from its US 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 ongoing 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 marine mammals in the face of growing conflicts between renewable resources, wildlife management and human behavior.

Site

Jutting south 800 miles from its border with California, Mexico's Baja



"I actively investigated almost 30 other programs before choosing SFS. I expected the experience of a lifetime, I was not disappointed."
John Beck, Grand Rapids, MI—Hillside College
(Photo: Steve L. Swartz)

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 Heermann's gulls.

Marine Mammal Studies Program

Site: Baja, MEXICO

Curriculum:

Semester Program

*Marine Mammal Biology
and Conservation*

Human presence is noticeably absent here. The few large cities and resort areas are separated by miles of rural coastline. Most of the inhabitants of the southern peninsula live in 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 harbor seals, California sea lions, bottlenose dolphins and Gulf Harbor porpoise. These waters also comprise key migration routes of gray whales, blue whales, false killer whales, fin and Bryde's whales and elephant seals.

Research Focus

In order to manage human activities for the benefit of both ourselves and marine mammals, it is essential that we understand the natural history and habitat requirements of each species within the Gulf of California. Our field work will directly contribute to and support ongoing work of Mexican marine mammalogists 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 is the reproduction and survival rate of seal pups? We will use photo-identification to study individual variations in movement and behavior.

Living and Working Conditions

The planned SFS Center at Bahia de los Angeles, on Baja's Gulf coast, will provide rustic living accommodations, a field computing facility and a small field library. Nearby are an extraordinary array of marine mammals and their habitats. On field expeditions we will camp in tents and cook over portable stoves and mesquite fires. Our travels will take us into desert terrain, to the Pacific coast gray whale breeding grounds, and to meet with other researchers in the town of Guaymas.

Weather in Baja can be unpredictable, especially during the winter when rainfall varies extensively. Winter temperatures range from the 70's F. to the 50's F. Summers are hot and the Pacific coast is often shrouded in fog, while the Gulf coast remains clear. Restricted water supplies require us to plan fresh water consumption carefully.

"I wanted to go on an exchange program but as a biology major it would just slow me down if I took time away. Reading the SFS brochure, I was convinced someone had designed this course just for me. I could travel, study an endangered species and get credit at the same time."

Patrick Zoeller, Lansing, MI—University of Michigan



"When I saw dolphins for the first time I remember thinking, 'I'm really out here looking at these spectacular animals within arms length!'"
Yvonne Kosten, Redwood City, CA—Canada College
(Photo: Bob Singer)



"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)

This 13 week semester program consists of five 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 their 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 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. The local ecosystem thus 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 they design independent research projects focusing on the behavior and ecology of marine mammals in the wild. These projects will support ongoing research by Mexican Marine Mammalogists 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, data analysis, and marine mammal identification at sea, to test these hypotheses.

Semester Program: *Marine Mammal Biology and Conservation*

Site: La Paz, Baja, MEXICO

Courses:

Marine Mammal Biology
Principles of Resource
Management
Cultural Ecology
Directed Research

Program Dates:

September 11-December 14
February 1-May 6

Finally, we will work on the communication of research results. Potential student projects include creating a photo-id catalogue of whales, determining water depth preferences of different species, investigating the association between marine mammals and marine birds, determining differences in the care given to pups by mothers at different ages, and assessing whether vigilance behavior of sea lions is affected by group size and approach of boats.

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



"I had begun to feel that I had chosen the wrong field. I wasn't sure how I could survive all the courses necessary to get a marine science degree. Now, when I get down in the dumps from too much work, I think back on my SFS course and get a new perspective on everything."

Lisa Steiner, Two Rivers, WI—University of Miami
(Photo: Steve L. Swartz)



Center for Northern Studies

Site: Wolcott, VERMONT

Curriculum:

Semester Program

The Changing Environments of the Circumpolar North

Departure Point:

Wolcott, Vermont

Program Dates:

September 7-December 14
February 6-May 19

We gratefully acknowledge the Boston Globe Foundation for their support of this program.

Background

Approximately one-sixth of the earth's land surface—10 million square miles—lies within the Arctic and Subarctic latitudes. Encompassing all or parts of eight nations, this vast territory, known as the Circumpolar North, includes an entire ocean, the world's second largest ice cap, and innumerable straits, bays and mountain ranges. A mere one percent of the Earth's population inhabits this wilderness yet these numbers include many of the viable surviving non-western cultures. The geologic and biologic resources hidden here could support much of the world's population for years to come.

It is these resources—some of the world's most productive fisheries, vast fields of coal, oil and other minerals, immense herds of mammals, and potential bases for military technology—that will vault the far north into the public eye and controversy in the decades to come. The ultimate resolution of issues including the role of the state in procuring power from the North, the rights of native peoples, air and water pollution under Arctic and Subarctic conditions, the welfare of stocks of mammals, and the location of military operations will impact our day to day lives and those of future generations.

Students have a unique option within this program to participate in an integrated two semester curriculum or to participate in one semester program.

The Center for Northern Studies was founded in 1971 by a small group of scholars who recognized the pressing international need for active research on the largely unexplored arctic and subarctic regions. As the only educational institution in the United States offering a comprehensive undergraduate program in Northern Studies, the Center's curriculum provides broad based training in theoretical and practical natural resource management research and policy. This curriculum provides a case study of the circumpolar north while preparing graduates to deal with resource management issues worldwide.

The natural world we see exists in time on a number of scales. The waxing and waning of glaciers and the slow change of the earth's climate mediate migrations and extinctions of plants and animals, force changes on humans, while altering the shape of the land itself. Much shorter term changes are often caused by living organisms themselves (e.g., insects and fire profoundly alter forests and rangeland). Humans are responsible for many of the shorter term changes, either directly in the case of agriculture and urban construction, or indi-



"Our lectures, discussions and debates brought to my attention concerns, challenging me to acknowledge and evaluate my individual actions upon society and nature. This heightened awareness forced me to accept greater moral responsibility for my conduct."
Jean Fang, Burr Ridge, IL—Cornell University
(Photo: Chris Fastie)

rectly in the case of introducing exotic organisms or altering the climate. Northern regions are particularly sensitive to change. Our programmatic theme is the changing environment, over years, decades, or millennia. Particularly important for a resource manager to understand is not only historical change but also to be able to see/uncover current changes, and through the past and present, be able to attempt predictions of future change.

Site

Located 30 miles south of the Quebec border, the Center for Northern Studies is nestled on the outskirts of the rural Vermont village of Wolcott. This natural subarctic laboratory is climatically and biologically comparable to Leningrad and Anchorage.

Students arriving for the fall semester will witness one of nature's most colorful panoramas as the lush green summer foliage assumes autumn hues. Deep green conifers provide contrast to blazing yellow and orange sugar maples. Winter can be experienced to the fullest here—as we ski, hike or snowshoe within the Center's 300 acre preserve, sightings of moose, sable, snowshoe hare, and even an occasional bear, will be common. Numerous northern bird species—three toed woodpeckers, loons, goshawk and northern ravens—appear throughout the landscape.

The nearby Green Mountains to the west and White Mountains of New Hampshire to the southeast maintain their snowcaps well into May. In March, precipitation coupled with the melting icepack results in omnipresent mud that can challenge even the most optimistic spirit. We are compensated when spring arrives at month's end. The land seemingly awakens, changing daily as larch and aspen refooliate, and ladyslippers and trillium appear on the sun-drenched forest floor. Patches of cotton-grass, Labrador tea and other heaths color the landscape.

The Center is housed in a wooden building on the edge of our study area. Facilities include seminar rooms, a laboratory, darkroom, computer room, and herbarium containing over 10,000 specimens from polar regions worldwide. Included in the library's ample holdings are more than 70 polar journals and periodicals, an outstanding collection of maps, reports and volumes relating to polar research and exploration. Students will live in homes nearby in groups of 5 or 6, sharing responsibilities for housekeeping and meal preparation. From this base we can conduct our field studies in both the boreal forests of the surrounding mountains and set out on extended field trips to Labrador, Quebec, or other subarctic regions.

Summer Course

Ethnobotany: Uses of Plants by Native Peoples

Site: ECUADOR

Purpose: to identify and collect plant specimens from the tropical rainforest containing active ingredients with pharmaceutical properties unknown to modern medicine; to help document the traditional medicinal knowledge of the Yumbo Indians now endangered by cultural changes.

Departure Point: Quito, Ecuador

Course Levels & Dates:

Intro: June 15-July 14

Advanced: July 21-August 19

Today, only one sixth of the rainforest's 3 million species have been identified. The greatest storehouse of information about the 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. In Ecuador, modern ways have reduced the Indians' dependence on folk remedies, and these age-old traditions are being lost. Socioeconomic upheavals are altering tribal structure, relocating people and destroying traditional folk ways, while deforestation is eliminating vast numbers of rainforest species at an alarming rate.

With the assistance of a Quichua Indian informant, we will identify and collect samples of diverse and little-known species from the tropical rainforest. We will investigate the traditional importance of these plants. What plants are of medicinal importance, and what are the active pharmaceutical ingredients? What is the distribution and abundance of these plants? How do the tribal cultures use and prepare these plants? What are the ancient customs and controls in the use of botanical knowledge? Answers to these questions will require techniques of both botanical and anthropological investigation.

Our base camp will be at the Reserva Biología Jatun Sacha, about 8 km ESE of Misahualli along the Rio Napo, only 1 degree south of the equator. During the first half of the course, our focus will be on the primary rainforest. One can expect almost daily encounters with mud as we hike through low-lying areas to our study site. Here we will collect herbarium specimens from undergrowth overshadowed by huge trees cloaked in epiphytic orchids, ferns and lianas, culminating in a deep lofty canopy towering 60 meters above us. We will conduct systematic transects to document the diversity of endemic and often previously undescribed species of plant life in this region. These "voucher specimens" will be prepared for identification and analysis at our base camp using specially made plant presses. During the second half of the course we will travel by motorized dugout canoes along the Rio Napo to reach Quichua Indians knowledgeable in the use of rainforest plants. Our informant will lead us into the forest on collecting expeditions, and will share with us Quichua conceptions of health, disease, anatomy, physiology, and supernatural influences. We can then contrast Indian knowledge and classification with the systematics and taxonomy of classical botany.



"What you get out of SFS is not just college credit and knowledge, but an understanding of why we are here and what we can do to help each other and the whole world."

Mark Skainy, Needham, MA—Paul Smith's College

(Photo: Julie Schwantes)

Faculty lectures will discuss the cultural history of the indigenous people of Ecuador, the botanical explorations of the early European explorers, the use of plants by indigenous tribes, and the taxonomy and physical adaptations of major plant groups. Advanced lectures will cover the biochemistry of plant alkaloids, the isolation and concentration of active plant products, introduction of ethnobotanical and anthropological methods, and descriptions of impacts of deforestation on people and plants.

Individual directed research projects will consider such questions as, what are the major biota within various levels of the primary forest? What factors threaten the survivorship of such unusual peoples and their culture? What are some of the important determinants of speciation across the divergent areas of Ecuador? Our results will be presented to the United States Agricultural Research Service and the Ecuadorian Government, and our plant specimens will go to the University of Chicago for further documentation.

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, when most of the rain falls, can be cool requiring a warm sleeping bag. Our primitive 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. Our tents will be pitched on platforms to keep out rain and the ever present mud. Our close proximity to the river makes bathing each day easy. We will purchase food in Misahualli and prepare our daily meals in a covered outside kitchen.

This course will be offered during January Term. Please contact the Admissions Office for details.

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. 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 how "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 (determined from aerial photographs and data from private and public resource organizations). 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 reaching 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 several areas on the Western slope and Front Range to determine types and distribution patterns of selected wildlife and then carry out systematic transects to map the 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 also travel to the spectacular San Luis Valley and the grasslands east of Chama and the San Antonio Peak in New Mexico. Comparing several study areas will add to our knowledge of the critical features of large mammal habitats and the relationship between the area of a particular ecosystem and type and diversity of species it will support.

Students will carry out directed research projects based on their own 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? How do various species differ in their habitat area requirements? 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 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

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

Site: Colorado and New Mexico
ROCKIES

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 large mammals in the Rocky Mountains; to initiate the development of a biological preserve system for Colorado to support and protect the state's wildlife.

Departure Point:
Denver, Colorado

Course Levels & Dates:
Advanced: June 18-July 17
Intro: July 24-August 22

our personal views about conservation and wildlife protection.

Weather conditions will range dramatically from mid-day heat to night-time 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 light-weight tents and outdoor equipment, facilitating our ability to create secondary camps as needed. We will prepare our food over campfires, and share camp chores.



"I thank SFS and my scholarship donors for a very special opportunity. We did a lot but there's still more to do. I'll be out there in the middle of the night, because, thanks to SFS, I've decided what I want to devote my life to!"

Michelle Boucher, Brockton, MA—Smith College
(Photo: Karen Josephson)

Summer Course

Tropical Ecology: The Dynamics of Deforestation

Site: COSTA RICA

Purpose: to determine the reproductive success and pollination rate of key plant species in deforested areas of varying size; to assess how rate of regeneration affects the genetic diversity of disturbed species in a tropical rainforest.

Departure Point:

San Jose, Costa Rica

Course Levels & Dates:

Advanced: June 15-July 14

Intro: July 21-August 19

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

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 on Earth, 3 million exist only in rainforests and only a sixth have been identified. Just as scientists are beginning to unveil their secrets, rainforests are being destroyed at a rate of 25-50 acres a minute.

In 1900 over 90% of Costa Rica was covered by forest; today that area has been reduced to less than 35%. Each day plant and animal species that have yet to be identified are lost forever. Little is known about the environmental conditions that must exist to allow deforested areas to regenerate. What happens to the biological integrity of a tropical rainforest when its area is significantly reduced? At what critical size does its regenerative capacity fail? Which species are more likely to be lost? Our research will focus on a comparison of reproductive success and pollination rate across a gradient of forest "islands" that differ in size. We will begin to answer these questions by documenting abundances of key species of plants and animals found in primary forests as well as in secondary growth areas.

Deep in the rainforest, we will make several forays into mountainous terrain mapping regions deforested at different times. At the same time, we will also document all species of animals we see and note tracks from larger mammals such as jaguar and puma. Using surveying tools, we will transect deforested areas at increasing distances from intact primary forest.



"It was as if someone yanked me out of my dollhouse existence, gave me a tour of the universe and returned me, lightened and enlightened, to an under-sized living room couch. I stepped out of my shoes for a month and when I came back they were too small, but I found a new pair with plenty of room to grow in."
Alexander Edmonds, Brooklyn, NY—St. Ann's School
(Photo: Don Hazlett)

Rainforest regeneration depends on successful establishment of seedlings. Our quantification of plant species frequencies in rainforest understories can lead to predictions of the future composition of rainforest as seedlings grow and mature into the forest canopy. Which species will fail to replace themselves? How does this failure rate vary with forest size? Our research findings can be useful to Costa Rica's natural resource management and conservation personnel.

Faculty will discuss species interactions, biological diversity, ecosystem stability, nutrient cycles and energy flow, soil development, succession and plant and animal identification. Additional material will focus on habitat destruction, the economics of deforestation, and the principles of natural resource management.

Student directed research projects may include a description of soil characteristics in deforested and primary forests, the effect of age of a deforested area on the complexity of tropical communities, or bird diversity in deforested regions.

Due to its neutrality and lack of an army, Costa Rica has a reputation as "the Switzerland of Latin America", and a stability conducive to long-term scientific research. During the third week of the course, we will visit The Organization for Tropical Studies' field station at La Selva. Here we will have an opportunity to talk with researchers about their ongoing rainforest studies.

We will work in a remarkable range of ecosystems: remote virgin tropical rainforest, a cloud forest with an elevation of 2,000 meters, and a steamy lowland rainforest. Sparkling waterfalls, tall trees dripping with epiphytes, and a huge array of animal life—tapirs, jaguars, toucans and capuchins—create an unforgettable tropical world. Temperatures at these locations vary from cool at higher elevations, to hot and muggy at lower elevations. Rain showers are short, but frequent. We will construct a rustic but comfortable campsite using tents and make-shift covered shelters. We will purchase our foods locally, and share in the preparation of the meals and the maintenance of the camp.

Adirondack State Park's six million acres are characterized by rolling mountains, expansive forests and some 4,000 secluded lakes. The area also offers one of the world's most striking illustrations of the impacts of acid deposition. Many species of fish have disappeared from lakes and streams that appear far removed from the effects of people, pollution, and other external pressures. Much of the blame for this environmental catastrophe has been placed on the phenomenon called acid rain, caused by acidic airborne pollutants from America's industrial heartlands.

Our results from seven years of study here suggest that not only is acid deposition exceptionally toxic to fish, but in lakes devoid of fish, insects become the top predator. Our current research focuses on the role of predatory insects in food chains as they take over the niche left vacant by the demise of fish populations. How do populations of zooplankton respond to acidity and to predation? What is the importance of naturally occurring acids relative to the deposition of acidic pollutants? Are the changing patterns previously identified continuing?

Our base of operation is The Cranberry Lake Biological Station in the western Adirondacks, on Cranberry Lake. From here we plan two extensive expeditions among the most isolated upper lakes. Our first expedition will take us through dense birch, beech and maple forests to the Five Ponds Wilderness Area south of Cranberry Lake. Here, in a classroom defined only by mountains and a huge sky, we will study how water reacts with the rocks and soils over which it flows and how these reactions affect the acid level of the water and the organisms it contains. We will collect water samples from pre-determined locations, as well as a variety of representative invertebrate species to better understand watershed dynamics and hydrology.

On our second expedition, we will canoe through a system of sparkling lakes and streams north of Stillwater Reservoir. Each day we will hike through pine-scented woods to different lakes from our base on the shores of Salmon Lake. Using small boats, snorkeling gear, and specialized nets, we will collect large predatory insects, zooplankton, and plant and water samples, in addition to measuring water clarity, depth and temperature. Analysis of our samples will allow us to determine the pH and buffering capacity of the water.

Faculty will introduce theories of limnology, water chemistry, and basic principles of ecology, physiological adaptations to acid-stress, impacts on forest ecosystems, mineral weathering of igneous rock, and management implications of liming and other forms of control technology. Basic laboratory and field techniques such as stream-flow measurement, titrations, determination of acid neutralizing capacity, and collection and identification of major plankton, plant, and macro-invertebrate species will be demonstrated. Individual directed research topics may range from the characterization of the zooplankton communities, to the determination of feeding preferences of invertebrate predators, or the description of daily migration of invertebrates in the water column.

Our long term data will allow us to determine how variations in aquatic chemistry affect distribution and adaptations of fresh-water organisms, and how new food chains develop in acidic lakes. Our final report will be submitted to the Department of Environmental Conservation and may influence future decisions concerning these watersheds.

Summer Course "Acid Rain": Changing Aquatic Ecosystems

Site: Adirondack Mountains, NY

Purpose: to study biological effects of atmospheric pollutants (acid rain) on sensitive Adirondack lakes and streams; to determine how the communities of these altered systems function, so future effects of acidification or neutralization can be predicted.

Departure Point:
Syracuse, NY

Course Levels & Dates:
Advanced: June 18-July 17
Intro: July 24-August 22

This is a wilderness experience, involving challenging hiking and canoeing. Weather in the Adirondacks is notoriously variable; while most days will be pleasantly warm, the evenings and nights will be chilly and the rain unpredictable. The rigor of our somewhat primitive campsites, however, will be offset by quite comfortable conditions at The Cranberry Lake Biological Station.



"Rather than being an abstraction, science became something concrete. After a lecture on aluminum I could see frothy bubbles of aluminum in the lakes on a stormy day. I was able to touch, see and experience what I was learning so everything fit together."

Kristin Steinmetz, Trenton, NJ—Haverford College
(Photo: William McComas)

Summer Course **Cultural Ecology: Conflicts in Ecological Management**

Site: Ladakh, India
NORTHERN HIMALAYAS

Purpose: to determine the cultural and ecological factors influencing the slow population recovery of the endangered snow leopard in the northern Himalayan Mountains; to measure the effects of habitat competition between domestic and wild ungulates, and possible impact on availability of prey for snow leopards.

Departure Point: Group meets in Delhi and flies together to Leh. Student responsible for fare to Leh.

Course Levels & Dates:

Advanced: June 15-July 14

Advanced: July 21-August 19

With an average annual rainfall of 3 inches, the upper reaches of the Indus River Valley in northern India have been relatively unpopulated by humans throughout history. This arid mountain desert has however, traditionally supported large populations of mountain ungulates including blue sheep, urial, and argali. These species, in turn, are the major sources of prey for such predators as wolves, snow leopards, and even golden eagles. Recent studies indicate that the frequency of tracks and scats left by snow leopards in the area is among the highest in the Himalayas. This information has prompted a proposal by the Indian government to create a national reserve to allow for the preservation of the endangered snow leopard.

This area, site of a recently constructed summer palace for the Dalai Lama, has become an important enclave of Tibetan Buddhism. An increasing number of settlers along the Indus Valley are developing areas of land to raise livestock such as yak, cattle and goat. Habitat previously available to wildlife is diminishing in response. This competition for space will intensify as the Indus River is dammed to provide irrigation and facilitate raising livestock.

Conflicts between development and preservation are not uncommon in the

practice of conservation biology. Yet here the parameters are unusual. Will the area be conserved? How will cultural attitudes impact plans for such a recovery? What are the ecological factors that might be expected to help or hinder the protection of the snow leopard?

Snow leopards have seldom been seen in the wild by humans. SFS students will continue a program to assess the chances for snow leopard recovery in this area by documenting the availability of natural prey species, the density of prey, the availability of forage and the competition created by increasing human land use. The cultural context in which the economy of the study area is being developed is also of importance in conservation planning. The religious beliefs of Buddhists militate against killing wildlife, yet unrestricted increases in domestic livestock and the development of grazing lands may create serious set-backs to snow leopard recovery. Snow leopard distribution is best assessed by systematically searching for the tracks and droppings that signal their presence and abundance in the study area.

We will assemble in Delhi, then travel to the city of Leh in the northern Indian province of Ladakh, at an elevation of 11,500 ft. After acclimating for several days near a small village, we will trek into the mountainous regions southeast of Leh, passing through deeply scarred narrow passages to set up our tent camp in a protected valley. Occasional fields of green vegetation watered by melting glaciers dot the sharp, putty colored landscape. Our field work will consist of mapping vegetation and documenting the occurrence of ungulate species and the plant

species on which they feed. Concurrently, we will be conducting baseline surveys for signs of the elusive snow leopard.

Faculty will review principles of wildlife conservation and population dynamics, prey-predator relationships, conservation biology, and cultural ecology. Techniques in range use determination, wildlife survey methods and statistical models for estimating abundance will also be demonstrated. Students will have the opportunity to conduct individual directed research on a number of questions including: What are the cultural attitudes toward land use and conservation? What are the seasonal distribution patterns of prey species? What are current levels of competition for forage between domestic and wildlife ungulates?

The last days of our course will be spent compiling the results of our research. Our report will be made available to wildlife officials in the Ladakh region and to biologists working with India's National Park Service.

We will live at a simple mountain base camp. Handling the high altitude and daily hikes will necessitate our being in good physical condition. Days will be hot and dry, the nights quite cool. Our food will be prepared by a local guide, with our assistance. The work we will be doing requires sensitivity, perseverance and maturity in the presence of a completely new culture. It is highly unlikely that we will have the rare opportunity to see a snow leopard in the wild. Yet the work that we do to illuminate the key ecological factors and their cultural context can lead to improved protection—a genuine contribution to the future.



"I learned how complex environmental issues are. The more I learned, the less I could state anything with certainty. Hopefully, this realization will help me be less impatient politically."

Kristin Steinmetz, Trenton, NJ—Haverford College
(Photo: Michael Warburton)

**The School
for Field Studies**

Summer Course Ecology: Assessment Monk Seal and Loggerhead Turtle

lonia, GREECE
assess the suitability of the
lands, Greece, as a refuge
endangered Mediterranean
al and the Loggerhead
turtle.

Point:
ia, Greece
Levels & Dates:
e 15-July 14
t: July 21-August 19

d's three species of monk
tly on the brink of extinc-
ocean monk seal, believed
, has not been seen for over
The Hawaiian monk seal
of recovery despite full pro-
editerranean monk seal is
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bance, preferring sandy
development and marine
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Many have been hunted
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of efforts are currently
Mediterranean to define a
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ited to monk seal habita-
disturbances would be res-
erves, and haul out sites
ected. Before such reserves
ned, biologists must deter-
as provide the best poten-
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ion major so I found
ping a science phobia. I
ience is really fun and it
of everyone, not just a
f pre-meds. Everything I
sense."

Trenton, NJ—

SFS students will have the unique opportunity to participate in a habitat survey of the Ionian Islands on the west coast of Greece. Past surveys have indicated that these islands constitute a suitable habitat for the recovery of the monk seal. The seldom seen monk seal has been observed in very small numbers in these waters. The Ionian Sea may be particularly important in that, if protected, seals may be able to return to the western Mediterranean where they are thought to be near extinction.

The Ionian Islands are also one of the most important breeding grounds for the endangered Loggerhead turtle. Greek and British scientists have been monitoring the numbers of Loggerheads coming to nest on the sandy beaches of these islands for the past five years and SFS students will have an opportunity to see them basking at sea, as well as laying their eggs on the isolated beaches of these islands.

Our research program will focus on an ecological inventory of this rugged and relatively uninhabited coast. From inflatable boats, we will systematically survey the coastline to determine the location of caves with underwater access, the availability of sandy beaches (which may also be used by nesting marine turtles) tucked inside lofty limestone cliffs, the near-shore water quality and



Working at night, SFS team members capture and weigh a loggerhead turtle to learn more about the ability of the Mediterranean coast to support endangered marine mammals. (Photo: Nancy Watson)

distribution and abundance of various marine animals, and the human use of the area for commercial fishing and recreational boat traffic.

Students will have an opportunity to become familiar with the Mediterranean marine fauna and flora, and to study their distribution and biology with particular reference to the prey species of both the seals and marine turtles. Our survey along the coast will also reveal other uncommon species sharing this habitat; including Eleanor's falcons, Cory's Shearwaters, and playful dolphins.

Upon meeting on the Island of Cephalonia, we will proceed to a campsite on the southern coast, a short distance from the sea and the marine turtle hatchery. From this base we will begin lectures and research, interspersed with outings to places of special historical and biological interest around the island.

Faculty lectures will provide the fundamentals of marine ecology (with particular emphasis on the Mediterranean), as well as material on seal and marine turtle taxonomy, biology, and behavior. Guest lecturers will introduce the natural history of the Mediterranean area, and, as the opportunity permits, we will visit local sites of cultural importance. Students will have an opportunity to conduct directed research projects, aimed at increasing our understanding of the coastal ecology of the islands. Projects may include a study of important prey species including fish and octopus; the distribution of other important vertebrates such as marine birds, turtles, and dolphins; and the analysis of seal tracks and scat within surveyed caves.

Data obtained from our coastal mapping and survey efforts will be made available to Greek authorities and international conservation bodies. Our work will be coordinated with other research and conservation programs aimed at protecting monk seals and marine turtles and setting up marine parks.

The weather will be hot and dry during the day. Evenings on the beach observing turtles can be quite cool, and days traveling by boat along the coast may be wet and rough. Students should be prepared to help with daily chores and to put up with the rigors of camping and small boat work.



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Summer Course Social Ecology of Spinner Dolphins

Site: Kauai, HAWAII

Purpose: to document the inshore use by spinner dolphins of an area in Hawaii that is becoming subject to greater recreational and commercial utilization by humans; to assess the potential for displacement from critical resting sites; to photo-identify individual animals and describe long-term social patterns and school stability.

Departure Point:
Princeville, Kauai

Course Levels & Dates:

Advanced: June 15-July 14

Intro: July 21-August 19

The island of Kauai, the most northerly of the seven inhabited Hawaiian Islands, is a dreamer's image of paradise. In the past, much of Kauai's northerly, or windward, shore has been relatively inaccessible. Today, helicopters and inflatable boats bring even the most isolated areas within reach of a constant flow of visitors. Resort development and increased recreational use of inshore waters is a constant threat to coastal species, such as the Hawaiian spinner dolphins, that seek near-shore refuge.

Elsewhere in the Pacific, spinners are a deep water species, rarely seen close to shore. The Hawaiian groups are unique. After feeding at night in deep oceanic waters offshore, spinner dolphins return each morning to protected small bays in certain areas of the Hawaiian Islands to rest. As late afternoon approaches, activity levels increase as they engage in a variety of behaviors apparently aimed at communicating group readiness to leave the resting area for a night of foraging.

Resting areas selected during daylight hours seem to be characterized by proximity to off-shore feeding areas, protection from shark predation and inclement weather, and avoidance of humans. Water clarity and freedom from human activity appear to be important determinants of area utilization.

SFS research teams will document spinner dolphin temporal and geographic use of the Kalihiwai Bay area of Kauai. Shore-based sighting teams will record the frequency and duration of dolphin presence. From small boats we will photograph individual dolphins, collect acoustic data, record habitat characteristics such as temperature, depth and turbidity, and note behavior. Our data will further clarify the social behaviors and habitat requirements of the Hawaiian spinner dolphin. How is activity level associated with time of day? To what extent do these dolphins form a "closed society"? What is the effect of human disturbance on spinner dolphin distribution and behavior?

We plan to establish our base camp on the outskirts of Kilauea, an old sugar plantation town, not far from the inshore waters around the Kilauea Point National Wildlife Refuge, our primary study site. Team members based on shore will use binoculars and spotting scopes to locate dolphins. Using CB radios they will confer with boat based team members to coordinate data collection and verify each others' observations. Spinner dolphins are difficult to approach under most circumstances, so care will be given to developing subtle techniques to photo-identify individual dolphins using dorsal fin shape and body markings. The boat team will also periodically record dolphin vocalizations to document relative amount of acoustic activity associated with changes in group behavior.

Our work will provide a basis for comparison with previous studies carried out in the southerly Hawaiian Islands, in

an area subject to considerable levels of habitat disturbance from agricultural runoff and boat traffic. Faculty will assist students working individually or in small groups to carry out directed research projects to complement the group research. Questions of interest may focus on clarifying the relationship between weather and inshore occurrence of dolphins. With what other species of cetaceans are spinners found? What age and sex classes of the population determine the general behavioral state of the group? Our results will be made available to the National Marine Fisheries Service, State of Hawaii biologists, and US Fish and Wildlife Service personnel.

Faculty lectures will address evolutionary theory, marine ecology, marine mammal taxonomy, cetacean anatomy, the physiology of sensory and communication systems, and the social ecology of toothed whales and dolphins. We will review basic principles of research methodology and biometric analysis, and students will be instructed in the use of visual and acoustic monitoring equipment. Cetacean research techniques will be described and demonstrated. Guest lectures will provide additional material on the flora and fauna of the Hawaiian Islands.

We will live in tents, and prepare our own meals. We will be careful to avoid over-exposure to the sun, a major concern in Hawaii. Our site is exposed to gusty trade winds, and early morning hours can be on the cool side. There will be occasional rain, and water work may sometimes be curtailed due to high winds.



"My goal has been to become a cetacean biologist but I realized this goal was based on a fantasy image, not reality. I didn't know what working in the field was like or how cetacean research was conducted. I decided the only way to learn was to experience them."

Stephen Lee, Chevy Chase, MD—Tufts University
(Photo: Nanci Shapiro)

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 brief 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 which 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. Three 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. Recently, major oil companies have applied for permits to conduct exploration activity in this important area.

SFS studies of humpback whales over the last six years have tracked changes in distribution throughout the Gulf of Maine, added to an ongoing catalogue of individually-identified whales, and documented behaviors associated with feeding episodes. Further effort is needed to determine the habitat requirements and use patterns of humpbacks, to help clarify the degree of recovery of this species, and the implications of recovery for future man-

agement policies. Our research activities 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 members of their species? 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 on a small island off the Massachusetts coast, preparing for our time at sea. We will have much to learn about boat safety, data collection, and team-work and will cover as much of the lecture materials 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 four watches that will rotate throughout the day and night. Our research day begins at sunrise. Once we sight whales, we will record their location, number, general activity, 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 predetermined ship transects, measuring ocean characteristics in areas differing in whale density, and photo-identification of individual humpback whales. We will document behaviors, particularly with respect to social interactions among coordinated groups of feeding whales. When possible, we will use underwater record-

Summer Course Humpback Whale Ecology

Site: NORTH ATLANTIC OCEAN

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 identified whales in the Gulf of Maine.

Departure Point:
Boston, MA

Course Levels & Dates:
Advanced: June 18-July 17
Intro: July 24-August 22

ing equipment to document sounds made during various activities. We will also note the type and occurrence of boat activity during our observation periods.

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 studying and identifying cetaceans. Student 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.

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. Data on sightings of other species of large whales will be sent to an ongoing monitoring project centered at the University of Rhode Island.

Life aboard the schooner will be close at times; efficient use of space is an important element of a ship's sailing capability. We will share watch rotations and clean-up chores. A willingness to be a co-operative 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)

Summer Course

Biology and Behavior of Bottlenose Dolphins

Site: GULF OF MEXICO

Purpose: to document through behavioral observation and photo-identification the social ecology and life history of bottlenose dolphins around the entrance to Mobile Bay; to investigate the impact of commercial fishing, natural gas exploration, and recreational boating on distribution, foraging strategies, and reproductive success of resident dolphin populations.

Departure Point:

Mobile, Alabama

Course Levels & Dates:

Intro: June 15-July 14

Advanced: July 21-August 19

Unchecked growth in commercial and industrial disturbances in the Gulf of Mexico threatens access to many coastal breeding and feeding areas critical for the continued presence of the bottlenose dolphin. In addition, a huge fishing industry competes for ever-dwindling food sources also suffering from habitat degradation.

Now, yet another source of disturbance threatens the social stability of dolphin groups. Curious, highly intelligent, and graced with a permanent smile, this species of dolphin has become the most often-captured for use in marine parks and research laboratories around the world. While many facilities have begun to breed dolphins in captivity, large numbers are still removed from the wild each year, through special permission of the United States Marine Mammal Commission. Recently, dolphins in and around Mobile Bay have become a major source of animals to be maintained in captivity. Dolphins are known to form highly social groups built on kinship and dominance hierarchies. The impact of removal on the social cohesion and ultimate reproductive success of affected groups has yet to be studied and documented.

Previous SFS research initiated photo-identification of individual dolphins for developing case histories based on later re-sightings. We will continue to photo-document movement, behaviors, and group membership of identified dolphins. Additional data will be collected on habitat parameters such as water depth, temperature, clarity, and distance from shore. Reactions to different types of human-generated activity will be noted, and amount of time spent in various activities such as foraging, reproductive activity, and resting will be recorded.

Documentation of dolphin social ecology and natural history will answer questions about habitat use and impact of disturbance. How do dolphins use different areas in and around Mobile Bay? How does commercial and recreational boat traffic influence distribution and movement patterns? What is the overall effect of human/dolphin competition for fish?

Our study will be based in Mobile Bay and the adjacent Gulf of Mexico waters. This extremely rich estuarine habitat is buzzing with human activity including commercial shrimping, gill netting of fish, sport fishing, oil and natural gas exploration and tanker and large ship traffic.

Weather permitting, much of our data collection will be made from outboard inflatables and small boats, to minimize disturbance. Each time groups of dolphins are approached, team members will begin pre-assigned tasks of photographing individual dorsal fins for later identification, recording location and habitat characteristics, and documenting group composition and social activity. In addition, we will use hydrophones (underwater microphones) to record changes in echolocation clicks, and variations in the whistles associated with social interaction. Shore-spotting teams will use spotting scopes and binoculars to monitor dolphin activity in pre-determined areas.

Each team member will carry out an individual project that may address age/sex differences in foraging strategies, variations in acoustic patterns at different times of the day, or in different areas of the study site, or identification of behaviors associated with social status. As time and opportunity permit, visits to near-by oceanaria, commercial fish processors and government agencies may occur.

Lectures will cover marine mammal taxonomy and evolution, cetacean anatomy and physiology, sensory and communication systems, and learning abilities. Material on quantitative analysis, cetacean research techniques, and general principles of sociobiology will also be presented.

Our results will be made available to the National Marine Fisheries Service and the Alabama Department of Conservation and Natural Resources.

We will live in a beach house on the tip of a narrow, 30 mile peninsula near the old Civil War site of Fort Morgan. The weather here is hot and humid. We will prepare our own meals and share in the house-keeping chores, highlighting our evenings with occasional barbecues on the beach.

This course will be offered during January Term.

Please contact the Admissions Office for details.



"I learned without even trying just because it was there all the time, and it was so interesting. We had an anatomy lecture that could have been dry as anything, but instead, Stu took us out to see a dolphin that had washed ashore and we could see how everything connected together."

Donna Lazendorf, Schenectady, NY—Union College
(Photo: Erie Taniuchi)



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 admissions process.

Admission to all SFS courses is open to eager, motivated students. A background in science is *not* required to be part of an SFS experience. (See page 4 for course levels). Participants are screened by the Admissions Committee to insure that you are choosing the right course for the right reasons. If you are willing to commit your emotional, intellectual and physical energies to working toward a better understanding of these crucial environmental issues, join us. We promise you 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 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. 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) 927-7777.

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 15th of every month.

Teams fill quickly. We strongly urge you to apply early to join the course of your 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 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. Upon completion of your course you may request an official transcript from Northeastern University at any time. Over 120 colleges and universities accept or award credit for SFS courses. Please consult your Registrar or the SFS Admissions Office for further details.

Changes

SFS programs are obviously different from travel or adventure programs. 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 St. John, Kenya, and Mexico.
- Some projects depend on the goodwill and generosity of individuals and institutions which lend support.
- Tenuous weather situations or 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 a student's conduct to be detrimental to or incompatible with the interests, 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.

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 affirmative action, equal opportunity institution.



"Arriving as an unknowing, 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)



Processes, Requirements and Costs

Tuitions

(all programs have additional \$100 Registration Fee)

SFS Fall 1989 and Spring 1990 Semester Programs	\$7,600
CNS Semester Program (not including Board)	\$6,300

Summer 1989 Courses (30 days)

Tropical Species Diversity/Australia	\$2,210
Wildlife Management/Kenya	\$2,390
Coral Reef Ecology/Virgin Islands	\$2,090*
Marine Parks Management/Virgin Islands	\$2,090
Ethnobotany/Ecuador	\$1,950
Landscape Ecology/Colorado	\$1,790
Tropical Ecology/Costa Rica	\$1,930
Acid Rain/Adirondacks	\$1,620
Cultural Ecology/Himalayas	\$2,050
Ecology of Bald Eagles/Alaska	\$1,840
Habitat Assessment for Seals and Turtles/Greece	\$1,850
Endangered Monkeys/Mexico	\$1,930
Social Ecology of Spinner Dolphins/Hawaii	\$2,050
Humpback Whale Ecology/North Atlantic	\$2,390
Biology and Behavior of Bottlenose Dolphins/Gulf of Mexico	\$2,010

January 1989 Courses

Endangered Monkeys/Mexico	\$1,660
Biology and Behavior of Bottlenose Dolphins/Gulf of Mexico	\$1,730
Ethnobotany/Ecuador	\$1,730

*add \$150 for SCUBA Certification fee if necessary.

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

Transportation and Travel Arrangements: To ensure 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 your travel from your area to the course, with any special arrangements you wish. Specific details will be forwarded to you upon acceptance. You are responsible for passport and visa fees.

Clothing and Equipment: SFS will provide food, cooking equipment, tents and all scientific and research equipment you will

require. You will be responsible for personal gear including sleeping bags, backpacks, clothing, and SCUBA gear (if applicable). Chances are you already have most of what you need, much of the rest you can probably borrow from friends.

Physical Examination and Medical Insurance: You must have an SFS Medical Release Form signed by a doctor. You will not be allowed to join an SFS program without proof of up-to-date medical insurance coverage.

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 1988, over 200 of our participants received financial aid totaling more than \$200,000.

If you will need financial aid to participate, we encourage you 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 you may qualify for assistance, please call the Admissions Office at (508) 927-7777.

Deposits, Tuition 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 (\$250 for financial aid candidates) for January and month-long courses or \$500 for semester programs is due no later than 10 days following acceptance to reserve your place. All students will be registered for academic credit with Northeastern University. The non-refundable registration fee of \$100 is due with your deposit. (Deposits and registration fees for financial aid candidates are non-refundable 10 days following financial aid offer.)

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.

The tuition fees listed in this catalogue 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 expedition is tentative until confirmed in writing by SFS.

Refunds

January and 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.

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 program 30 days prior to 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.

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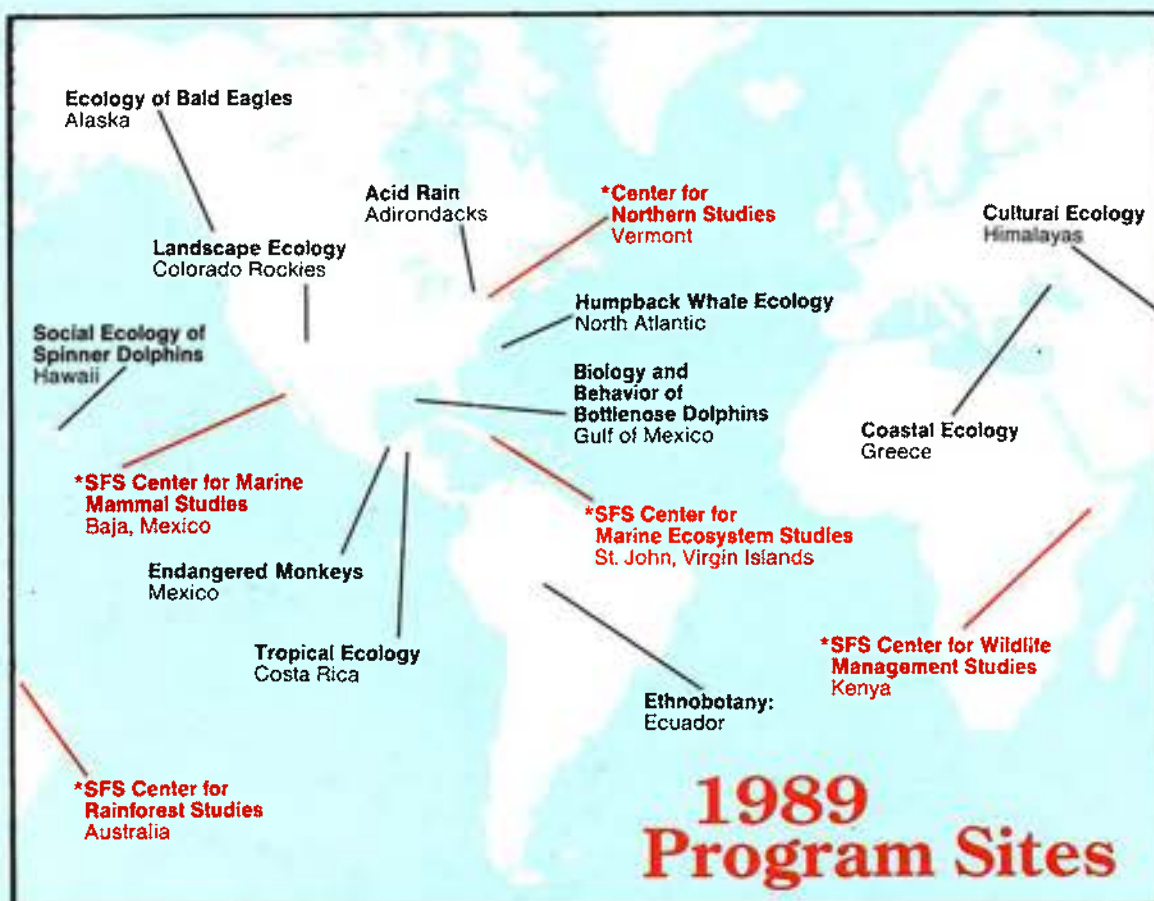
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The world is your classroom

Semester Curriculum

The academic material in this semester will be presented in an integrated fashion rather than fragmented into discrete courses. For purposes of discussion, the subject matter is divided into the following courses:

Natural Science of Zimbabwe will address the natural environment of Zimbabwe, drawing on a background of basic ecology and including consideration of climate, soils, plant and animal systems, with particular attention paid to agricultural systems (esp. techniques used by the communal farmers), energy systems, mining, population dynamics and large animal ecology.

In **Social and Political Systems of Zimbabwe** we will discuss the human history of Zimbabwe including settlement by Bushman, Shona and Ndebele populations, and the arrival of European settlers. The economic development of the country, based on the agriculture, mining and industry up to the present will be examined, as will the transition from Rhodesia to Zimbabwe. We will deal with the current political system in the context of changes to policies concerning environmental resource management and land tenure. Comparisons between commercial land use practices (game ranching, beef production) and subsistence practices (pastoralism, hunting/gathering) will include an analysis of the cultural and economic pressures that drive each system.

Sustainable Development will focus specifically on the challenge of meeting basic needs of a rapidly growing population in a natural environment with limited resources over a sustainable period of time. Sustainable development will be defined and we will attempt to identify realistic objectives using Zimbabwe as a case study. We will examine the problems, including population growth, degraded natural resources, dependence on over-exploited timber resources, and foreign debt repayment, in meeting these objectives. Sustainable development issues in other countries will be used for comparison, with the role of developed countries given particular attention.

We will lay the groundwork for **Directed Research** during our first weeks in the field as we visit areas of relatively undisturbed savanna (wildlife areas), communal lands that are both lightly and heavily inhabited by tribal populations, commercial farming areas, urban areas, and peripheral "townships". In each area we will visit local extension offices, research stations, family planning centers, etc. Students will then choose a field research topic addressing a conservation, social, or welfare issue proposed to SFS by a government or non-government agency. Students will develop research objectives and design data collection with faculty supervision. Potential projects

may include assessing the impact of gold panning activities on the environment in Mashonaland, researching options for innovative water resource management by local peoples, monitoring indigenous woodlot management in Shurugwi, or studying wildlife management practices. Results of each project will be made available to local agencies and will constitute a base for ongoing studies at the Center.

Prerequisites: Semester Applicants must complete the following college-level courses (or their equivalent) before going to Zimbabwe:

1. an environmental studies course
2. an ecology course
3. a course in international environmental studies, development studies, African studies, or the equivalent



"I learned how complex environmental issues are. The more I learned, the less I could state anything with certainty. Hopefully, this realization will help me be less impatient politically."
Kristin Steinmetz, Trenton, NJ
Haverford College
(Photo: Wendy Hughes)

The SFS Center for Studies in Sustainable Development is the result of cooperative effort between The School for Field Studies and a Consortium of the Environmental Studies Departments of Brown University and Allegheny, Bowdoin, Colby, Dickinson, Middlebury and Williams Colleges. The majority of spaces on the semester are reserved for students from Consortium Schools who should contact their Environmental Studies Departments for details. Students from non-Consortium schools should contact the SFS Admissions Office for further information on applying to semester programs.

Summer Course Sustainable Development: Framework for a Future

Site: SFS Center for Studies in Sustainable Development/
ZIMBABWE

Departure Point: Harare,
Zimbabwe

Course Levels & Dates:
Advanced: June 18-July 17
Intro: July 24-August 22

SFS will offer a program during the Summer of 1990, focusing on as yet undetermined selected topics in sustainable development in Zimbabwe. Students will be based at the Center and will spend much of the program in the field. In addition to visits to agencies in Harare, we will visit some or all of the following: areas of relatively undisturbed savanna where Zimbabwe's still magnificent herds of wildlife roam, communal lands that are both lightly and heavily inhabited by tribal populations, and commercial farming areas. The specific sites of our visits will be determined by the specific issues we address during the program. In each area we will visit local extension offices, research stations, family planning centers, etc. Students will then choose a field research topic addressing a conservation, social or welfare issue from a list presented to SFS by a government or non-government agency. Students will develop research objectives and design data collection with faculty supervision, and then will spend approximately one week in a field situation.

This summer program is open to all students. Prerequisites are the same as for all SFS summer courses. To receive further information and a course update, please call (508) 927-7777 and ask for the Zimbabwe Program.

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 densest 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.

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 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, students 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 m radius buffer zone around eagle nests versus a proposed 0.5 km use area. Our study area, located approximately 40 miles north of Juneau, is relatively undisturbed, and will serve as a control for data collected in the more disturbed areas nearer to Juneau.

Sea kayaks will serve as our primary means of transportation. 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 hump-back 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. Tracking tagged eagles with the aid of radiotelemetry equipment will 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.

In addition to the group research project, students 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.



"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."
(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.

Departure Point:

Juneau, Alaska

Course Levels & Dates:

Intro: June 18-July 17

Advanced: July 24-August 22

Faculty will introduce students to 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.

Our campsite requires us to practice minimum-impact camping. We will leave little behind but our footprints. Meals will be prepared under rustic camp conditions, encouraging great leaps of creativity in the preparation of culinary delights on Coleman stoves and campfires. The weather will be cool and often rainy. Wilderness and safety training will be an important aspect of the course in preparing students for the remoteness of the site, the presence of cold water, and the proximity of black and brown bears.

As the rate of human population growth continues to accelerate throughout the world, undisturbed natural habitats of non-human species have become increasingly rare. Destruction of a natural habitat not only translates to the potential extinction of a species but it also impacts the opportunity for critical research which may be used to maintain the species. One solution to protecting a population of endangered primates has been to relocate them to a habitat similar to their natural one, where they are protected and may be researched at close-range.

In 1974, a small colony of stump-tail macaques, originally hailing from Asia, was relocated to an island in Lake Catemaco, Veracruz State, Mexico. With the help of the National Science Foundation, a project was initiated to more fully understand this endangered species. This is the sole study site in the world where it is possible to find this species in a semi-natural, free-ranging situation.

Continuing research begun by SFS two years ago, students will document how patterns of courtship and mating are related to the distribution and abundance of resources. An important element of our research will be to determine how to best manage breeding colonies of endangered non-human primates. Categorizing interactions between individuals, we will document whether the location chosen for mating is related to cover density, distance from other group members or the age of mating pairs. For example, does visual and auditory isolation from the group increase mating frequency of younger group members? Can manipulation of cover density increase genetic diversity by allowing different animals to mate? Our research will also provide guidelines for zoos and wildlife parks so they can minimize negative consequences of captivity.

After meeting at the airport in Veracruz, we will travel south to Catemaco. Our field camp is located at Pipiapan, one of the few remaining rainforests in Mexico. We will live in a comfortable but very basic tent camp in a grassy field at the forest's edge. The basecamp is a forty minute hike from the shore of the lake. Each day we will travel by boat to the island to observe the macaques.

At the start of the course we will learn to distinguish individual animals. Males are much larger than females, so sexes are quite distinct. Further, individual stump-tails are readily identified by their variable skin and hair color. Unlike many primates in the wild, the stump-tails are accustomed to observers and tolerate closer observation of their behavior than is usually possible with other species.

Our daily schedule will be demanding: Three teams of observers will conduct observations on the island through the daylight hours, on a rotating basis. Special attention will be given to the composition of dawn and dusk sleeping groups, requiring early morning observation shifts. Data will be entered on lap-top computers, for later analysis at the basecamp on mainframe statistical software. When we are not on the island, our time will be devoted to data analyses, topical discussions, course readings, homework assignments, and faculty and guest lectures. Possible research projects may investigate patterns of affiliation between adult males and females; maternal investment in offspring of different sexes; individual dynamics among age groups; patterns of aggression relative to resource distribution.



"I don't know how to explain how magic that point on my SFS course was when 'ecosystem'—the intricate networking—clicked. I felt like Helen Keller."
Wendy Todaro, Seattle, WA—Swarthmore College
(Photo: Kevin Crooks)

Summer Course Endangered Monkeys: Social Ecology of Stumptail Macaques

Site: Lake Catemaco, Veracruz, MEXICO

Purpose: to study the social ecology of a small, captive colony of endangered stump-tail macaques (*Macaca arctoides*) maintained on an island; to analyze how resource distribution effects this primate's behavior patterns, including foraging, parenting, aggression and courtship.

Departure Point:
Veracruz, Mexico

Course Levels & Dates:

Advanced: June 18-July 17

Advanced: July 24-August 22

Faculty lectures will provide a scientific introduction to the study of primate social behavior and ecology, and principles of animal behavior and behavioral ecology. In addition, we will examine the role of management of wild animals in captive and semi-natural conditions to maintain species diversity, and the economics of tropical deforestation and conservation.

Our tent camp has a latrine and a covered kitchen/lecture area. A small generator provides electricity for our computers and lights. All group members are expected to share chores in the kitchen and sleeping areas. We will attempt to minimize our impact on the area since our host, the University of Veracruz, anticipates using the area for future release of howler and spider monkeys. Once a week, we will make the thirty minute trip to Catemaco, a small town where life revolves around the central square and market, for supplies.

Our research will take place during the height of the rainy season when as much as 16 inches of rain may fall each month. Temperatures stay mostly in the 80's but may reach 94°F on exceptional days.

SFS gratefully acknowledges the National Science Foundation for their sponsorship of this course as part of the Research Experience for Undergraduates Program 1988, 1989.



SFS faculty are special people. Selected for their extensive teaching and field experience, knowledge of the research and strong interpersonal skills, they are carefully chosen from hundreds of applicants worldwide. Complementing their strong backgrounds in the sciences (the majority hold Ph.D.s) 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.

Alejandro Acevedo, Ph.D. (Universidad Autonoma de Baja California Sur) Marine Biology. *Ecology of Spinner Dolphins*.

Rocio Alarcon, M.S. (Pontificia Universidad Catolica, Ecuador) Ethnobotany/Botany. *Ethnobotany*.

Brad Bennett, Ph.D. (University of N. Carolina) Biology. *Ethnobotany*.

* **Hans Bertsch**, Ph.D. (University of California, Berkeley) Zoology. Field Director, SFS Center for Marine Resource Studies. *Marine Ecology and Management; Marine Resource Management*.

Seema Bhatt, M.S. (University of Delhi) Zoology. *Cultural Ecology*.

Jay Buckley, M.Ed. (Chaminade University) Education. *Coral Reef Ecology*.

Lori Buckley, M.S. (Louisiana State University) Vertebrate Zoology. *Coral Reef Ecology*.

Nanette Chadwick, Ph.D. (University of California) Zoology. *Coral Reef Ecology*.

Sal Cerchio, M.S. (Moss Landing Marine Laboratory) Marine Science. *Humpback Whale Ecology*.

Tony Cummings, M.E.S. (Yale University) Environmental Studies. *Tropical Ecology: Dynamics of Deforestation*.

* **Peter Edmunds**, Ph.D. (University of Glasgow) Marine Biology. Resident SFS faculty. *Marine Biology and Management; Coral Reef Ecology*.

Bruce Fouke, Ph.D. Cand. (S.U.N.Y.-Stony Brook) Carbonate Sedimentology and Geochemistry. *Marine Parks Management*.

Joseph Fox, Ph.D. (University of Washington) Forest Resources and Wildlife Management. *Cultural Ecology*.

Nicky Goudberg, Ph.D. (James Cook University) Zoology. *Biogeography: Patterns of Ecological Diversity*.

Jo Guerrero, M.S. (Moss Landing Marine Laboratory) Marine Science. *Marine Mammal Biology and Conservation; Ecology of Spinner Dolphins*.

Rebecca Ham, M.S. Cand. (University of St. Andrews, Scotland) Research Psychology. *Endangered Monkeys*.

Ruth E. Happel, B.A. (New York University) Ph.D. candidate (Harvard University) Anthropology. *Endangered Monkeys*.

Carolyn Heath, Ph.D. (University of California) Biology. *Social Ecology of Spinner Dolphins; Marine Mammal Biology and Conservation*.

Hussein Isack, Ph.D. (University of Oxford) Zoology. *Wildlife Ecology and Management*.

Tom Jefferson, M.S. (Moss Landing Marine Laboratory) Marine Science. *Ecology of Spinner Dolphins*.

Sherman Jones, III, M.S. (Texas A&M University) Zoology. *Biology and Behavior of Bottlenose Dolphins*.

Stephanie Kane, Ph.D. (University of Texas) Anthropology. *Marine Biology and Management*.

* **Jeffrey Klahn**, Ph.D. (University of Iowa) Zoology. Resident SFS Faculty; *Biogeography: Patterns of Ecological Diversity; Tropical Species Diversity*.

* **William Laurance**, Ph.D. cand. (University of California, Berkeley) Zoology. Field Director SFS Center for Rainforest Studies. *Biogeography: Patterns of Ecological Diversity; Tropical Deforestation*.

Jennifer Lyman, Ph.D. (University of California, Riverside) Botany and Plant Science. *Landscape Ecology*.

Giles Marion, Ph.D. (University of California, Berkeley) Soil Ecosystems. *Acid Rain*.

* **Beth Mathews**, M.S. (University of California) Marine Science. *Humpback Whale Ecology*; Acting Field Director; SFS Center for Marine Mammal Studies. *Marine Mammal Biology and Conservation*.

Colin Matthews, Ph.D. (University of Bath, UK) Plant Pathology. Resident SFS Faculty. *Biogeography: Patterns of Ecological Diversity*.

Margaret Mayer, M.S. (University of Rhode Island) Botany. *Landscape Ecology*.

Gary Miller, Ph.D. (University of New Mexico) Biology. *Ecology of Spinner Dolphins; Ecology of Harbor Seals*. Resident SFS Faculty. *Marine Mammal Biology and Conservation*.

Greg Meyer, B.A. (University of California, Santa Cruz) Environmental Studies. *Ecology of Spinner Dolphins*.

Chris Neefus, Ph.D. (University of New Hampshire) Marine Botany. *Marine Parks Management*.

David Neill, Ph.D. (Washington University) Biology. *Ethnobotany*.

Craig Onque, M.S. (Nova University) Marine Biology. *Coral Reef Ecology*.

Phil Pepe, Ph.D. (University of Southern California) Marine Biology. *Coral Reef Ecology; Marine Parks Management*.

Robert Phillips, Ph.D. (S.U.N.Y. Buffalo) Freshwater Biology. *Acid Rain*.

Dennis Rasmussen, Ph.D. (University of California) Comparative Psychology. *Endangered Monkeys*.

Hildegard Reiser, Ph.D. (Northern Arizona University) Zoology. *Ecology of Bald Eagles*.

* **JoAnn Resing**, M.S. (Duke University) Zoology. Resident SFS Faculty. *Biogeography: Patterns of Ecological Diversity*.

* **Richard Ruggiero**, Ph.D. (Rutgers University) Wildlife Ecology and Management. Director of Academic and Scientific Affairs, SFS Center for Wildlife Management Studies. *Wildlife Ecology and Management*.

Keith Rittmaster, M.Sc. (Duke University) Environmental Management. *Biology and Behavior of Bottlenose Dolphins*.

Jan Roletto, M.S. (San Francisco State) Biology/Marine Biology. *Ecology of Harbor Seals*.

Marilyn Schlitz, Ph.D. cand. (University of Texas at Austin) Anthropology. *Marine Ecology and Management*.

Joanne Sharpe, Ph.D. (University of Georgia) Forestry. Acting Field Director, SFS Center for Rainforest Studies. *Biogeography: Patterns of Ecological Diversity*.

William Sheehan, Ph.D. (Cornell University) Insect Ecology. *Tropical Ecology: Dynamics of Deforestation*.

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

Elizabeth Swain, M.S. (University of Iowa) Botany. Resident SFS Faculty. *Tropical Species Diversity*.

Tolumbaye Tadinger, Ph.D. (University of Nebraska) Range Science. *Wildlife Ecology and Management*.

Sam Thomas, Ph.D. cand. (University of Florida) Anthropology. *Wildlife Management*.

Susan Toch, M.A. (University of Waterloo) Environmental Planning. *Marine Ecology and Management*.

Oswaldo Vasquez, M.S. (University of Odesa, USSR) Marine Biology and Ichthyology. *Humpback Whale Ecology*.

Pat Ward, M.S. (Humboldt State University) Wildlife Management. *Ecology of Bald Eagles*.

Christine Watson, M.S. (University of Pretoria, Rep. of South Africa) Zoology. *Wildlife Management*.

Richard Watson, Ph.D. (University of Witwatersrand, Rep. South Africa) Zoology. Resident SFS Faculty. *Wildlife Management*.

Gary Williams, Ph.D. (University of Cape Town) Zoology. *Marine Ecology and Management*.

* **SFS Resident Faculty at Centers.**
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