

1986 COURSE CATALOGUE SCHOOL FOR FIELD STUDIES

Environmental Field Research Programs Around the World



The world is your classroom

Book learning only provides information. This information needs to be placed in a real-life context for it to truly come alive and for you to experience its meaning. Science is a wonderfully straightforward discipline for this process. It includes the possibility of discovery, the challenging of assumptions, the creation of hypotheses and the discipline of data collection. Learning to apply these skills is the essence of true intelligence not to mention the basis of career success in many endeavors.

We are privileged to be in a position to offer you the challenges described in this catalogue. They are unique opportunities. Join us and share an adventure in learning!

Sincerely,

James L. Elder, Jr.

James L. Elder, Jr.
President



P.S. Call us at (617) 497-9000, our Admissions staff will be happy to answer your questions.



1986 Curriculum

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SFS is a private, nonprofit, educational institution.

Front Cover Photo by Ben Baxter

Inside Cover Photos by Katherine Browne and Joe Madison

What is SFS?

Since 1980 the School for Field Studies has mounted more than 75 student **research teams** in unique **field-based courses** throughout the world, immersing students directly in the ecosystem they are studying and teaching them the **skills** they will need to address critical environmental issues.

Courses

We have built our educational model on the examination of a particular environmental problem or issue—such as acid rain, wildlife management or deforestation—while structuring our courses around traditional academic disciplines, including wildlife biology, tropical ecology, archaeology, marine biology and geology. Rather than being a clear, text-book case, each problem we investigate involves a complex network of interrelated social, biological and technological processes. SFS courses are structured, intense academic endeavors accredited for college-level science.

Each course incorporates lectures, assigned readings, critical reviews of current research papers, independent projects and objective performance evaluations. Training in field research methodology leads to long, often arduous hours of data collection using SCUBA diving, tracking, censusing, capturing or any of a dozen other methods. Accompanying this atmosphere of serious research is the sense of discovery, the knowledge that we are contributing to a valuable effort, and the joy of sharing a remarkable experience.

Research

Our research component offers us a unique opportunity to make a personal contribution to science and humanity. Addressing issues such as how to feed an expanding world population, how to control loss of species diversity and how to balance the growing conflicts between development and conservation, we engage in critical, real-world problem-solving.

"Doing" science is harder work than reading about science. We think of science as a verb—an

action word—not a noun. Each course concludes with a final report, many of which have been published in scientific literature (bibliography available upon request). Examples of research projects include: the effects of boat harassment on whales and seals, the impacts of hazardous waste on shellfish populations, the behavioral changes evidenced by ungulates on a Kenyan game ranch and the potential pharmaceutical uses of plants growing in the Ecuadorian Andes.

Field Based Curriculum

The world *is* your classroom—and it's the best of all possible laboratories. By situating our courses in the midst of a few carefully chosen ecosystems, we have an unparalleled opportunity to observe real-life illustrations of what we only imagined in classroom lectures. Facts and theories come to life in a way that textbooks can't match. Much of our work—our wildlife management research in Kenya, our archaeology study in Belize, our behavioral studies of primates in Panama—

requires special permits, affording us access to sites and experiences not available to tourists. Camping in tents provides us a mobile base of operations and an opportunity to experience first-hand the delicate balances and interactions of the ecosystem we are studying.

Skills

SFS courses are designed to teach the skills you need—in research methodology, teamwork, a scientific discipline, and outdoor living. No other program offers growth and development in all these areas. You do not need field training, a science background or previous experience to participate in an SFS course. *We have designed courses on two levels to accommodate introductory and advanced students.* We will teach you how to approach a problem, how to form a hypothesis, how to work as a team utilizing each member's strengths and weaknesses to the benefit of the entire group. You will learn how to engage in problem-solving under real-life circumstances. These skills are valuable in any career you choose to pursue.

SFS Faculty Profile

Dennis R. Rasmussen

Hometown: Davis, California

Profession:

Faculty at California State University at Sacramento

Age: 36

Education:

- Ph.D. in Comparative Psychology, University of California - Riverside

Experience:

- Animal Keeper - Los Angeles Zoo
- Field Director - Olive and yellow baboon study, Tanzania, East Africa
- Principal Investigator - Social/sexual behavior of bonnet macaques: California Primate Research Center
- Leader - Field research expeditions to Panama since 1981 to study tamarin monkeys
- Published over a dozen papers and presented over twenty papers at scholarly assemblies. Selected papers include:

Rasmussen, D.R. 1980. Clumping and consistency of primates' patterns of range use: definitions, sampling, assessments, and applications. *Folia Primatologica*, 34, 111-139.

Rasmussen, D.R. 1981. Communities of baboon troops (*Papio cynocephalus*) in Mikumi National Park, Tanzania: A preliminary report. *Folia Primatologica*, 36, 232-242.

Rasmussen, D.R. 1981. Pair-bond strength and stability and reproductive success. *Psychological Review*, 88, 274-290.

Rasmussen, D.R. 1982. Ovariectomy: influence on social interactions of *Macaca radiata*. *International Journal of Primatology*, 3, 325.

Rasmussen, D.R., K.L. Rasmussen. 1979. Social ecology of adult males in a confined troop of Japanese macaques (*Macaca fuscata*). *Animal Behavior*, 27, 434-445.

Hobbies: Camping, reading science-fiction

Dennis has been leading SFS field expeditions studying the Panamanian tamarin since summer 1985. He is in the process of establishing a nonprofit primate research center where he spends most of his time when not in Panama with SFS or teaching. The father of a two year old son, Dennis and his wife expect a new addition to their family in late spring.



Photo by Suzanne Freedman

Teams

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 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 something about ourselves, how we relate as members of a team, how we adapt to new people and different environments. Living and traveling together for an entire expedition can be challenging. While there is little opportunity for extended ventures on your own (due to time and safety considerations), you will have time to yourself for personal reflection.

A sense of camaraderie intensifies 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. Learning how to work with each other's strengths and weaknesses and how to communicate effectively within a diverse group are skills we will utilize far into our futures. Not the least of the benefits of an SFS course is the strong network of friendships that grow from sharing special experiences and working toward a common goal.

Team sizes range from 10 to 15 students and 2 faculty on month-long courses to 20 students and 3 faculty on semester programs.

Students from public and private high schools and colleges and graduate programs, from science as well as liberal arts majors, and from across North America and many foreign countries have contributed to the success of SFS research teams. Ranging in age from 16 to 26, all share a desire to learn more about the natural world.

SFS faculty are special people. Selected for their extensive teaching and field experience, knowledge of the research topic and strong interpersonal skills, they are carefully chosen from hundreds of applicants worldwide. Complementing their strong backgrounds in the sciences (many hold Ph.Ds) are a broad range of skills and experiences that uniquely qualify them to lead SFS courses.

Research by members of our faculty has resulted in hundreds of

published scientific articles, documenting research funded by National Geographic, NATO, the National Science Foundation, the EPA and Sea Grant among other sponsoring organizations. Individual faculty members have lived underwater for weeks at a time, crewed sailboats across the oceans, lived in African villages for years, shared the neighborhood with yellow-tailed baboons in Tanzania, kayaked down the Yukon River and explored burial mounds of the ancient Maya.

The success of SFS programs—to effectively challenge your intellectual physical and social capacity and to build your self-confidence and self-reliance—can in large measure be attributed to our outstanding faculty.

“When I signed up for the course, I was expecting to find fourteen scholastically intense researchers and me. As I talked to the other students, I found people with a wide diversity of interests. We were not all majoring in biology. There were economic majors, liberal arts majors and the ever present undecided majors.”

Timothy Jon Van Norman
El Paso, TX
Washington State University

SFS Student Profiles

Caroline Culver

Hometown: Washington, D.C.

School: Duke University

SFS Courses:

- Wildlife Management, Kenya/1982
- Population Dynamics of Endangered Species, Greece/1984

Interests:

Animal Behavior, Biology, Marine Biology

Previous Experience:

- Seacamp
- Camping in the Sierras, Rockies and Alaska
- Courses in Biology and Animal Behavior

Hobbies: Swimming, sailing, skiing, SCUBA

Career Goal:

To work as a zoologist in developing countries

After her first trip to Kenya with SFS in 1982, Caroline developed an unquenchable desire to learn more about the country, its people, ecosystems and wildlife. She has since returned to Kenya on three occasions to study blue monkeys in Kakamega, to teach English to secondary students in Kaimosi and to work as a safari guide. Caroline hopes to return this summer to continue her work as a guide which she claims is an excellent way to share her enthusiasm and knowledge of the country with other people.



Photo by Geoff Levine

David Blum

Hometown: Hershey, Pennsylvania

School: Harrisburg Academy

SFS Course:

Marine Mammal Biology and Conservation, Kenai Peninsula, Alaska/1985

Interests: Marine Biology

Previous Experience:

- Backpacking in Canada
- 5 years at summer camp in Ontario
- Canoe tripping

Hobbies:

Lacrosse, drawing for school newspaper, skiing, canoeing, sketching marine life

Career Goal:

To work as a marine biologist

Interested in marine animals since he was very young, David joined SFS to get exposure to marine biology that he couldn't get at his high school. His SFS experience in Alaska censusing harbor seals along Kenai Peninsula affirmed his interest. David is now investigating colleges with marine biology programs.



Photo by Stephanie Litman

Admission, Financial Aid & Academic Credit

Academic Credit

All SFS courses are accredited for academic credit through Northeastern University in Boston. Twenty-one day January term courses carry 4 quarter credits, month-long summer courses carry 8 quarter credits, and semester programs total 20 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 over 80 colleges and universities that have awarded/accepted credit in the past include:

Augsburg College
Barnard College
Berea College
Boston University
Brown University
Carnegie-Mellon University
Clark University
Colby College
Colgate University
College of the Atlantic
Dartmouth College
Duke University
The Evergreen State College
Framingham State College
Guilford College
Hamilton College
Harvard University
Haverford College
Indiana State University
Kansas State University
Macalester College
Marlboro College
Mount Holyoke College
Ohio State University
Pennsylvania State University
St. Lawrence University
Salem College
Simon's Rock College
Smith College
Swarthmore College
Tufts University
University of Cincinnati
University of Connecticut
University of Maine
University of Massachusetts
University of New Hampshire
University of North Carolina
University of Pennsylvania
University of Vermont
University of Wisconsin
Washington University
Wellesley College
Williams College
Xavier University

Please contact the Admissions Office for further details.

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 1985, over 100 of our participants received financial aid totaling more than \$100,000. 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.**

Admission

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. 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. (See Processes and Requirements section for further information on admissions.)

The School for Field Studies admits students of any sex, religion, race, color, national and 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 and loan programs, and athletic and other School-administered programs. SFS is an affirmative action, equal opportunity institution.

For additional information,
call the SFS Admissions Office
at (617) 437-9200.

SFS Research Papers (Partial list)

- Arctic Botany, Brooks Range 1982.
Fetcher*, N., T.F. Beatty**, B. Mullinax**.
D.S. Winkler**. 1984. Changes in arctic
tussock tundra thirteen years after fire.
Ecology 65: 1332-1333.
- Community Ecology, Mount St. Helens 1982,
1983.
Adams*, A.B., E.H. Merrill*. 1983. Plant
association in the northwest section of the
blast zone of Mount St. Helens, Washington.
Presented to the Northwest Scientific Associa-
tion's 56th Annual Meeting, The Evergreen
State College, Olympia, Washington.
- Coral Reef Ecology, St. John, U.S. Virgin
Islands 1982, 1983, 1984, 1985.
Brody*, M., S.J. Miller*, M.T. Balbach**, J.M.
Eagles**, M.L. Finley**, H.C. Fowler**, R.D.
Ing**, R.A. Madon**, W.S. Maldonado**,
D.P. Remsen**, N.A. Rose**, P. Simpson**,
T.R. White**. 1984. Man and the Biosphere:
Ground Truthing Coral Reefs for the St. John
Island Biosphere Reserve. Report to the
Virgin Islands National Park Service.
- Ecology and National Park Planning,
Atacama Desert, Chile 1983.
Raedeke*, K.J., J.A. Simonetti*, M.A.
Brannon**, M. Gamble**, P. Hayward**, E.
Hyde**, O. Komar**, R. Olivia**, R.
Pearson**, P. Aumsey**. 1984. Sierra Las
Topias, coastal northern Chile as a guanaco
reserve: A preliminary biological survey
Final report to Corporacion Nacional
Forestal, Santiago, Chile.
- Environmental Geology, Mt. Vesuvius, Italy,
1984.
Hazlett*, R., R. Elan*, D. Buesch*. 1984. *In
preparation*. Avalanche Deposits of the 1944
Eruption, Mt. Vesuvius, Italy. *Bulletin
Vulcanologique*
- Hazardous Waste and Coastal Ecology,
Chesapeake Bay 1985.
Kannan**, K., W.D. Marshall, J.S. Blais, W.I.
Hatch*. 1985. *Littorina irrorata*, a bioindi-
cator of alkyllead pollution in Chesapeake
Bay. Presented at the Eastern Region Con-
ference of the Canadian Association on Water
Pollution Research and Control, McGill
University, Montreal.
- Limnology, Adirondacks, New York 1983.
Singer*, R., D.A. Roberts*, 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 Mammal Biology and Conservation,
Glacier Bay, Alaska 1982.
Calambokidis*, J., G. Steiger**, R.A.
Butler**. 1983. *Submitted*. Biology and
behavior of molting Canada Geese in Glacier
Bay, Alaska. *Journal of Wildlife Manage-
ment*. Abstract in Proceedings of First Glacier
Bay Science Symposium.
- Population Dynamics of Endangered Species,
Greek Islands 1983, 1984.
Husband*, T., P. Davis*. 1984. Ecology and
behavior of the Cretan Agrimi. *Canadian
Journal of Zoology* 62:411-420.
- Wildlife Conservation, Kenya, 1982, 1983.
Stelfox*, B. *In review*. Effects of Fire and
Topography on the Athi Plains Ecosystem,
Kenya. *African Journal of Ecology*.

*SFS faculty
**SFS students

SFS Curriculum

January and Month-long Summer Courses

SFS January term courses (accredited for 4 quarter credits) depart in late December. Month-long summer courses (accredited for 8 quarter credits) depart in June, July and August. You can expect a compact, intense learning experience, exposing you to issues that will engender thought and reflection long after your course has ended.

Course Levels

Level A courses are taught at an introductory (college freshman) level. They assume little background in the academic discipline and no field work experience. They are open to students who have finished their junior year in high school. Level A courses are designed for people who want initial exposure to field experience in environmental disciplines.

Level B courses assume completion of one or more of the following:

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

Level B courses are taught at a more advanced academic level and usually involve more detailed data collection. They are directed towards people who are committed to environmental studies and are seeking experience which will help them make or further career plans.

Course Schedule

Our Course Schedule is designed to help you learn as much as possible in a short period of time. 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. Our programs are run like college-level classroom courses conducted in the field for hands-on experience and understanding. You can expect a course with the equivalent academic content and rigor of a course taught on a college campus. A detailed syllabus, prepared for each course, describes research objectives, and includes reading lists and information on the site, necessary personal



Photo by Christopher Neefus

The SFS team approach to problem-solving gives each participant the satisfaction of making a personal contribution to an environmental research project.

equipment as well as medical, visa and travel information. At the end of your course, we expect you to have the skills—and the questions—to continue your own search for answers.

Introduction

- general discussion of expectations and individual introductions
- safety and first aid procedures
- outdoor skills training
- explanation of the research project; history of the problem
- guidelines for academic evaluation
- pre-test in skills and readings
- data-keeping procedures
- initial exploration of site

Weeks One & Two

- lecture on general ecosystem organization, environmental issues, local natural history and peoples
- topical lectures on course material
- introduction to scientific method, research methodology, field tools and techniques
- overview of research problem and research design
- daily research and academic lectures/discussions
- data collection in the field
- introduction to laboratory methods
- student critique of scientific papers

Midpoint

- interim evaluation of student progress
- 1-2 day field trip and relaxation
- student presentations of scientific papers

Weeks Three & Four

- continuation of data collection; lectures/discussions
- lab work, data processing and analysis
- independent projects wrap-up (2 days)
- 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

"This is the first time I've ever learned about something and then walked out of the classroom and actually experienced that knowledge, and tested its validity. What an incredible idea."

Paul Pottinger
New York, N.Y.
Riverdale Country Day School

Population Dynamics

Kenai Peninsula, Alaska

Purpose

To examine the ecology, biology, and behavior of harbor seals to evaluate their responses to human activities and to assist conservation and regulatory agencies in developing sound management policies regarding the distance from which boats may approach harbor seals.

Course Levels, Dates: Level A: June 16-July 15
Level B: July 22-August 20

Background

Thousands of harbor seals frolic on the glistening icebergs of Alaska's Kenai Peninsula. Here, where snow-covered peaks rise above crinkled fjords, they make their homes with humpback whales, sea otters and stellar sea lions as their neighbors. Currently, human activities, such as tourism, energy exploration, and the fishing industry, are expanding relentlessly it seems, into these once secluded waters. Are the harbor seals affected by these activities? Is their future security jeopardized in any way? SFS is trying to find out.

Following our research of marine mammals in Glacier Bay from 1982 through 1984, we began a study last summer in the Kenai Peninsula area of Prince William Sound. Two teams of SFS students kayaked along 150 miles of coastline, collecting behavioral observations on stellar sea lions, harbor seals and sea otters. Our results suggest that harbor seals are more plentiful in areas distant from daily human disturbance by kayakers, sailors and fishermen. This summer, we will return to the sites of our studies in 1985 at Blackstone Bay and Nassau Fjord to continue our study of harbor seal populations.

Research Focus

What is the relationship of environmental variables—such as site availability, other marine mammals, human disturbance, or resource distribution—to the behavior of harbor seals? Are harbor seals and pups changing their relative locations within the waters surrounding the southeastern section of Kenai Peninsula in response to the availability of icebergs to haul out on? Are harbor seals being disturbed enough in certain areas to warrant new management efforts?

We'll teach you the kayaking and data collecting skills you'll need, but get your arm muscles in shape for our travels through aquamarine Alaskan fjords.

Course Design

Our journey will begin in the small town of Whittier on the northern end of Kenai Peninsula. After loading our research equipment and supplies for one month into two person kayaks, we will set off along Passage Canal and Perry Passage to observe seals in these heavily commercialized waters. As we glide along the rocky shore, we can observe the seals without disturbing them as they slip gracefully in and out of the water. Lectures on marine mammal biology and physiology, the natural history of Kenai Peninsula, field identification of mammals and birds, field methodology and research techniques and marine mammal conservation and management will prepare us for our research.

After paddling through Prince William Sound towards Perry Island, we will kayak to our primary research sites. The A-level team will concentrate its studies on Blackstone Bay in the northern region of Kenai Peninsula, while the B-level team will head further south to Icy Bay to pursue more in-



Photo by Claire Saks

of Harbor Seals

tensive behavioral and ecological data collection. On our journeys, we will enter some of the most spectacular natural classrooms imaginable.

Once we have established base camps at the edge of virgin forest of spruce, alder and hemlock, we will explore the upper recesses of the study sites to determine several locations where seal populations appear to be most dense. Keeping the kayaks at least 100 meters from the seals to avoid disturbing them, we will census seals at each site spending long hours observing their behavior with binoculars and spotting scopes. When other vessels move into these locations, several members of our team will scramble up rocky embankments or onto glaciers where they can observe variations in the behavior of seals in the presence of vessels.

Returning to the base camps at night, we will compile behavioral data from our various study sites. Faculty will present additional lectures on population census techniques, physiological adaptations of marine mammals, principles of resource management and classifications of social behavior.

Extended field trips to the Kenai Fjord National Park and the Chugach National Forest will provide an opportunity to observe the diverse ecosystems of Kenai Peninsula. In addition, we will work on independent projects that may focus on topics including: What are the best ways to distinguish individual harbor seals from each other? What is the nature of the interactions between mothers and their pups? Possibilities exist to focus on other animal species, such as seabirds, to study their distribution, feeding patterns, and other behavior.

"I gained one thing from each person on the trip whether it was a small piece of knowledge or a friendship. Everybody contributed something that made this trip so special."

Michelle Parra
Santa Fe, N.M.
Stanford University

In the last few days of the course, we will work intensely to compile, compute and analyze our data, asking such questions as: Are some activities more disturbing than others? Are there long-range or short-term effects? Are only certain components of their behavior disturbed? Building on the preliminary results we obtained in 1985, we will present our observations and conclusions to the U.S. Forest Service, which manages the National Forest and Wilderness Area.

Living and Working Conditions

The rugged terrain and distances to be covered make water transport the only feasible way for us to move about our study sites. Our ocean kayaks are an ideal low profile vehicle from which to observe marine mammals without disturbing them.

Our campsites will be on small, secluded rocky beaches. These sites are strictly regulated requiring us to practice low impact camping techniques to minimize our disruptive effects on these locations. Some sites are so isolated that we will probably go for days without seeing other people.

"I thought I knew what 'wilderness' meant, I didn't. We experienced wilderness like few have."



Photo by Barbara Taylor

Harbor seals are the subject of our study but we can expect to encounter a myriad of marine animals including whales, sea otters and sea lions.

The field work is sometimes repetitive, requiring both patience and dedication. The weather will vary dramatically, from warm, sunny stretches to cold, overcast days with thick fog or pounding rain - the local rainfall averages 160" per annum. Except for a few days at the beginning and end of the expedition, we will be camping out far from civilization of any sort and our shelter and meals will be quite simple.

Tuition: Level A - \$1,420 Level B - \$1,520

Departure Point: Whittier, Alaska



Photo by James Ebersole

Ecology of Bald Eagles

Kenai Peninsula, Alaska

Purpose

To study the ecology of nesting and newly fledged bald eagles in Alaska to determine their habitat requirements and assist reintroduction efforts in the New England states.

Dates: July 22-August 20

Course Level: A

Background

A bald eagle rises from its perch in the cliffs embracing an Alaskan fjord. Spreading its wings and majestically maneuvering out over the water, it begins to hunt for food. Alaska is home to thousands of bald eagles, a species that was once close to extinction in the contiguous United States. Most Americans have never seen a live bald eagle, our national symbol.

Bald eagles have been almost completely eliminated in much of North America by habitat disruption, shooting, trapping and poisoning. As they have disappeared, so have their habitats which once constituted some of the most spectacular wilderness areas in the world. Reintroducing eagles into remaining wilderness areas can serve as a focal point for the preservation and protection of these areas. However, programs designed to help reintroduce eagles to various parts of the United States suffer from a lack of information on the habitat requirements, food preferences and behavior of eagles.

We hope to contribute some of this needed data as a result of our research in the remote fjords of the Kenai Peninsula, along the south central coast of Alaska. Here, thousands of eagles still nest in tall sitka spruce on thickly forested mountains. We plan to observe these eagles—their feeding habits, nesting sites, and social interactions—to provide information vital to the success of reintroduction efforts in the New England states.

For additional information, call the SPS Admissions Office at (517) 451-2600.

Course Design

We will begin our study searching for eagle nests in the Crafton Island area on the eastern side of Kenai Peninsula where tall fir trees along the ragged coastline are home to hundreds of bald eagles. Paddling our two-person kayaks beside active glaciers and through the deep, pristine fjords these glaciers carved, we are likely to spot humpback whales, orca, sea lions and harbor seals. An introductory lecture on the taxonomy of birds will help us recognize the many species that inhabit this area, such as kittiwakes, mures, tufted puffins and glaucous-winged gulls. Other lectures will cover Alaskan ecosystems, the life history of bald eagles, behavioral ecology, techniques of behavioral analysis and

Research Focus

We will observe nesting eagles and young eagles as they leave the nest and become independent, paying particular attention to factors affecting survival and successful nesting. How much food do nesting eagles need for themselves and their young? What happens to young eagles after they leave the nest? How far do they move? How do parent eagles react to the removal of their young for reintroduction elsewhere?

Few Americans have been fortunate enough to ever see an eagle, our symbol of freedom, soar through the skies or perch proudly in the branches overhead.



Photo by S. Lipshutz/VIREO



Paddling along the rocky coast in our kayaks, we will locate eagle nests and then put into shore to continue our observations from a closer vantage point.

the history of raptor population decline and recovery programs.

For the first several days we will attempt to take a full survey of eagles in the coves and inlets near Crafton Island recording when possible the locations of their nesting spots. As the eagles soar overhead seemingly suspended in the wind currents, one person will stabilize the kayak while the other tracks them with binoculars making note of their landing sites on detailed maps.

Once we have completed our survey, we will begin documenting the behavior of the eagles that inhabit the sites we have located. Kayaking back to each location, we will hike up to high vantage points from which we can look down on the nests. On hikes through dense coniferous forests and flowering alpine meadows we may encounter moose, blacktail deer, brown and black bears, porcupines, otters and mountain goats. As we near these sites, we will station ourselves behind natural blinds to avoid disturbing the birds. Using binoculars and spotting scopes we will observe the eagles and their newly-hatched fledglings—usually 2 or 3 per nest. How often do parent eagles visit the nest? What kind of food do they bring their young? How much food do they bring? How does the behavior of adult birds without young vary from those with young?

Some young eagles will be testing their wings for the first time shortly after our arrival. We will follow these eagles as they first become in-

“I saw how beautiful and fragile the Alaskan wilderness is and how people are constantly stressing it, wanting to bring civilization and exploit the resources that are there now. I saw how important it is to preserve, in its most pristine state, one of the last pure wilderness areas in the world.”

Jeanne Guild
Chester, VT.
Colby College

dependent, and collect important data on their behavior. Students may choose the movements of these juvenile eagles as a topic for an independent project. Other project topics include variations in nest size and reproductive success of eagles, interactions between adjacent nesting pairs of eagles and the spacing of eagle nests in relation to food resources.

As we learn more about the lifestyles of eagles, the faculty will give advanced lectures on optimal foraging strategy, energy budgets and feeding efficiency, reproductive effort and cost, evolutionary strategies of reproduction, territoriality in birds, and altruism and selection. Daily observations and lectures will be interspersed with field trips to points of interest, including a visit to the Nellie Juan Glacier, where we will study changing climate and ecological succession.

Results of our eagle nest survey will assist the Forest Service, National Park Service and Alaska wildlife management personnel with management and impact plans for the area. Our information may be of even greater value to the eagle recovery programs in New England, which will use the data to provide the protection and special habitat that reintroduced eagles need to survive and reproduce.

Living and Working Conditions

Our site has been described as an aquamarine jewel in a forest setting. The sight of snow-capped peaks reflected in rippling, ancient fjords is truly unforgettable. The scenery will likely distract us from spells of cold and damp weather; there are no words to describe the beauty and inspiration of a sunny day in Alaska.

Our site is isolated, so we will carry in all our equipment and food. We will cook a lot of camp food, creating culinary delights from dried meals, beans and rice. Because our site is located in the National Forest wilderness area, we will practice minimum impact camping.

We will go to sleep to the blow of a killer whale on the bay and to the cry of the grey owl in the trees. We will wake to the noisy squabble of the kittiwakes and, best of all, to the scream of an eagle.

Tuition: \$1,490

Departure Point: Whittier, Alaska

“What’s for dinner, Mom?” We need to determine the food requirements of fledgling eagles in order for relocation efforts to be successful.



Medicinal Botany: Discovering Medicines

Ecuador

Purpose

To identify and document the uses of plants in tropical rainforests that contain active ingredients with pharmaceutical properties previously unknown to modern medicine.

Dates: June 16-July 15; July 22-August 20

Course Level: B

Background

Tomorrow's cure for cancer may come from a plant that grows in a tropical rainforest. Today, more than 25 percent of all pharmaceuticals come from this rapidly disappearing resource. Treatments for Hodgkin's disease, hypertension, and rheumatoid arthritis have been derived from tropical flora. The essential ingredients for birth control pills and Curare, a muscle relaxant now used in all heart surgery, grow only in rainforests.

The western world has tapped only a tiny fraction of the medicinal potential in this ecosystem. Only one-sixth of the forests' 3 million species have ever been identified much less investigated in any detail. Because of this, the greatest storehouse of information about the pharmaceutical properties in plants resides not in university libraries, but in the oral traditions of indigenous people who have used these plants for their own care for centuries.

This information source is being threatened in three ways. First, modern medicine has reduced the dependence on folk remedies, and the traditions are not being passed on to younger people. Second, socioeconomic upheavals are altering social structure, relocating people and destroying traditional folk ways. Finally, deforestation is eliminating vast numbers of species from the earth on a daily basis.

Research Focus

This summer, on the edge of the Ecuadorian rainforest, we have the unique opportunity to help preserve this knowledge before it is lost forever. We will investigate questions including: What plants do the local people use? How do they use and prepare these plants? What is the distribution and abundance of these plants? What are the ancient uses of medicinal plants?

Course Design

Following our arrival in Quito, we will board a bus and head northwest through the lush green highlands of the Andes. As we rise to higher elevations along narrow winding roads, we will pass Otavalo Indian villages with thatched cottages surrounded by crops of corn, wheat and potatoes. Our first destination will be a small village approximately

four hours north of Quito. After setting up our base camp on the outer fringes of the village, we will spend the next several days talking with local people about their traditional uses of various plant species for medicinal purposes. We will learn how they use plants to treat medical problems from swelling and digestive problems to eye infections and sprains. Discussions with people of all ages will help us understand how the applications of plants has changed over the generations.

We will then travel southwest out of the highlands toward the Pacific Ocean to a small research station called Rio Palenque. Situated in a large, isolated stand of rainforest surrounded by lush farmland with banana, palm and rubber trees, this station has been the site of extensive rainforest research over the past decade and has served as the temporary base camp for two previous SFS Tropical Rainforest Ecology teams. Working closely with local researchers, we will enter a forest of huge orchids, bromileads and balsa to learn about the great diversity of floral and faunal species that live in the rainforest and to begin to develop plant identification skills. Faculty will also present introductory lectures on the cultural history of the indigenous people of Ecuador, the botanical explorations of the early European explorers, the use of medicinal plants by the Inca and the taxonomy and physical adaptation of plants.

Once we are familiar with the

Long, dugout canoes will allow us to travel into isolated regions of the jungle to conduct our research.



Photo by Eric Pallant

covering New Plant

flora and fauna of the rainforest ecosystem, we will move our base camp east over the snow-capped peaks of the Andes and then by dugout canoe to a small Quechua Indian village on the "Ceja de Selva", the eyebrow of the jungle where the local people have been able to maintain their traditional knowledge of medicinal plants. With our camp established outside the village, we will hike in each day on narrow foot paths overhung with epiphytes and lianas to observe the various uses of plants and to study the medicinal preparations of these plants.

Because village elders are usually most knowledgeable about plants used for major illnesses, we will spend several days with the leader collecting species in the dense tropical forest. Brightly colored toucans, parrots, huge frogs and grasshoppers and magnificent Morpho butterflies with their iridescent blue wings will be common sights on these expeditions. While taxonomic keys will help us identify many of the plants we will collect, we may find species that have never been previously identified.

We will also work closely with many of the local people who grow medicinal plants around their small thatched huts for more common illnesses. Our findings will be entered in a team journal for analysis at our base camp. All plant samples will be labeled and carefully pressed and dried. Back at our camp each night, faculty will present advanced lectures on the biochemistry of plant alkaloids, deforestation impacts on people and plants, and the isolation and concentration of active plant products.

"What better way to discover if you really love doing something than to try it while you are getting eaten alive by insects, slipping and sliding in mud and fighting your way through tangled vines. It was great!"

Leslie Millett
El Paso, TX.
U. California Berkeley

Photo by Nina Marshall



In talking with people who live in the rainforests like this Peruvian, we may find clues to help us unlock the mysteries of the rainforests' giant, unopened medicine chest.

As our research progresses, we will compare the uses of plants by the highland and lowland peoples we have visited and document variations in preparation techniques and applications. We will also have the opportunity to work on independent research projects that allow us to investigate topics related to the focus of our team research. Possible topics include the influence of altitude, soil type, and other physiochemical factors on the autecology of a particular species, species diversity in different areas of Ecuador and the history of the use of a particular plant by several indigenous groups.

We will then return to Quito to analyze our findings from the three

regions we have investigated and to compile a complete list of the plants that are used for medicinal purposes in the different regions. This report will be presented to the U.S.

Agricultural Research Service and the Ecuadorian Government to provide important information on the broad range of medicinal substances that may be extracted from plants in tropical rainforests.

Living and Working Conditions

Except for a few days in guest houses in Quito and the Río Palenque field station, the dense tropical forests will be our home for the month. Our tent camps will be pitched beneath spreading cecropia trees dripping with thick vines—a world reminiscent of Tarzan movies. Overhead, the canopy abounds with noisy animal life from screeching toucans to iridescent blue butterflies. We will be living in similar fashion to the villagers, eating local foodstuffs, primarily corn products, chicken, and of course, the local plants. Weather will vary from the temperate climate of Quito to the hot, moist weather of the lower elevations. Short downpours will punctuate the warm and comfortable days and cool nights.

Tuition: \$1,590

Departure Point: Quito, Ecuador

The rainforest is a truly unique experience. Its sights, sounds, smells and colors are unlike those existing anywhere else on earth.

Photo by Eric Pollard



Humpback Whale Eco

North Atlantic

Purpose

To study the impacts of human activities such as whale-watching and fishing on the behavior of humpback whales to aid in planning for their preservation.

Course Levels, Dates: Level B—June 8-July 7: Level A—July 2-July 31:
Level A — July 27-August 25

Background

The power and grace of a 40-ton whale as it propels its massive body out of the water is breath-taking. Humpbacks, the most active and playful of whales, like to roll on the surface and to "lob," standing on their heads with their tails out of the water, thrashing the waves with their flukes.

It is little wonder that the multi-million dollar whale-watching industry off the coast of New England will attract more than 100,000 people this year. While humans have been awed by these leviathans for centuries, the whale's now precarious existence makes them even more intriguing. As boats full of spectators stalk these gentle giants, scientists worry about the impact of this activity on the whales' behavior. They fear increasing numbers of vessels may prevent efficient or sufficient feeding in the summer. This could pose a serious threat to the species, as it is believed whales do not feed in the winter when they migrate to the Caribbean to breed.

SFS teams have studied whales for the past 4 years. For three summers we have investigated the impact of whale-watching off Stellwagen Bank in the Gulf of Maine, one of the most popular whale feeding grounds in the Atlantic. This summer, we will be observing some familiar friends, as resident whales include about 200 recognized individuals, some of whom will be returning from winter migrations with new calves.

Previous SFS teams have found humpback whale behavior frustratingly unpredictable. Although the mammals seem to breach more while feeding in the evening, there is no consistent long-term pattern for this behavior which seems to depend on food distribution and local conditions. Whales also tend to approach quiet, stationary boats and to shy away from noisy, moving vessels, except when they are feeding, when they ignore everything. Our emphasis this year will be to try to factor out some of the variables that make whale behavior so seemingly unpredictable.

Research Focus

By studying whales both near to and removed from vessels, we can quantify any behavioral changes. What behavioral variations exist between disturbed and undisturbed whales? Are dive times, directional movements, group sizes or feeding times affected by the presence of boats? Are these behaviors influenced by size or gender of the whales? Do individual whales exhibit particular patterns of behavior?

Course Design

Our home and classroom for much of this month-long odyssey will be a large schooner. From the vessel's broad open decks we will be able to enjoy the vast open sea as well as observe whale behavior and record environmental conditions. We will divide our team into three 8-hour watches that will rotate throughout the day and night. As one watch catches up on their sleep, the science watch will conduct the team research while the sailing watch assists in shipboard responsibilities.

For one week before boarding our ship, we will camp on an island off the coast of Massachusetts where the course begins with a series of lectures on 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 researching and identifying cetaceans. Faculty members will teach the practical skills needed for research aboard our floating laboratory such as how to determine our position at sea, how to use various instruments such as depth sounders, sextants and lorans, and how to record detailed observational data.

After boarding our schooner, we will begin our days by rising at dawn to collect data on the feeding behavior and social interactions of humpback whales. Sailing through the chilly waters of the Atlantic



Photo by Lars Jones

Trying to overcome our excitement and amazement to accurately record behavioral data when these 40 ton creatures breach or spyhop is one of our biggest challenges.

logy

from Cape Cod to Stellwagen Bank, we will scan the ocean for groups of humpback whales and the more elusive rare right whales.

Once we are close enough to examine the whales' behavior either with the naked eye or binoculars, the science watch will divide into two teams. The first team will photograph tail patterns to help identify individual whales. We will then collect behavioral data at ten minute intervals for each of these whales focusing specifically on dive sequences, direction of movement and feeding habits. Analyses of these data will help us determine if whales do exhibit repeatable daily patterns of behavior.

As the first team proceeds with its work, the other team will log the time, weather, visibility, water temperature, clarity and salinity, density of fish and other environmental variables. We will alternate between teams on a regular basis in order to become proficient at research skills in both behavioral and environmental studies.

Students in the B-level course will delve further into the study by collecting data on the sex and size of the whales in an attempt to draw a correlation between these factors and behavioral patterns. In addition, this team will participate in lectures on energy budgets and reproductive potential, and life history strategies of whales.

Students in both levels will be able to pursue individual interests by designing and working on independent projects. Possible topics include identifying individual whales from photographs, recording the daily movements and activities of individual whales, and analyzing breaching behavior and its correlation with sea conditions.

Field trips will take us to the Center for Coastal Studies in Provincetown, where we will examine an extensive computerized photo record of individual whales, and to the Ocean Research and Education Society in Gloucester, where we can plug into an extensive database of winter Caribbean whale photographs.



Photo by Tim Dietz/New England Aquarium

Do whale watching boats alter the behavioral patterns of their star attractions?

As the course draws to a conclusion, we will compile our data on the variables that appear to be the most suitable for assessing the impact of whale watching on whales. We will then compare those variables between whales in disturbed and undisturbed populations. The results of our studies will be submitted to the National Marine Fisheries Service where they may be used to help establish policies governing the whale-watching industry.

Living and Working Conditions

In pursuit of whales, we will sail our boat through choppy Atlantic waters, with salty sea breezes and sun caressing our faces. Our expedition will have much of the excitement and drama of the whale hunting era which almost drove the species to extinction.

Ahab never had it this good. Life aboard our modern vessel will be comfortable, if not spacious. Food is hearty and plentiful. We will share watch rotations and clean-up chores. Shipboard life requires patience and consideration for shipmates and diligence in areas of personal responsibility.

The rocking vessel causes seasickness in 99.9 percent of people, most of whom recover and get sea legs within 24 hours.

Tuition: \$1,490

Departure Point: Boston, Massachusetts

"Trying to remember names, how to fight the Orientals and how to use the hand saws were three of the early problems."

David Bravo
Ardmore, PA.
Ursinus College



Photo by Cynthia Baimon

Shipboard life is rigorous, rejuvenating, romantic and restricting and requires the patience and cooperation of everyone on board.

For additional information,
call the SFS Admissions Office
at (617) 497-9000.

Farming the Desert: E

Negev Desert, Israel

Purpose

To study the adaptations of desert plants to high salinity and low water availability to determine if specific cultivation techniques and species can be utilized for desert agriculture.

Dates: July 22-August 20

Course Level: A

Background

“If the State does not put an end to the desert, the desert may put an end to the State.”

This warning issued by Israel's first Prime Minister, David Ben-Gurion, has implications that reach far beyond these biblical lands. Each year as the desert claims over 27,000 square miles of the Earth's once arable land, the threat of mass starvation looms larger for the one-sixth of the world's population that lives in arid areas.

While arid desert covers two thirds of Israel, her inhabitants have made the prophecy of Isaiah, “the desert shall rejoice, and blossom like a rose”, a reality. Using centuries old irrigation and agricultural methods aided by modern technology, Israel produces 80 percent of its own food while exporting many profitable crops such as olives, apricots, avocados and pistachio nuts. Israel has set an example much of the world is seeking to follow; cultivating the desert to feed the people.

Sdeh-Boker, one of the world's leading sites for the study of desert agriculture, is located in the Negev Desert. Scientists here have made significant contributions to the ongoing effort to make the desert productive. Their studies of water harvesting techniques, groundwater utilization and trickle irrigation have potential worldwide applications.

But while water is essential to growing plants, the salt found in all water, which remains in the soil after evapotranspiration, can build up in irrigated areas, lead to the death of plants, and render soil permanently useless—as has happened in vast areas of the Colorado Basin and Mexico. Salinization (the build-up of these salts in soils) is an issue

of global concern. Our research will focus on the native flora of the desert, its water use, and adaptations and common characteristics which allow it to survive in this harsh environment.

Research Focus

What are the physical characteristics of the desert environment? What natural adaptations occur in plants that live in deserts? What natural resources are most abundant? What impact does salinity have on plant growth? Historically, how have the local people adapted to the desert? What plant species are most capable of growing in the desert?

Course Design

A Bedouin astride his camel brings to mind scenes from Lawrence of Arabia as we leave Tel-Aviv and head by bus into the Negev. A seemingly endless rolling beige carpet of sand stretches out ahead of us, occasionally colored by a flowering cactus or

a scurrying lizard. As we near Sdeh-Boker, bright green squares of cultivation rise mirage-like from the desert, tributes to the success of the scientists here.

Sdeh-Boker and its laboratory, greenhouses, library and lecture halls will serve as our base of operations, although we will camp in the desert for over half of the course. We will begin by spending several days traveling into the Central Negev highlands to become acquainted with the geology, archaeology, flora and fauna of the Negev, and to document all the different plant species we find, documenting the environments these species inhabit.

Introductory lectures will cover the history of the Negev, physiology of desert plants and organisms, physical microclimates, soil structure, and the impact of salinity on plant growth.

We will select 3 small plots of land outside the borders of the campus that exhibit a broad range of desert plants. Using conductivity meters, we will study the patterns of salt deposition in the soils at increasing depths and distances from the plants. Shovels and picks will enable us to expose the root structure to examine how the growth of the roots has responded to varying levels of salinity. With hygrometers, tape measures, and thermometers, we will also measure the environmental conditions of the habitats of these plants as well as their physical

What are the adaptations that have occurred or must be encouraged in plants to make the desert bloom?



Photo: Ben-Gurion University

ecology of the Negev



When one first encounters the starkly sculpted desert, it seems inconceivable that anything or anyone could possibly live here.

characteristics. How deep are their root structures? What is the salinity concentration and moisture content in the soil?

We will then collect several samples of these plants along with soil samples for detailed laboratory analysis. Gradually through our analysis of a variety of different plants, we can determine many of the traits that allow these plants to live in the desert. At Sdeh-Boker, we will then look at agriculturally grown plants with which scientists have experimented to determine if these plants exhibit similar traits. Through this comparison, we can make recommendations about designing guidelines for selecting plants that may be most tolerant of

“When I first looked at the price I quickly put the catalogue down. Later, after reading through the course descriptions, I realized that SFS might just be able to help me and I could save my money. By summertime, what I could not afford I received from SFS financial aid and my parents.

Albert Luppens
Lee's Summit, MO.
Northwest Missouri State University

high salinity levels.

Rising early each morning to avoid the intense midday heat, we will spend the first several hours of the day in the field conducting our research. In the late morning, faculty will present more advanced lectures on desertification processes, modelling desert ecosystems, economic management of water resources, and applications of ancient technology to modern agriculture.

Each student will work on an independent project to complement team research efforts. Topics we can address include stomatal concentration on leaf surfaces along a moisture gradient, root depth and branching pattern along moisture and salinity gradients and the effect of salinity on the root structure in natural and agricultural ecosystems. We will also have the

opportunity to take field trips to several ancient archaeological sites including King Solomon's Pillars and Masada.

In the last few days of the course, we will draw together all the data from our team and independent research projects and make oral presentations of our findings to a group of Sdeh-Boker scientists. We will then prepare a report for the Ministry of Agriculture to help develop plans for selecting appropriate plants that are capable of surviving high levels of salinity.

Living and Working Conditions

This is the land Moses described as “flowing with milk and honey” 3,000 years ago. The Negev Desert, with its rocky tablelands and angular topography stands in sharp contrast to the agriculturally rich land to the north. The stark beauty of the desert is exemplified in bright orange sunsets reflected on rippled golden sands, a precursor of the starfilled nights that will follow. Except for the occasional wind, there is no sound other than the crunching of one's feet on the sand and the rasp of one's breathing.

Desert weather is quite predictable; days will be hot and dry, evenings cool and breezy. Food will be simple. Our menus will be augmented by fresh fruit and vegetables grown at Sdeh-Boker.

Tuition: \$1,590

Departure Point: Tel Aviv, Israel

While our travels are made by van rather than by camel, we expect to encounter Bedouins and their camels during our time in the desert.



Reintroduction of Endangered Alpine Ibex in Switzerland

Purpose

To investigate the environmental impact of reintroducing the alpine ibex to their original habitat and to assist in the development of wildlife management strategies.

Course Levels, Dates: Level A—June 16-July 15; Level B—July 22-August 20

Background

Fortress Switzerland features a spectacular but unforgiving mountain terrain, an unlikely place for the unpromising task of reintroducing a species that was once nearly extinct. Yet the once endangered alpine ibex has apparently done the improbable. Reintroduced to its former habitat 50 years ago, this eight-foot long mountain goat of curved horn and thick fur is abundant once again; more than 3,000 now roam the mountain passes.

So what's the problem? Throughout the world, many animal species have been driven to near extinction despite Herculean efforts to save them. Why can we save some species and not others? What are the lessons to be learned from 80 years of efforts to conserve the ibex?

The remarkable success story of the alpine ibex is not without some costs; overgrazing has caused a variety of critical environmental problems including erosion, avalanches, and food shortages for wild and domestic animals. Our study will consider the problems faced by existing fauna when species are reintroduced.

Research Focus

Last summer, we began our studies of the ibex to collect data on its habitat use and to determine the impact of overgrazing on its alpine environment. We found that although overgrazing was evident in some areas, the ibex has made a dramatic recovery. In our field work

this summer, we hope to explain why the ibex has been so successful where other animals have failed and to gain a better understanding of the conflicts between the growth of the ibex population and the ecological stability of its habitat. With our data, we will design a management plan that will allow the successful reintroduction strategy for the ibex to be repeated for different species in other locations.

Our research will focus on these questions: What habitats do ibex prefer and what features of the habitats are most important to them? In what ways do ibex affect these habitats? How do human activities influence ibex populations? How can the populations of ibex be managed to prevent further damage to their environment?

"All of a sudden, we looked up and it was as if the ibex knew we were watching them and decided to put on a show."

Course Design

From Zurich, we will travel by train through spectacular, mountainous countryside to the base of the Rothorn Mountain near Brienz in central Switzerland. Following orientation lectures on animal behavior, ecology and evolution of the ibex, national park management and wildlife measurement techniques, we will hike through dense fragrant forests, dwarfed by magnificent spruce and pine towering hundreds of feet above us, to begin our research. Seeking out an individual or a small group of ibex and trying to move quietly within several hundred feet of them, we will collect detailed behavioral data, focusing particularly on food preferences, social structure, and foraging behavior. In our log books, we will record the presence of all other species of large mammals seen at our study site such as red deer, chamois, and roe deer.

We plan to conduct an intensive analysis of the ibex habitat. Following several botany lectures designed to help us identify various plant species, we will use tapes, compasses and transects to measure the frequency and distribution of different species of vegetation. Data on variables of the habitat microclimate, including humidity and sunlight will be collected, in order to gain specific information about the en-



Photo by Katherine Browne

Endangered Species:

environmental conditions in which various ungulates live.

After completing our preliminary studies on the slopes of the Rothorn, we will take a train south toward our second study site, at the base of Dom Mountain, the highest peak in Switzerland. This site is near the town of Saas Fee which is close to the Italian border. Our trip will take us through narrow, winding mountain passes and quaint Swiss villages where small cottages are scattered across even the steepest terrain. Here, among intermittent stands of spruce and sun-splashed meadows dotted with wildflowers, we will spend several days conducting comparative studies of the foraging behavior of ibex. Relaxing around a campfire at night, we will discuss the social, political and economic factors affecting environmental policies for the areas in which we are conducting our research.

Moving on to our final study site—the imposing, deep valley created by the snow-capped peaks of the Jungfrau, Monch and the Eiger in the heart of Switzerland—we will hike up steep, grassy and forested slopes, to continue collecting data for our behavioral and ecological studies. Comparing these data to our earlier research enables us to determine any variations between the behavior and habitat preference of ibex at the different study sites. This information is critical for understanding the adaptability of the ibex to different environments.

Our field work will be coupled with lectures on topics ranging from concepts of vegetation succession and alpine ecology to wildlife population analysis and the interrelationship between ibex and other organisms. Independent projects give us the opportunity to explore tangents of our major research project. Several possibilities include investigating the effects of altitude on local floral distribution, constructing a time budget on specific alpine ungulates, or examining the impact of hunting on ungulate populations.

The last days of our study will be spent analyzing our behavioral and environmental data to understand the utilization of the alpine habitat

by the ibex and to assess the impact of the ibex on the environment. Our findings will be incorporated in a final report to be presented to the Swiss Federal Forestry Agency to aid in the design of future wildlife management strategies.

Living and Working Conditions

This country is raw physical beauty taken to a high art. Perhaps the most difficult challenge will be to keep our minds on the research at hand, for the actual scenery is more breathtaking than any calendar picture. Weather conditions, even in summer, can be as surprising and rugged as the mountains. Our field work will be conducted in alpine valleys and on the sides of rugged, glaciated peaks. Temperatures within these different environments vary considerably from the relative warmth of lower elevations to the cold winds of the higher terrain. We plan to conduct our research from the early morning until the afternoon, when weather conditions are most stable. We will be camping in sensitive alpine areas, and therefore will carry only essential equipment.

Tuition: \$1,590

Departure Point: Zurich, Switzerland



Photo by Katherine Browne

Some research has more compensation than others. Searching for ibex can require long hours of patiently scanning the indescribable alpine landscape.

"I was, to be honest, a little scared to delve into science because I feared I might not do well. I wanted to conquer this fear and break down self-created barriers or limiting images of myself. I felt an SFS course, with the immediate, hands-on activity oriented way of learning would be an exciting way to help this, and possibly even excite me about doing scientific research."

Tom Meier
Lake Geneva, WI.
Lake Forest College

"Patience, tolerance, and a sense of humor become a welcome and paramount part of your personality."



Photo by Katherine Browne

Biological Indicators of

Chesapeake Bay

Purpose

To assess the effectiveness of using periwinkle and fish distributions to determine the impact of municipal and industrial wastes by comparing polluted and unpolluted regions of Chesapeake Bay.

Dates: June 16-July 15

Course Level: A

Background

One of the most superlative examples of nature's productivity is being challenged by an equally impressive example of human progress, in a confrontation that may yield no winner. Estuaries—those regions where land, ocean and rivers come together—are the most productive of all ecosystems on Earth; they are the unique home for numerous species of birds, mammals, fish, shellfish and plants. The largest estuary in the world, the Chesapeake Bay, with its 8000 miles of shoreline, provides vast breeding grounds for wildlife and supports the largest crab and shellfish fishery in the United States. The Chesapeake Bay region is also home to one of the largest industrial centers in the world. A witches brew of hazardous waste, byproducts of industrial development, now threatens Chesapeake Bay.

Large industrial complexes in the major ports of the Chesapeake including Baltimore and Norfolk, pump billions of tons of hydrocarbons and heavy metals in the bay which have dramatically reduced the annual yield of fish and shellfish. Because the Chesapeake and other estuaries are a vital source of food, it is imperative that we understand how hazardous waste alters these fragile ecosystems.

Last summer we began our research on the Chesapeake, documenting the diversity of fish species in pristine regions of the bay and in the heavily industrialized Baltimore Harbor. Our initial results indicate a decrease in fish species within the harbor region compared to other areas of the bay. Simultaneously, we

initiated an ongoing project to identify a species that can be used as a biomonitor of conditions in the bay. Our research found the marsh periwinkle to be an extremely sensitive and potentially effective indicator of changing conditions.

This summer, we will expand on both these projects. First, we will use data on the distribution of periwinkles to document the conditions of the bay in different regions. Second, we will correlate this data with the distribution of various fish species, such as striped bass, carp, catfish and alewives. Our research is vital to local and national policy makers in determining ways to preserve these unique wetlands.

Research Focus

What are the current levels of hazardous hydrocarbons and heavy metals in industrial and rural areas of the bay as assessed through the use of the marsh periwinkle as a

biomonitor? What are the effects of hazardous wastes emanating from industrial areas on species diversity and population dynamics?

Course Design

Our field work will be conducted at three sites on Chesapeake Bay including two polluted areas near Baltimore and Norfolk and a pristine section of the bay approximately 100 miles south of Baltimore. At each site we will attempt to determine the distribution of fish and shellfish species and how these distributions relate to the concentrations of key pollutants. We will also identify the flora and fauna common to the bay and learn dredging techniques, determine signs of physiological stress, take water samples, and conduct chemical analyses.

Arriving at our first site, south of Baltimore, we will set up our tents in a remote campsite beside the bay. Faculty will lecture on the physical, chemical and biological oceanography of estuaries and salt marshes.

Traveling in our small motor boats to spectacular salt marshes and secluded islands, we will conduct our sampling under the watchful eyes of the osprey, egrets and sandpipers who make this bay their home. Breaking into two groups, one team will focus on collecting periwinkles from the reeds and

Blue skies, golden sunshine, sparkling, cool water and the perfect "fishing".



Photo by Pedro Malave

f Water Pollution

sawgrass noting their distribution and size. The other team will use seine nets along the shoreline and through small inlets to collect fish (possibly for dinner!) and determine which species are most common in different areas. Several periwinkle and fish specimens from each team will be preserved for later analysis at the lab for hydro-carbon content.

We will then move north to our second site on the fringes of Baltimore Harbor. Repeating our sampling along the shore and in saltmarshes, we will document changes in the distribution of periwinkles and fish in these waters laden with hydrocarbons and heavy metals. Our base camp here will be situated in a beautiful, sequestered spot on the upper reaches of the Potapscow River—the same river that becomes Baltimore Harbor downstream.

The southern bay in Norfolk is the final site on our agenda. Using the research techniques we have refined at the other two sites, we will determine if there are any differences in species diversity between this heavily polluted region and Baltimore Harbor. Based at a small private campground on the bay, we will conduct most of our research on the Elizabeth River. During respites from our field work, faculty will present additional lectures on marine taxonomy, land use and marine resource planning, statistical analysis, population modeling and public policy formation.

We will also be able to pursue independent projects on topics such as the relationship between distance from pollution sources and the growth rate of snails, body organ weight under different concentrations of heavy metals, and snail size and abundance at varying depths.

In the last few days of the course, we will travel to Saint Mary's College to analyze our field data from all three sites and to assess the effectiveness of periwinkles as a biomonitor in polluted waters. We will also assess how varying levels of pollution can alter the distribu-



Photo by Pedro Malave

The smiles from this team may have something to do with their unofficial award for best meals created in the field.

tion of fish. This research will provide valuable information to scientists and policy makers for determining the severity of the threat of hydrocarbons and heavy metals to this and other endangered wetlands throughout the country.

Living and Working Conditions

This will be a month of broad horizons and spectacular sunsets, of learning to recognize dozens of shorebirds and waterfowl, of trying to keep a compass direction in thick, early-morning fog, and of steady concentration under a hot, reflected sun.

Field work will be conducted both in open areas of the bay and near mud flats and beaches where retreat from the sun for lectures and discussions is a welcome relief. The climate on Chesapeake Bay is characterized by hot, humid days though frequent rains and gentle ocean breezes will cool us off.

At our three primary campsites, we will cook for ourselves with campstoves, and have ample fresh water for drinking and washing.

Tuition: \$1,290

Departure Point: Baltimore, Maryland

“I found that a basic understanding of environmental issues, and an appreciation for their impact, is something which comes in handy in Washington! Working in Senator Mitchell's office, it has become quite clear that ecological concerns are not limited to those who spend their lives studying them.”

Colleen Quint
Portland, ME.
Bates College



Photo by Beverly Winkler

Analyzing our specimens and water samples from the bay will involve exposure to some of the more sophisticated tools of field research.

Deforestation: Tropical

Costa Rica

Purpose

To determine the effect of distance between a primary, tropical rainforest and a clearcut region on the distribution of plants and animals in regenerating areas in order to help design reserves to protect these fragile ecosystems.

Dates: July 22—August 20

Course Level: A

Background

In the words of the World Conservation Strategy, rainforests are 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 even been identified.

Today, just as scientists are beginning to unveil the hidden secrets of this ecosystem, rainforests are being destroyed at a rate of 25-50 acres a minute. If current rates of clear-cutting continue for crops, cattle, timber and firewood, over half of the world's rainforests will be essentially eliminated within 25 years. Each day several plant and animal species that have yet to be identified are lost forever. The potential threat of the "greenhouse effect", is of equal concern. Without the tropical rainforests to turn carbon dioxide into oxygen, some scientists have suggested that the Earth's climate may gradually become warmer causing the polar ice caps to melt and massive flooding to occur.

Global conservation efforts have recently begun to focus on designing reserves in deforested regions so these regions may one day return to primary forest. Little is known, however, about the environmental factors that must be present to allow deforested areas to regenerate. One of the major factors may be the proximity of primary forest to the deforested areas. In our research, we will investigate the role neighboring primary forest plays in the process of regeneration.

Research Focus

For the past two summers, our Rainforest Ecology teams in the Amazon Basin of Ecuador have studied plant regeneration in tree-fall gaps and the impact of soils in different areas of the jungle on regeneration. In our field work this summer, we will have the rare opportunity to investigate the interrelatedness of plants, animals, and humans—the web of life—by addressing questions such as: Does the species composition of specific plant and animal groups vary between primary rainforest and mature second growth rainforest? What is the impact of primary forest on this composition? Does the population density of mammals vary with age of a deforested area and distance from the primary forest?

Course Design

The central region of Costa Rica is mysterious and enticing. Steep mountain ranges, tall trees dripping with epiphytes, sparkling waterfalls and a huge array of animal life—tapirs, jaguars, pumas, ocelot, toucans and capuchins—create an unforgettable tropical world. Costa Rica's lack of an army and its neutrality have earned it a reputation as "the Switzerland of Latin America", and have provided a stability conducive to long-term scientific research. Deep in the jungle 8 miles from the nearest town, we will set up our camp at Rara Avis, a 1700 acre wildlife refuge owned and designed by Amos Bien, leader of two previous SFS teams studying tropical rainforest ecology in Ecuador.

Our journey to Rara Avis will take us down barely passable dirt roads that weave like snakes through overhanging jungle over steep mountains. Arriving at our camp, we will stow our gear in screened cabins within sight of a cascading waterfall. Faculty will lecture on ecosystem stability, nutrient cycles and energy flow, soil development, succession and the techniques for using plant

Hiking through the jungle can sometimes be compared to tackling the most strenuous of obstacle courses.



Photo by Eric Pallant

1 Rainforests

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

identification keys. We will take several hikes into the lush, green forest around the camp to see first-hand what we learn in our lectures. As we make our way through stands of huge mahogany and cecropia trees, and past colorful miniature orchids, the cacophony of birds and monkeys in the branches overhead will constantly accompany us.

Following several days of orientation to the rainforest ecosystem, we will head out on day and extended overnight expeditions into the mountainous terrain to explore and map with compasses regions that have been deforested at different times in the last twenty years. Government records and conversations with local residents will enable us to determine when these areas were first deforested.

With our map complete, we will conduct a survey of the animal and plant species at these sites. Using tape measures and various surveying instruments, we will lay out transects in deforested areas at increasing distances from the primary forest. In pairs, we will then walk along these transects recording all species of animals we see as well as tracks from larger mammals like jaguar and puma. We will also bait and set small traps along the transects to help determine the range of smaller animals that inhabit these areas. Compiling and analyzing our data from each transect will help us determine the variation in composition as one moves further from the primary forest. After sampling several sites, we will move into the adjacent primary forest to conduct similar studies on animal composition in these undisturbed areas.

At the same time we are conducting our research on animals, we will take a survey of plants at each site and then compare our findings to the distribution of plants in the primary forest. Again, we hope to be able to assess the importance of the proximity of primary forest on the recolonization by plants in deforested areas.

Photo by Herb Lawler



The species diversity in this sea of vegetation is greater than in any other biome on earth.

As we progress with our field work, faculty will present additional lectures on the economics of deforestation, erosion and habitat destruction, interdependence of organisms and the principles of natural resource management. We will also have the opportunity to work on a variety of independent projects. Topics will include soil characteristics in deforested and primary forests, effect of the age of a deforested area on the complexity of tropical communities and bird diversity in deforested regions.

Toward the end of our third week in the field, we will take an extended hike to La Selva, a large, progressive research station owned by the Organization of Tropical Studies. Here, we can talk with scientists about their research, our data and plans for future preserves.

"Personally, my experience in Ecuador was the best thing I have ever done. Not only the travel-knowledge angle of the course, but the sense of personal satisfaction. I worked out the travel arrangements. I paid for it. I flew there alone. I did it myself. It's the type of independent experience I needed at this point in my life."

Laurie Sanders
Cheshire, CT.
Smith College

The last three days of our course will be devoted to compiling all our findings in a final report which we will present to the Organization of Tropical Studies. Our data on the impact of the proximity of rainforest on the recolonization by animals and plants of deforested areas will provide valuable information for the design of management plans for reserves in deforested regions.

Living and Working Conditions

Our research at Rara Avis will take us to a remote virgin tropical rainforest, a cloud forest with an elevation of 2,000 meters, and a steamy lowland rainforest near sea level. The temperature at these locations varies from cool at higher elevations, to hot and muggy at lower elevations. Rain showers at all the study sites are short, but frequent.

Our campsite consists of bunk beds in screened rooms covered by a thatched roof. A dining and meeting room, with a kitchen is nearby. We will carry in our food, purchased at local markets in Las Horquetas.

Tuition: \$1,590

Departure Point: San Jose, Costa Rica

Environmental Geology Impacts

Hawaii

Purpose

To analyze the 1790 deposits of Kilauea volcano and characterize such infrequent but powerful explosive eruptions in order to better predict the force and devastating power of future explosions.

Dates: June 16-July 15

Course Level: A

Background

Rising out of lush tropical rainforests and surrounded by sparkling beaches, the active volcanos of Hawaii rumble an occasional reminder to inhabitants that they do not live on Fantasy Island. Kilauea, the youngest and most active volcano in the Hawaiian Archipelago, has produced as many as 50 explosive pyroclastic (fiery fragmental) eruptions in the last 100,000 years, the most recent of which occurred in November 1985. The last major eruption occurred in 1790, killing an unknown number of native Hawaiians who were traveling through the region.

Worldwide, volcanos including the

79 A.D. Pompeii eruption of Mt. Vesuvius, the 1902 eruption of Mt. Pelee in Martinique and most recently, the 1985 blast from Nevado del Ruiz in Columbia have caused thousands of deaths and extensive property damage. Volcanologists are therefore extremely eager to evaluate the explosive potential of all volcanoes. Their research attempts to answer questions such as: What triggers explosive eruptions? How widespread do the devastated areas extend? How do the explosive products move across the landscape? Once these questions are answered, societies can begin to make intelligent decisions as to how they can live safely in the shadows of these powerful manifestations of the evolving earth.

Hawaii is one of the most spectacular active volcanic regions in the world. Set in the sparkling blue waters of the Pacific, the islands teem with thundering waterfalls, huge fragrant flowers, and exotic animals. The location is also one of the safest for our scientific research. Since 1823, when detailed accounts of volcanism in Hawaii began, only one person has died as a result of eruptions. In our field work this summer, we hope to gain a more thorough understanding not only of the mechanisms of explosive eruptions at Kilauea, but also of similar hydromagnetic eruptions in other regions of the world.

Research Focus

Previous SFS Environmental Geology teams have studied volcanos in Iceland and Italy. This year students will study deposits from the 1790 eruption of Kilauea. These deposits are ideal for our research since they are well exposed and have not been as extensively altered by weathering as have deposits from older eruptions. They therefore provide an excellent opportunity to study their internal compositional and textural variations. This information can be used to evaluate changing mechanisms during eruptions and to determine how the resultant energy was dissipated. Previous researchers have concluded that the eruption lasted between several days and a few weeks. Did eruptive phases increase or decrease in violence during this time? Are there periods between eruptive phases that are recorded by material reworked by wind or water? Why did the eruption finally stop?

Course Design

Native islanders will welcome us at the airport in Hawaii with songs and flowers. Traveling through the tropical panorama, we will catch our first glimpse of the eerie, sparsely-vegetated volcanoes which are to be our classroom and home. We will set up camp at 4,000 feet near the summit of Kilauea.

To introduce the team to the geologic and cultural development of the Hawaiian Islands, the faculty will lecture on topics including

Lunar-appearing landscapes in Hawaii Volcano National Park provide a sharp contrast to the lush vegetation for which the Hawaiian Islands are famous.



Photo by David Barrett

Semester Programs

Semester Curriculum

SFS semester programs allow you to study an environmental issue and field techniques in greater depth, as we place our scientific research within a larger framework of social, political and economic concerns. Here, we have the ability to observe and participate in local issues and then situate them within their global context, a unique educational opportunity rarely available to students. Semester programs (accredited for 20 quarter credits) depart in January, February, June and September.

Each SFS semester course is a rigorous, carefully designed program of study, fully equivalent to any college-level course on the same subject. Courses are linked by a common focus on the flora, fauna, or human populations that comprise the ecosystem under study and that together must be considered in any plan to evaluate or preserve natural habitats and wildlife populations. **Interdisciplinary Research**, the capstone course, makes this link explicitly by asking students to apply all course work to an independent (or small team) study in a particular environment.

You will complete the equivalent of 20 quarter hours (15 semester hours) of college studies through a linked series of five courses, involving lectures, discussions, assigned readings, training in field techniques, and extensive first-hand experience. There also will be ample exposure to the people and culture of the area, as well as training in field anthropology.

Prerequisite: A minimum age of 18 is required; one college level biology course is highly recommended.

Courses

Exact titles, content and itineraries of each of the five semester courses vary with the program, but the general structure of the courses is similar. Each 4 quarter course includes approximately 48 hours of lecture/discussion sessions. All courses have reading assignments, written and oral evaluations of the students, laboratory and field projects, and many periods of informal discussion. The structured part of the laboratory/field projects totals

about 16 hours per week, but the nature of the program is such that learning often takes place in impromptu settings; thus the figures listed above are minimum contact hours.

The five semester courses are:

Introduction to Exotic

Ecosystems (4 quarter credits): An introduction to the flora and fauna of the study region. Emphasis is on diversity, evolution, taxonomy and practical methods of curation and identification.

Population and Community

Ecology (4 quarter credits): A detailed study of the interaction of the biota with their environment, building on the foundation established in **Introduction to Exotic Ecosystems**. Topics will include population growth models, predator-prey cycles, nutrient cycles, energy flow, and symbiosis.

Humans and the Natural

Environment (4 quarter credits): An investigation of practical applications of theory to environmental issues. Problems of resource management, pollution control, and environmental policy making are included, as well as the historical issues which have brought about current problems. This course extends the theoretical material taught in the first two courses to the problem-solving arena of policy makers.

Peoples and Cultures

(4 quarter credits): To fully understand environmental problems, we must place them within the context of their cultural, political and economic components. A broad survey approach is utilized with an understanding of cultural impacts on environmental issues as a unifying theme.

Interdisciplinary Research

(4 quarter credits): SFS is firmly committed to a "hands-on" approach to science. We want all students to experience the rewards and frustrations associated with designing, initiating, and completing a research project. Within semester programs, each student will investigate a particular aspect of a major research question that will require the practical application of much of the knowledge and skills students have gained throughout

the program. The combination of all the field work conducted by the students will form an integrated team approach to environmental problem-solving.

"One of the outstanding strengths of an SFS

Semester Program is its ability to provide a cohesive program of interrelated academic components; it is a program in which the whole is greater than the sum of the parts. It is unusual for a student to experience a semester where each academic component has been designed to complement and support the other components. A second advantage is immediate access to the ecological systems being studied. We have made every effort to take full advantage of these unique opportunities."

Dr. Christopher Neefus
Program Director
Marine Biology and Management Semester Program
Final Report

"The chance to work with a small and talented group of students of varied backgrounds towards a common cause is what I feel this entire course was all about."

Rusty Yeager
Evansville, IN
Indiana State University



Photo by Patty Lemay

Natural Resource Cons

Alaska

Courses: Introduction to Exotic Ecosystems • Wildlife Biology • Principles of Resource Management • Environment and Society • Interdisciplinary Research.

Dates: June 6 - August 22, 1986

Global Issue

In today's world of limited resources and rapidly expanding technological growth, proper management of our natural resources is emerging as a top priority. For thousands of years we have taken the basics of food, fuel, water and sunlight for granted on the assumption that these resources were infinite. In most cases, their exploitation had few noticeable consequences.

Today, we know differently. There are indefinite costs to developing natural resources, costs which can be measured and costs which cannot. Our awareness of these costs comes just at the time when we are becoming equally aware of the finite nature of these resources. How can we conserve these resources and simultaneously use them? Can we accurately measure the environmental costs of development to make sound decisions as to whether the costs justify the benefits? These are the types of questions facing people in government, industry and independent sector organizations that are charged with resolving the conflicting trends of population growth and a globally shrinking resource base.

Local Concern

An ongoing drama has been played out in Alaska over the past twenty years. Preservationists citing the need to preserve Alaska as one of the world's few remaining areas of pristine wilderness have been pitted against industry's need to tap Alaska's vast energy resources. The construction of the trans-Alaskan pipeline provides a textbook example of a project that was pursued with total awareness of its potential environmental impacts. Every attempt was made to keep its effects to a bare minimum. After extensive pre-construction impact studies, and at enormous cost, the pipeline was rerouted around sensitive tundra, elevated in places to allow caribou to pass, and refrigerated for miles to insure the warm oil would not melt the delicate permafrost.

While great care was taken to prevent the pipeline from disturbing the environment, less attention was focused on the indirect effects generated by the ease of access to the interior which the pipeline construction afforded by way of the new haul-road created to facilitate the pipeline's construction. Although travel is restricted, the entire road which

parallels the pipeline for 577 km receives considerable traffic from tourists and pipeline maintenance crews. It is feared that this traffic interferes with animal migratory patterns and prevents large mammals from reaching resources such as mineral deposits, which are essential for their survival.

Research Focus

In our second semester program based in Alaska, we will investigate secondary impacts of the pipeline on wildlife by studying and comparing the behavior and distribution of moose, sheep, elk, caribou, bear and more furtive animals like wolves and fox along the haul-road and in several parks and wilderness areas. In addition, we will examine the role that naturally occurring mineral deposits, which animals visit to supplement their diets, play in the migratory patterns of various species.

Itinerary

This mobile semester begins with a 3-day ferry ride from Seattle to Haines, Alaska at the top of the panhandle, just north of landlocked Juneau.

Boarding vans in Haines, we will travel the Alcan Highway through the Yukon Territory, past 19,500 foot Mount Logan, and on through the Klondike region to Fairbanks, where we will set up a base camp outside of town. We will then drive south through lush forests to Denali National Park, known for its magnificent wildlife. Here, we will initiate our research by observing the ecology of various species of wildlife including wolves, moose, caribou and bear.

From Denali, we will follow the restricted haul-road for several days across the Yukon River to the snow-capped mountains of the Brooks Range, one of the most remote areas in North America. Setting up camp at Galbraith Lake, we will continue our research. We will go on several extended backpacks into this arctic-alpine wilderness area. Deep forests of white spruce, birch, balsam and poplar give way to black spruce and ultimately moss and lichen-covered rock as we ascend to higher altitudes. Likewise, moose, caribou, and grizzly bear give way to Dahl sheep at the higher elevations.

On our way to the origin of the pipeline at Prudhoe Bay on the Arctic Ocean, we will drive through the colorful arctic coastal plain, where miles of frozen tundra are covered with a carpet of flowers. This region represents the most extreme wildlife habitat on earth. We will wrap-up the course at our base camp in Fairbanks.

It doesn't get much better than this—Alaska in all its splendor.



Photo by Jim Dersole

ervation

Program Structure

This program moves through five courses which begin with theoretical considerations in **Introduction to Exotic Ecosystems** to an awareness of the resources at risk in **Wildlife Biology**, to learning skills of **Principles of Resource Management**. **Environment and Society** places environmental issues in their cultural, historical and social context, and **Interdisciplinary Research** provides hands-on experience with environmental problem-solving.

Introduction to Exotic Ecosystems addresses basic principles of ecology, evolution, population dynamics, and community structure. We will investigate the diverse floral and faunal composition of Alaska's different ecosystems as well as the ecological characteristics that support this diversity. Energy relationships and nutrient cycles within these ecosystem will be discussed along with concepts of ecological stability. Field work will include investigations of population growth and regulation.

Wildlife Biology allows us to go beyond a general overview of Alaska's ecosystems and their fauna and flora to explore in detail the major faunal groups of the regions through which we will travel. We will study the evolution, natural history, ecology and behavior of selected small and large species focusing specifically on their morphology, physiology and behavioral ecology along with their adaptations to the arctic environment. This course will cover field identification of common mammals and birds, classifications of social groupings and behaviors, and techniques for surveying and censusing populations.

Principles of Resource Management introduces us to conservation and management principles and their application to problems in soils, water, forests, wildlife, mineral and energy resources. Building on our knowledge of basic ecological concepts, we will integrate them with educational issues, conflicts, and history of the conservation movement. We will consider the complex interactions between humans and the natural environment in addition to multiple-use management of forest land for water, wildlife and recreation.

Environment and Society is an introduction to the way people and environments interact both globally and locally. We will begin by considering the movement of people across the

Bering Land Bridge about 25,000 years ago. We will study the cultures of the different peoples of Alaska, and consider their natural resource base and their impacts on the environment. We will investigate demographic patterns in historic times and the impact of technological change on cultural values and subsequent alterations in the way people perceive their environment. This study will lead us toward a consideration of the philosophical structure which determines land-use patterns in different cultures.

In **Interdisciplinary Research**, we will conduct independent field research projects based on topics related to our team research. Some possible topics include: the distribution of required mineral deposits for wildlife in selected regions of Alaska; time/energy budgets of caribou, Dahl sheep, and other animals; forage use by various herbivores; and the acclimatization of moose, elk or caribou to the presence of humans and vehicular traffic. These projects will enhance our understanding of how human presence is affecting Alaskan wildlife and in particular the impact resulting from improvements to the public access roads since the opening of the pipeline.

Living/Working Conditions

Most of Alaska is in the North Temperate Zone; only one-quarter is located north of the arctic circle. Variations in temperature between these sections are extreme, especially in the interior. We can expect average temperatures between 42°F to 64°F with an average monthly rainfall of about 4" depending on our location.

Special permits allow us to travel the haul-road paralleling the pipeline through Alaska's magnificent wilderness from Fairbanks to Prudhoe Bay.



Photo by Jack Shea

We hope to document the importance of naturally occurring mineral deposits to the behavioral physiology of large mammals such as elk and caribou.

We will experience about 20 hours of sunlight each day.

We will be driving in four wheel-drive vehicles and will need to be self-contained in terms of our food, water, gas, communication, and repair and maintenance equipment. Our accommodations will vary according to our travel plans. We will have several base camps, consisting of a primitive field station plus permanent structures in which we can sleep, dine and compile our research data. While we are on the road, we will camp amid the splendor of a desolate, virgin wilderness.

Tuition: \$4,850

Departure Point: Seattle, Washington
(Course ends in Fairbanks, Alaska)



Photo by Jim Eberhardt

Marine Biology and M

Virgin Islands

Courses: Introduction to Exotic Ecosystems • Population and Community Ecology • Principles of Resource Management • Cultural Ecology • Interdisciplinary Research.

Dates: September 14, 1986 - December 7, 1986
February 4, 1987 - April 29, 1987

Global Issue

Because the majority of the earth's surface - over 70% - is covered by oceans, 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. The narrow coastal region on which coral reefs and algal beds lie are an important exception.

The entire reef complex serves as a hub of productivity in the midst of relatively unproductive tropical ocean ecosystems. Coral reefs protect shores and harbors from erosion and wave action and provide a spectacle for tourists that has tremendous economic importance in many tropical communities. It has been suggested that reefs play a role in the critical regulation of the ocean's salt content by creating what are essentially evaporation lagoons between themselves and the shore. In addition, coral reefs provide a habitat for over one-third of all fish species, ensuring an important source of protein for local populations.

Not only are reef ecosystems limited in size and number, they are extremely fragile. Disturbing one component may set the entire system off balance. Worldwide, these ecosystems are being seriously impacted by oil, sediment, sewage, toxic wastes, dredging, land development and overfishing. White skeletons of reefs are often all that remain of once productive communities.

Local Concern

Historically, the inhabitants of the Virgin Islands have grown lucrative crops - sugar cane, bananas, and coconut, raised cattle and goats, and supplemented their diets with food from the surrounding waters. Overgrazing and overplanting, however, have now rendered much of the land unsuitable for agriculture. Currently, the Virgin Islands' rapid population growth and booming tourist trade place severe demands on the fisheries. Yields from the fishing industry have dropped substantially recently, giving

rise to a major concern that the local fisheries are rapidly being depleted. Despite this concern, very little is known about the size of the fisheries and how it should be managed.

Research Focus

Focusing directly on the fisheries resources of the Virgin Islands, we will conduct a thorough inventory of the population of conch, sportfish and commercially harvestable fish in nearshore Caribbean waters and assess the impact of current levels of stress on these resources in an attempt to devise appropriate guidelines for future use.

Site

The Virgin Islands lie at the eastward edge of the Greater Antilles chain of Caribbean Islands, just east of Puerto Rico. The environments of these tropical paradises vary from lush green forests of fruit and palm trees to dry, desert-like terrain. Some islands are pristine and undeveloped; others have oil refineries and are plagued with pollution problems. All are characterized by sandy

Following daily lectures we will proceed to our natural laboratory—the clear, turquoise waters and the glistening coral reefs that lie just offshore.

beaches, mangrove swamps and quiet lagoons created by the extensive coral reefs that usually fringe each island.

We will collect data at sites in the U.S. and British Virgin Islands, traveling by SFS's sailboat between islands. Our home base will be the Virgin Islands Ecological Research Station (VIERS), a small, isolated field laboratory several hundred yards from the shore of Lameshur Bay on the island of St. John. Owned by the College of the Virgin Islands, VIERS is located within the Virgin Islands National Park, which encompasses much of St. John, and has been the site of five years of SFS research. Facilities include small screened cabins, a dining hall, classroom, laboratory and library with computers for our use.

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

Program Structure

Through a series of five courses, we will investigate first-hand the economic, political, historical, and scientific issues involved in managing fisheries resources in the Virgin Islands. **Introduction to Exotic Ecosystems** will orient us to the marine environment and its major



Photo by Christopher Neefus

management

groups of organisms. Study topics will include evolution of major marine groups, algae phylogeny and morphology, physiology of cells, reproduction in marine organisms, nutrient cycling, photosynthesis and respiration. The field and lab component of the course will cover the identification of fish, plants and invertebrates. Using SCUBA, we will utilize non-destructive techniques of collecting such as underwater photography and in-situ observations. Classroom studies and field research will occasionally be interrupted for field trips.

In **Population and Community Ecology** we will consider the physiological and behavioral responses of marine organisms to their environment and examine evolutionary responses to long-term environmental changes.

Basic ecological principles of energy flow and nutrient cycling and food chains will be addressed as well as the role of symbiosis, competition and predation in the structure of marine communities. Finally, we will study the stability of the ecosystems and their ability to recover from disturbance. In the lab/field portion of the course, students will participate in supervised exercises to learn techniques of underwater observation, data analysis, and data presentation in preparation for individual projects.

In **Principles of Resource Management** we will consider the inherent complexity of marine management problems and how conservation policies are made on a local as well as global scale. Locally, we will look at problems faced by the Park Service in establishing and enforcing policies for protection of the marine environment under various types of park use. This course is designed as a seminar in which we will analyze papers and present issues for group discussion. Discussion topics include population growth, economics of conservation and problems of pollution.

In **Cultural Ecology**, we will study the economics, politics and human cultures of the Caribbean and relate these factors to the management and preservation of the marine environment. We will investigate the development and structure of different societies and document how the oceans and fisheries have been incorporated in their cultures. Lectures by faculty and guests will address topics including recent political and cultural developments, the alien-immigration problem and the effects of major industries, such as tourism and oil ship-



Facilities at V.I.E.R.S. include screened bungalows, a laboratory, dining hall, classroom building and library complete with computers for our use.

ping, on the economy and culture of the region. To give our studies empirical significance, we will do field work in the local communities exploring attitudes on fisheries, the National Park and conservation issues.

The **Interdisciplinary Research** component of our program will complement our overall objective of quantifying the impact of fisheries on the National Park ecosystem. Material presented in other course work will be applied to this research. Each student will take on a component of the large topic as an independent project. Topics may include diurnal changes in fish distribution, species diversity and abundance in local fish catches and the distribution of fish species in fished and unfished habitats. 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.

Even traveling between research sites is exciting aboard SFS's 48 foot sailboat Xanadu II.



Living/Working Conditions

Our semester on the tropical island paradise of St. John will be filled with hours of underwater observation and classes in the warm sunshine. Accommodations at the V.I.E.R.S. facility will be rustic, but comfortable. The site has electricity and solar-heated outdoor showers. Likely visitors to our camp include wild donkeys, mongoose and hummingbirds.

Meals are prepared by the V.I.E.R.S. staff, but students assist in clean up duties. From time to time we will sample island cuisine, which is spicy and flavorful. Stewed fish, curry fried plantain, breadfruit and manioc are local delicacies.

Tuition: \$5,450 + \$100 SCUBA fee

Departure Point: V.I.E.R.S., St. John, Virgin Islands

Photo by Wendover Neeb

Photo by Norman Fortier

Wildlife Biology and Kenya

Courses: Wildlife Biology • Population and Community Ecology • Cultural Ecology • Environment and Society • Interdisciplinary Research.

September 14, 1986 - December 7, 1986;

January 3, 1987 - March 28, 1987

Global Issue

Biotic diversity, not merely in numbers of species but in the full array of genotypes that make up the earth's inhabitants, can be preserved only fractionally in isolated national parks and wildlife reserves. Further, the combination of expanding human populations and developing economies render many habitats unsuitable for wildlife. We must seek 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.

Local Concern

Kenya offers a dramatic illustration of this conflict. Population and economic growth have placed severe pressures on rapidly diminishing natural habitats, which are needed to sustain Kenya's majestic and irreplaceable wildlife herds. The increasing need for meat in particular has led to extensive ranching of strains of beef cattle. However, these strains were originally developed in countries with relatively abundant grasslands and water, commodities in short supply in Kenya. Cattle are also very labor intensive to manage, requiring for example, regular attention for parasite control.

Substituting native species of ungulates (e.g. Thomson's gazelle, hartebeest, wildebeest, zebra) for domestic cattle offers an alternative which preserves the natural ecology, uses less water and energy, and can lead to increased food production in a country with the highest human population growth rate in the world. But does game ranching really preserve the native ecology? How do harvested populations differ from natural herds?

Research Focus

Our research goal is to document the efficiency of raising native ungulates as an alternative protein source for human consumption. To increase our five-year data base on the productivity of the Hopcraft Ranch, we will measure the

weight, amount of meat per animal, parasite load and sex of the animals which are cropped weekly. We will address specific issues such as the difference in behavior of the animals on the ranch as compared to populations on national parks and game reserves elsewhere in Kenya.

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 of eastern Kenya as large carnivores such as lions, cheetahs and leopards prowl in the brush. The lush mountain forests of western Kenya 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 cool off in lakes shared with white pelicans and pink flamingos.

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

"I survived the long hours, unpredictable weather, and living conditions which typify field research, and I have concluded that this is indeed the type of work I want to pursue."

Edward O'Brien
South Portland, ME

Our base of operation will be "Wildlife Ranching and Research Ltd.," established by Dr. David Hopcraft, a Cornell University graduate, as an experimental game ranch where the population of various large mammals could be protected, ranched and carefully monitored. Situated approximately 40 kilometers southeast of Nairobi in the Athi Kapiti Plains, the Ranch consists of laboratory facilities, a slaughterhouse, a small library, and 81 square kilometers of protected savanna where wildebeest, giraffe, and gazelle roam freely. The SFS tent camp nearby in its own isolated setting includes a permanent dining/lecture hall and open air showers.

Program Structure

This semester program is designed to allow students to compare first-hand aspects of game ranching with the management of preserved herds. Our objectives are: to learn about the 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 the East African savannas through a discussion of their evolution and ecological requirements. Emphasis will be placed on the diverse ungulate populations with particular regard to the physiological and behavioral ecology of individual organisms and natural social groupings. The field and laboratory portion of this course will take place at the Ranch and in various national parks including the Masai Mara Game Reserve and Nairobi



Photo by David Hopcraft

Management

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, and standard techniques for population sampling. We will also spend a week on 14,000-foot high Mt. Kenya where daily lectures will focus on geomorphology, glaciology, and the various plant and animal species living at different altitudes on the mountain.

In Population and Community Ecology, we will begin with mathematical models of population dynamics from which we will form the basis for an investigation of interactions between populations of different species, including competition, predation, parasitism and mutualism. Coevolutionary aspects of each 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. We will spend a week studying the coastline of the Indian Ocean near Mombasa, where fishing and shelling are impacting Kenya's fragile coral reef communities.

Cultural Ecology will introduce us to the varied cultural heritage of Kenya. The first week includes an introduction to basic Swahili, which will help us communicate with those Kenyans for whom English is a second language. We will then review the East African evidence for human evolution and concentrate on the traditional cultures of the major indigenous groups of the area. The social, political and economic impact of the colonial and post colonial eras will be examined during the last week of the course. The course will consist of classroom lectures and field trips to areas or events of cultural interest including local Akamba and 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 ecosystems emphasizing the degree of management required at each level.

The capstone course, building heavily on the other four, will be **Interdisciplinary Research**. In the first three weeks of this course, we will sharpen our hypothesis formulation skills, learn specific research techniques, and gather preliminary data on potential research topics. Coinciding lectures will be presented on approaches to biological research, sampling design, experimental design, and basic statistical analysis.

Our field research, commencing in the fourth week, will involve two large scale projects conducted throughout the semester and a series of smaller, week-long projects. Potential topics may include examining different aspects of ungulate ecology and behavior; examining the impact of the tourist industry on the coral reef community; and determining methods for assessing the stability of different biomes.

Our field work will be conducted within the Ranch and in various national parks enabling us to perform comparative studies of species in controlled and uncontrolled conditions. The laboratory and slaughterhouse on the Ranch will facilitate our investigation of the taxonomy and biology of various species.



In addition to studying gazelle, wildebeest, giraffe and zebra, we will see cheetahs, lions, elephants, hippos—all the wildlife we've seen in pictures and read about.



Photo by John Burley

"One of my most vivid memories is when we went and visited a secondary school and spoke with the students there. We went and sat with a class of students and answered questions about America and Americans—it gave me a lot of insight as to how they perceived us. Questions such as 'can you see the sky in New York City?' or 'what tribe are you from?' emphasized the inescapable differences between our cultures."

Katy Heinzel
Princeton, N.J.
University of Pennsylvania

Living/Working Conditions

The average temperature in Kenya ranges from 70° F to 85° F; between January and March, frequent rain showers can be expected while September through November is much drier. We will use vans to travel through the Ranch and the national parks. Although for safety reasons we will conduct most of our observations in the Parks from within our vehicles, the Ranch will give us the freedom to do much of our research on foot.

We will sleep on cots in our tents on the Ranch and on foam pads while on safari. It will not be unusual to awaken to the chatter of a local troop of monkeys or the shuffling of a herd of giraffe passing by our camp. Sufficient solar-heated water for showers will provide a welcome relief from our days on the warm, dusty savannas.

Tuition: \$6,070 + \$90 field trip fee

Departure Point: Nairobi, Kenya

Prerequisite: One College-level biology/ecology course.

Biogeography: Impact

Australia

Courses: Cultural Ecology • Introduction to Exotic Ecosystems • Population and Community Ecology • Interdisciplinary Research • Environment and Society.

Dates: February 4, 1987 - April 29, 1987

Global Issue

Scientists are usually unable to predict the consequences of the extinction of a single species just as an airline passenger cannot assess the effect of the loss of a single rivet on the future of an airplane. But both can easily tell the long-term consequences of continually losing species or rivets. Thus, maintaining as many species as possible makes good management sense.

Although destruction of habitats by humans is by far the largest cause of extinction of species, some plants and animals are threatened by other factors. In many areas, endemic (existing nowhere else on Earth) flora and fauna, are endangered by exotic (introduced) species. The native species are often quite vulnerable, having evolved to fill a very specific niche in an ecosystem where there was previously little or no competition from other species. They therefore fare poorly when placed in competition with hardier non-native species.

Kangaroos bounding through the grasslands will be a constant reminder of the uniqueness of our study site.



Local Concern

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, and a unique evolutionary pattern occurred. Instead of the dominance of placental mammals found elsewhere in the world, marsupial (pouch-bearing) mammals—kangaroos, koala bears 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 strange evolutionary links—the egg-laying, milk-producing, furred duck-billed platypus, the even stranger spiny anteater, and the air-breathing lungfish which crawl about mud flats on their fins. Within the last century, however, the introduction of non-native or exotic species such as rabbits, rats, water buffalo and European carp has seriously threatened many of these native species.

Research Focus

In our first semester in Australia, we will work with scientists from the Parks and Wildlife Service surveying areas of existing rainforest in Lakefield National Park and investigating how endemic species compete with exotic species for resources including space and food. We will collect extensive data on the resource requirements of endemic and exotic species and determine where overlaps and as a result, conflicts, occur. Based on our findings, we hope to design management strategies for the Parks and Wildlife Service that will help them preserve endemic species.

Site

The Cape York Peninsula of far northern Queensland, has the greatest climatic, societal, and biological 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 only tropical rainforest runs down to the water along the shoreline paralleled by the 2,000 kilometer-long, magnificent Great Barrier Reef.

In the middle of this spectacular strip of rainforest approximately 140 miles north of Cairns is the Lakefield National Park, site of our home base for the semester. Virtually uninhabited, this 2,200,000 acre park, established in 1975, is characterized by diverse environments from dense jungle to savannas. On daily trips into the rainforest, we may encounter over 500 species of canopy trees, and an equal number of animal species including the cuscus, pademelon wallaby, tree kangaroo, giant lorikeet, Bird of Paradise, 2-foot long forest dragon lizard, and frogs and toads in more colors and shapes than you can imagine. Flights of up to 2,000,000 flying foxes (which are actually bats) cloud the evening skies. Crystal-clear streams wind their way through dense, lush vegetation and occasional waterfalls fill the air with the persistent hum of crashing water.

Program Structure

Through five distinct but interrelated courses, we will investigate the scientific, economic, political and historical issues that must be considered in determining strategies to preserve the endemic wildlife of Australia. **Cultural Ecology** introduces us to the origins of the aboriginal people indigenous to Australia

Photo: Australian Tourist Commission

s on Diversity

and describes their rich culture, language and lifestyle. We will study the impact of the early European settlement of Australia in the 17th century by the Dutch and proceed with a consideration of the impact of English colonization.

A major component of this course will address how the native Australians interacted with their environment. Australia has a rich diversity of environments, from the tropical rainforest of Cape York to the central desert, and the resulting ecological diversity will provide a background to help us understand how people adapted to various environmental pressures.

Introduction to Exotic Ecosystems provides the ecological background to understand the tremendous diversity of Australian ecosystems. We will focus mainly on the rainforest, but field trips to the savannas, outback, eucalyptus and acacia woodlands will enrich our studies. A field trip to the Great Barrier Reef, one of the largest and most spectacular reefs on Earth, will introduce us to the diversity of marine life off the Australian coast including over 1,500 species of fish and 400 species of coral. Lecture topics include diversity of plants and animals, nutrient cycling and soil development, impact of climate, energy flow, and life cycles. Field work will take place daily, as we explore the habitats, measure the abundance of life forms, and study the evolutionary principles which account for the convergent forms in Australia.

Building on these foundations, **Population and Community Ecology** will enable us to develop skills so we can take a more rigorous approach to studying the array of organisms we encounter. This course begins with discussions of population growth models, demography, adaptive strategies of organisms and principles of population genetics and evolution. We will examine complex interactions like predator-prey-parasite relationships which help explain ecological diversity and the survival of species. Labs will involve careful measurements of growth parameters, computer modeling with our portable computers, and the development of a mathematical model of population growth, genetic diversity or some other aspect of ecology based on field observations.

Research skills will be developed in **Interdisciplinary Research**. We will learn to ask scientific questions, investigate past research, pose hypotheses which might explain the phenomenon in question, perform experiments or measurements which determine the veracity of the

hypotheses, and generate conclusions. Topics will include understanding interspecies interactions, relationships between climatological events and behavior, nutrients and species distribution, and the study of phenomena such as competitive exclusion and displacement. The results of our studies will be collected and presented in written form to the scientific community and orally to the Parks and Wildlife Service scientists.

Environment and Society will relate the above courses to the human issues of the present and future both locally and globally. We will study the need for natural resources presented by expanding populations, and consider the conflict between development and conservation. Australia's sparse population and abundant natural resources has protected it from the ecological ravages which have occurred in other industrialized countries. Recently, however, issues which plague the U.S. - the disposal of hazardous wastes, deforestation, water pollution, and air pollution - are being felt in Australia. Guest speakers will present a view of the sometimes emotionally-charged resource management issues. The relationship between political, social, and economic systems and the environment will be presented to attempt to explain why conservation efforts work some places and not others.



Photo: Australian Tourist Commission

Among our considerations in Cultural Ecology will be the traditions of the aboriginal people of Australia.

Living/Working Conditions

Be prepared for wet weather. The summer rainy season is November through April, and an average of 60 inches of rain can be expected to fall in this period. Frequent thunderstorms will be punctuated by intense sunshine. Ocean breezes keep the air temperature in the 80's. Our base camps will be primitive but comfortable, with screened-in bunkhouses, modern showers, and adequate cooking facilities.

Perishable food items will be available only immediately after our resupply trips, so our food will be plentiful but repetitive at times. Access to the rainforest will be via four-wheel drive vehicles when the water is down, and by inflatable raft at high water periods.

Tuition: \$5,820

Departure Point: Cairns, Australia

Queensland is best known for its diverse habitats and breath-taking scenery.



Photo by George Gibson

Conservation of Tropical Ecuador

Courses: Introduction to Exotic Ecosystems • Societies and Cultures of Ecuador • Cultural Ecology and Ethnobotany • Natural Resource Management • Interdisciplinary Research.

Dates: January 3, 1987 - March 28, 1987

Global Issue

The complex role of tropical rainforests in the world's ecosystem has just recently come to the public's attention. At least half, if not more, of all species of plants and animals on earth live in tropical rainforests—a genetic resource that increasingly serves mankind through advances in agriculture and medicine. The rosy periwinkle helps combat leukemia while curare is used in heart operations. Even birth-control pills can be traced back to the rainforest. Yet, only one-sixth of the more than two million species present in tropical rainforests have ever been identified.

Tropical rainforests are justly called the "lungs of the earth". They are the single largest source of the oxygen we breathe as well as primary regulators of carbon dioxide which, in turn, regulates our global climate. Half of all wood on the planet grows in tropical forests, despite the fact that the forest soil is generally of low quality and unsuited for agriculture.

Unfortunately, despite the vast resources of tropical rainforests, they are shrinking at an alarming rate—50 acres a

minute—as development spurred by rapid population growth reaches further into the jungle. Some experts estimate that tropical rainforests may be eliminated by the end of this century.

How can we unlock the genetic and ecological secrets of this "library"? We can try random screening of plants, but a much smarter solution may be to ask the "librarians"—those members of traditional cultures who have used the forests' plants and animals after many years of patient trial and error.

Local Concern

The Amazon rainforest alone supports at least 10% of all living species, and at the same time is home to many of the world's remaining aboriginal cultures. In the last 30 years these once isolated peoples have been substantially impacted by outside pressures. Modern medicine has decreased child mortality; increased communication with the outside world has stimulated a more consumer oriented lifestyle; logging has simultaneously displaced communities while creating easier access for outsiders.

Research Focus

We will document the abundance and diversity of plants with medicinal or economic value in the lowlands and uplands of Ecuador and assess the minimum size of an area of tropical rainforest that will insure the preservation of this diversity. We will lay out small plots in the forest and working with local people determine the abundance of usable plants. Measuring the diversity between plots will enable us to apply statistical functions to estimate the numbers of new species of potential importance in similar unmeasured areas.

Site

We will begin our program on the western side of the Andes between the mountains and the ocean in rich, agricultural land where banana, rubber and palm plantations speckle the landscape. Our base camp will be situated in dense jungle at the Rio Palenque field station where extensive research on rainforests has been conducted over the last decade. Here, one can walk a mile and not encounter the same species of tree, see orchids growing up tree trunks, spot up to 800 species of colorful birds, and encounter traces of puma and jaguar while monkeys screech in the trees overhead.

We will then follow small winding roads east into the Andes to a highland cloud forest. As we reach higher elevations, our velvet-green surroundings become increasingly lush due to the high levels of precipitation. This trip will take us by small Indian villages where we will establish our base camp at a village edge adjacent to the cloud forest. Much of our time will be spent hiking through the forest taking a thorough inventory of flora and fauna.

Our final research site will be on the eastern side of the Andes on the edge of the rainforests of the far reaching Amazon Basin. After descending from the highlands into more humid territory, we will board small dugout canoes and head down an Amazon tributary to a region near several Quechua Indian villages.

Course Structure

Our introduction to the rainforest begins at Rio Palenque where we will spend the first two weeks of our initial semester in Ecuador. We will spend the next ten weeks working closely with local people such as the Quechua Indians at our two base camps to learn as much as possible



After paddling down Amazonian tributaries in dugout canoes, we will make camp near a Quechua Indian village to continue our research.

Photo by Nina Marshall

cal Resources

about their cultural heritage, their use of the products of the rainforests—especially medicinal uses of plants—and the impacts of technology on their lifestyles.

In **Introduction to Exotic Ecosystems**, we will study the flora and fauna of rainforests and cloudforests and investigate their interdependence on nutrients, energy, soils and structure. Extensive field trips will familiarize us with the large diversity of plants and animals and enable us to develop techniques for identification. At our field laboratory, we will perform measurements of growth, standing crop, and food chain interactions in order to develop a model of the exchange of materials between components of these ecological systems.

In **Societies and Cultures of Ecuador**, we will study the Early and Late people of the tropics, the rise of the Inca culture and the impact of the European invasion on the cultural heritage of Ecuador. We will review the development of the Mestizo people, and examine the rich mix of heritages which comprise the people of modern Ecuador. To supplement readings in our text, we will review papers, attend lectures by scholars and local people, and visit several nearby villages.

Cultural Ecology and Ethnobotany focuses on the traditional uses of natural resources by indigenous peoples and the impact of the different environments of Ecuador from the high, cool mountains to the steaming Amazon jungle on the development of the cultures of these people. Through extensive field work, we will examine the demand for resources for food, building materials and clothes and determine how these demands affect the resource reserves of the rainforest. We will have the opportunity to meet with villagers whose ancestors have lived in the same area for hundreds of years to learn about the uses of plants for medicines and foods.

In **Natural Resource Management** we will consider methods by which managers determine how best to allocate natural resources and resolve conflicts between the need to utilize resources and the desire to preserve valuable habitats. Lectures will introduce us to multiple land-use strategies, development of reserves and parks, environmental economics and formulation of policies to regulate forestry, mining and road building. Readings such as the World Conservation Strategy and discussions on the applications of solutions to resource development and conservation in other



Photo by Brian Boon

Much of our time will be spent talking and working with local villagers to learn about their uses of products from the rainforest.

areas of the world will help us understand specific resource issues in South America.

In our final course, **Interdisciplinary Research**, we will be able to apply the knowledge and skills we have gained in our other courses to an independent research project. We will spend two weeks investigating aspects of the interaction between humans and the environment and then narrow in on topics for our projects. Examples of topics include studies of the use of particular plants for medicines, the history of the use of a certain artifact, the food resource base of a village and a study of the impact of a certain convenience, such as the outboard motor, on the structure and economy of a region. At the end of the course, we will present final reports on our projects to local government officials and scientists.



Photo by Nina Marshall

Living/Working Conditions

You will be in an area which is far removed from your familiar surroundings. It will be hot and humid, and frequently raining at low elevations, while our trips to higher sites will provide some relief from the heat, but not the frequent rains. We will carry most of our food into the jungle with supplement it with delicacies from local markets.

Our field stations, complete with dining/lecture halls and tentsites, will give us bases in which we can study, eat, and relax in physical comfort, but the cultural dislocation will be ever-present. We must be continuously sensitive to the fact that we are guests in an area rich in a tradition which is foreign, complex, and easy to misinterpret. Participants must have a mature outlook on this situation to maximize their own benefits, including the rare opportunity of actually getting to know people who live across a large gulf of cultural development.

Tuition: \$5,080

Departure Point: Quito, Ecuador

We will investigate the profound impact the introduction of modern conveniences—cars, outboard motors, chainsaws—has had on the lifestyle of local villages.

Semester Basics

Special Skills Development

Each course is designed to develop your ability to implement methods of observation, measurement, recording, interpretation and analysis in the biological sciences. Some field techniques include:

- plant/animal identification
- map making
- quadrat and transect analysis
- computer modeling
- hypothesis formulation
- research design
- resource sampling and assessment
- scientific report writing
- behavioral observation techniques
- statistical analysis
- population modeling
- survey and census
- using photographs as a recording device
- standing crop measurements

Concurrent with academic and field training, there will be instruction in outdoor skills; planning field expeditions; safety, health and risk assessment; and emergency procedures.

Schedule

The semester programs are eleven to twelve 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 sight-seeing in the major towns and cities of the area are scheduled as an integral part of the semester program.

Courses are taught six days a week, excluding Sundays, which are usually free for recreation and travel. We will also have two breaks of two days each between weeks 5 and 6 and weeks 9 and 10. In each session, two courses usually run concurrently on a M-W/T-Th-S rotating basis, except when overnight field trips require changes. Each day will have a 2-3 hour classroom component in which all new lecture material is presented and assigned reading discussed and the field exercise for the afternoon is planned. Three hours or more in the afternoon will be occupied with field work and training, which complement the morning's lectures and reading material. Evenings are unstructured; we will schedule films, guest speakers, and cultural events, and the field library will be available

for research and assigned reading. You may participate in planning evening programs in your own areas of interest.

Much of the program will be allocated for supervised field research on a topic of your choice. Your project will incorporate material from most of your previous and concurrent coursework to answer a specific question about the ecosystem you have been studying. The last two days will be used to present the results of your directed research to the group and some outside guests, as well as to complete evaluations and prepare final versions of papers.

Evaluations

The faculty will conduct periodic 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. Evaluations, academic work and letter grades will be forwarded to your home institution as requested.

Student Body

Each semester program expects to enroll 18-24 students from across the U.S. and abroad, as well as one or two students from the host country in which we are staying.

Faculty

Semester programs are usually taught by the field director, two senior faculty, and one teaching assistant (depending on actual enrollment). Faculty members and the field director will hold a Ph.D. or its equivalent.

"We washed in glacial streams, cooked in the rain, slept under the stars..."

lent and have substantial teaching and research experience at the program location.

Living Conditions

Each semester program will have a dormitory-style base from which we depart for field work and trips. Facilities will be primitive, but will include a kitchen, basic lab, and library. We will cook most of our meals and do most cleanup and routine maintenance. We will camp while in the field.

Academic Credit

SFS semester programs are accredited through Northeastern University for a total of 20 quarter credits. You will receive an official transcript from Northeastern following the completion of your program.

"I wanted to learn about all the parts that make up the wilderness by seeing them first-hand and spending time in the wilderness instead of memorizing facts and theories in a brick building so distant from the area being studied. In college, each class is totally separate, and I couldn't see where all the parts of my education were coming together or leading me to something in the future."

Jeanne Guild
Chester, VT.
Colby College



Photo by Jack Shea

y: Modeling Volcanic

aspects of Hawaiian culture, Hawaii in the framework of plate tectonics, identification of minerals and rocks, stratigraphy and the relationship of earthquakes to volcanism. We'll study geologic and topographic maps of the area surrounding Kilauea to identify the major ash-falls, lava flows and avalanche deposits that swept into surrounding regions during the last eruption.

Day trips will take us to different locations on the slopes to examine these features. As we move across the slopes, the deposits and flows will present a sharp contrast to the rich, fertile land leading up to the crater. One goal of our research is to quantify vertical and lateral changes in the composition and size of the deposits. Using tape measures, compasses and pocket alidades, and by digging profile pits to gain information on changes in movement and size that may not be obvious on the surface, we plan to construct stratigraphic maps of the structure and sequence of these complicated formations. These maps will help decipher the story of the eruption now recorded only in the rocks.

Our next challenge is to collect samples of these formations to determine their composition and to use the data in conjunction with our maps to identify the possible sources of specific deposits and lava flows.

"The sight which greeted me made the suffering of the climb

worthwhile. Against the dark sky was the bright orange color of molten lava flying up from one of the cinder cones within Stromboli's crater. I just stared, awestruck, unable to believe that I was actually sitting on the side of a volcano, watching it erupt. This was what one saw in National Geographic or on NOVA—never in my wildest dreams did I imagine that I would ever witness it first-hand."

Kathryn Sposato
Pittsboro, N.C.
Wellesley College

Faculty will instruct us on techniques to test for composition and coloration to identify different types of rocks and to determine their origin. Did these rocks come from within the volcano or from its slopes? What activity during the eruption placed these rocks in their present position? Field lectures at this point will focus on the mechanisms of volcanic eruptions, petrologic and geochemical variations during single eruptions, prediction of eruptions, and geological hazards.

In addition to analyzing and mapping the sequence of deposits and lava flows, students will undertake independent projects. These may involve conducting a petrologic study of a more recent minor eruption, examining glass particulate content on rocks to determine the explosivity of the eruption or studying surface morphology and variations in crystal size of different types of lava flows to understand their flow mechanisms.

To broaden our perspective on volcanism, we will take several field trips to study the more typical Hawaiian volcanic features. We will visit Halemaumau, the crater in the Kilauea caldera that until 1924 was a constant lava lake; the eruption sites of Kilauea Iki and Kapoho; the Kaumana Caves, and the famous Black Sands Beach. We will also have an opportunity to explore the lava tubes, tunnels formed in molten lava, that can be found in lava from Mauna Loa to Hilo.

The results of our study on the succession of events that took place in Kilauea's last major eruption will be given to the United States Geological Survey to help predict the impact of future eruptions of Kilauea.

Living and Working Conditions

Our campsite on Kilauea, which will consist of A-frame cabins with cots, will be overshadowed by the dramatic 14,000 foot volcano of Mauna Loa. Considering the depth of the surrounding sea floor, the com-



Photo by David Buesch

Buried in these lava formations are thousands of years of geological history.

panion volcanoes of Mauna Loa and Mauna Kea rise more than 30,000 feet above their base, thus making them the tallest mountains on earth.

Equally impressive is the splendor of the beautiful island itself. The tropical climate, lush vegetation and sandy beaches have attracted tourists from around the world, making Hawaii a fascinating mix of cosmopolitan and simple lifestyles. The hot, tropical sunshine is punctuated by frequent short showers. Nights on the volcano will be cool and comfortable.

We will have plenty of fresh water for washing and drinking. Our meals are usually plain, but hearty, and will be augmented by native fresh fish and exotic fruits.

Tuition: \$1,490

Departure Point: Hilo, Hawaii

Coral Reef Ecology*

St. John, Virgin Islands

Purpose

To investigate the effects of human activities such as boating and diving, on the corals, fish and other ecologically important members of coral reef communities to assist in maintaining the stability of these fragile ecosystems.

Dates: June 16-July 15; July 22-August 20
December 27, 1986 - January 17, 1987

Course Level: A

Background

Plunging into the warm, blue-green waters of the Caribbean gives one entry to another world. A spectacular array of fluorescent fish dart between living corals and sponges. Primitive-looking blow fish float by while sea urchins with their sharp, black lacquer spikes hide in the reef's crevices. There are even animals that bloom like flowers. The human-imposed dimension of time seems not to exist in this fluid paradise. Unfortunately, time and humans may be the ecosystem's worst enemies.

More than 700,000 tourist flock to

the Virgin Islands each year to bask in the tropical sun and dive amid the world's most beautiful coral reefs. Are these tourists destroying this fragile ecosystem as they lodge their boat anchors into the reefs and poke and prod at the reef's inhabitants?

In the Virgin Islands National Park there are areas where overfishing, heavy tourist diving and boat anchorage have destroyed fish populations, reef habitats and seagrass beds. Our study this summer will focus on determining the severity of this problem. What are the likely changes in coral reef ecosystems if human activity increases?

Underwater research often requires special skills beyond those needed for terrestrial research.



Research Focus

Questions we will address in our research include: What happens when an anchor drags over coral? How sturdy are different coral species? Is the damage caused by anchors so severe that a new community develops? What is the succession of species which invade a new scar from anchor damage? For instance, are algae and sponges supplanted by urchins and sea cucumbers, which finally give way to dominant corals, or does another "climax" community, like a seagrass bed, develop? How long do these (or other) patterns of succession take? Are there positive impacts of anchor damage? Do they provide a refuge for conch, lobster, and other species?

Course Design

Much of our time during our first few days on St. John will be spent near the white dock that juts into the blue waters of Lameshur Bay. Upon our arrival at our research base, the Virgin Islands Ecological Research Station (VIERS) on the isolated southeastern side of the island, we will spend our first week taking a full SCUBA certification course. Concurrently, introductory lectures given by our faculty will expose us to the taxonomy and evolution of marine plants and animals, community structure, principles of field experimentation and fish feeding ecology. Shallow dives in the clear turquoise water will enable us to explore the diverse flora and fauna of the reef ecosystem.

Our data collection will begin with a visit to a relatively undisturbed site in Lameshur Bay. With our snorkeling gear, we will dive on the reef to document its physical condition, noting the diversity of hard and soft corals, size of coral

Photo by Christopher Neefus

heads, and the diversity of organisms such as crustaceans, mollusk, starfish, urchins and sponges. Working in pairs, we will lay transects on the reef to determine the concentration of different species of marine life.

We will then travel by boat to several other relatively undisturbed sites on the southeastern side of St. John to document the variations in species composition and the condition of the reef at different locations. At VIERS, careful analysis of our data from each site will help us differentiate between variations in species composition that are due to natural causes and to human disturbances.

After collecting sufficient data from these sites, we will travel to three areas where boat traffic is heavy. Here, using SCUBA, we will conduct comparative studies of coral conditions and species diversity. Accompanied by brightly-colored fish of varying shapes and sizes, we will explore the reef for large anchor scars, noting their size and abundance. Detailed observations of the species inhabiting these scars and adjacent areas will help us assess how the reef has been altered and whether a new community has developed. As we collect data and analyze our findings, faculty will present advanced lectures on physiological adaptations of marine organisms, behavioral ecology, and nutrient requirements of marine organisms.

As our analysis of disturbed and undisturbed sites progresses, we will begin work on independent projects. Topics may include: species diversity in anchor scars, community succession in impacted areas, effect of depth on the size, shape, and recovery time of anchor scars.

At the end of the course, we will analyze our results and determine the long-term effects of damage to the reef ecosystem such as scars caused by boat anchors on the concentration and distribution of inhabitants. Our data will provide the Park Service with vital information on the potential impact of heavy tourist use on this valuable ecosystem.

For additional information, call the SFS Admissions Office at (617) 497-9000.

Photo by Wendover Neffus



Getting our gear organized for our morning dives will be one of the first hurdles of the day.

Living and Working Conditions

Arriving on 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! VIERS is a rustic but adequate research station with screened cabins, open-air sanitary facilities, a laboratory and library, none of which are impervious to heat, humidity or small insects.

The mean annual temperature is 79° F, ranging from extremes of 65° F-95° F. Most of the rainfall occurs during the summer, but water shortages are frequent since the non-porous clay and rock in many areas does not readily absorb water from hard rains. Our showers and general water usage will therefore be somewhat restricted. We will carefully monitor outdoor exposure since sunburn is a common danger in the Caribbean.

Tuition: \$1,680 + \$100 SCUBA fee

Departure Point: VIERS, St. John, Virgin Islands

Note: SCUBA certification will be offered in this course.

* This course will also be offered in the January Term, 1987. Please contact the SFS Admissions Office for details.

“We've only been here four days and I've learned more about marine life than I thought I would in the whole course. The diving is fantastic and the diversity of the reef is unbelievable.”

Helga Sprunk
Sterling Heights, MI.
Michigan State University



Photo by Prentice Stuart

Spectacular angelfish are a common sight on the reefs of the Virgin Islands.

Marine Ecosystem Un

St. John, Virgin Islands Research Focus

Purpose

To quantify the effects of local fisheries and development impacts on edible fish species (red snapper, grouper and barracuda) in the Virgin Islands National Park to assist in formulating sustainable management plans to prevent overfishing.

Dates: June 16-July 15

Course Level: B

Background

Today, over 70 million tons of fish are harvested annually from the oceans. In many areas of the world, fish stocks have been drastically reduced with little hope of recovery. This is a bad omen at a time when we are coming to the realization that we must turn to the sea to help feed the world. What can we do to insure the future availability of these important resources?

Fish would not be the first of the Virgin Islands' resources to be exploited. The slash-and-burn agricultural practices of the Arawak Indians, followed by excessive land clearing during the colonial days of the sugar plantations have resulted in deforestation, irreplaceable soil erosion and the loss of several species of mammals. Subsequently,

many island residents adopted a simpler lifestyle, relying on fishing and the farming of bananas, coconuts, mangoes and limes for nutritional and economic support. Currently, overfishing to feed a growing local population and a booming tourist trade threatens the islands' fisheries.

Much of the waters surrounding St. John have already been depleted of large reef fish and other edible marine life, while species including red snapper, barracuda and grouper are now in peril. Our data on the abundance of commercially harvestable fish populations will be used by the Park Service to help assess the impact of local fisheries in the park and to develop fisheries management policies that will preserve fish stocks while allowing the local people, who depend upon these resources, to continue using them.

How abundant are populations of red snapper, grouper and barracuda? Does the population size of these species vary with location, intensity of fishing pressure, habitat type or physical variables? Does the vulnerability of these species to overfishing differ because of their behavior or distribution?

Course Design

St. John—the most beautiful and least disturbed of the U.S. Virgin Islands—rises from the sea, her topography of volcanic origin now clothed in a mantle of subtropic vegetation. Upon arriving, we will make our way to Lameshur Bay on the isolated southeast coast of the island, site of the Virgins Islands Ecological Research Station (VIERS). Located within the Virgin Islands National Park, VIERS has been the site of four years of SFS research.

Our first days will pass quickly, filled with lectures on principles of population growth and control, reef ecosystem dynamics, and management theory. Dives off the VIERS dock will enable us to check our SCUBA equipment, refresh our skills and begin to explore the turquoise waters of Lameshur Bay.

We will begin our field research by taking a complete census of several commercially harvestable fish including red snapper, grouper and barracuda. Our initial dives will enable us to identify these species with ease—the snapper with its distinctive hues; the fast and lean barracuda, whose large teeth belie its curious, (but usually harmless to humans) nature; and the grouper, difficult to miss with its large proportions. Divided into pairs and utilizing hand slates, we will patrol adjacent sections of the reef, tabulating each species as we go. Aboard our boats once more, we will tally our data for total population counts of each area of the reef.

St. John, with its small coves and inlets, is the ultimate tropical research site.



Photo by Christopher Neufus

der Stress

Next, we will document the habitats and behavior of these species, focusing specifically on feeding habits, social interactions (between individuals of the same and different species), antagonistic behavior, and territory size. Once sufficient data has been collected, we will construct a number of detailed ethograms (catalogs of behaviors), to provide us with a structured outline for behavioral data analysis.

We will then use maps of St. John and adjacent waters to select several sites exposed to varying levels of fishing. At each of these sites, we will again take population counts of species, record their behavior, and document the characteristics of their habitats. Comparison of our data between undisturbed and heavily utilized areas will enable us to determine the types of ecosystems and fish species that are most susceptible to overfishing.

Between dives, faculty will present lectures on food chain dynamics, statistical interpretation, and the ideals and actualities of fisheries management. Guest lecturers including U.S. Park Service managers will speak on marine resources.

As our research progresses, we will design independent projects, either on an individual basis or as part of a small group. Topics may include: differential behavior of fished and unfished populations, effects of continuous trap fishing on the diversity of fish populations, and territory size of prey species in relation to predator diversity. We may also make several night dives on the reef affording us an opportunity to see a very different panorama—octopi feeding, basket stars, and feeding corals with their polyps fully extended—than we view by day.

At the end of our course, we will analyze our findings and determine the habitats that are most preferred by different fish species and the species that are most susceptible to overfishing. We will then compile our data in a report for the National Park Service to assist in their work in regulating the fishing industry within the Virgin Islands.

Photo by Christopher Neefus



Despite extensive overfishing, large schools of brightly-colored fish still inhabit the reefs.

"Talking with my peers I learned that other recent or soon-to-be graduates are also confused about their future plans. It was good to be able to discuss our hopes and fears together and I gained a little self-confidence and have a brighter outlook on my future as a result of our discussions."

Ed O'Brien
South Portland, ME.
University of Maine/Orono

Photo by Christopher Neefus



Our accommodations at V.I.E.R.S. will be simple but comfortable.

Living and Working Conditions

One could not ask for a more ideal setting for a tropical research base. Set among swaying palm trees only a few hundred yards from the ocean, V.I.E.R.S. provides us with all the living and research facilities we will need including screened bunk houses, dining and lecture halls, a library and a laboratory. The diverse ecosystems in close proximity to V.I.E.R.S. including beautiful coral reefs, a mangrove swamp and the blossoming forests of the Virgin Islands' National Park offer a broad range of natural classrooms.

The mean annual temperature on St. John is 79° F, ranging from extremes of 63° F to 95° F. Most of the rainfall occurs during the summer, but water shortages are frequent so our showers and general water usage may be somewhat restricted.

Tuition: \$1,680

Departure Point: V.I.E.R.S., St. John, Virgin Islands

Note: SCUBA certification is a pre-requisite for this course.

Ecology of Poisonous

St. John, Virgin Islands

Purpose

To study the distribution and origin of toxins in ordinarily edible fish, such as grouper, snapper and barracuda, and to determine ways of detecting the poison in individual specimens.

Dates: July 22-August 20

Course Level: B

Background

A woman cooking dinner for her family offers a piece of the fish she is preparing to the family cat. The cat gulps the treat and settles down to wash herself. After watching the cat, who is now purring contently, the woman proceeds with dinner. This scene is repeated many times daily throughout the Caribbean.

All cats are not as lucky as this cat, this time. Many ordinarily edible tropical fish, such as barracuda, snapper and some species of grouper, occasionally contain high levels of toxins which can cause permanent neurological impairment or even death. Very little is known about this phenomenon called Ciguatera. We do know it originates in toxic single-celled algae which are eaten by fish and then passed up through the food chain. These toxins occur sporadically and unpredictably, which likens eating some species of fish to a form of Russian roulette, and places the family cat in the role of a guinea pig.

Ciguatera poses a serious health hazard in areas such as the Caribbean, where a large influx of tourists are likely to be unaware of the danger of eating certain fish. Furthermore, the uncertainty and risk associated with eating some species effectively removes them from consideration for human food and fisheries production.

Research Focus

Since the toxins originate in tiny single-celled algae, called dinoflagellates, we will focus most of our research on these algae. Is the distribution of dinoflagellates affected by light, current, and temperature? How does dinoflagellate distribution vary within and between bays? We will also study the human aspect of the problem. How can fish with accumulations of toxins be recognized? Is the local perception of areas in which toxic fish occur grounded in reality?

A face only mother could love.

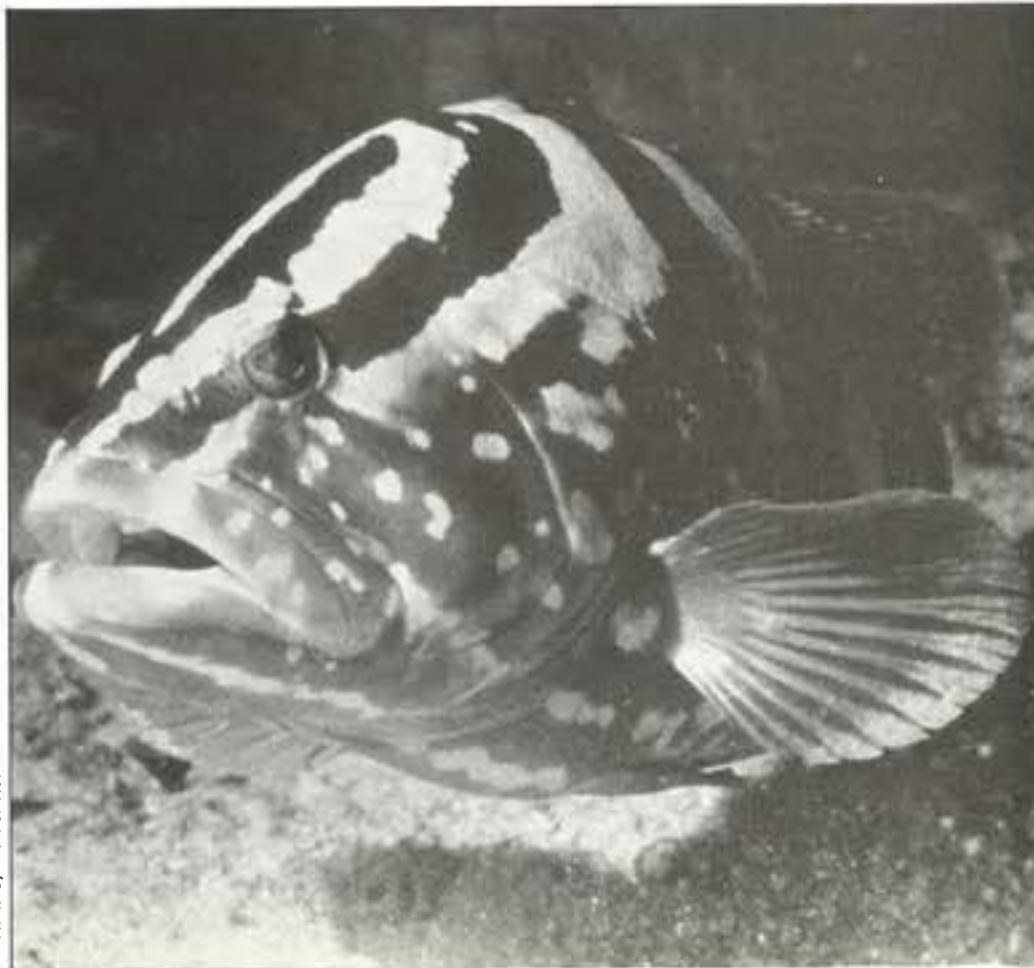


Photo by Premice Stout

Course Design

Nestled at the foot of a steep hillside, several hundred yards from the turquoise waters and gleaming white beaches of Lameshur Bay, the Virgin Islands Ecological Research Station (VIERS) will be our base of operations for the next thirty days. VIERS is a remote and rustic research station situated within the boundaries of the Virgin Islands National Park.

After orienting ourselves to the facilities—a laboratory, library, screened cabins and lecture hall—we will spend a day or two brushing up on our SCUBA skills. Faculty will lecture on predator/prey cycles, algal taxonomy and diversity, coral reef ecology, population growth and food chain management.

Our field research will begin with several boat trips to different regions of the reefs near Lameshur Bay to locate sites where high concentrations of toxic dinoflagellates may be

For additional information, call the SFS Admissions Office at (617) 497-9000.

Fish

found on seaweed. With our SCUBA gear, we will dive between spectacular coral heads accompanied by bright blue-green wrasse, butterfly fish, sergeant majors and majestic angelfish to record data on environmental variables. We will focus specifically on water turbulence, light penetration, and temperature to help us determine the variables that encourage the growth of dinoflagellates. We will also scrape surfaces of attached seaweed and pull plankton nets from our boats through the water column to collect samples of dinoflagellates for detailed analysis back at VIERS.

Once we have determined the types of ecosystems that are most hospitable to toxic dinoflagellates, we will document the fish species that inhabit these ecosystems and feed on the algae. Diving to the bottom and stationing ourselves quietly to avoid disturbing the fish, we will record the small prey species that are most extensively consumed by large predatory fish. Outside of park borders, we will catch several fish for later dissection at our lab to determine the concentration of toxins in their digestive system. By understanding the predator-prey relationships on the reef, we can assess the stages at which toxins enter the food chain.

After conducting a study of Lameshur Bay, we will travel to several other sites along the reefs of St. John to explore the difference in concentration of toxic dinoflagellates between bays. We also hope to collect data that will expand our knowledge of the particular species of algae that are most commonly covered by dinoflagellates.

To complement our field research, we will pursue specific tangents of our team research through independent projects. Possible topics may include the concentration of dinoflagellates on different types of bottom-dwelling plants, the concentrations of algae in toxic fish, or how different fish species react to blooms of toxic algae. Breaking up our long days of underwater research will be visits to several towns on St. John and St. Thomas to talk with local people about

Photo by Wendover Neefus



Small boats will enable us to travel to different bays around St. John to conduct comparative studies of dinoflagellate populations.

health problems caused by toxic fish.

In the last three days of the course, we will devote ourselves to compiling our data and writing a report on the ecosystems where toxic dinoflagellates are likely to occur and which fish species are likely to contain high levels of the toxin. This report will be submitted to the National Marine Fisheries Service and the U.S. Park Service to assist in designing regulatory policies for the fishing industry that will help reduce the potential threat of Ciguatera to the local people.

"Participating in a field course like this one is a fantastic opportunity for any undergraduate considering marine science as a career. The chance to spend three or four weeks completely immersed in the field is an experience usually reserved for graduate students."

Tracy Farmer
East Pepperell, MA.
Smith College

Photo by Christopher Neefus



Living and Working Conditions

This is a tranquil but demanding classroom. The seductive environment of a blue water bay and simple Caribbean living take a necessary back seat to the long hours of study and underwater collection.

The mean annual temperature on St. John is 79° F, ranging from extremes of 63° F to 95° F. Most of the rainfall occurs during the summer, but water shortages are frequent since the nonporous clay and rock in many areas does not readily absorb water from hard rains.

Accommodations on the VIERS facility consist of wooden, dormitory type buildings in a rustic setting of palm and fruit trees. The site has electricity, telephones and solar-heated outdoor showers. Likely visitors to our site include wild donkeys, mongoose and hummingbirds.

Our meals are usually prepared by the VIERS staff and we will assist in all clean up duties. From time to time we will sample local island cuisine, which is spicy and flavorful. Stewed fish, curry, fried plantain, breadfruit and manioc are local delicacies.

Tuition: \$1,680

Departure Point: VIERS, St. John, Virgin Islands

Note: SCUBA certification is a prerequisite for this course.

Through our frequent dives, we will rapidly be able to identify many of the organisms we see on the reefs.

Wildlife Management

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 that of protected populations in national parks, to assess the long-term implications of game ranching as a wildlife management technique.

Course Levels, Dates: Level B—June 16-July 18; Level A—July 22-August 22

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 flamingoes, to the vast savannas and escarpments approaching Mount Kenya—is becoming a vulnerable and worried land. With the highest population growth rate in the world, Kenya is severely challenged by the now conflicting priorities of preserving its land, saving its wildlife and feeding its people.

Do you try to save the land for the wildlife, and for the tourist industry, or do you turn it over to the people for cattle grazing? Some biologists have proposed what at first seemed a radical solution: the practice of game ranching, in which populations of various species of ungulates (cloven hoofed mammals) are strictly managed in a protected environment and periodically cropped to be used as food. By carefully monitoring these populations not only can high-protein food be produced, perhaps with greater efficiency than domestic animals, but also wildlife can be preserved in its natural habitat without degrading the ecosystem.

SFS students will have the unique opportunity to become directly involved in this drama, examining the long-term implications of game ranching first-hand.

Giraffes are our constant companions at our base camp on the Hopcraft Ranch.

Research Focus

The success of wildlife ranching depends on whether wild ungulates can be maintained on limited areas under a regular cropping regime. In our sixth consecutive year of research in Kenya, we will assist in analyzing criteria that are crucial to game ranch management. We will investigate questions such as: How much time do different species spend watering and how much time shading? What is the moisture content of forage and faeces? When do different species forage? What is the ratio of males to females in harvested and unharvested populations?

Course Design

After meeting in Nairobi, we will head 40 kilometers southeast through the rolling savanna to our research site, Wildlife Ranching and Research, Ltd., an experiment in game ranch management founded by Dr. David Hopcraft. Consisting of a compound with research facilities and a small library, the ranch covers 81 square kilometers of open savanna offering habitats to an enormous range of African wildlife.

Once we've established camp within the borders of the ranch, we will meet with local specialists to discuss the major wildlife management objectives of the ranch and learn about the cropping method that is used here. A series of lectures will include game ranching philosophy, introduction to East African ecosystems, general principles of ecology, and ungulate taxonomy and identification.

Research conducted by two SFS teams last year determined that species have different abilities to withstand drought and may be affected differently by cropping in wetter and dryer years. Our new concerns are: Does cropping alter reproductive abilities of different species? Do

Photo by Robert Singer





With neighbors like these, it is essential to keep close to camp at night.

species differ in their ability to withstand a cropping regime?

Rising early each morning, we will travel either by foot or in land-rovers to specific sites in the ranch to begin our field survey. By careful observation with spotting scopes, we will collect detailed records of the population sizes of wildebeest, gazelle, zebra and giraffe. We will also note their food preferences, the ratio of males to females, and the number of pregnant females.

Each Thursday night, the ranch personnel ride out to conduct their cropping regime. When they return, we will be able to examine carcasses to study anatomy and physiological functions. From samples of stomach content, we will be able to determine food preferences and requirements. With these data, we will conduct a survey of forage plant distribution and the water content of these plants. The B-level team will also study evolutionary relationships and how they are reflected in taxonomy and systematics.

Faculty will present advanced lectures on ungulate parasitology, ungulate social systems, the role of parks in wildlife conservation and the economics of game and cattle ranching. Students will also have the opportunity to work on independent projects on topics such as a comparison of sex ratios on and off the ranch and observations of foraging strategies in water stressed ungulates.

Field trips outside the ranch will take us to some of the more spectacular Kenyan parks including;

Amboseli to examine the effects of intense tourist pressure on wildlife; Masai Mara Game Reserve to observe the annual migration of over one million wildebeest; and Nairobi National Park to compare our data on species populations with park data.

Our research is part of a continuing analysis of the game ranch as an economically and ecologically viable concept. Our results from both team and independent projects will be integrated directly into ranch management analyses and allow the government of Kenya and outside conservation agencies to monitor the effectiveness of the ranch. Among the most important results of our work is the ongoing demonstration to local farmers that the ranch can provide a major source of food while making money.

"I'll never forget the feeling of the ranch at night, the burning eyes of the wildlife as they watched our passing on night drives, the shriek of tree byraxes, the calls of lions, hyena and hippo drifting through the camp. Nor will I forget the quiet walks around the ranch with the friends that I made."

Timothy Jon Van Norman
El Paso, TX.
Washington State University

Even in Kenya, there's no getting away from daily chores—dishes, laundry and cooking.

Living and Working Conditions

Although located near the equator, Nairobi enjoys a climate similar to that of a New England September. Nights are cool to chilly, days are warm to hot. While rain is scarce and water supplies restricted, there will be sufficient water for showers. Adapting our working hours to match the schedules of the animals we observe, we will rise in the cool dawn and take a break during the mid-day heat when the animals are less active.

Accommodations consist of large wall tents on platforms. The ranch has a meeting hall, open air showers and outhouses. Our lab, located two kilometers away, houses a specimen collection and small library.

Tuition: \$1,980

Departure Point: Nairobi, Kenya



Acid Rain: Changing A

Adirondack Mountains, New York

Purpose

To study biological effects of long-range transport of atmospheric pollutants (acid rain) on sensitive Adirondack lakes and streams in order to understand how the communities of these altered systems function, so that future effects of acidification or neutralization can be predicted.

Date: July 22-August 20

December 27, 1986 - January 17, 1987

Course Level: A

Background

In the famous Black Forest of Germany, over 40% of the coniferous trees are dying while in the Adirondacks, all species of fish have disappeared from hundreds of lakes and streams. Much of the blame for these environmental catastrophes has been placed on the well publicized phenomenon called acid rain which is caused by acidic airborne substances derived from industry.

The Adirondack State Park offers one of the world's most dramatic illustrations of the impacts of acid rain. With over 6 million acres, the Park is characterized by beautiful, rolling mountains, huge expanses of deciduous and coniferous forests and 4,000 secluded lakes. These lakes, nestled between the mountains and surrounded by rocks left untouched since the glacier retreated 12,000 years ago, appear to be as removed from the effects of pollution, people and other external pressures as can be imagined. Yet, scientists have shown that they have been altered by acid rain, giving rise to the popular but deceptive notion that these are "dead" lakes; in fact, these waters contain abundant plant and animal life and are very much alive despite their acidity.

Studies imply that acid rain raises the level of acidity in certain inherently sensitive lakes and streams, particularly those that do not have limestone bedrock to buffer the im-

pact of the acid. The effects of this acid rain are complex but one widely supported conclusion is that fish are especially sensitive. Other organisms, however, such as insects, algae, plankton and higher plants, survive and even flourish.

In the three years SFS teams have been studying this topic, we have learned that acid deposition is exceptionally toxic to fish. As the fish die off, they are replaced by insects as the top predator. This phenomenon occurs at each level in the food chain as new organisms step in to replace those that cannot tolerate acidity.

What, another newt?



Photo by Debbie Roberts

Research Focus

What is 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 changes have occurred in our study sites over the last four years? What is the relative importance of naturally occurring acids?

Course Design

This is a wilderness experience. We will canoe and hike through some of the most beautiful and remote backcountry in the eastern United States. Our base of operation will be a turn-of-the-century Adirondack lodge on Lake George known as the Fresh Water Institute, a field station for Rensselaer Polytechnic Institute. From here we plan two extensive expeditions into a classroom defined only by mountains and a huge sky, camping amidst the most isolated upper lakes.

Our first expedition will take us along narrow winding trails through dense birch, beech and maple forests to a small stream west of Lake George called Beaver Brook, site of a major, long-term project led by SFS's Dean, Dr. Robert Singer.

quatic Ecosystems*

The study focuses on how water interacts with the rocks and soils over which it flows and how these interactions affect the acid level of the water and the organisms living in it. After we acquaint ourselves with the site, faculty will present initial lectures on the theories of limnology, water chemistry, basic ecological principles and methods of research. Next, we will learn how to measure stream flow, to perform titrations and to determine acid neutralizing capacity, to identify plants, plankton and invertebrates and to collect and study microscopic organisms.

After long hours of study and research, it will be a welcomed relief to snuggle into our sleeping bags under star-studded skies. But the learning doesn't stop here. SFS students have been known to stay up late into the night admiring and pointing out constellations which most city dwellers never knew existed.

After four days at this site, we will return to the laboratories at the Fresh Water Institute to analyze our samples and compile data on the daily changes in physical, chemical and biological parameters in Beaver Brook. Additional lectures will focus on improving our collecting and analyzing techniques as we try to grasp some of the subtleties of aquatic ecology.

Next, we plan to canoe through a system of sparkling lakes and streams north of Stillwater Reservoir on an extended expedition. With our base camp established on the shores of remote Salmon Lake, we will hike through pine-scented woods to different lakes each day. Using small inflatable rafts or snorkeling gear and specialized nets, we will collect large predatory insects, zooplankton, and plant and water samples which we will later test to determine levels of phosphorous, chlorophyll and other chemicals.

During our time within this watershed, we plan to complement our team research with a variety of independent projects. Topics may range from the characterization of the

"We were learning all the time. Everything we did taught us a little more about some aspect of science. Our projects became obsessions which we dreamt about, talked about, worried about and carried out. It was all so rewarding."

Sara Abraham
Madras, India
Brandeis University

zooplankton communities to the determination of feeding preferences of invertebrate predators and daily migration of insects in the water column.

From the data we have compiled, we can build a solid network of information on the biology and chemistry of these lakes to determine how the distribution of organisms differs with variations in chemical conditions and how new food chains have developed in acidic lakes. At night over a dinner we prepare on portable stoves, we'll discuss the social, political and economic implications of the acid rain controversy. Faculty and guest lecturers will present additional lectures on physiological adaptation to acid stress, impacts on forest ecosystems, mineral weathering of igneous rock, and policy implications of liming and control technology.

With the field research portion of our work completed, we will return



Photo by Emily Porath

The Adirondacks Mountains are arguably the finest remaining wilderness area in the Northeast and the ideal environment in which to study the impact of acid rain.

to the Fresh Water Institute to formulate correlations and conclusions about the ecosystems of the lakes and the biological and chemical variations among lakes within the watershed. As we complete a final report and leave the scenic beauty of the Adirondacks, we can be satisfied knowing we contributed information that may influence future policy decisions on how to restore aquatic ecosystems altered by acid rain.

Living and Working Conditions

Weather in this Adirondack wilderness is notoriously variable; while most days will be pleasantly warm, the evenings and nights will be chilly and the rain unpredictable. Extensive hiking and canoeing are necessary to reach our study sites and will undoubtedly challenge us; but even on the longest days we'll be well compensated by the extraordinary panoramas and peaceful quiet of this country's oldest mountains.

While our campsites will be primitive, conditions at the Fresh Water Institute will be quite comfortable with rooms, beds, plumbing and a large, inviting, stone fireplace.

Tuition: \$1,290

Departure Point: Bolton Landing, New York

* This course will also be offered in the January Term, 1987. Please contact the SFS Admissions Office for details.



Photo by Debbie Roberts

Even a spectacular setting can't dull the pain of final exams.

Maya Archaeology*

Northern Belize

Purpose

To recover evidence of Maya ecology, settlement and subsistence at a small site in northern Belize, and provide new information concerning the environmental factors that may have influenced the origin and collapse of Maya civilization.

Dates: June 16–July 15

Course Level: A

December 27, 1986 - January 17, 1987

Background

If mysteries intrigue you, so will this course. The challenge for this SFS team in Central America is to determine how one of the world's great civilizations, with a population once reaching 14 million, was able to cultivate a living from inhospitable jungle for almost three thousand years, and what led to its eventual collapse.

Despite extensive excavations of Maya settlements, surprisingly little is known about their lifestyle, food sources, and social structure. Recently archaeologists have taken a new and unique approach to exploring the history of the Maya by digging at small sites instead of larger elaborate political centers, where the sheer mass of material has made it difficult to understand what exactly is being unearthed.

Our course will be located at one such site, an ancient village consisting of several pyramids, burial mounds and house mounds called Kichpanha in northern Belize. Concentrated in a 4 square kilometer area, with a crystal blue lagoon to the southwest, brackish swamps to the north, and dense tropical jungle to the east, Kichpanha provides an ideal location to investigate the Maya civilization. Our faculty member, Eric Gibson, found and initially mapped the site several years ago and returned with Leslie Shaw last summer to lead our SFS expedition.

Two weeks into their excavation, the team realized that they had a wealth of artifacts at their fingertips. Along with numerous clay pottery fragments, shells, animal bones and human skeletons, the team discovered a carved bone exhibiting some of the earliest known signs of Maya

hieroglyphics. Continuing our excavation this summer, we hope to recover artifacts that will reveal further enlightening information about the daily life of the Maya at Kichpanha.

Research Focus

How did the Maya use the land? Did they develop from semi-nomadic hunters and gatherers and gradually become more adept at agriculture? Was their collapse due to ecological forces that resulted in famine and warfare?

Course Design

At our tent camp surrounded by tall, leafy palm trees, thick brush, and elephant ear plants on the shore of a lagoon, faculty will lecture on the history of archaeology, regional ecology and Maya archaeology. Extending the survey of Kichpanha conducted by last year's team will be the first step in our research. After clearing dense vegetation from unexplored portions of the site with machetes, we will use transects, tapes, maps and compasses to record and map all archaeological features such as stone tool scatters, mounds and burned rock concentrations.

Next we will continue excavating the more productive pits discovered by last summer's team, carefully unearthing and recording all artifacts. Some of the objects we will uncover will be extremely fragile and will require the use of such delicate excavating tools as dental picks, fine brushes and bamboo splints. As we become comfortable with our excavating skills, we will conduct small sub-surface probes at features that may indicate positions of additional buried artifacts. Our mapping of these artifacts will enable us to reconstruct the layout of the village while piecing together specific information on the Maya culture at this site. How old is the site? What were the primary food sources of the Maya? For what types of activities was the site used?

As we progress with our research, we plan to probe into a pyramid

Unexplored for hundreds of years, Kichpanha holds many clues to the ancient history of the Maya



Photo by Kathryn Morgan



Photo by Kathryn Morgan

The intriguing secrets we unveil among these rocks will be our reward for hours of painstaking excavation.

and a burial mound at the site to seek out plant remains and exotic items including obsidian and jade pieces, pottery and sting-ray spines to help us date the site and learn about the environment in which the Maya lived. Other remains such as human bone may give us evidence of nutritional stress which may in turn suggest changes in regional environmental conditions.

Additional lectures will cover the development of agriculture, climatology, local geology and the use of paleobotanical data recovery. We will continue to refine our archaeological field techniques including surveys, test probes, excavation, records and chemical analysis. During the last two weeks, independent projects may involve collecting floral and faunal specimens used today by the Maya, or conducting analyses of material from human burials or from prehistoric "garbage dumps".

Several field trips by Land Rover through the dense oak, cedar and pine forests to some of the more impressive archaeological sites in northern Belize including Cerros, Nohmul, Santa Rita and Altun Ha will allow us to examine the diversity of Maya settlements. By focusing particularly on the size, setting and scale of each site, we can gain a better understanding of the regional, political and ecological system in

which Kichpanha functioned. Our knowledge of this system will be enhanced by lectures on the history of Belize, the prehistory of Central America and the rise of Maya political centralization.

With the data we collect on the food resources and ecology of the Maya at Kichpanha, we hope to link the collapse of the Maya civilization at this site to a major environmental factor such as a climatic shift or a drought. Our research in conjunction with other archaeological studies will help us to further the current knowledge of this exemplary civilization and possibly provide us with information on Maya agricultural techniques that could be useful today.

"Patience, tolerance, and a sense of humor become a welcome and paramount part of your personality. Pitching a tent in the dark, only to discover that it's situated uncomfortably over a mound of dung, unites team efforts, and brings forth the best of individual humor."

Alicia Hinkle
Newport News, VA.
Columbia College

Living and Working Conditions

Among the smells of fragrant flowers and the sounds of exotic wildlife—parrots in the canopy overhead to tapirs in the surrounding underbrush—our site in the Belize jungle provides the perfect setting for this intriguing course. The Caribbean climate in northern Belize is temperate most of the year, with a median temperature of 85° F, but rain and humidity can be high in June. Frequent plunges in the lagoon adjacent to Kichpanha will offer welcomed relief from the humidity. Our research will require the physical stamina to spend long hours shoveling and sifting dirt and hiking over limestone ridges and up and down pyramids. Our base camp will be simple but comfortable with plenty of fresh food and water, though hot showers will be few and far between.

Tuition: \$1,590

Departure Point: Belize City, Belize

* This course will also be offered in the January Term, 1987. Please contact the SFS Admissions Office for details.



Primate Biology and B

Panama

Purpose

To research group leadership, social organization and ecology of the endangered Panamanian tamarin, and to estimate the population density of the species in an area that may be declared the first natural forest reserve for the tamarin's preservation.

Course Levels, Dates: Level A — June 16-July 15
Level B — July 22-August 20.
December 27, 1986 - January 17, 1987

Background

The rufous-naped or Panamanian tamarin once thrived in the lush jungles of Panama. Groups of up to ten of these tiny ten-inch monkeys dwelled in the branches of cecropia trees, jumping rapidly and gracefully through the treetops. While exportation of the tamarin for housepets and research animals has diminished the population, man's development of the tamarin's habitat poses a far more serious threat to the species. Unless measures are taken to protect or relocate them, the rapid deforestation now occurring may drive these gremlin-like creatures and many of their neighbors to extinction.

Students will have the rare opportunity to study a population of

Panamanian tamarins previously unknown in scientific literature. Our study will provide a strong contribution to the protection and management of this diminutive monkey.

Dr. Dennis Rasmussen, our faculty member, has studied Panamanian tamarins at our field site since 1981. Our previous research at this site proves it has a higher density of tamarins than any other studied area. This discovery by the School for Field Studies last summer indicates that the secondary neotropical jungle at our field site is a particularly favorable habitat for the tamarin. SFS, the University of Panama and several conservation organizations are therefore now working toward establishing the area as the first reserve for the Panamanian tamarin.

Research Focus

Our main study will focus on the leadership, social organization and ecology of tamarins located on the potential reserve. We will collect data on behavior, social interactions and population size. What patterns of range-use and social interaction exist within and between groups of tamarins? Has the density of tamarins in our study area changed over the last year? What is the current total density of tamarins in this area?

As a secondary project, we will study how monkeys in a specific population react to strangers. We will place a caged tamarin high in the trees within the habitat of the resident population. This method of reintroduction may help preserve tamarins as their original habitats are destroyed.

Course Design

Our research will take place in lush, uninhabited neotropical jungle in a country that has been an important crossroad to the world for centuries. After arriving at Panama's international airport, we will board the historic Panama Railroad, built over a century ago, and cross from the Pacific Coast to the Atlantic Coast in less than an hour. Speeding by the Panama Canal and the Barro Colorado Nature Reserve of the Smithsonian Tropical Research Institute, the train will carry us deep into the steaming jungle with which we will soon become intimately acquainted. We will leave the train at the small Panama Canal Commission town of Gatun on the shore of Gatun Lake.

After hauling our gear to the shore and loading it into our motor boats, we will travel five miles across the lake to our base in a tranquil cove. Here, accompanied by the cacophony of a colorful and diverse array of tropical birds, we will carve a small base camp from the dense jungle for our tents. Our first few days will focus on learning skills essential for working safely in the jungle. We will also learn how to observe Panamanian tamarins and other creatures, such as capuchins,

Sharing and overcoming the inevitable rain, mud and frustrations of data collection continually reinforces team spirit and our sense of camaraderie.



Photo by Ed O'Brien

behavior*

howler monkeys and the coati mundi, a close relative of the raccoon.

Chopping through the overgrowth with machetes, we will improve and expand on the network of trails made during previous SFS courses. Further details will be added to maps of the area by use of hand transits and thirty meter tapes. Capturing, measuring, and marking tamarins from as many groups as possible, we will add to the over thirty individuals we have identified during previous courses. This will give us an opportunity to examine the monkeys more closely. With the aid of radio tracking, we will observe and follow our main study group through dense jungle from dawn to dusk. The data we collect on spatial leadership and social organization will be the first ever assembled on this endangered species.

The B-level team will board inflatable boats and capture tamarins whose habitat will soon be deforested. These tamarins will then be introduced onto uninhabited islands in Gatun Lake. If the tamarins flourish on these islands, the surplus young may someday provide a source of tamarins for replenishing jungles where their numbers have been seriously depleted.

After long days in the jungle, we will wash off the mud and grime of the jungle and relax with a refreshing swim in the clear, warm water of Gatun Lake. Evening lectures and discussions may focus on topics such as methods for observation and collection of systematic data, primate taxonomy, the evolution of primate behavior, and quantitative methods for the analyses of behavioral data. After our first week of field work, everyone will begin an independent project with faculty assistance. Potential topics for independent projects include range-use, trapping methods and success, estimated population density, leadership of tamarin groups, and mother-infant interactions.

Photo by Suzanne Freedman



Cages placed high in the treetops will help us capture and tag additional tamarins for our control population.

"Now I understand why focusing public attention on an appealing animal that is endangered is so critical. By protecting tamarins and their environment, we also protect all the beautiful creatures that live and flourish in the jungle."

Leslie Millett
El Paso, TX.
Loretto Academy High School

The results of our team and independent projects will be presented orally to students and faculty members of the University of Panama who are particularly interested in our research efforts. Written summaries of our results will be provided to the Smithsonian Tropical Research Institute, the Ministry of Natural Resources of the Republic of Panama, the National Park Foundation and the University of Panama to aid in the development of a potential preserve at our research site.

Living and Working Conditions

The watchword here is wet: rainfall averages 11 inches a month and is often accompanied by magnificent lightning and thunder. The temperature range is pleasant from a maximum of 85° F during the day to a minimum of 70° F at night. Our base camp will consist of comfortable tents established at a site we will carve in the dense jungle on the shore of Gatun Lake. We will enjoy ample but basic food bought at western-style supermarkets in Colon (about 90 minutes away by boat and train) which we will supplement with an abundant supply of fresh fish caught right at our campsite on the lake.

Tuition: \$1,590

Location: Panama City, Panama

* This course will also be offered in the January Term, 1987. Please contact the SFS Admissions Office for details.

Photo by Dennis Rasmussen



Dolphin Biology and Gulf of Mexico

Purpose

To determine the effects of human activities such as shrimping, boating, and oil exploration on the behavior of bottlenose dolphins (*Tursiops truncatus*) to assess the long-range impact of these activities on dolphin populations.

Course Levels, Dates: Level B—June 5-July 3; Level—B July 2-July 30;

Level A—July 30-August 26

December 27, 1986 - January 17, 1987

Background

Among the most beloved marine mammals in the world are dolphins which have been regarded by fishermen and sailors as a symbol of happiness and good luck for hundreds of years. Their intelligence and playfulness make them a joy to observe. Unfortunately, as humans encroach upon the habitats of these seemingly happy-go-lucky mammals, we may be altering their natural behavior and perhaps even their ability to survive.

As we turn more to the sea for resources, we need to know how our activities affect populations of marine organisms. We hope this knowledge will help us to protect these populations before they become endangered. By studying the bottlenose dolphin in areas of high human activity, we hope to determine how this activity affects dolphin ecology.

The power of humans over nature is epitomized in Mobile Bay, Alabama, where in the past two years engineers have merged two rivers well inland of where they formerly met and dredged a large channel through the bay. This has resulted in increased port activity and a drastic change in the environment of the bay. Although extensive studies were conducted to determine the impact on the bay ecosystem, no research was performed on the possible effects on the large, local dolphin population. Our study will address these effects.

Research Focus

By studying dolphin behavior in areas of high human activity and comparing it to behavior in areas of low human activity, we hope to determine the effects of commercialization on dolphin populations. Our research will focus on questions including: Is dolphin behavior correlated with levels of human activity? Are the group sizes of dolphins correlated with levels of human activity? Are there resident dolphins in Mobile Bay, or are they transient to the area? How much time do dolphins spend foraging behind commercial shrimp boats as compared to foraging on their own?

Intelligence is in the eye of the beholder.

Course Design

The warm azure waters of Mobile Bay and the adjacent Gulf of Mexico will serve as the base for our study. Framed by long white sand beaches and windswept dunes, 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. Since it is also an area with high concentrations of bottlenose dolphins, it is not unusual to see the playful mammals dancing in the wake of a huge commercial vessel or waiting for scraps beside a fishing boat.

This is a new site for SFS's research on dolphins. Last summer, our faculty, Beth Goodwin and Lisa Ballance, led two teams of SFS students in the Florida Keys comparing the behavior of captive and wild dolphins. Through their comparisons, the team was able to assess the environmental conditions that are most optimal for raising captive dolphins and to collect preliminary data on how human activities affect the presence and behavior of wild dolphins. Beth Goodwin also studied dolphin behavior in Mobile



Photo by Robert Singer

Behavior*

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

Michael Boyle
Gaithersburg, MD.
University of Maryland

Bay in 1983. Her data on the identification of individuals, and interaction between dolphins and shrimpers and tankers will provide a solid base for our study.

Boarding SFS's 30 foot twin-engine boat and outboard-powered inflatables each day, we will head out to the bay in search of schools of dolphins (*Tursiops truncatus*). Some team members will record minute by minute behavioral observations, including the amount of time the dolphins spend above and below water, feeding, avoidance and social activity. Other team members will take photographs to be used to identify individual animals by their distinctive dorsal fins. B-level students will use hydrophones to record echolocation noises and social interaction sounds as the dolphins whistle and squeal beneath our boats. We hope to statistically test the relationship of specific noises to particular behaviors.

Faculty will lecture on statistics, the taxonomy of marine mammals, and cetacean evolution. This information will provide us with the biological background with which to study these intriguing creatures. Comparing the behavior of dolphins as they interact with each other around boats, and when they are alone, will enable us to determine how the animals are affected by shipping. We will also compare dolphins in the bay with a separate population that remains several miles offshore.

Communicating with these highly intelligent animals is an experience not easily forgotten.

As our research intensifies, faculty will present additional lectures on diving physiology and the basic anatomy of the brain, organs, skull and skeleton as well as more advanced lectures for B-level students on echolocation and physiology of thermoregulation and osmoregulation. Students will also have the opportunity to pursue specialized interests in dolphin behavior through independent projects. Some possible projects include: correlating vocalizations with different types of behavior; documenting the amount of time dolphins spend feeding behind shrimp boats or oil rigs; and recording levels of activity at different times of day.

Field trips to oceanariums at Fort Walton, Florida and Biloxi, Mississippi, will enable us to study captive dolphins and talk with trainers. We will also visit a shrimp boat, a shrimp mariculture operation, and possibly an oilrig to learn how these operations could potentially affect dolphin populations.

Toward the end of the last week of our course, we will analyze our findings on the effects of recent developments in the bay on the behavior of dolphins. We will submit a final report on our findings to the National Marine Fisheries Service to help them develop policies to minimize the impact of human activity on dolphin populations.

Photo by Beth Canale, '83



Can dolphins live in close harmony with man and his technology?

Living and Working Conditions

The tip of a narrow, 30 mile-long peninsula near Fort Morgan, an old Civil War fort, is the site of our basecamp. The area is flat, with large expanses of white beaches and sculptured sand dunes covered with sea oats. Brown pelicans, royal terns and black skimmers squawk overhead and the lush vegetation supports numerous species of land birds.

The weather is warm and humid, perfect for refreshing swims in the rolling waves. Calm periods alternate with sea breezes and we may be treated to an occasional tropical storm. We will prepare our own meals at the campsite, dining on many of the specialties of the area such as shrimp, king mackerel and red snapper.

Tuition \$1,550

Departure Point Mobile, Alabama

* This course will also be offered in the January Term, 1987. Please contact the SFS Admissions Office for details.

Photo by Lisa Ballance



Faculty-1985/86

(partial list)

Lisa Ballance: M.S. candidate, Moss Landing Marine Laboratory, California.

Dusty Becker: M.S., Forest Science, Yale School of Forestry and Environmental Science; Ph.D. candidate, Wildlife Biology, Cambridge University, England.

Amos Bien: M.A., Ecology, State University of New York, Stony Brook; President and General Manager of a proposed land use project in Costa Rica.

David Buesch: Ph.D. candidate, Geology, University of California, Santa Barbara.

Phil Davis: Ph.D., Resource Development, Michigan State University; Assistant Professor, Department of Range, Wildlife and Forestry, University of Nevada, Reno.

Eric Gibson: Ph.D. candidate, Anthropology, Harvard University; Teaching Fellow, Anthropology Department, Harvard University.

Beth Goodwin: M.S., Physiology and Behavioral Biology, San Francisco State; SFS permanent faculty, Caribbean.

Walter Hatch: Ph.D., Marine Biology, Boston University; Assistant Professor, Biology, St. Mary's College.

Richard Hazlett: Ph.D. candidate, Geology, University of Southern California; Instructor, Geology Department, Pomona College.

Valerie Kapos: Ph.D., Biology, Washington University; Research Associate, Missouri Botanical Garden.

Amy Knowlton: B.S., Geography, Boston University; Cartographer, Ocean Spray, Inc.; Research Assistant, Right Whale Project, New England Aquarium, Boston, Massachusetts.

Stan Koster: Ph.D., Wildlife Ecology, Michigan State University; Professor, Olivet College.

Don Levitan: Ph.D. candidate, Biology, University of Delaware.

Suzanne Macy: Ph.D., Animal Behavior, University of Washington.

Christopher Neefus: Ph.D., Marine Botany, University of New Hampshire; Research Consultant, University of New Hampshire.

Dennis Rasmussen: Ph.D., Comparative Psychology, University of California, Riverside; Director, Animal Behavior Research Institute.

Deborah Roberts: Ph.D. candidate, Biology, Rensselaer Polytechnic Institute; Research Assistant, Fresh Water Institute, Rensselaer Polytechnic Institute.

Photo by Jack Shea



Chris Waythomas presents a lecture on arctic geology in an atypical classroom in northern Alaska.

Leslie C. Shaw: Ph.D. candidate, Anthropology, University of Massachusetts; Teaching Assistant, Anthropology, University of Massachusetts.

Jack Shea: M.S., Wildlife Ecology, University of Alaska; Director, Outdoor Experience.

Nancy Shea: Ph.D. candidate, Philosophy, University of Massachusetts at Amherst; Environmental and Outdoor Educator, Outdoor Experience.

Carol Skinner: M.S., Zoology/Ecology, Purdue University; Ph.D., Ecology/Animal Behavior, Kent State University; Instructor, Biological Sciences, Kent State University.

Brad Stelfox: Ph.D., Wildlife Productivity, Department of Animal Science, University of Alberta; SFS permanent faculty, Kenya.

Reed Stewart: M.A., Ph.D., Geography, Clark University; Professor, Geography, Bridgewater State University; Field Director, SFS-Africa.

Chris Waythomas: Ph.D. candidate, Geology, University of Colorado; Teaching Assistant, Geology, University of Colorado.

Richard Winn: Ph.D., Marine Biology, University of Southern California; Professor, Biology, Mira Costa College; Field Director, SFS-Caribbean.

Interns-1985

Salvatore Genovese: B.A. candidate, Biology, Swarthmore College.

Bill Helprin: B.S., Environmental Studies and Biology, St. Lawrence University; SFS intern, Wildlife Management/Kenya, Summer 1985; SFS intern, Wildlife Biology and Management/Kenya, Fall 1985.

Derek Madden: B.A., Geography; B.A., Environmental Biology, California State University, Fresno.

Laura Marsh: B.S., Animal Behavior, University of California, Davis.

Minny Purinton: B.S., Environmental Biology, Evergreen State College; SFS intern, Wildlife Biology and Management/Kenya, Fall 1985.

"I think the School for Field Studies is doing a lot of terrific things for the generation of scientists to be."

Kimberley Thorsfeldt
Northwood, IA.
University of Iowa

Marleni Ramirez describes the physiological traits of a tamarin monkey.



Photo by Stephanie Clapes

Processes and Requirements

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.

Applicants for admission are required to submit an SFS application form, a 300 word essay describing their reasons for participating, a \$25 application fee and an SFS reference form. Applicants for month-long courses should have completed their junior year in high school. Semester applicants must be 18 years of age should 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 (617) 497-9000.

Acceptance

The Admissions Committee will review completed applications for summer courses on February 1 and 15, March 1 and 15, April 1 and 15 and May 1, 1986. All applications received after May 1 will be reviewed on a rolling admission basis for any remaining openings. Applications for January 1987 courses will be reviewed beginning September 15, 1986. Fall and spring semester applications will be reviewed on a rolling admission basis.

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.

Students will be notified of the Committee's decision within two weeks of the above review dates. Course syllabi for month-long courses will be available in early March and will be sent to all accepted applicants. Course faculty will contact all accepted students during this period to discuss their participation in the program.

A non-refundable deposit of \$350 (\$250 for Financial Aid Candidates) for January and month-long courses, \$500 for semester programs, is due no later than 10 days following your acceptance to reserve your place.

No student with an outstanding tuition balance will be allowed to participate in the program.

Open House

A series of open houses for those students interested in learning more about the SFS experience will be held in New York and Boston in February and March. Contact the SFS Admissions Office for details.

Each year, admissions representatives visit high schools and colleges across the country to talk with students about SFS. Watch for a presentation at your school.

Tuition

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 expedition. It also includes group equipment, medical supplies, scientific instruments and material. **It does not include transportation to and from the departure point** or the fee for students receiving academic credit from Northeastern University for January Term or month-long courses. The fee for academic credit for the semester courses is included in the tuition charge.

Personal gear such as packs and sleeping bags and personal equipment such as SCUBA gear are the responsibility of each student, as are medical insurance, inoculations, passports and visas. 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.

How To Figure The Total Cost Of Your SFS Course

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

Transportation and Travel Arrangements

To insure the best possible group fares as well as orderly arrivals to the departure site, we work with one travel agency which handles all SFS travel. We strongly recommend that you utilize this travel agent who will make arrangements for you from your area to our site. Specific details will be forwarded to you upon your acceptance. To help with your planning, the following are representative round-trip fares from New York City.

Anchorage, Alaska	\$800*	Belize City, Belize	\$475
Oahu, Hawaii	\$525	Zurich, Switzerland	\$750
Panama City, Panama	\$570	St. Thomas, Virgin Islands	\$330*
San Jose, Costa Rica	\$550	Quito, Ecuador	\$550
Nairobi, Kenya	\$1300*	Tel Aviv, Israel	\$800
		Australia	\$1300

* Transportation for semester programs may be higher due to length of stay.

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

All participants must have an SFS Medical Release Form completed and signed by a doctor. No one will be allowed to join an SFS course without proof of up-to-date medical insurance coverage.

The above elements should all be considered in estimating the cost of your course.

Financial Aid

Financial aid is available to qualified students in the form of scholarships and/or short-term, interest-free loans. Students in need of financial assistance are encouraged to request and complete a SFS Financial Aid Application and return it as soon as possible. Last year, over 100 students received SFS aid totaling over \$100,000. Aid is awarded by need until funds are exhausted. Semester participants may be able to apply federal financial aid monies toward their tuition accounts. For more information on how you may qualify for assistance, please call the Director of Admissions at (617) 497-9000.

Academic Credit

Academic credit may be arranged through Northeastern University (there is a \$75 registration fee for month-long courses) or possibly your home institution. Over 80 colleges and universities accept or award credit for SFS courses. Please consult your registrar and the SFS Admissions Department for further details.

Refunds

Most of the costs of an expedition are incurred well in advance of its departure. Students who withdraw or otherwise fail to carry through jeopardize the success of an expedition. As the costs of replacing participants are high, refunds are made only in the event of cancellation of the course.

Tax Deductions

Fees and directly related out of pocket expenses such as airfare may be treated as a tax-deductible contribution to a scientific research effort. Since tax circumstances vary with the individual, you should consult your own tax advisor.

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 expedition 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 expedition, 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 expedition if he/she is deemed unsuited for the project for any reason. All expeditions, fees, and dates are tentative until verified and confirmed in writing by the School for Field Studies.

Changes

SFS expeditions 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, Belize, and Ecuador.
- 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 plans.

Applicants are advised that these or other variables may require changes before or during an expedition. 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 be flexible.

Application for Admission

04

School for Field Studies • 196 Broadway • Cambridge, Massachusetts 02139

Name	Home Telephone #	Soc. Sec. #	
Permanent Address			
Street	City	State	Zip Code
College	Class/Year	Your Telephone # at School	ext.
Secondary School	Class/Year		
Mailing Address			
Street	City	State	Zip Code
Major (actual or intended)	Contact me at Home:	School:	
	(dates)	(dates)	

I am applying to:

1st choice	Dates
2nd choice	Dates
3rd choice	Dates

If my first choice is full, ☐ wait list me for my 1st choice, or ☐ assign me to my 2nd or 3rd choice.
☐ Do you need a financial aid application? ☐ Are you interested in the possibility of being a team journalist?
☐ Would you like information on applying for academic credit? ☐ A team photographer?

If you are applying to a "B" Level course, do you have the required prerequisite? _____

School-related field courses or research in which you have participated:

Other off-campus programs in which you have taken part:

Extracurricular activities/clubs or organizations:

Special skills/certificates/licenses/awards:

Outdoor/camping experience:

Travel (when, where, with whom, how long):

For more information, please contact the SFS Admissions Office at (617) 497-9000.

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President

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Timothy M. Stout
Operations/Publications Manager

Carlin M. Finke
Development Assistant

Marketing/Admissions
Andrea C. Walgren
Director of Admissions

Teresa A. O'Neil
Admissions Counselor

Lauren E. Howell
Admissions Assistant

Program
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Dean

Pauline H. Gehrich, M.S.
Program Manager

Susan Allen
Program Assistant

Leslye Herrmann
Assistant to the Dean

Reed Stewart, Ph.D.
Field Director, SFS - Africa

Brad Stelfox, Ph.D.
Permanent Faculty - Africa

Richard Winn, Ph.D.
Field Director, SFS - Caribbean

Elizabeth Goodwin, M.S.
Permanent Faculty - Caribbean

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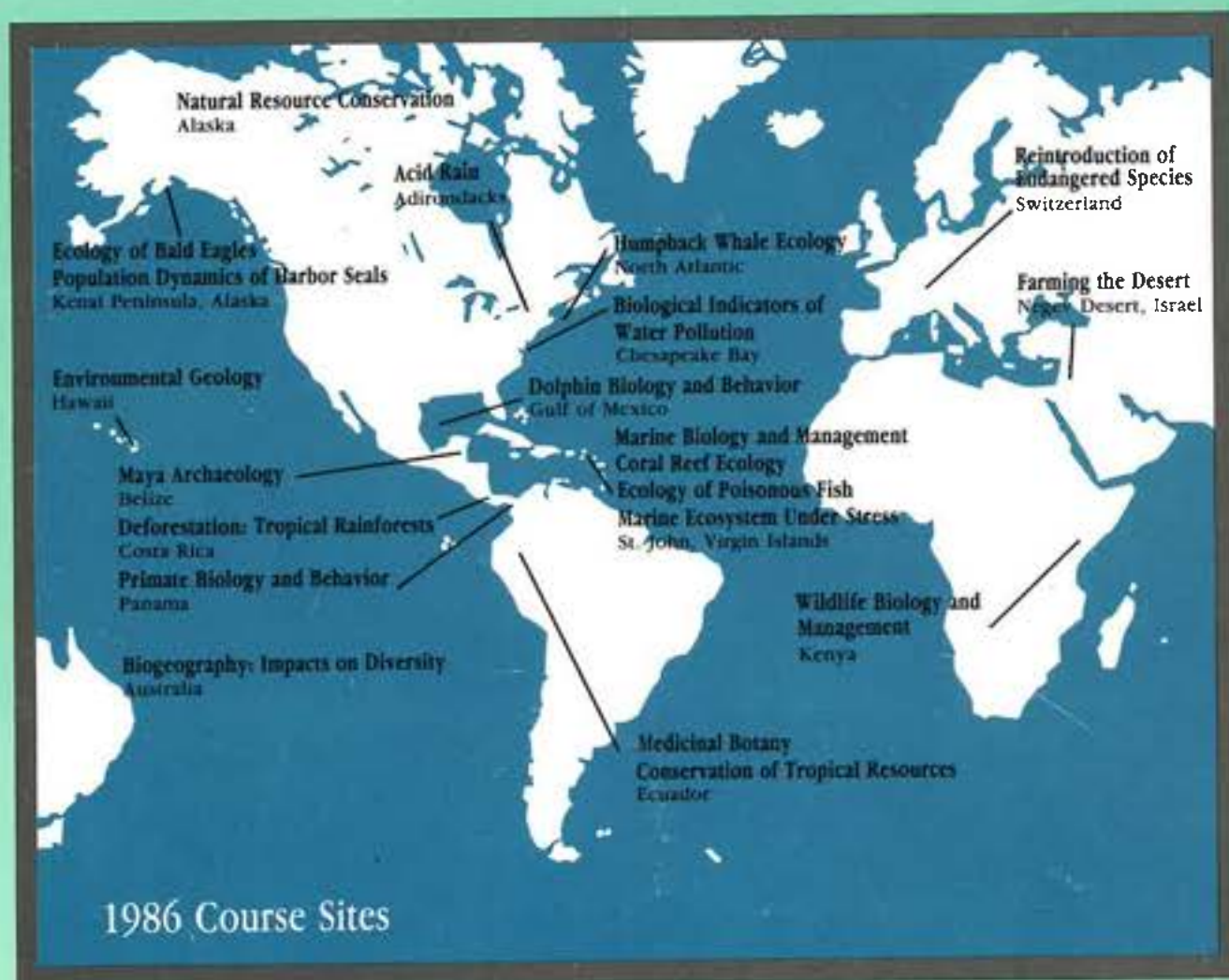
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