

SCHOOL FOR FIELD STUDIES

1985 COURSE CATALOGUE

January, Summer, and Semester Programs Around the World



THE WORLD IS YOUR CLASSROOM



AN INVITATION-

For many people the most extraordinary result from man's trips to the moon has not been a new perspective of the moon but rather the dramatic new vision we received of Earth itself. The photos showed clearly that we are all part of the same intricate web of life. This realization is at the core of SFS's purpose. We want as many people as possible to gain an understanding of our role and place in this continually evolving relationship among all the participants in the global ecosystem. We also want to show that there is no real conflict between development and conservation—they are two sides of the same coin and one cannot continue for long without the other.

We will be sending 400 students around the globe in 1985 to study some of the most interesting and pressing ecological issues of our time. How many chances in a lifetime will you have to make a valuable contribution to the solution of such problems, all the while receiving in-depth education and training—and having an adventure in the process?

Newsweek called SFS "a chance to investigate the environment at intimate range." *The New York Times* called SFS a program "providing experience that can have a lasting impact." What makes SFS the leader in field education is the extraordinary care and attention we give to what actually takes place in the field. All SFS courses, whether our short thirty day courses or our eighty-four day semesters, involve a deliberately structured educational process. We are continually seeking to push the limits of field education and training toward the most comprehensive and intensive program possible. There is every reason on Earth why learning should be an adventure—as well as a real chance to participate in the world and all its complexities. Take the chance with SFS and see for yourself.



Sincerely,

James Elder
James L. Elder, Jr.
President

P.S. We are pleased that we can keep our total costs of room, board and tuition down to an average of \$50.00 a day—less than the average private college or other off-campus programs. If this is still beyond the resources of your family, we will do our best to assist you with financial aid.

"There is such a thing as a passionate desire to understand, just as there is a passionate love for music. This passion is common with children, but it usually vanishes as they grow up. Without it, there would be no natural science and no mathematics."

Einstein

Curriculum

Semester Programs	Natural Resource Management	Alaska	June 7-August 22, 1985	8
	Marine Biology and Management	Virgin Islands	September 16-December 9, 1985 February 4-April 29, 1986	10
	Wildlife Biology and Management	Kenya	September 14-December 7, 1985 January 3-March 28, 1986	12

Summer Courses	Humpback Whale Ecology	Gulf of Maine	Level B: June 17-July 16 Level A: July 23-August 22	14
	Population Dynamics of Endangered Species	Switzerland	Level A: June 17-July 16	16
	Maya Paleoecology	Northern Belize	Level A: July 23-August 22	18
	Marine Mammal Biology and Conservation	Kenai Peninsula, Alaska	Level A: June 17-July 16 Level B: July 23-August 23	20
	Primate Social Behavior	Panama	Level A: June 17-July 16 Level B: July 23-August 22	22
	Acid Rain and Freshwater Ecology	Adirondack Mountains, New York	Level A: July 23-August 22	24
	Environmental Geology	Mt. Vesuvius, Italy	Level A: June 17-July 16	26
	Aquaculture	Hawaiian Islands	Level A: July 23-August 22	28
	Coral Reef Ecology	St. John, Virgin Islands	Level A: June 10-July 2 Level B: July 6-July 30 Level B: August 4-August 28	30
	Soil Conservation	Abiquiu, New Mexico	Level A: June 17-July 16	32
	Hazardous Waste and Coastal Ecology	Chesapeake Bay	Level B: June 17-July 16	34
	Wildlife Management	Kenya	Level B: June 15-July 18 Level A: July 22-August 23	36
	Tropical Rain Forest Ecology	Amazon Basin, Ecuador	Level B: June 17-July 16 Level B: July 23-August 22	38
	Dolphin Biology and Behavior	Florida Keys	Level B: July 23-August 22	40

January Term Courses	Winter Moose Ecology	Northern Maine	42
	Tropical Park Management	Big Cypress National Preserve, Florida	42
	Coral Reef Ecology	St. John, Virgin Islands	43
	Primate Social Behavior	Panama	43

What is SFS?

Since 1980 the School for Field Studies has mounted more than 55 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 soil conservation—while structuring our courses around traditional academic disciplines, including wildlife biology, tropical ecology, archaeology, marine biology and geology. Each problem we investigate, rather than being a clear, text-book case, involves a complex network of inter-related 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. Our days are full from morning till night with training in field research methodology and 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. '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 soil type on tropical plant diversity, effects of boat harassment on whales and seals, hazardous waste impacts on shellfish populations, and effectiveness of erosion control methods over a fifty year period.

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 paleoecology study in Belize, our geological mapping at Mt. Vesuvius—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.

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

Tim Yarrington
Westfield, NJ
Westfield High School

Skills

SFS courses are designed to teach the skills you need—in research methodology, teamwork, a scientific discipline, and outdoor living—to successfully meet your goals. 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 a SFS course. We have designed courses on two levels to accommodate introductory and advanced students. We will teach you how to approach a problem,



"I have ten new life-long friends. I have been a part of a highly educational experience. These things I know. It's been a very positive experience, one I will cherish all my life." R. Nelson
Ralls-Athens, Georgia-Vanderbilt University.

Photo by Shawna Allen



Photo by Cindy Bainton

The frequent challenges of SFS field research inevitably lead to increased self-confidence.

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.

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 environ-

ments. 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 the quiet time to yourself for a good deal of personal reflection.

A sense of camaraderie and shared commitment 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 high schools, public and private colleges and graduate programs, from science as well as liberal arts majors, and from across North America 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 (the majority hold Ph.Ds) are a broad range of skills and experiences that uniquely qualify them to lead SFS courses.

“Without reservation I can tell you that I would not be where I am today without that summer on St. John with SFS under my belt.”

C. Shannon Briscoe
Research Assistant
Harvard University

Members of our faculty have lived underwater for weeks at a time, crewed sailboats across the oceans, lived in African villages for four years, shared the neighborhood with yellow-tailed baboons in Tanzania, kayaked down the Yukon River, explored burial mounds of the ancient Maya and learned to eat snakes and insects in South and Central American jungles. Their work has resulted in over 300 published scientific articles, documenting research funded by National Geographic, NATO, the National Science Foundation, the EPA and Sea Grant among other sponsoring organizations.

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.



No matter how removed we are from civilization, a strong sense of comradeship will help overcome even the most difficult mental and physical challenges.

Photo by Naomi Tien

"I took this course to find out if I wanted to pursue a career in Marine Biology. I discovered that this is not what I want to do, but I'm certainly glad I found out by taking such an exciting field study. I don't regret taking the course for a minute, if I hadn't I might have wasted so much time for lack of the right information."

Elizabeth Vigdorth
Memphis, TN
Memphis State University

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 8 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 40 colleges and universities that have awarded credit in the past include:

Boston University
Clark University
Colby College
Colgate University
College of the Atlantic
Duke University
The Evergreen State College
Framingham State College
Guilford College
Hamilton College
Haverford College
Mount Holyoke College
Ohio State University
Pennsylvania State University
St. Lawrence University
University of Cincinnati
University of Connecticut
University of Massachusetts
University of North Carolina
University of Pennsylvania
Washington University
Williams College

Please contact the Admissions Office for further details.

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 experience to last a lifetime.

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.

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 1984, over 45% of our participants received financial aid totaling more than \$50,000. 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.**

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 actual experience in environmental disciplines.

Level B courses assume completion of one or more of the following or the equivalent: 1. college-level course in an appropriate discipline (biology, ecology, geology, etc.), preferably a laboratory course; 2. a SFS Level A course or other scientific field experience; or permission from the instructor. Level B courses are taught at a more advanced 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 choices.

Course Schedule

Our Course Schedule is designed to help you learn as much as possible in a short period of time. Our programs are run like college-level classroom courses conducted in the field for hands-on experience and understanding. A detailed syllabus, prepared for each course, contains background information, reading lists, etc. 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

Week 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 days field trip and relaxation
- student presentations of scientific papers

Week 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



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



Long, quiet hours behind a spotting scope are an essential element of our research on porpoises and seals in Alaska.

Photo by Sarah Fox

Semester Programs

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.

“It was an experience on which monetary values cannot be put.”

David Bravo
Ardmore, PA
Ursinus College

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.

Directed Research, the capstone course, makes this link explicitly by asking students to apply all coursework to an independent (or small team) study in a particular environment.

Students 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:

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

Population and Community Ecology (4 quarter credits): A detailed study of the interaction of the biota with their environment. 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 be fully understood, environmental problems should be placed in the cultural milieu which must ultimately face the solutions and may be the initial cause of the problem. This course studies the history, social structure, customs, and politics of the local region. A broad survey approach is utilized with an understanding of cultural impacts on environmental issues as a unifying theme.

Directed Research (4 quarter credits): SFS is firmly committed to a 'hands-on' approach to science. We want all students to experience the satisfaction, frustration, and growth associated with designing, initiating, and completing an actual 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.



Photo by Annelise Allen

"Despite the problems we faced, everyone worked together and worked together well. Despite our varying backgrounds, we all worked as a team. That was crucial at many times and I felt I could count on my fellow teammates." Steven Senator-Summit, New Jersey-University of Pennsylvania.

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

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 native peoples, 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 10 and 11. 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 the student's 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.

"I participated in SFS to obtain some sort of feel for field work. I not only had that opportunity, more importantly, I was given the chance to create my own project, collect data on my project, interpret my data, write my own report and present it to the group. It was something I had never done before and enjoyed doing."

Mark Leondires
Danvers, MA
Colby College

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 mid-point and conclusion of each course. Evaluations, academic work and letter grades will be forwarded to the student's home institution as requested.

Student Body

Each semester program expects to enroll 18-25 students from across the U.S. and abroad, as well as one or two students from the host country in which we are studying.

Faculty

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

Natural Resource Management

Alaska

Purpose

To explore the impacts on wildlife of increased forestry along the Alaskan pipeline.

Dates: June 7—August 22, 1985

Site

The pipeline corridor acts as one of the world's greatest manmade transects, passing through the principal biomes of Alaska from precipitous mountain ranges to huge forests and the tundra-covered lowlands and plateaus of the North Slope. The highway passes through one of the great wilderness areas in the world, where moose, bear, eagles, geese, and dall sheep abound amid mountains and glaciers under a breathtaking sky.

Construction of the pipeline was recognized as a threat to this beautiful land; its direct effects could melt tundra, interfere with animal migrations, pollute rivers, and permit further, easier access to the interior. During planning and construction, a great deal of attention was directed toward conserving and protecting the environment. In the delicate northern tundra ecosystem, the pipeline is elevated to protect the easily disturbed thin layer of top soil. In southern regions, portions of the pipeline are buried so as not to disrupt patterns of animal migration. But indirect impacts of the pipeline were not as well considered and will serve as the research focus for this program. We know that forestry practices can damage the habitat of some large animals like bear while simultaneously improving browsing conditions for deer. Runoff into rivers accelerates after clearcutting. Small increases in nutrient inputs can help fish production but large inputs choke the rivers with algae and weeds.

What is forestry along the pipeline doing to the resources in this region? We will compare and contrast the status of principal resources along the length of the pipeline in order to answer this question. Extensive side trips will help us to explore unaffected regions and to learn about the ecology and people of Alaska.

We will be living, working, and traveling in three main regions of Alaska. Coastal Alaska, which extends from the Alaska Range to the Gulf of Alaska, contains rich mineral deposits and fairly fertile lands. Its relatively warm waters contain salmon, cod, halibut, crabs, scallops, and shrimp. Interior Alaska, located between the Alaska and Brooks Ranges, consists of extensive tundra-covered lowland and plateaus fed by several large river systems. A variety of fur-bearing animals, birds, and big game live in this area. Arctic Alaska, populated mainly by Eskimos, is a region dominated by barren tundra and mountains extending from the Arctic Ocean to the formidable Brooks Range, which runs from east to west in northern Alaska. Several excursions will take us through some of these spectacular areas, including a hike along the Yukon River in Central Alaska and treks through the foothills of the Brooks Range.

Global Issue

The colonists that landed on the east coast of North America in the seventeenth century began felling timber for fuel, homes and shipbuilding. Now, after two hundred years of migration across the continent, there are few vast tracts of virgin timber left in the continental U.S. This scenario is similar to what has happened throughout much of South America and Africa, where deforestation has become a problem of major international concern. By literally altering the face of the globe, we risk losing many species of plants and animals, running out of timber resources which many people desperately need for firewood to stay alive - reducing the productivity of the land through erosion, and even changing the climate of the planet.

Local Concern

Until recently one great timber resource was the thousands of square miles of forests in southern and central Alaska. With the completion of the trans-Alaska oil pipeline in 1977, an 800 mile corridor was opened up which bisects the state from Valdez Harbor in the south to Prudhoe Bay in the north. This paves the way for exploitation of the rich mineral, forest, hunting, fishing, and recreational resources of Alaska. Predictably, forestry has increased dramatically along with attendant environmental impacts. What are and what should be the long-term plans for management of the Alaska forests? How does forestry affect the bird, caribou, dall sheep, moose, deer, and wolf populations? How does forestry threaten the wild rivers of Alaska? How does development affect the cultural stability and life style of once isolated Eskimos?



Photo by Jack Shea

The tools of field scientists are often simple but essential.

Program Structure

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

Introduction to Alaskan Ecosystems covers basic principles of ecology, evolution, population dynamics, and community structure. Energy relationships and nutrient cycles within an ecosystem will be discussed along with concepts of stable ecosystems. Field work will include investigations of population growth and regulation. This course introduces students to the concepts and theory needed in applying the skills learned in other courses.

In **Wildlife Biology**, we will learn about the major faunal groups in the Alaskan regions where we will work, including their evolution, natural history, ecology and behavior. We'll focus on the morphology, physiology and behavioral ecology of small and large mammals along with their adaptations to a cold environment. This course will cover field identification of common mammals and birds, classification of social groupings and behaviors, and techniques for surveying and censusing populations. The sensitivity of these animals to alterations in their habitat resulting from the pipeline development makes this course much more than a theoretical survey of wildlife.

We will apply our knowledge of Alaskan ecology and wildlife biology in our **Principles of Resource Management** course by studying conservation and management principles and their application to problems in soils, water, forests, wildlife, mineral and energy resources. We will build on our knowledge of basic ecological concepts and 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 timber, water, wildlife and recreation.

Resource management problems affect biological communities, but the sources of the problems are usually people. Our fourth course, **Human Ecology**, is an introduction to native populations from their migration over the Bering Land Bridge at least 25,000 years ago to their contemporary socio-cultural patterns. We will investigate demographic patterns, cultural history, and technological growth in reference to conservation and management policies, as well as consider human biological, cultural, and behavioral adaptations to the environment. The impact of Americans from the "lower 48" will be

considered in regard to changing environmental management policies and effects on native Alaskans.

In the final course, **Directed Research**, students will select a topic on which they will conduct independent field research under faculty supervision. This research is called "Directed" rather than "Independent" because we want student projects to mesh so that collectively, the group may tackle a broad range of integrated topics. Some possible choices include: investigating the effects of forestry on migratory routes of caribou; comparing two sites with different forest management strategies, such as sustained yield, selective clear-cutting, or reforestation; evaluating a multiple use (timber, forage, wildlife, recreation) managed area; and comparing areas around the pipeline corridor which contain elevated and buried portions.

During the first three weeks of the program, we will learn basic research skills, and specific field and laboratory techniques. Lectures will focus on the nature of scientific research, experimental design, and elementary statistics. We will begin our field research in the fourth week.

Living and 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 to experience average temperatures between 6°C and 18°C with an average monthly rainfall of about 4" depending on our location.

We will be driving in four wheel drive vehicles, and we 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 2-3 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 and virgin wilderness.

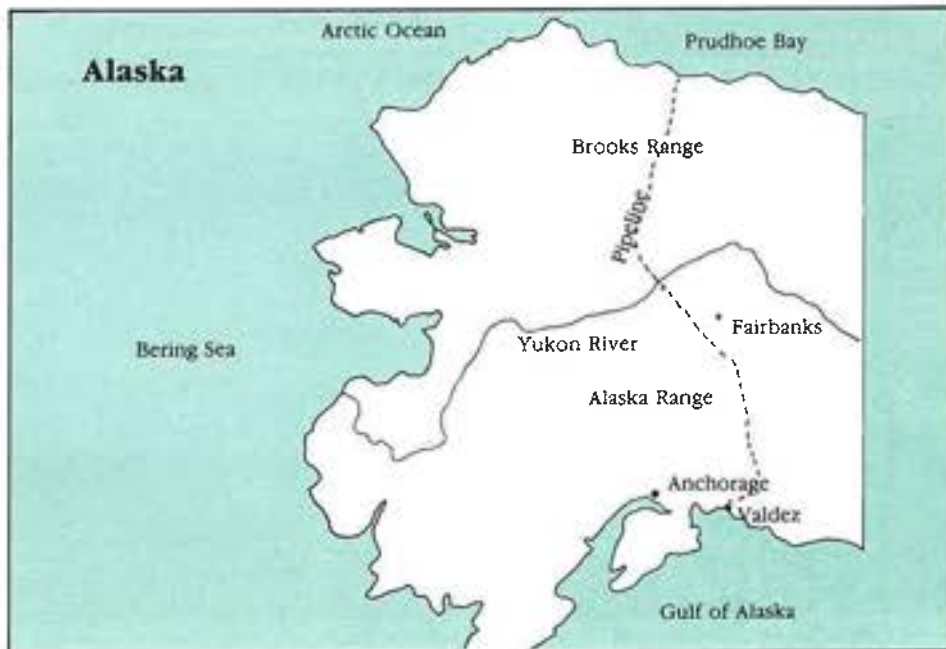
Tuition: \$4600

Departure Point: Anchorage, Alaska



Photo by Jack Shea

The Alaskan pipeline offers a sharp contrast between technology and nature. Can they coexist in harmony?



Marine Biology and Management

Virgin Islands

Purpose

To produce a management plan and inventory fisheries resources in selected areas of the U.S. and British Virgin Islands so that maximal sustainable yields can be harvested without adverse environmental impacts.

Dates: September 16, 1985—December 9, 1985;
February 4, 1986—April 29, 1986

Global Issue

Of the 72% of the earth's surface that is covered by ocean, the narrow coastal regions upon which coral reefs and algal beds lie represent only about 0.2% of the ocean's area. Yet one third of all fish species are supported on these fragile strips, and there are countless species of invertebrates found only on reefs. These habitats are threatened by oil pollution, over-fishing, sedimentation, land development, toxic wastes and dredging. The extent and diversity of many reef organisms is unknown, and sensible management plans await a more complete understanding of the resources and biological interactions on the reef.

Local Concern

The Virgin Islands are undergoing rapid population growth (doubling every 33 years) and much of the food for the islanders traditionally has come from the sea. In spite of the importance of this valuable but threatened ocean resource, many regions have not been inventoried and fishing limits have been set without sufficient information. Even areas where the reef populations are known should be periodically resurveyed to measure the success of current management policies.

Numerous other management decisions are made about marine resources in the Caribbean. These include mooring

rights, construction policies, waste disposal permits, and permits to conduct drilling and research. The development and enforcement of these policies varies among islands due to political differences and previous local experience.

Our specific purpose will be to assess the population of conch, sportfish and commercially harvestable fish in near-shore Caribbean waters in order to determine the relationship between current levels of exploitation and resource quantity; then we can recommend coherent management plans to the U.S. Park Service and the regulatory commission of the British Virgin Islands.

Site

The Virgin Islands extend east of Puerto Rico for about 200 miles. We will focus our attention on the U.S. Virgin Islands, principally St. Thomas and St. John, and on the British Virgin Islands at the eastern edge of the Greater Antilles.

These tropical paradises vary from lush forests of fruits and palms to dry, almost desert-like islands. Some are pristine and undeveloped; others have oil refineries and are plagued with pollution problems. They all have excellent fisheries resources, magnificent clear blue water, and exquisite coral reef habitats.

Our home base is the Virgin Islands Ecological Research Station (VIERS), on isolated Lameshur Bay, St. John. This small field site is surrounded by U.S. National Park Service land and is owned by the College of the Virgin Islands. Small bunkhouses half a mile from the Bay will be home, with a dining hall, library, microcomputer, and classroom for our use. The shore facility includes a laboratory, boat dock, and an unspoiled coral reef.

Program Structure

Through a series of five courses, we will investigate the economic, political, historical, and scientific issues involved in managing fisheries resources in the Virgin Islands. We will compare the problems and attempts at solutions on several islands, after first using our home base, St. John, as a case study.

The group will be split for two three-week periods; half will stay at VIERS and work along St. John and St. Thomas, while the other group will travel to more distant islands, performing comparative surveys of the U.S. and British Virgin Islands (BVI). During the second period the first group will stay at VIERS while the second explores other areas in the BVI.

The five courses in this program include: *Marine Biology; Peoples and Cultures of the Caribbean; Tropical Ecology; People, Pollution and Policy; and Directed Research*. In *Marine Biology*, we will study the flora and fauna of the Caribbean focusing particularly on the diversity of fish,



Surrounded by unspoiled National Park land, our home base on St. John serves as a perfect natural lab.

Photo by Kenneth Andrasco

plants and invertebrates. Comparisons will be made of communities associated with mangroves, seagrass beds, coral reefs, and plankton. This course will consider how organisms acclimate to environmental changes over the short-term and adapt biologically over the long-term.

Peoples and Cultures of the Caribbean will involve a detailed study of the different modern cultures in the Caribbean that have resulted from diverse colonial histories. We will examine the influences of the Africans, Spaniards, Dutch, English, French, and Americans and investigate the pre- and post-colonial history of the islands. Activities will include visits to several towns, native guest lecturers, literature reviews, tours of historic sites, and a considerable amount of reading.

In **Tropical Ecology**, we will study the interactions between flora, fauna, and the physical and chemical environment. Basic ecological principles (population growth, food chains, energy flow, nutrient cycling, predator-prey dynamics) will provide a foundation to study the unique characteristics of tropical ecosystems. Advanced topics will include terrestrial ecology (plants, birds, soils, mammals, and reptiles) for half the group and the other half will emphasize marine interactions among algae, seagrasses, coral, plankton, other invertebrates, and fish. This course complements **Marine Biology** by adding the influence of terrestrial processes and biota.

Pollution can be controlled but the dilemma of who should pay the cost,

and who should share the burden of this cost, is a political decision. In **People, Pollution and Policy**, we will study the principal pollution problems of the Caribbean (oil pollution, land development, erosion, loss of habitat, siltation, air pollution, toxic chemicals, urban runoff, etc.) and relate these environmental issues to the underlying economic and political causes and solutions.

Directed Research will give us the opportunity to gain first-hand experience in investigating the fisheries resources of the Virgin Islands. The material presented in the course work will find direct and immediate applications in the research. Each student will take on a component of this large topic as an independent project. The U.S. National Park Service (NPS) in consultation with the SFS faculty will coordinate the projects. Examples of projects include: documenting the effects of turbidity on conch populations; assessing the impact of boat anchors and other external pressures on the habitat of the spiny lobster; investigating the effects of fishing pressure on grouper density in four Virgin Islands; and examining fisheries management on five Caribbean Islands.

These projects bring together skills and knowledge acquired from other courses. You will learn to identify organisms, perform and record accurate observations while underwater, design a sampling program, and analyze your results. Final presentations will be made to the class, faculty, and interested local scientists.



Photo by Kenneth Andrusko

With specimens at our fingertips, opportunities abound for impromptu discussions of the mysteries of the sea.

Living and Working Conditions

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

The mean annual temperature on St. John is 79°F, ranging from extremes of 65°F to 95°F. Most of the rainfall occurs during the summer, but water shortages are frequent since the nonporous clay 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.

VIERS is a rustic but adequate station with bunkhouses and open-air sanitary facilities, none of which are impervious to heat, humidity, or small insects. We will be doing some of our own meal preparation and will be responsible for keeping the station and its facilities clean and orderly.

Our shipboard time will be somewhat cramped, a discomfort easily relieved by the beauty and variety of the Caribbean vistas.

Tuition: \$4800

Departure Point: VIERS, St. John, Virgin Islands



Photo by Chris Neefus

Research 50 feet underwater requires a firm grasp of the essentials of teamwork.

Wildlife Biology and Management

Kenya

Purpose

To determine the environmental costs and benefits of game ranching as an alternative to cattle ranching in Kenya.

Dates: September 14, 1985—December 7, 1985;
January 3, 1986—March 28, 1986

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. Social and economic growth have led to increased land usage, destroying the natural habitats needed to sustain Kenya's incomparable herds of grazing ungulates. One of the most urgent problems has arisen from the extensive use of strains of domestic beef cattle developed for other regions. This has caused increased erosion, excess water use, and necessitated the implementation of intense measures to

control parasites. Substituting native species of ungulates (e.g. Thompson'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?

Site

The enormous variety of wildlife in Kenya occupies an equally remarkable variety of terrain. The expansive savannas of eastern Kenya support ungulates such as antelope, buffalo, giraffe, and zebra as well as large carnivores such as lions, cheetahs and leopards. In the lush mountain forests of western Kenya are duikers, bushbucks, forest hogs and colobus monkeys as well as a large number of impressive birds. The lakes of the Great Rift Valley that traverses this countryside are home to hippopotamus and numerous water birds including color-coded flocks of white pelicans and pink flamingos.

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

Our base of operation will be "Wildlife Ranching and Research Ltd.", established by David Hopcraft, a Cornell University graduate, as an experimental game ranch where the population of various large mammals could be protected and carefully monitored. Situated approximately 40 kilometers southeast of Nairobi in the Athi Kapiti plains, the Ranch consists of a compound with a camp site, eating and dining areas, laboratory facilities, a slaughterhouse, and a small library, and 81 square kilometers of protected savanna where wildebeest, giraffe, and gazelle roam freely among the gently rolling terrain covered with thick grass and acacia trees.

Program Structure

This semester program is designed to allow you to compare first-hand all aspects of game ranching with the management of preserved herds. We will accomplish this through classroom lectures, organized seminars, field and laboratory demonstrations, films, and group and individual research projects structured around four distinct but inter-related courses and a specific research goal.

These are our objectives: to introduce you to the organisms, habitats, peoples and cultures of East Africa; to provide you with an understanding of, and appreciation for, ecological princi-



Photo by Geoff LeVner

Is game ranching an answer?

ples in general and the ecology of East Africa in particular; to train you in the general research methods of hypothesis formulation, research design, data collection and data analysis; to provide you with hands-on experience with specific techniques used in ecological research and wildlife management; and to increase your awareness of the philosophical, social and economic justifications for various conservation strategies. The five courses in which you will participate include **Introduction to Wildlife Biology, Population and Community Ecology, Peoples and Cultures of East Africa, Man and the Natural Environment, and Directed Research** (4 quarter credits each).

Introduction to Wildlife Biology will orient you to the major vertebrate groups of the East African savannas through a discussion of their evolution and their ecological requirements. Emphasis will be placed on the diverse ungulate population 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 Amboseli National Park, Masai Mara Game Reserve, Mt. Kenya National Park and Nairobi National Park. This portion will cover field identification of common birds and mammals, classification of social groupings and behaviors, demonstrations of ungulate anatomy and parasitology, techniques for capturing organisms and standard techniques for population sampling.

In **Population and Community Ecology**, we will start 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. Evolutionary aspects of each of these relationships will be discussed with particular 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. Field work at the Ranch will include investigations of food choice, niche overlap, interference and exploitative competition, mutualism, predator-prey interactions, parasite-host interactions and community structure.

Peoples and Cultures of East Africa will introduce us to the varied cultural heritage of Kenya. The first week will be devoted to basic Swahili lessons which will give us sufficient background to communicate effectively with native Kenyans. We will then review the East African evidence for human evolution and concentrate on the traditional cultures of the major tribes of the area. The social, political and economic impact of the colonial and post colonial era 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 particular cultural interest including local Kikuyu and Masai villages.



On the equator, even the most rugged animals must resort to afternoon siestas.

Our fourth course, **Man and the Natural Environment**, 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 man's role in the environment and his options for conservation of the unique species and environments of East Africa. Our numerous safaris in Kenya will allow us to examine a number of approaches to land utilization and the impact these have on the natural communities of organisms. We will discuss the goals of various conservation programs and justifications for these goals. The course will present options for preservation from the level of the individual organism to entire ecosystems and will emphasize the degree of management required at each level, including ways in which careful planning may reduce costs and increase efficacy of management programs.

The capstone course, building heavily on the other courses, will be **Directed Research**. We will investigate a number of relevant research questions on ecology and conservation biology that are of particular interest in Kenya. In the first three weeks of this program, we will sharpen our research 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.

In the fourth week we will begin our actual field research, involving 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 such as resource use patterns, activity patterns, and social interactions and the impact of

cropping on the behavior of ungulates; investigating the role of parasitic infection in harvested ungulate populations; and determining methods for assessing the stability of different biomes. Through these projects we will become proficient at numerous research skills including data analysis, field identification, lab procedures, and measurement criteria.

Our field work will be conducted both within the Ranch and in various National Parks to enable 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.

Living and Working Conditions

The average temperature in Kenya ranges from 70°F to 85°F; between March and May frequent rain showers can be expected. September through November is much drier. We will use Land Rovers 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.

Our accommodations will be primitive but comfortable, consisting of small huts or large tents. We will sleep on cots in the Ranch and on foam pads while on safari. Sufficient water for showers will provide a welcome relief from our days on the warm, dusty savannas.

Tuition: \$5400

Departure Point: Nairobi, Kenya



People are an integral part of any proposed solution.

Photo by Lisa McLaughlin

Photo by Jack Shea

Humpback Whale Ecology

Gulf of Maine

Purpose

To determine how environmental variables - especially the impact of tour vessels - influence the distribution and behavior of humpback whales in order to assist in planning for the conservation of such endangered marine mammals.

Course Levels, Dates: Level B—June 17-July 16;
Level A—July 23-August 22

Background

Off the coast of New England over 100,000 people will join whale-watching cruises this year; for many small seaports this has become a lucrative business. Recently, however, whale specialists have expressed concern about the impact of whale-watching on the animals. They suggest that vessels disturb the whales, possibly altering their behavioral patterns and thus, perhaps, their ultimate ability to survive.

Last summer two SFS teams 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 year, in SFS's fourth season studying these magnificent animals, we will take a new approach to impact studies by documenting the behavior of 'undisturbed' whales and comparing it to that of 'disturbed' ones.

Research Focus

What behavioral variations exist between disturbed and undisturbed whales? Do vessels affect feeding habits? Are we possibly forcing these animals from their critical feeding habitat or is the feeding cycle so flexible that intermittent vessel interference can be tolerated? What variables of their behavior are most suited for determining levels of disturbance?

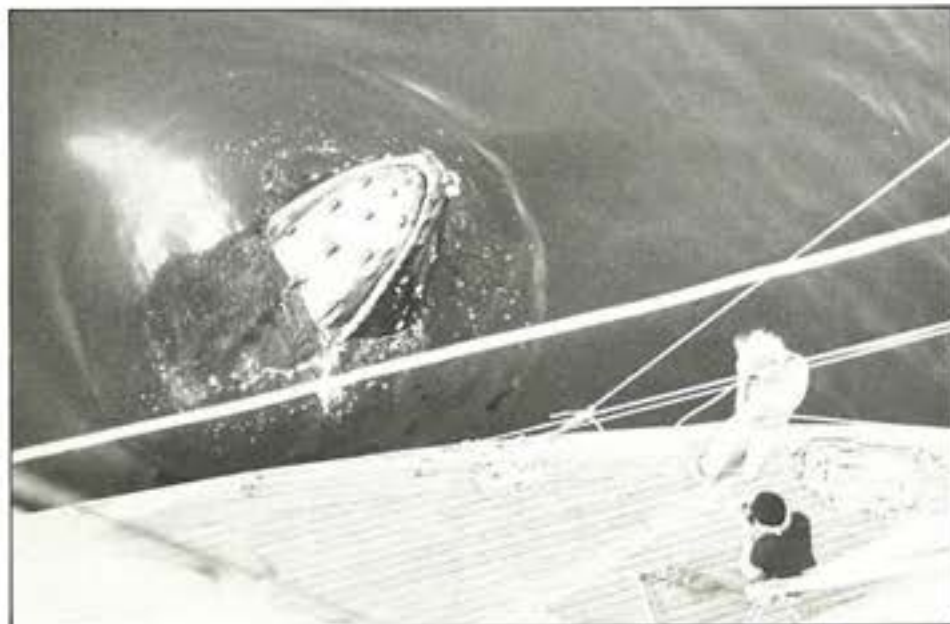
Course Design

Our unique base of operation throughout the course will be the majestic, completely renovated 88-foot schooner, *Bowdoin*. Designed in 1921 for Admiral MacMillan to withstand the extreme ice conditions of the far north Atlantic, the *Bowdoin* has survived 26 Arctic voyages, including two winters frozen in pack ice. Its large cabin space and extensive open deck allow us to make extended overnight journeys off Cape Cod and up the coast of Maine to track and study different populations of whales.

During our first few days aboard the *Bowdoin* we will engage in a full series of lectures and discussions on marine mammal conservation, public policy, human/cetacean interaction and whale evolution and taxonomy. Several hours each day will be devoted to learning the skills we need for our research: how to record detailed observational data; how to identify whales; and how to use various research instruments, including current meters, depth sounders and sextants. We also will spend time learning sailing skills and safety procedures as well.

Sailing through the chilly waters of the Atlantic from Cape Cod to Brown's Bank, south of Nova Scotia, we will scan the ocean for groups of humpback whales, and the more elusive, rare, right whale, either gliding along in pursuit of food or resting majestically near the surface. The captain will then maneuver the boat toward the whales, always keeping a respectful distance. Fortunately humpback whales show little fear of boats and in fact seem quite curious about us. They will frequently swim beside our schooner and occasionally breach, lifting their massive bodies entirely out of the water.

Once we are close enough to examine the whales' behavior either with the naked eye or binoculars, the science watch will divide into two



Humpback whales spy hopping alongside our schooner appear as interested in us as we are in them.

Photo by Lars Jones

teams. The first team will record behavioral data on variables including feeding habits, social interaction, respiration rates and movement through the water. Simultaneously the other team will log the time, weather, visibility, water temperature, clarity and salinity, density of fish and other environmental variables. We plan to alternate between teams on a regular basis in order to become proficient at research skills in both behavioral and environmental studies.

The B-level team also will record diving and surfacing rates when we are adjacent to the whales. In addition the team will pay closer attention to actually identifying individual whales and mapping their movements in an effort to learn about the actual distribution of the whales in this part of the ocean.

Gradually we will collect sufficient data on the behavior of different humpback whale populations to be able to piece together major behavioral patterns for various activities including feeding, diving, and surfacing. We can then compare this information to behavioral data - collected by previous SFS teams and other cetacean specialists - on disturbed populations. Comparisons of environmental conditions also will be made to determine if whales are driven to less desirable environments by vessels.

Along the coast of Maine we will visit ports of call such as East Boothbay and Bath, where the *Bowdoin*, the last American flagship built for Arctic research, has resupplied since the 1920's. Involved in conducting research and teaching expeditions for the first time in twenty-five years, she will be the focus of considerable interest from old and new friends alike.

During our days off Maine's coast, we will have the opportunity to pursue independent projects of our own design. Possibilities may include looking for increased activity levels at different times of day, correlating the density of whales to the density of human presence or investigating whale surface activity in relation to fish density. The B-level team will use hydrophones to record and analyze feeding sounds and cameras to photograph complex behavior sequences. During the last few days of the course we will make presentations of our findings to our teammates, faculty and visiting whale specialists.

In our impact study of how vessels affect humpback whales, our data from a population that is relatively unharrassed by vessels will be compared to data on harrassed whales collected simultaneously by other researchers. Preliminary findings from

these comparisons will be compiled in a final report which we will present to the National Marine Fisheries Service and whale-watching and cetacean research communities for incorporation in policy guidelines for the whale-watching industry.

“All of a sudden a whale would change direction and come toward us and follow us for a few hours . . . then it would raise itself out of the water just to look at you. And you're trying to take data and say 'wow' at the same time . . .”

Beth Greiff
Beaver Dams, NY
Mount Holyoke College

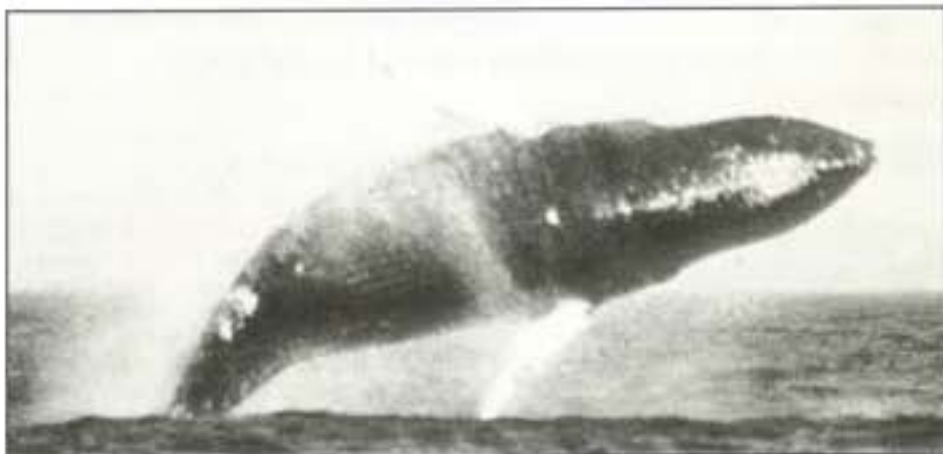
Living and Working Conditions

Think of yourself sailing away for most of a month from the usual hurried reality of life into another era aboard a magnificent, solid, old schooner that softly creaks and groans under you as it crisscrosses an environment of the widest sky and simplest perspective.

We will plan sailing, scientific and sleeping watches for all of us. Shipboard life requires patient and careful concern for your shipmates and diligence in each of your individual responsibilities. And be prepared - no matter what watch you are on - for the sometimes fabulous, sometimes frightening and always unpredictable raw ocean weather.

Tuition: \$1390

Departure Point: Boston, Massachusetts



Even at 40 tons, these majestic creatures are able to propel their entire bodies above the ocean's surface.



Our work will continue the schooner Bowdoin's legacy and historical mission of field research begun in the arctic by Admiral MacMillan decades ago.

Photo by Lars Jones

Schooner Bowdoin Association

Population Dynamics of Endangered Species

Switzerland

Purpose

To investigate the complex effects of reintroducing endangered species to their original habitat and to determine how such populations should be properly managed.

Dates: June 17-July 16 Course Level: A

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 endangered alpine ibex has apparently done the improbable. Reintroduced to its former habitat fifty years ago, this 8-foot mountain goat of curved horn and thick fur is abundant once again; over 3,000 now roam the mountain passes.

So what's the problem? Wildlife biologists have noticed that the current population of alpine ibex is placing severe demands on its habitat; overgrazing has caused a variety of critical environmental problems including erosion, avalanches, and food shortages for wild as well as domestic animals that share the ibex's magnificent home. Thus SFS has an ideal opportunity to pursue its work in designing strategies to save and successfully manage endangered species. Hard data on exactly how the ibex inter-

acts with its environment are urgently needed, not just for the survival of this fascinating animal but for the actual preservation of a habitat rich in all manner of alpine species, from the marmot to the chamois.

Research Focus

This new SFS course is an extension of our past research on the Greek Islands in which we helped design management strategies to save the endangered agrimi, the rare goat of Crete. In our field work this summer, we need to examine the behavior and ecology of the alpine ibex in order to document the conflicts between the growth of its population and its impact on the environment. What habitats do ibex prefer and what features of the habitats are most important to the ibex? In what ways do ibex affect these habitats? How can the populations of ibex be managed to prevent further damage to their environment?

Course Design

From Zurich, we will travel by train through spectacular, mountainous countryside to the Swiss National Park in eastern Switzerland. Following a brief orientation at our secluded base camp with lectures on animal behavior, ecology and evolution of the ibex, national park management and wildlife measurement techniques, we will hike through Norway spruce and pines 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 plan to collect detailed behavioral data, focusing particularly on food preferences, social structure, and foraging behavior. In our log books, we also will record the presence of all other species of large mammals seen in our study site area.

We plan to conduct an intensive analysis of the ibex habitat. Following the presentation of brief 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. Elaborate equipment, such as pyrliometers, hygrothermographs and psychrometers, also will be used to examine variables of the habitat microclimate, including humidity and sunlight, in order to gain specific information about the environmental conditions in which various ungulates live. Top-



Photo by Thomas Husband

The ibex appears not only to have a precarious foothold on this cliff, but on its long-term future as well.

“To think that I might be one of the last people in the world to enjoy the antics and revere the magnificence of these strong but gentle creatures was inconceivable. Extinction means forever; a permanent, irreparable loss. I truly grasped the significance of my summer expedition, and the efforts of wildlife conservation organizations throughout the world.”

Janice Janas
Flushing, NY
Harvard College

ographical information is also necessary to determine the types of terrain that ungulates such as alpine chamois and red deer prefer for grazing.

Having completed our preliminary studies in the Swiss National Park, we will take a train west toward our second study site at the base of the Rothorn near Brienz. 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 meadows covered with wildflowers, we will spend two 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 magnificent, 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. We also need to focus on the foraging patterns of other species to record any signs of erosion or other habitat damage attributable to excess grazing.

Our field work will be supplemented with lectures on topics ranging from concepts of vegetation succession to alpine ecology and wildlife population analysis. We will have the opportunity to explore tangents of our major research projects through independent projects. 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, essential for managing the ibex population before more serious problems arise from over-utilization of its habitat.

Living and Working Conditions

This country is raw physical beauty taken to a high art. The most difficult challenge will be keeping our minds on the research at hand, for the actual scenery is much better than any calendar picture and the 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. Pre-course physical conditioning is recommended to enable each team member to handle the long hikes through rough terrain to our study sites.

Tuition: \$1490

Departure Point: Zurich, Switzerland



Photo by Thomas Husband

As we travel between course sites, we will venture through picturesque Swiss villages surrounded by spectacular mountain peaks.



Photo by Kirtland Barker

Is overgrazing by the alpine ibex and other animals at high altitudes seriously damaging the fragile alpine ecosystems of the Swiss Alps?

Maya Paleoecology

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: July 23-August 22 **Course Level:** A

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 their eventual collapse.

We will look specifically at their agricultural tradition and whether ecological forces and inefficient agricultural practices were major factors in their demise. By doing so, we

may be able to gain information on how the Maya were able to convert dense jungle into highly productive land, information that could be useful to agriculturalists in other areas of the world.

Despite extensive excavations throughout Maya settlements, surprisingly little is known about their lifestyle, food sources, and social structure. Recently archaeologists have taken a new and unique approach 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.

Research Focus

This new SFS 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. Preliminary excavations by our faculty member, Eric Gibson, and other archaeologists have uncovered promising clues such as shells, animal bone and early pottery that provide evidence of Maya food sources and of the period at which the village flourished.

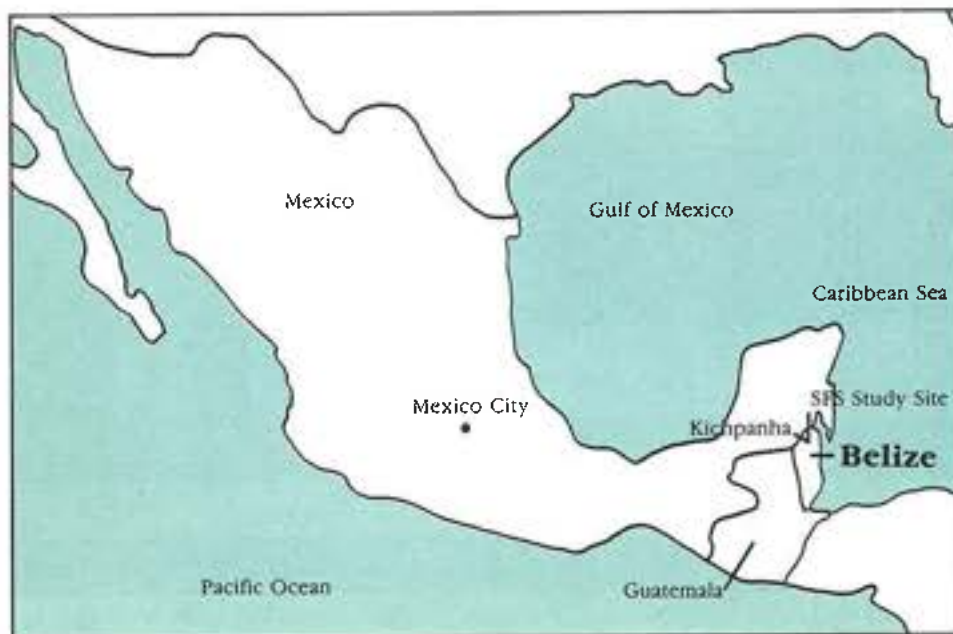
Concentrated in an area 4 square kilometers with a crystal blue lagoon to the southwest, brackish swamps to the north, and dense tropical jungle to the east, this village provides an ideal location for us to investigate the Maya civilization. Where did it originate? How did they use the land? Did the Maya 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 the lagoon, faculty will lecture on the history of archaeology, regional ecology and Maya archaeology. Our field work will then begin with a complete survey of Kichpanha. 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 pottery and stone tool scatters, mounds and burned rock concentrations.

We will conduct small sub-surface probes at features that may indicate positions of additional buried artifacts. Our mapping of the artifacts we collect 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?

We plan to probe into a pyramid and a burial mound at the site to recover artifacts such as plant remains and exotic items including magnificent obsidian and jade artifacts, 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



“I am not scientifically oriented so this was a new experience for me. It was great - I have a better feeling for science now and though I know its not my major area, I learned I really do enjoy it.”

Tani Denham
Laramie, WY
Doane College

changes in regional environmental conditions. Some of the artifacts we may come across will be extremely fragile and will require the use of such delicate excavating tools as dental picks, fine brushes and bamboo splints

Additional lectures will cover the development of agriculture, climatology, local geology and the use of paleobotanical data recovery. We'll continue to refine our archaeological field techniques such as surveys, test probes, excavation, records and chemical analysis. In 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 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 food resources and the environmental conditions in which they lived, we may be able 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.



Photo by Eric Gibson

Searching for clues to the Maya culture beneath the surface requires both patience and extreme attention to detail.

Living and Working Conditions

Among the wild fragrant smells and exotic wildlife of the Belize jungle, from parrots in the canopy overhead to tapirs in the surrounding underbrush, we will feel far from the conventional surroundings back home. 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 August. 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: \$1450

Departure Point: Belize City, Belize



Photo by Irwin Roemer

As we proceed with our excavation, our faculty member Eric Gibson will guide us in our mapping of the ancient village of Kichpanha.

Marine Mammal Biology and Conservation

Kenai Peninsula, Alaska

Purpose

To examine the ecology, biology, and behavior of harbor seals, harbor porpoises and sea otters in order to evaluate their responses to human activities and to assist conservation and regulatory agencies in developing sound management policies.

Course Levels, Dates: Level A—June 17-July 16;
Level B—July 23-August 23

Background

Human activities, such as tourism, energy exploration, and the fishing industry, are expanding relentlessly it seems, into some of North America's most northern and secluded waters. Are the marine mammals in these areas affected by this? Is their future security affected in any way? SFS is trying to find out.

In Glacier Bay from 1982 to 1984, we developed and implemented new methodology for censusing harbor seals and discovered new hauling sites and unusual peak hauling times. Population counts compared the distribution and behavior of seals at two separate inlets. These projects, initiated by SFS faculty and students teams, will be followed up by National Park Service personnel in the near future.

As the glaciers continue to retreat, causing less ice to fill the bays, as more tourist boats plough the waters, what is the effect on the local marine mammals? Would, indeed, they tend to maintain a stable population in spite of such changes?

We have chosen a site this year on the Kenai Peninsula south of Anchorage, Alaska. Here each summer the seals haul out onto islands and icebergs to give birth to their young, making it easier for us to observe them. We can contrast the response of the seals to our presence in kayaks with that of larger tour boats and the local fishing fleet.

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 the seals and porpoises? What are the implications for management and conservation?

Are the 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? Can harbor porpoises be identified and monitored sufficiently to determine the size and range of the Kenai populations?

Course Design

We will spend much of our time kayaking in this busy and spectacular classroom. Set among majestic, snow-capped mountains and fjords, bordered by virgin forests of spruce, alder, hemlock and birch, our campsite neighborhood will be shared by moose, black bear, fox, lynx, mink, marten and wolverine, by bald eagles, tufted puffins, loons, trumpeter swans, oyster catchers, and three-toed woodpeckers, by sea otters, harbor seals, porpoises, sea lions and minke, beluga and killer whales.

It will, of course, be important to have a solid grasp of the geology and ecology of a coastal mountain ecosystem. Lectures will cover marine mammal biology and physiology, the natural history of the Kenai Peninsula, field identification of mammals and birds, pinniped (literally 'winged feet') population dynamics, social structure, field methodology and research tech-



Photo by Donald Brewster

Special, ocean-going kayaks, our primary mode of transportation, provide one of the few ways to approach marine mammals without disturbing them.

niques, marine mammal conservation and management, and ecological succession.

In addition we will study marine mammals in a different part of the coastal mountain fjord ecosystem, the ecological role of bald eagles and bears, cetacean dynamics, and the biology of seabirds. The faculty also will teach censusing techniques and use of data sheets to keep an accurate count of observations. We will keep a naturalist's field journal, in addition to personal journals, to record places traveled, species seen, and time and weather conditions for each phenomenon observed.

In the field we will keep at least 100 meters from the animals at all times to avoid disturbing them. We will focus especially on the seals' reactions to vessels of various sizes that enter their waters. If the seals are upset, pups may be separated from their mothers and lost. Our observations - made with a surveying instrument called a theodolite - will help to determine whether vessels do, indeed, disturb the animals and will provide a basis for future management decisions.

Field trip destinations are an exciting mix: seabird and eagle nesting spots, marine tidepools, Kenai Fjords National Park, Chugach National Forest (another slice of the sub-arctic ecosystem, located on the northeastern third of the Kenai Peninsula) and perhaps even an area of productive fishing to see how this industry affects marine mammal life.

Among the questions you might pursue as an independent project during the course are: What are the best ways to distinguish individual marine mammals from each other? What is the nature of the interactions between mothers and their calves? Do some of these animals have specific territories and if so, how are they staked out or defended? Or you might focus on other animal species, such as seabirds, and study their distribution, feeding patterns, and other behavior.

The B-level team will have the opportunity to pursue somewhat more intensive behavioral and ecological data collection and analysis, to travel to more remote locations than the A-level team and perhaps to do more extensive sea-kayaking.

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? We hope to pre-

ent our observations and conclusions to wildlife managers and other resident naturalists as a contribution to protecting these vulnerable marine species, while we take with us a new understanding of the realities of field work and memories of the Kenai Peninsula's vivid beauty.

Living and Working Conditions

This will be a month of constant challenge, from the course work as well as from the raw wilderness camping. But it will challenge you to see and experience as much as to learn.

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 pounding rain—the local rainfall average is 160" per annum—or thick fog. 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: \$1490

Departure Point: Anchorage, Alaska

"I thought I knew what the word 'wilderness' meant. I didn't. We experienced wilderness like few have. We washed in glacial streams, cooked in the rain, slept under the stars, wore the same clothes, had no electricity, no mirrors, no running water. You really got the feeling of being part of the land, being part of nature."

Leslie Bonnaville
Livonia, MI
University of Michigan



Photo by Barbara Taylor

What is the impact of increased vessel activity on harbor seals and porpoises?



Primate Social Behavior

Panama

Purpose

To survey and census groups of the endangered Panamanian tamarin, to measure patterns of range use, and to assess the permeability of groups by strangers in order to help preserve this endangered species.

Course Levels, Dates: Level A—June 17-July 16;
Level B—July 23-August 22

Research Focus

We will determine the current distribution and group sizes of a population of tamarins on the Atlantic coast of Panama. What patterns of range use and social interaction exist within and between groups of tamarins? How will individuals within groups of tamarins react to strangers so that the efficacy of introduction efforts can be evaluated?

Course Design

In this new SFS course, our research will take place in lush, uninhabited primary and secondary neotropical jungle in a country that has long been an important crossroad for the world. We will fly to Panama City and reach our designated site by first travelling on the historic Panama Railroad, built from 1848 to 1855, across the isthmus to the small town of Gatun at the northern (and western) end of the Panama Canal.

From there we will board small boats for the eight-mile trip across Gatun Lake to our base on a tiny island close to our field site. Here we will set up camp among cecropia trees and begin to learn the skills essential for working safely together in the dense, trackless jungle, a habitat the Panamanian tamarin shares with capuchin, howler and nocturnal owl monkeys, not to mention an exceptional abundance of colorful resident and migrant birds and animals. Initial lectures will be on the history of primatology, primate evolution, observational behavior methods, ecological field techniques and scientific report writing.

Our first project is to reestablish contact with groups of tamarins censused in 1982 by our faculty member, Dr. Dennis Rasmussen. The A-level team, using machetes, will forge a network of trails to allow these groups to be tracked quietly during their daily activities. Upon locating a group, we will trap, measure, mark and release several individuals. The measurements will help determine the approximate age and sex ratio of groups while the marks will facilitate the process of identifying groups of individuals when we are taking censuses and recording patterns of habitat use.

One group of tamarins will be selected for intensive study by both the A and B-level teams. Following this group from dawn to dusk for the rest of the course to familiarize its

Background

Once found in large numbers throughout the dense jungles of Panama, Panamanian or rufous-naped tamarins have suffered severe population loss from the rapid destruction of their habitats for timber and agricultural needs and from exportation as house pets and research animals. International legislation has curtailed exportation effectively, but the continued growth of human settlements still poses a critical threat to these

small - they are but ten inches long and weigh only one pound at full adulthood - new-world monkeys, one of about twelve different types of tamarins found only in Central and South America.

Biologists have focused on documenting their behavior and ecology and designing methods for their conservation. One conservation method that has yet to be thoroughly tested is to transfer monkeys from disturbed locations to remote, protected areas currently inhabited by other tamarin groups and then determine whether such groups will accept strangers.



Photo by Dennis Rasmussen

What does the future hold for these primates?

members with our presence, the A-level team will attempt to trap, weigh and mark every member. Hand transits and tapes will enable us to map the group's range and record the pattern of use of that range. The B-level team will expand on this research, conducting detailed analyses of behavioral interactions between individuals and making assessments of resource quality.

We then plan to introduce caged tamarins into the group's territory and collect systematic data on the reactions to strangers of different sexes and ages in an effort to determine how permeable tamarin groups are to such immigration. We will record and evaluate patterns of social interactions, such as jealousy between members of the breeding pair, evoked by the presence of strangers. Does any increase in scent markings and vocalizations by tamarins result from the introduction of newcomers?

Returning by boat to our island camp each evening, we will participate in lectures on primate taxonomy and systematics, the nature-nurture controversy, socio-ecological analyses and the evolution of social organization and structure. We also plan to design independent projects. Topics may include: patterns of range use among tamarins; frequency and context of agonistic behavior; variability in group composition (age and sex structure); and the relationship between tamarins and human activities such as agriculture and logging. The B-level team will learn to use various advanced statistical methods to analyze its data.

A mid-course field trip across Gatun Lake to the Atlantic coast will take us to an area where Panamanian tamarins have recolonized areas abandoned by man. This unusual adaptability of tamarins may hold a key to their long-term future, for it strongly suggests that the species is capable of acclimating to new environments.

During the last days of the course, we plan to complete a thorough report on the behavior, habitat preference, resource utilization, population density, and group structure of Panamanian tamarins, in addition to our findings on how they react to strangers. This report will be distributed to local agencies, including the ministries of the Panamanian government and the Smithsonian Tropical Research Institute at Barro Colorado to assist in their efforts to protect and preserve the tamarin.

Living and Working Conditions

The watchword here is wet: rainfall averages 11 inches a month. But the temperature range is warm and pleasant, from a daily maximum of 85°F to a nightly minimum of 70°F. We will live in comfortable tents on our own island and enjoy ample but basic foods bought in the city of Colon (about 90 minutes away by train and boat). In addition, we can catch an abundant supply of fresh fish right at our campsite, and the secluded beach allows us to bathe in the warm, clear water of the Gatun Lake at night.

Tuition: \$1550

Departure Point: Panama City, Panama

“Our group had to be self-sufficient; we had ourselves and not much else. It was amazing to see how we got along and grew together.”

Rosemary Knapp
Berkeley Heights, NJ
Rutgers University



Searching for the tiny, evasive tamarin in dense vegetation may at first seem like trying to find a needle in a haystack.

Acid Rain and Freshwater Ecology

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 the communities of these altered systems and to determine the advisability of restoration attempts such as liming.

Dates: July 23-August 22

Course Level: A

Background

The Adirondack State Park, the largest state park in the United States, with over 6 million acres, is characterized by beautiful, rolling mountains, huge expanses of deciduous and coniferous forests and 4 thousand secluded lakes. These lakes, nestled between the mountains and surrounded by rocks left untouched since the glacier retreated, appear to be as removed from the effects of pollution, people and other external pressures as can be imagined. Yet, scientists have shown that these lakes have been altered by "acid rain", giving rise to

the popular but deceptive notion that these are "dead" lakes; in fact these wilderness lakes contain abundant plant and animal life and are very much alive despite their acidity.

Evidence exists which implies that acidic airborne substances, derived from industry, raise the level of acidity in certain inherently sensitive lakes and streams, particularly those that do not have limestone bedrock to buffer the impact of the acid. The effects of this "acid rain" are complex but one widely supported conclusion is that fish are especially sensitive and have been lost from numerous lakes and streams once teeming with sportfish. Other organisms, however, like in-

sects, algae, plankton and higher plants, survive and even flourish.

These altered ecosystems have been the subject of SFS expeditions for the past two summers. In our previous research on how the chemical and biological characteristics of these lakes have been changed, we have produced sufficient information to enable us this year to consider how the components of the food chain interact and how various restoration techniques such as liming may alter these acidified systems to restore their chemical neutrality and possibly their fisheries.

Research Focus

How do short term changes in pH affect the primary production of algae and higher plants? 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?

Course Design

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

Our first expedition is through dense birch, beech and maple forests to a small stream west of Lake George called Beaver Brook. This stream is the site of a major, long-term project led in 1983 and 1984 by SFS's Dean, Dr. Robert Singer. It 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. Following initial lectures on the theories of limnology, water chemistry, basic ecological principles and methods of research, we will begin to develop valuable research skills including: how to perform titrations and to determine acid neutralizing capacity; how to identify plants, plankton and invertebrates; how to collect and study microscopic organisms; and how to record data on the environmental variables of the



We will leave all signs of civilization and venture up Stillwater Reservoir to our primary study site.

Photo by Edward Rhee

lakes we are studying.

Returning to the biological and chemical laboratories at the Fresh Water Institute, we will analyze our samples and develop our first findings on the sources of acid neutralizing capacity at 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 lakes and streams north of Stillwater Reservoir on an extended expedition to test these waters. With our base camp established on the shores of remote Salmon Lake, we will hike out each day to different lakes. Using small inflatable rafts or SCUBA gear and snorkels, we will collect phytoplankton, zooplankton, and plant and water samples which we will later test to determine levels of phosphorous, chlorophyll and other chemicals. Simultaneously, measurements will be made of water clarity, depth and temperature throughout the lake system.

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 zooplankton communities with and without artificial pH adjustment to determinations of food chains, and the effects of liming on phosphorous and chlorophyll concentrations. These projects allow us to investigate tangents of the major research projects that are of particular interest to us and will give us the opportunity to further develop our field research skills.

From the data we have extracted, we will build a solid network of information on the biology and chemistry of these lakes. This information will help determine how the distribution of organisms differs with variations in chemical conditions and how changes in acidity level resulting from restoration techniques would affect the aquatic ecosystem. Each night at our campsite over a dinner we prepare on portable stoves, we'll discuss the critical social, political and economic implications of the acid rain controversy. Faculty will present additional lectures on physiological adaptation to acid stress, 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 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. From our findings, we hope to predict how various restoration techniques may affect the lakes. As we complete a final report and leave the scenic beauty of the Adirondacks, we will have the satisfaction of having contributed information that may influence future policy decisions on how to restore aquatic ecosystems altered by acid rain.



Our schedules are intense, but time can always be found for personal reflection.

Photo by Kenneth Andraske

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 spectacular quiet of this country's oldest mountains.

While our campsites will be primitive, conditions at Fresh Water Institute will be comparatively comfortable with rooms, beds and full plumbing available.

Tuition: \$1170

Departure Point: Bolton Landing, New York

“Often, doing research oneself and making the mistakes too, is a more efficient way of absorbing material. It is definitely a more satisfying way.”

Cynthia Bainton
Wolfeboro, NH
Bowdoin College



“It was a new thing for me to take a measurement in the field and be confident of its accuracy.” Kirsten Turner-Marlboro, Vermont-Marlboro College.

Photo by Barth Anderson

Environmental Geology

■ Mt. Vesuvius, Italy

■ Purpose

To map and sample the succession of ashfall and pyroclastic deposits from the 1944 eruption of Mt. Vesuvius in order to help develop models that characterize eruptive activity and that may help minimize its effects on adjacent human settlements.

■ Dates: June 17-July 16 ■ Course Level: A

Background

The historian Will Durant wrote "Civilization exists by geological consent, subject to change without notice." Nowhere, perhaps, is this more evident than in the Mediterranean, birthplace of ancient cultures. In addition to the coasts and landscapes of legendary fame, the region throbs with geothermal energy. Island arcs of volcanoes that arose eons ago are very much alive, and more than 200 million people worldwide live in their shadows every day.

The titanic explosion of Mount Vesuvius in A.D. 79 buried both

Pompeii and Herculaneum. However, in spite of its history of ancient and recent eruptions, settlers move closer every year. The city of Naples, adjacent to Vesuvius, is built on an ash deposit which would have buried the city if it had erupted in historic times. As recently as 1983 thousands of residents were evacuated from the western suburbs of the city during an episode of seismic unrest. Almost two million people live in potential geological peril here and geologists now recognize that the catastrophic nature and frequency of eruptions make this one of the most hazardous volcanic regions on earth.

Research Focus

The most recent outbreak at Vesuvius took place in 1944 near the close of the Second World War. This eruption is significant not only because of its historical timeliness, but because it terminated almost 300 years of nearly continuous, unprecedented activity at the volcano. Last year, an SFS team found deposits from this eruption were the result of gravity-driven avalanches and not gas-driven pyroclastic discharges as had been previously thought. This finding sheds new light on the nature of the activity during the eruption.

In our field work this year, we need to explore these deposits in greater detail in order to gain a more complete understanding of the eruption. What is the size, composition and source of specific avalanches and deposits? What was the chronology of events of the 1944 activity? Our findings should help us assess the significance of the volcano's dormancy and what it portends for the future.

Course Design

At our base camp in the sheltered garden of the Old Vesuvius Volcano Observatory overlooking the Bay of Naples, initial lectures will cover physical volcanology, the role of volcanism in cultural development, and the hydrophysics of volcanoes. We'll study geologic and topographic maps of the area around Vesuvius to identify the major ashfalls, lava flows and avalanche deposits that swept into surrounding regions during the 1944 eruption.

Brief field trips will take us to different locations on the slopes to examine these features. As we move across the slopes, these deposits and flows will present a sharp contrast to the rich, fertile land scattered with vineyards and orchards leading up to the cone. It is this land that lures the Neapolitan settlers to coexist with the volcano. On the western side, the relatively barren land near the summit is covered with small tufts of colorful wildflowers and encroaching pine forests that have successfully established their niches in this hostile terrain.

A series of avalanche deposits and lava flows which blanket the lower slopes of the cone will serve as our open-air laboratory. With tape measures, compasses and pocket altimeters, and by digging profile pits to gain in-



Photo by Carolyn Pfattheicher

Even the most simplistic measurements can become tedious.



Photo by Carolyn Pfauter

Last year's team compared trekking across the slopes of Mt. Vesuvius to hiking across an enormous english muffin.

formation 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 determine the chronology of events that took place during the last eruption and to assess the magnitude of these events.

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 figure out the possible source of specific deposits and lava flows. Faculty will instruct us on various research methods such as composition, coloration and acid tests for identifying different types of rocks and determining their sources. 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 mechanics of volcanic eruptions, geoarchaeology and stratigraphy, plate tectonics, petrology and geochemistry. Volcanic eruptions affect weather and climatic patterns, as the accumulated dust in the atmosphere blocks sunlight and traps heat, altering ground temperatures for years at a time. They also supply key evidence necessary to refine the developing theories of plate tectonics. These concepts will be illustrated daily as we come across recently active vents, ash deposits and lava flows on the slopes of Vesuvius.

In addition to our analysis and mapping of the sequence of deposits and lava flows, we plan to pursue small group projects. These may involve conducting a petrologic study of eruptive products of a single Vesuvius eruption in order to determine how the eruption affected a particular area or possibly examining the geological structure of the ancient crater wall to ascertain changes in the evolution of the volcano.

Following the research phase of the course, we will take an extended field trip to the Aeolian Islands to the site of the world's namesake Volcano, Vulcano. We will ascend the active volcano Stromboli to observe and record its frequent eruptions. Short field exercises designed to enable us to improve our ability to identify certain types of explosive deposits will be conducted on the islands of Lipari and Vulcano. Additional field trips may include the historical sites of Pompeii and Ercolano and the famous Musea Nazionale in Naples.

The final days of the course will be spent compiling the results of our research. Our data will help to determine the sequence of events that took place during the 1944 eruption and possible reasons for Vesuvius' present dormancy, and it should assist geologists in developing a more accurate model for recent eruptive activity and its impact on surrounding communities.

Living and Working Conditions

We will camp on the outskirts of Naples, full of the great zest of the Italian people and one of the most fascinating cities in the world. The Isle of Capri, vacation spot of emperors, lies off the Mediterranean coast.

Sunny southern Italy is blessed with near perfect temperate weather year round, although cool nights and occasional rain showers may occur near the beginning of the course. At local markets, where we will have the opportunity to talk - parlare! - with some of the native people who live in the shadow of Vesuvius, we will stock up on supplies of fresh fruits, vegetables, cheeses, and breads. Camping will be rustic at best at the Observatory with limited shower facilities.

Tuition: \$1480

Departure Point: Naples, Italy

Prerequisite: Introductory level geology course.



Photo by Carolyn Pfauter

The Mediterranean is one of the most geologically active regions in the world.

“The setting was magical—a combination of color and starkness, softness and severity. Yellow and magenta alpine flowers sprung out of the inhospitable spiky lava while ladybugs climbed over the volcanic rubble.”

Claudia Polsky
New York, New York
Harvard College

Aquaculture

Hawaiian Islands

Purpose

To compare the techniques and examine the economics of prawn farming in order to help advance the science of aquaculture, critical to mankind's efforts to feed an ever-burgeoning population.

Dates: July 23-August 22 **Course Level:** B

Background

This new SFS course in Hawaii explores a rediscovered frontier in the critical challenge of feeding the people of this planet: aquaculture, or the 'farming' of our water resources, a science brought to Oahu by Polynesian explorers in 1000 A.D. Ponds seven centuries old are still in use today, and new techniques involving nutrient enrichment of enclosed populations in intensive, controlled habitats produce yields of fish, shellfish and even edible algae at a fraction of the cost of conventional, hunt-and-capture fishing.

By exploring and comparing different ways of farming prawn (which are similar to shrimp) on the Hawaiian island of Oahu, we hope to contribute to the important prospect of increasing our planet's diet from labor and time intensive land-based solutions to the promising sea-based horizons of aquaculture.

Research Focus

Can controlled aquatic ecosystems be managed effectively to supply adequate food supplies for the future? The warm, consistent climate, rich aquatic resources and favorable government policies have encouraged the development of a large number of aquaculture projects in Hawaii to answer this question. Most of the operations are relatively small, but they do include several successful commercial ventures as well as experimental research facilities.

Working at several of these facilities, we will study the pros and cons of different aquacultural techniques. What are the best conditions for culturing the large, tasty, freshwater Malaysian prawn? What is the ideal harvest size, population density, and feeding schedule? What is the minimum amount of feed that can still support an active prawn population?

Course Design

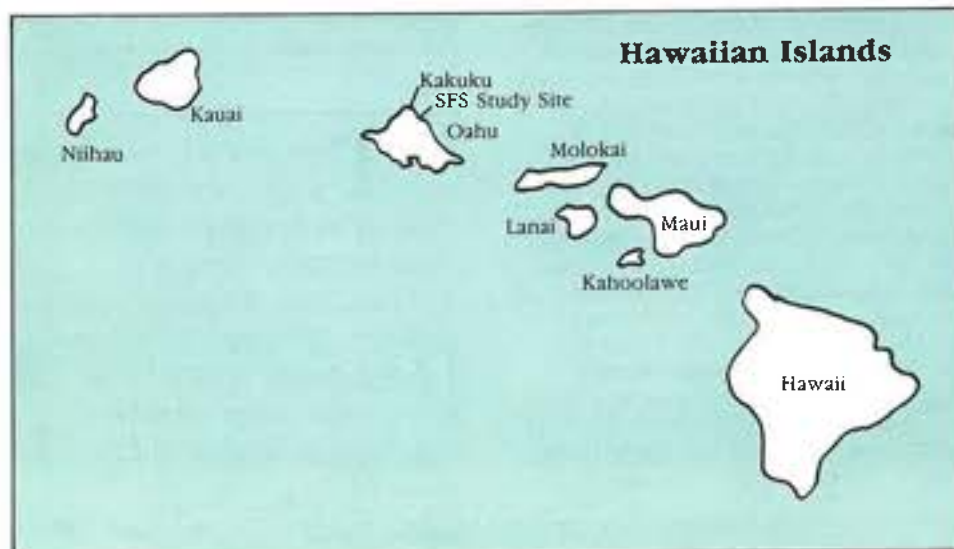
The island of Oahu is an oasis of color, full of exotic species of plants and animals, blessed with near-perfect weather, all on a volcanic stage of cliffs, waterfalls and white, sandy beaches. On the secluded north side of the Island, two miles down a dirt road, is our primary research site, the Prawn Aquaculture Research Program of the University of Hawaii. Nestled in a lush valley, this site includes 21 earthen experimental ponds, each 200 square meters and about 3 meters deep. The ponds are stocked with Malaysian prawns, one of the largest cultured crustaceans in the world, with long, light blue legs adapted for climbing waterfalls in their original habitat. They weigh approximately one-tenth of a pound, with a high proportion of edible tissue to body mass.

After we have settled into our tent camp, faculty will introduce us to the history of aquacultural development, population growth rates, water chemistry, predator/prey dynamics, food chain interactions and general animal nutrition. We will discuss the techniques and economics of aquaculture and begin to develop the field skills we need to investigate the prawns and their environment. In our daily work we will become involved in all aspects of aquaculture management: monitoring the ecology of each pond, evaluating food sources, testing water quality, measuring population densities and determining when prawns should be harvested. Over the period of the course, we will have the unique opportunity to observe and analyze the entire life cycle of this species from hatching to harvesting.

Working with collecting nets, we will capture, inspect, weigh and determine the health of prawns in each pond. The information we acquire, when combined with our data on the environmental conditions of the ponds, will enable us to assess the impact of variations in these conditions on the prawns. How the prawns are faring in each pond is a good indication of the mini-ecosystem as a whole. Coinciding lectures will cover the taxonomy and morphology of prawns, biochemistry of enclosed aquatic systems, and major factors that affect aquaculture—soil, water, topography, and climate.

Our analysis of the effectiveness of different harvesting methods will begin with seining - fishing with large nets that have weights at the bottom and floats at the top - a technique in

Hawaiian Islands



which many animals are able to elude the nets. We'll compare this most traditional method with what is called a 'draindown', where all the water is systematically drained from a pond. Experimenting with both these methods will allow us to determine their relative efficiency. What system produces the highest yield under similar environmental conditions? What system is most economical?

Several field trips will be made to various aquacultural sites around Oahu, including the Anuenue Hatchery near Honolulu where we will examine the larval culturing operation. We will meet with aquaculture specialists throughout the Island to learn about many of the major projects that are under way and about some of the obstacles faced by aquaculturalists. Combined with the knowledge and skills we have gained from our field work, this exposure will give us the background to conduct independent projects. These may involve carefully monitoring the diet of prawns to determine how it may alter body size; assessing the metabolic conditions in ponds through parameters such as chlorophyll, oxygen content, and bacterial activity; and tracking the surprisingly rapid growth of the prawns.

Toward the end of the course, we will compile all our data from our field trips and the ponds at the Prawn Aquaculture Research Program. We will then integrate our findings with those of colleagues at the Department of Animal Sciences at the University of Hawaii to assess which aquacultural techniques are most productive. This information will play an important role in establishing and refining the techniques which will render high quality, protein-rich food available to world markets.

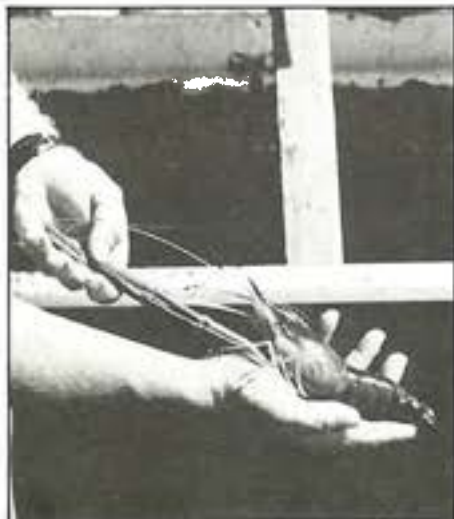


Photo by Lori Moore

Can the culturing of these delectable culinary delights provide a reliable and economical source of food?

Living and Working Conditions

This is a rare opportunity to experience the original, untouched beauty of a Hawaiian island, as our tent camp will be situated at an isolated region of Oahu, called Kahuku, far from any reminders of tourist mania. The weather on Oahu reaches the 80's during the day and the low 70's at night. The hot, tropical sunshine is punctuated by frequent short showers. A cool breeze off the ocean will offer a welcome relief from the mid-day heat. After our long days of field work, ample quantities of fresh fish and crustaceans plus exotic fruits and vegetables will be a reward for our labors. Also there will be a sufficient fresh water supply for our daily requirements.

Tuition: \$1480

Departure Point: Honolulu, Hawaii

“A climate of economic growth, in the developing and developed nations alike, is absolutely essential if human degradation is to be reduced and ultimately eliminated. But economic growth on the careless pattern of the past century poses an undeniable threat to the environment, and ultimately to the very ecological foundations of development itself.”

Robert McNamara
Past President
World Bank



Photo by Lori Moore

Our study site on the northern tip of Oahu consists of 21 earthen ponds stocked with delicious Malaysian prawns.

Coral Reef Ecology

■ St. John, Virgin Islands

■ Purpose

To investigate the delicate relationships among coral reefs, indigenous fish and other ecologically important members of the community in order to assist in maintaining the stability of valuable reef ecosystems.

■ **Course Levels, Dates:** Level A—June 10-July 2;
Level B—July 6-July 30; Level B—August 4-August 28

Background

Coral reefs, calcium carbonate skeletons of tiny coral animals, are tremendously complex structures supporting a remarkable range of plants and animals. Although they appear massively solid, they are, in reality, extremely fragile. In many areas throughout the world, they appear to be rapidly degrading due to commercial development pressures and damage from boat traffic, tourists, divers, and man-made pollutants.

In an attempt to preserve these ecosystems and to gain information that will allow scientists to predict how they are affected by external

pressures, much attention has focused on the composition and interactions within coral reefs. Of specific interest to scientists are the hundreds of species of exotic fish from the large barracuda to the tiny wrasse that affect a reef and its inhabitants in numerous ways. They affect competitive interactions between corals and algae, divide the reefs into territorial parcels, and contribute to large-scale erosion processes and affect the lives of other kinds of marine organisms.

In this fourth year of SFS underwater field work off St. John, we will explore and document these interactions. We will attempt to determine how external pressures alter these interactions and, in turn, predict what long-term effects will result.

Research Focus

What is the nature of feeding associations among fish and invertebrates in a coral reef? What are the important symbiotic and predator/prey relationships? What species are most important to the ecological balance of the reef and what are their preferred habitats? How will overfishing affect the reef?

Course Design

Our base of operations on St. John will be VIERS (the Virgin Islands Ecological Research Station), a secluded research station on Lameshur Bay at the remote southeast corner of the Island. Chosen for its complete isolation, this station is surrounded by tropical forest, white beaches and a magnificent coral reef. The VIERS compound consists of bunkhouses, a small library, laboratory and classroom facilities, and kitchen and dining areas.

Upon our arrival, the A-level team will spend the first week taking a full SCUBA certification course, while the subsequent B-level teams will spend several days refreshing their SCUBA skills. Introductory lectures will concern 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 diversity of flora and fauna on the reef.

We will begin our field research by censusing the fish and invertebrate populations in Lameshur Bay. After laying transects along different sections of the reef, we will swim along them to obtain population counts of various species. Faculty will assist at first in identifying many of the species but we should quickly be able to recognize the more common species on our own.

With our census complete, we will construct ethograms (catalogs of behaviors) to give us a structured outline for collecting our behavioral data. Equipped with small slates for recording data, we will begin our dives to document feeding habits, social interactions between individuals of the same and different species, antagonistic behavior, and also territory size for a number of different species. The B-level teams will construct more detailed ethograms and perform more complex evaluations of fish territoriality.



Lameshur Bay with its turquoise water and spectacular coral reefs offers an isolated tropical paradise in which to conduct our field work.

Photo by Christopher Neelus

We also plan to investigate in detail several symbiotic relationships between fish, including wrasse and goatfish. Through careful analysis of these data, we can construct a model of how fish interact with their environment and with other reef inhabitants and how they divide resources on the reef. During respites from our dives, faculty will present lectures on experimental design, behavioral ecology and physiological adaptations of marine organisms.

As the course progresses, we will design independent projects, either on an individual basis or as part of a small group. Topics may include: the effects of fish predators on invertebrate activity patterns, intraspecific competition between urchins, effects of overfishing on the coral reef ecosystem, and constructing time budgets for a particular fish species. We also may make several night dives on the reef on which we will see octopi feeding, basket stars, and feeding corals with their polyps fully extended.

At the end of our course, we will analyze our results and try to determine the role of fish on the coral reef. From our knowledge of the interactions between fish and other inhabitants of the reef ecosystem and of the control fish have over the number and diversity of plant and animal species, we will be able to predict what may happen as the result of environmental disturbances on the reef. This information will be summarized and a final report will be presented to the Park Service to assist in their work in preserving the reef.

Living and Working Conditions

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

The mean annual temperature on St. John 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 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.

VIERS is a rustic but adequate station with bunkhouses and open-air sanitary facilities, none of which are impervious to heat, humidity, or small insects. We will be doing some of our own meal preparation and will be responsible for keeping the station and its facilities clean and orderly.

Tuition: Level A: \$1550 + \$100 SCUBA fee
Level B: \$1580

Departure Point: VIERS, St. John, Virgin Islands

Note: SCUBA certification is offered during the Level A course but is a prerequisite for the Level B courses.



Photo by Kenneth Andrasko

Team A will begin with a SCUBA certification course.

“Our first snorkel was breathtaking. Can you imagine seeing clearly to 40 feet? Beautifully colored tropical fish, corals and sponges made the experience so exciting. How will we ever learn what all of this is and what it means? It was so overwhelming! Yet within a week we were well on our way to understanding these local waters. Just being there in the water was the ideal way to learn.”

Merle Potchinsky
Binghamton, NY
Brandeis University



Photo by Tim Stout

Understanding the role of fish on coral reefs is crucial to understanding the vulnerability of these fragile ecosystems.

Soil Conservation

Northern New Mexico

Purpose

To investigate and determine how to best prevent soil erosion on farm and rangeland by studying specific conservation techniques.

Dates: June 17-July 16

Course Level: A

Research Focus

We will investigate the problem of soil erosion and evaluate different methods for erosion prevention by addressing questions such as: What natural processes and human activities affect soil erosion? What methods are effective in restoring soil fertility? How do various management concepts - such as varying the grazing pressure, water use, manipulating livestock, fire control and reseeding - influence the processes of rangeland depletion? We plan to examine the relationship of soil quality to the distribution of plants and animals and to assess the feasibility and cost-effectiveness of various soil conservation techniques.

Course Design

Our base of operations will be Ghost Ranch situated in Abiquiu, New Mexico, some 50 miles northwest of Santa Fe. One of the most historic ranches in New Mexico, the Ranch got its name over a century ago when several cattle rustlers were caught and hung from cottonwood trees on the Ranch. Legend has it that their spirits still roam the area.

Encompassing approximately 21,000 acres, Ghost Ranch is perched on a dry, 6,500 foot plateau, speckled with cacti, sagebrush and occasional stands of ponderosa pines, providing a habitat to a multitude of wildlife from mule deer and jack rabbits to coyotes and foxes. The gently rolling terrain that dominates most of the Ranch is punctuated by 1,000 foot mesas, enormous rock chimneys, arroyos and deep river canyons that feed the Rio Grande. This region contains a working ranch, controlled and uncontrolled watersheds, rangeland, wildlife conservation areas and experimental agricultural plots where various native perennial grasses are grown. A vast plot of Federal land encircles the Ranch, protecting it from developmental pressures.

After making camp in an isolated region of the Ranch, we will hike or travel by horseback over small, back-country trails to familiarize ourselves with the diverse topography and to investigate the different land-use programs on the ranch, including cattle-grazing, agriculture, recreation and wildlife habitats. We plan to study the distribution and frequency of various types of vegetation and examine soil conditions such as permeability, compactness and nutrient content. With information from these studies, we

Background

From the devastating American 'Dust Bowl' of the 30's, so well described in John Steinbeck's "The Grapes of Wrath", to the current browning of Africa, where thousands of square miles of once rich land turns to dust each year, we are reminded of one of mankind's most critical problems: the preservation of arable land.

Overgrazing, drought, and foraging for firewood, combined with severe windstorms, serve to destroy fertile land. SFS students have a superb opportunity to study the crucial issue of soil conservation at a large experimental ranch in northern New Mexico, and to help develop conservation techniques that will allow the continual use of land crucial to the world's food supply without jeopardizing that land's long-term fertility.



Photo by Robert Singer

Life clings precariously to the steepest slopes against the power of erosion.

can assess the impact of land-use practices on the terrain. As night falls at our camp and deep purple shadows engulf us, faculty will present lectures around open fires on local geology and geography, history of land use and management, principles of soil analysis and erosion processes.

We then will begin an analysis of the many different soil conservation techniques currently used on the ranch including: contour terraces; earth dams; water spreaders; seeding trials designed to test the effectiveness of native and imported grass plantings; and range pitting in which soils are stirred up gently to create water collecting basins. Using shovels and sieves, we plan to collect soil samples and study soil profiles at experimental sites where these methods are used. Back at camp we'll conduct chemical tests to determine nutrient content, chemistry, and soil structure.

Additional lectures will focus on the effects of drought and pesticides on soils, the importance of trace elements in soils, soil chemistry, and the function of soil conservation agencies and related policies and programs. We may also have the opportunity to complement our team research with independent projects such as: comparing soil types in grazed and ungrazed areas in terms of fertility, productivity and differences in plant composition; investigating how the establishment of a permanent water source affects plant growth and soil development; and assessing the effectiveness of the "holistic resource management" approach in controlling range deterioration.

Upon completing our research, we will compile and analyze our data and determine what combination of soil conservation techniques would be most appropriate for Ghost Ranch. Our suggestions should help the Ranch personnel make refinements in their land-use strategies and conservation techniques, allowing them to continue to use the land without threatening its long-term fertility. In addition we will have contributed to the wider search for effective conservation of arable land throughout the world.

Living and Working Conditions

This is the land of jackrabbits, coyotes and roadrunners, a land cut in sharp and unpredictable ways, surrounded by mountain ranges, crossed by arroyos and canyons, dotted with cactus, and all under a nighttime sky

so spectacularly clear you won't want to sleep.

At a latitude of $36^{\circ} 15'$, with sparse shade, our days of field work on the Ranch will be hot. Midday temperatures can reach 90 degrees with low humidity. At night the temperature drops substantially as thousands of brilliant stars illuminate the Ranch. The only noise will come from the sounds of wildlife and restless wind blowing through the canyons.

Although our camp will be isolated from the main compound at the Ranch, we will be able to use the showers and various other amenities. Weekly trips into Abiquiu will enable us to stock up on food.

Tuition: \$1290

Departure Point: Albuquerque, New Mexico

“Last night after everyone went to bed, I lay down in the thicket and thought, nothing special, just thought. It was so peaceful, the silence was almost deafening.”

Clay Rips
San Antonio, TX
Alamo High School



We will explore many of the rugged canyons carved by wind and water.



Careful farming practices can increase agricultural productivity in the fragile soils of the lowlands.

Photo by Stephen McNeil

Photo by Jim Shipley

Hazardous Waste and Coastal Ecology

Chesapeake Bay

Purpose

To assess the effects of municipal and industrial wastes on shellfish and wetlands by comparing polluted and unpolluted regions of Chesapeake Bay.

Dates: June 17-July 16

Course Level: B

Background

The productivity of estuaries - those regions where land, ocean and rivers come together - is the highest of all ecosystems on Earth; they are the unique home for numerous birds, mammals, fish, shellfish and plants. The largest estuary in the world, the Chesapeake Bay, whose thousands of miles of shoreline and islands provide vast breeding grounds for wildlife and support the largest crab and shellfish fishery in the United States, is currently being threatened by a witches brew of hazardous wastes from the most industrialized region of the world.

Hazardous waste issues are relatively new and highly complicated. For a decade scientists and the public have been concerned with the contamination of groundwater and drinking water supplies by toxic wastes, which, unlike organic wastes such as sewage, are not broken down naturally and absorbed by organisms. Relatively little attention, however, has focused on the buildup of toxins in marine ecosystems.

These complex environments are being damaged by a variety of hydrocarbons such as oil, pesticides and industrial wastes, as well as by heavy metals and huge loads of nutrients from domestic and municipal sewage.

Last year, an SFS team initiated our studies of hazardous wastes by examining their effects on clams and other invertebrates in Narragansett Bay in Rhode Island. In our field work this summer, we will continue our investigation by documenting the impact of hazardous wastes on oysters and crabs in several regions of Chesapeake Bay, work that is vital to local and national policy makers in determining ways to preserve these unique wetlands.

Research Focus

How do hazardous wastes emanating from the Baltimore Harbor area affect the oyster and crab populations in the Bay? What parameters are most important for assessing the environmental condition of the Bay? To what extent do hazardous wastes affect the environment at varying distances from their sources?

Course Design

Our field work will begin at the first of our two study sites, approximately 100 miles south of Baltimore in a pristine section of Chesapeake Bay that has not been seriously affected by hazardous wastes. After we have set up our tents in a remote campground beside the Bay, faculty will give us the background material to conduct our research through lectures on hydrology, water chemistry of estuaries, plant communities, benthic animals, nutrient dynamics and the natural history of the region.

The first questions we will be trying to answer are: What are the inhabitants of the two regions? What are their distributions? How do these distributions relate to the concentration of key pollutants? We will also learn to identify the flora and fauna common to the Bay and develop skills for dredging, determining signs of physiological stress, water sampling, and chemical analyses, skills we will refine throughout the course.

Small motor boats equipped with elaborate gear for dredging will take us from our camp site to several different locations along the lower Bay to collect oysters, crabs and water samples. Here, among small islands and in open areas of the Bay, we will determine the population size and growth rate of both species at each site and then preserve several oysters and crabs to analyze later in a laboratory for effects of toxic wastes. Water samples will be tested for



Photo by Jill Tucox

Among the many bottom samples we dredge up from the Bay will be the occasional flounder which will become a welcome addition to our meals.

salinity, pH, oxygen, heavy metals and other variables. These data will give us clues as to the biological and chemical conditions of the water at these sites. Variations between sites will indicate the extent of toxic waste deposition in the lower Bay.

Having studied a relatively unpolluted region of the Bay, we will move north below Baltimore to a site of long-term deposition of hydrocarbons and heavy metals. Our campground here is a beautiful, sequestered spot on a remote peninsula near Meredith Creek, Maryland. We will use the techniques we acquired in the lower Bay to document the physiological condition of the crabs and oysters and again conduct water sample analyses. Our data on crabs and oysters in unimpacted areas will serve as our basis for assessing the extent of the impact on these species in the upper Bay. 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 and decision-making.

Field trips will include tours of industrial sites, treatment facilities, nature preserves, and several water quality laboratories where state-of-the-art techniques permit researchers to isolate literally thousands of toxic chemicals. These trips will give us the unique opportunity to talk with specialists at all stages of the hazardous waste lifecycle from deposition to treatment.

Toward the end of the course, we will explore independent projects that allow careful examination of an aspect of our major research that we could not investigate as a team. Possibilities may involve examining: the relationship between distance from pollution sources and the growth rate of oysters, body organ weight under different concentrations of heavy metals, and oyster size and abundance at varying depths.

By quantifying the impact of hazardous wastes in one area of this vast ecosystem, our final report will aid other researchers and policy makers in determining the severity of the threat to this rare aquatic wilderness. This will help clear the way for regulations necessary for the preservation of such wetlands throughout the country, and our results in the Chesapeake may be used to either restrict harvesting in regions where we measure impacted populations, or to open up additional fisheries.

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 almost 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 a gentle ocean breeze is usually present. The Bay is partially protected from strong winds, but choppy seas are common and may on several occasions keep us from going too far from land. At our two primary campsites, we will cook for ourselves with campstoves, and have ample fresh water for drinking and washing.

Tuition: \$1290

Departure Point: Baltimore, Maryland



“I dug deeper into myself and found out some things I liked and others I’m working to change. My course gave me a great deal of self-confidence and motivation that I didn’t know I had. I really found my tolerance and endurance levels, I have a firm base to answer ‘can I really do that?’”

Anne Todd
Willoughby, OH
Beloit College



Unexpected finds are the joy of field research.

Wildlife Management

Kenya

Purpose

To compare the behavior of large mammals (gazelle, giraffe, wildebeest, zebra, etc.) in hunted populations on a game cropping ranch with that of conserved populations in protected national parks in order to assess the long-term implications of game ranching as a management technique.

Course Levels, Dates: Level B—June 15-July 18;
Level A—July 22-August 23

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 Kilimanjaro - 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 to be a radical solution: the practice of game ranching, in which populations of various species of ungulates 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 a 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.

Research Focus

In this fifth consecutive year of SFS field work in Kenya, we will examine several specific aspects of game ranching: What impact does cropping have on the behavior of large ungulates? Is it possible to achieve and maintain a balanced ecosystem for the mammals within a game ranch? Compared to other methods of producing food on the savanna, such as raising cattle, is game ranching economical?

Course Design

After meeting in Nairobi, we will head southeast through the savanna to our research site, Wildlife Ranching and Research, Ltd., an experiment in game ranch management founded by Dr. David Hopcraft. This ranch consists of a compound with research facilities and a small library and 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 specialists to discuss the major wildlife management objectives of the ranch and to learn about the cropping method that is used. A series of lectures will cover the mechanics of game harvesting, plant identification, nutrition and distribution, general principles of ecology, ungulate census techniques, and the geography and human ecology of East Africa.

Rising early each morning, we will travel to specific sites in the ranch to begin our research. Either on foot or from our vehicles, we will make careful observations with spotting scopes and binoculars of the behavior of different species, group size, numbers of animals of each sex and age, and the distances at which the animals become startled by our vehicles. The continual monitoring of these variables is critical to the success of a management strategy.

We will vary our data collection sites on a daily basis in order to obtain information on animals throughout the ranch and to take a total census of various species. Unlike the National Parks in Kenya, the ranch gives



Photo by Sarah Lampert

The Ranch's pet cheetah is occasionally our unexpected guest at our campsite.

us the freedom to collect our observational data outside of our vehicles.

On several occasions during the course, we will have the opportunity to participate in the evening game cropping regime on the ranch. In Land Rovers, we will maneuver quietly through the large open plains of the ranch to locate and harvest individuals of predetermined ungulate species. These individuals will then be brought back to the camp so we can study their musculature, organ development and digestive anatomy. From samples of stomach content, we will be able to determine food preferences and requirements.

The B-level team will have the option of becoming more involved with the cropping and rendering operation, concentrating on ungulate anatomy, structure and functional relationships. The team also will look into the evolutionary relationships and how they are reflected in taxonomy and systematics.

Day trips outside the ranch will take us to some of the more spectacular Kenyan parks, including Amboseli, Masai Mara Game Reserve and Nairobi National Park. Here we will conduct comparative studies of behavior, social organization and group structure, and flight distances for the species we examined in our earlier studies in a game ranch setting. As we conduct our research, we will undoubtedly be accompanied by an enormous variety of animals including cheetahs, leopards, baboons and hyenas; with luck we will once again witness the sight of over one million wildebeest roaming among the flat-topped acacia trees in the Masai Mara.

During our stay in these parks, field lectures on techniques for aging ungulates, effects of environmental quality on ungulate body condition, ungulate resource use, and experimental design will accompany our field work. In addition, we will work on a variety of independent projects, examining such questions as: Do cropped species on the ranch become alert and flee at a greater distance or at the same distance as those in National Parks, and do cropped species invest more time in vigilant and mobile activities than non-cropped species?

As the course ends, we will discuss our observations - on ungulate populations and the impact of cropping on the flight distances, sex ratios, and behavior of different ungulate species - with the specialists at the Hopcraft ranch, officials of the Kenyan Game Department and others who are engaged in wildlife management and

conservation efforts. Our findings will assist in the refinement of the long-term cropping regime within the ranch and, hopefully, contribute in some small way to helping Kenya solve its land-use dilemma.

Living and Working Conditions

Prepare for one of the hottest and most interesting months of your life. No matter how long you live, you will always remember the landscapes, the animals and the people of Kenya.

Located on the equator, Kenya has a climate that is marked by extremely hot, dry days with only intermittent afternoon showers and relatively cool nights. Although during the summer months rain is scarce and water supplies limited, there will be sufficient water for cold showers. We will usually be up before sunrise and will take several hours off during the most intense heat of the day.

The complexities of working in this untamed land mean that plans must be approached with flexibility and patience. Unforeseen problems or changes in our agenda will require cooperation and good humor on the part of everyone.

Tuition: \$1860

Departure Point: Nairobi, Kenya

“When I first learned about SFS I couldn't believe it! Here was a chance to combine my interest in biology with my love for the outdoors. I decided it was the opportunity of a lifetime, one I couldn't afford to pass up.”

Shirley Silvester
Bloomfield, CT
Bloomfield High School



Photo by Lisa McLaughlin

Magnificent giraffes are a common sight in both National Parks and on the Ranch.



Photo by Jack Shea

“Not only did I learn a tremendous amount about the study of wildlife, but I also learned a lot about dealing with people with whom I had to live closely for five weeks.” Zadya Lundgren-Torrington, Connecticut-Hampshire College

Tropical Rain Forest Ecology

Amazon Basin, Ecuador

Purpose

To increase mankind's understanding of the regeneration potential of disturbed rain forests by examining how plant species adapt to poor soil conditions.

Dates: June 17-July 16; July 23-August 22 Course Level: B

Background

Rain forests represent one of the world's most biologically complex and important ecosystems, providing habitats for millions of species of plants and animals, from lichen to mahogany trees, from jaguars to armadillos. The abundant plant life is particularly important for its major role in maintaining global temperature by controlling the amount of carbon dioxide in the atmosphere. In addition, many of the rare flora found

only in these forests are the source of life-saving medicines.

Increased pressures from expanding populations and developing economies have caused huge quantities of trees to be removed from rain forests for fuel and shelter, with millions of acres being cleared for agriculture. Recent estimates have shown that at the present rate of destruction, all tropical rain forests with the exception of two areas - western Brazil and central Africa - will have been destroyed by the year 2000.

Research Focus

Since so little is known about the complexities of rain forests, it is critical that additional research be conducted to further our understanding of these ecosystems. In this second year of SFS research in Ecuadorean rain forests, we will have the rare opportunity to investigate the interrelatedness of plants, animals, and humans - the web of life - by addressing several important questions: What plant species are most adaptable to poor soil conditions and are capable of extracting 'unavailable' nutrients from the soil? Can indigenous people use these species among crop plants in order to continue to farm the same plot of land year after year, instead of cutting more forest every year? What species are most capable of regenerating in deforested areas?

Course Design

After meeting in Quito for lectures on the history and culture of Ecuador, we will travel across the snow-capped western Andes to a field station to spend several days developing botanical, field, and orientation skills including plant identification, plant preservation, and soil analysis techniques. Crossing the Andes again at 12,000 feet through forest, desert and paramo, we descend to 1,800 feet, to a river called Rio Napo, a tributary of the Amazon. Here, after loading our equipment into a giant dugout canoe, we will travel to a small isolated indian village where we will establish our base camp. The Quechua Indians in this region are extremely friendly and will welcome us into their village.

Following faculty lectures on tropical deforestation, plant identification, Ecuadorean climate, biotic zones and tropical forest structure, we will enter a forest of huge orchid and vine-covered trees. Venturing through this natural greenhouse, we will stop at tree-fall gaps to collect plant and soil samples, examine herbivory rates on plants and measure plant distribution and frequency along transects. The soils here are extremely nutrient deficient so our data will help determine the more hearty species in the rain forest.

After two weeks, we plan to pack our canoes and travel down the river, moving even deeper into the pristine Amazon jungle, accompanied by the howling of monkeys in the canopy overhead. Here, the rain forest is un-



Photo by Sarah Porter

Long dugout canoes will serve as our primary mode of transportation down the Rio Napo.

“What we don’t have in Connecticut - and what I guess is the most impressive thing about the rain forest - is the diversity of growing things. Imagine walking for thirty yards in the New England woods and finding only two or three plants and trees which are the same species-it simply doesn’t happen. When we did our forestry transects in the jungle, that’s precisely what we found. There were butterflies and shiny beetles and weird, stingless bees which would drink your perspiration or fragrances from the flowers, mixing them into exotic perfumes.”

Phil Robakiewicz
Wallingford, CT
Brown University

touched by humans and the soils are some of the richest in the Amazon basin. Because few indigenous people live in the region, we will hack out a small clearing in the lush, thick jungle for our camp.

Daily hikes into the jungle to collect plant and soil samples will allow us to examine how the plant life differs from our previous study site. Plant species found in both sites will indicate that these species are most adaptable to a large range of soil conditions. We hope to discover those capable of extracting “unavailable” nutrients, such as phosphorous, that are chemically bound in the soil. Such species may be useful among crop plants for enriching soils so agricultural land can be used year after year, thus eliminating the need to destroy more forest.

Subsequent lectures on a host of subjects ranging from nutrient cycling, successional processes and patterns, and seed dispersal to symbioses and sustained yield forestry will be presented by the faculty. In addition, we plan to conduct independent projects focusing on topics such as the relations between the degree of herbivory and plant nutrient content,

relations between litter density and soil quality, and uses of plants by indigenous peoples.

At the end of the course, we will catalog our plant and soil samples and review our data. Our findings on those plants which are capable of indirectly providing nutrients to crop plants will be of great use to tropical agriculturalists, who are constantly facing the conflict between the increasing demand for food resources and the rapid destruction of tropical



Photo by Sarah Porter

Perhaps what is most intriguing about rain forests is that so little is known about them.

rain forests. Our analysis of vegetation in tree-fall gaps will help to determine how forests may regenerate after they have been cut and to predict the long-term impact of deforestation on a rain forest ecosystem.

Living and Working Conditions

Heading east over the Andes is like disappearing into a forgotten world: the Amazon jungle, remote, mysterious.

At Quito and other higher elevations, the temperature is cool in the daytime and cold at night. As we descend to the lower elevations, temperature and humidity increase. Hot, muggy days will be common at our two primary study sites; however, frequent rain showers and the tree canopy will offer welcome respite from the sun.

Accommodations range from bunkbeds in a field station to camping in a more spartan, jungle environment. At some sites we may be able to stay in shelters offered by the indigenous people; and on most days we will cook for ourselves, usually over a wood fire.

Tuition: \$1550

Departure Points: Quito, Ecuador



As we move further into the rain forest, the only signs of civilization will be small Quechua Indian villages along the Amazon.

Photo by Sarah Porter

Dolphin Biology and Behavior

■ Florida Keys

■ Purpose

To compare the communities of wild dolphins to captive ones in order to understand the relationship between behavior and environment.

■ Dates: July 23-August 22

■ Course Level: B

Background

Dolphins are the most studied of all marine mammals. Their intelligent antics have amused and astounded millions of people in shows and movies, but the stereotype of "Flipper" is based on a super-smart "Lassie" model, not on a real dolphin. Evidence suggests that wild dolphins have very different social structures and behaviors than those of the captive animals that are so much better known.

We need to understand natural dolphin communities in order to determine how we are altering the behavior of the captive animals. Understanding this normal behavior will add considerably to our knowledge of these impressive and respected an-

imals, improving attempts to train, breed, and ultimately understand their intraspecific communication and behavior.

Research Focus

To determine differences in behavior between captive and wild dolphins we will investigate the following questions: Where are the local wild dolphin populations? Can we learn to identify individuals in the pods? Do dominance hierarchies exist in wild and/or captive populations? Have the captives shifted their orientation from an acoustic, aquatic world to a visual, terrestrial one? Do the captive dolphins include humans in their group dynamics?

Course Design

The Florida Keys represent a truly tropical archipelago connected to mainland Florida by a ribbon of highway and bridges which extend over 90 miles into the Gulf of Mexico. The azure waters of the Gulf and the Atlantic freely mingle beneath the bridges, and all manner of marine life inhabits these shallow coastal waters. The rich, warm water provides an excellent feeding and nurturing habitat for dolphins, and the gentle climate and steady tourist trade has encouraged the development of several facilities for maintaining captive dolphin populations.

The captive population we will work with in this new SFS course is situated at a private club; here three veteran dolphins are kept in a 100 meter-long natural channel. Informal demonstrations are given to club members but "tourist shows" are not provided to the public. The three female dolphins, which will serve as our models of captive animals, are all over twenty years old and well accustomed to humans. They are not completely enclosed, as the fence between the channel and the open water is low, full of holes, and easily surmountable by the nimble animals, but all three dolphins have apparently chosen to stay with the good food, safe environment, and companionship of people. Over the course of our field work, we will get to know these dolphins individually.

From the perimeter of the channel, we plan to record extensive data on dolphin feeding habits, social interactions, and how they budget their time. Our team will be divided up into three groups, each focusing on an individual dolphin in order to obtain data for the entire threesome. Data for each will then be compared to determine any possible trends in their behavior. We also will study their biology, focusing on their sexual cycle about which little is known. This should lead us to a better understanding of their lifecycles.

As we become increasingly engrossed in our field work, faculty will lecture on diving physiology of marine mammals, adaptations to the marine environment, dolphin anatomy, coastal ecology, social structures and methods of ecological research. Material from these lectures will help us understand the behavioral and biological data and give us the backbone to launch into our comparative studies of dolphins in the wild. Advanced lectures will in-



Photo by Bob Singer

How does captivity and human interaction alter the behavior of dolphins?

"I will be able to use the skills I have gained for the rest of my life. To me, this is significant and far surpassed my expectations. College would have been much easier for me if I had acquired these skills three years ago."

Lars Jones
Tempe, AZ
Arizona State University

clude speculative topics like interspecific communication and intelligence evaluation.

Our investigation of wild dolphins will involve considerably more exploration and approximately half of our field time. Using small motorboats, we will maneuver between the small islands, sand bars, and coral reefs to track down pods of dolphins. Over a period of several days, we will learn to distinguish individuals within these pods by their fluke markings, snout shape, and size. A portfolio of photos will be assembled to serve as an atlas of local individuals.

Upon spotting a pod, we'll follow those dolphins at a distance to avoid disturbing them. Working in pairs, one student will call out the sequence of behavioral patterns of a known individual while the other student will record the information in a notebook. Each team will select a different dolphin in order to determine common behavioral activities. We often may lose our selected pod, for the dolphins can swim faster than our boats, but with perseverance we should be able to collect sufficient data from these wild dolphins to make adequate behavioral comparisons to the dolphins in captivity.

Although most of our energy will be devoted to studying the behavior of both captive and wild dolphins, we will have the opportunity to explore a particular aspect of the group research through independent projects, the results of which will be incorporated into our final report. Topics may include investigating the daily distribution patterns of wild dolphins, determining food preferences of captives, and assessing the responses of prey fish when exposed to recorded vocalizations of dolphins.

If time permits, we may also have the chance to visit several other dolphin facilities and to possibly even attend a typical "tourist show". Our proximity to the beautiful John Pennekamp State Recreation Area allows easy access to one of the most spectacular underwater parks in the world.

The results of our work will be presented in a public seminar, and we hope to publish much of the data in order to disseminate our findings as widely as possible to the scientific community.

Living and Working Conditions

Key Largo, the largest of the Florida Keys, is an unusual combination of natural beauty and native architec-

ture. Our campsite here is conveniently located near the boat dock and the dolphin channel.

We will cook our own breakfasts and dinners at the campsite, including in our meals much of the fresh fish and fruit for which Florida is famous. Lunches will be 'brown-bagged' aboard ship and served cafeteria style at the resort. July is hot and damp in Florida but we always will be near a refreshing dip in the ocean. Stubborn mosquitoes necessitate insect repellent, but sultry tropical evenings, palm trees and the island-dotted expanse of ocean make it easy to tolerate the heat and insects.

Tuition: \$1420

Departure Point: Miami, Florida.



What is she thinking?

Winter Moose Ecology

Northern Maine

Purpose: To study the winter ecology (distribution, feeding habits, habitat use and behavior) of the North American Moose in order to assist the Maine Department of Fisheries and Wildlife in designing effective wildlife and land-use management strategies.

In recent years, the North American Moose, one of the largest and most majestic mammals in the United States, has been subjected to a number of pressures - including hunting, logging and the use of herbicides by lumber companies - that have posed serious threats to its population, threats that have encouraged wildlife biologists to try to determine how best to manage the moose population and the use of its habitat.

Deep in the thick forests of northern Maine, our team will venture out on foot, snowshoes and skis to study the ecology of moose focusing particularly on their

feeding habits, social interactions and habitat use. We will conduct comparative studies of moose populations in virgin forest, a natural burn area, and logging sites



Photo by Jack Wixham

Radio collars will help us track moose in order to determine their foraging patterns and the size of their home range.

to assess how behavior may be altered by changes in their habitat. Several moose, equipped with radio transmitters, will be tracked to determine daily movement and to estimate the size of the moose home range.

At night we will return to our comfortable, snow-shrouded cabins to discuss our findings and listen to lectures on the general ecology of the region, land-use management, the social structure and behavior of moose and their interaction with other mammalian species. In the last few days of the course, we will compile our results in a final report which we will present to the Maine Department of Fisheries and Wildlife to assist in the design of effective management strategies for the moose and their habitats.

Tuition: \$990

Departure Point: Presque Isle, Maine

Tropical Park Management

Big Cypress National Preserve, Florida

Purpose: To collect data on the population sizes and growth rates of ecologically important communities and exotic species of plants and animals - including Melaleuca and tropical fish, hardwood hammocks and cypress forests - to aid resource managers in making rational policy decisions about controlling access, hunting, and water use.

Big Cypress National Preserve in the Everglades is characterized by diverse ecosystems, from wet, lush cypress and mangrove swamps inhabited by wading birds, fish and alligators to the drier uplands of tall, moss-covered pine trees, Florida deer and wild boars. Much of its enormous diversity of plants and animals is not found anywhere else in North America. As development has increased around the perimeter of the Preserve, much of this ecosystem and its wildlife diversity has been endangered by pressures from

accidental fires, oil drilling, off-road vehicle users, jets, and hunting and poaching.

In our field work we will investigate through independent projects specific aspects of the Preserve's biology to assess the potential impact of external pressures on different species of plants and animals; we need to help determine how the Preserve should be managed to prevent additional disturbance to its ecological stability. From our small base camp in the center of the Preserve, we will drive, hike or canoe to remote regions to conduct our research.

As we proceed with our field studies, faculty will demonstrate research skills - such as plant identification and sampling, and data collection and analysis - and present lectures on tropical ecology, adaptive strategies, community ecology and field research design. Finally each of us will present the findings

of our independent projects and prepare a report for the staff of Big Cypress to contribute to their continuing work to manage the Preserve.

Tuition: \$950

Departure Point: Miami, Florida



National Park Service

In order to assess the impact of external pressures, we must understand the species composition of the Preserve.

Coral Reef Ecology

St. John, Virgin Islands



Photo by Kenneth Andrasko

"Besides collecting data we also had the opportunity to analyze and manipulate this data and to truly understand the meaning of our efforts in the field." Mark Leondires-Danvers, Massachusetts-Colby College

Purpose: To examine species composition and community interactions within coral reefs and to assess the impact of external pressures in order to help preserve these valuable ecosystems.

Approximately two-thirds of St. John is comprised of the Virgin Islands National Park which extends out beyond the shore to the magnificent reefs that encircle the Island. With this unusual status as a land and marine park, management of the Park is complicated by both terrestrial and aquatic problems. In this course, we will focus particularly on the latter and attempt to determine how external pressures from siltation, boat anchors, and the shipping and oil industries are affecting the reef and its inhabitants.

Our base of operation will be the Virgin Islands Ecological Research Station (VIERS), a small well-equipped station surrounded by palm trees and white, sandy beaches on the secluded southeast corner of St. John. Using snorkel and SCUBA equipment, we will make frequent dives on the reef and adjacent seagrass beds to investigate several ma-

ior inhabitants such as urchins and dusky damselfish, to determine their role in the interactions within the ecosystem. By collecting extensive data on their feeding habits, interactions with other species, distribution, and population structure, we can predict how density fluctuations caused by external pressures could affect other species on the reef.

Each night back at VIERS, we will compile and analyze our data and participate in lectures and discussions on marine ecology, ocean chemistry, and predator-prey relationships. At the conclusion of the course, we will organize our findings and present them to the National Park Service to contribute to their efforts to preserve this fragile ecosystem.

Tuition: \$1350

Departure Point: VIERS, St. John, Virgin Islands

Primate Social Behavior

Panama

Purpose: To survey and census groups of the endangered Panamanian tamarin, to measure patterns of range use, and to assess the permeability of groups by strangers in order to help conserve this endangered species.

Large and flourishing populations of tamarin monkeys once were found in the neo-tropical jungles of Central and South America. With the rapid expansion of human settlements and the resulting destruction of the tamarin habitat, these populations have been reduced dramatically. In Panama, behavioral scientists have expressed great interest in understanding the social organization and ecology of these tiny New World monkeys and in determining methods for conserving them.

In this third SFS expedition to Panama, our team will investigate small tamarin groups on a secluded peninsula on the south shore of Gatun Lake. With our base camp es-

tablished on an uninhabited island, we will use small boats to commute each day to the peninsula. Although at first the jungle will seem impenetrable, we will be able to quickly carve out a network of trails with machetes to track the tamarin. Careful observations will be made of tamarin behavior, including food preferences, social interactions and ranging behavior. We will then investigate a preservation method that involves transferring an individual from a group in a threatened area to one in a protected area.

Lectures throughout the course will be presented on primate evolution, primate taxonomy and systematics, ecological field techniques, and socio-ecological analysis. At the end of the course, we will distribute our findings on the ecology of tamarin and on the reaction of tamarins to strangers to the Panamanian government and the Smith-

sonian Tropical Research Institute to help in their efforts to conserve this species.

Tuition: \$1320

Departure Point: Panama City, Panama



Photo by Dennis Rasmussen

Pet tamarins can help us locate tamarin groups in the dense neo-tropical jungle.

Faculty — 1985

(partial list)

Richard B. Aronson: Ph.D., Biology, Harvard University.

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.

James Brown: Ph.D., Forest Ecology, Duke University; Professor, Natural Resource Science Department, University of Rhode Island.

David Campbell: Ph.D., Zoology, University of Rhode Island; Assistant Professor, Zoology Department, University of New Hampshire.

Thomas Cervone: Ph.D., Biology, St. Bonaventure University; Assistant Professor, Biology, University of Indiana at Evansville.

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

Jessica Dimuzio: V.M.D., University of Pennsylvania School of Veterinary Medicine; Director, Animal Health Training Program, Harcum College.

Ron Elan: M.S. candidate, Geology, University of Southern California.

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

Timothy Halvorsen: Ph.D., Zoology, University of Maryland.

Richard Hazlett: Ph.D., Geology, University of Southern California.

Thomas Husband: Ph.D., Wildlife Ecology, Michigan State University; Associate Professor, Natural Resource Science Department, University of Rhode Island.

Ann Johnson: Ph.D., Ecology, University of California at Davis; Visiting Assistant Professor, Biology Department, Bucknell College.

Benjamin Kaghan: M.S. candidate, Zoology, University of Massachusetts; Teaching Assistant with the Writing Program, University of Massachusetts.

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

Stan Koster: Ph.D., Wildlife Ecology and Management, Michigan State University; Teaching Associate, Department of Fisheries and Wildlife, Michigan State University.



Stan Koster analyzing data on ungulate behavior with an SFS student at our campsite in Kenya.

Photo by Annelise Allen

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

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

Douglas Patterson: Ph.D., Anthropology, University of Washington; Technical Assistant, Falcon Technology, Inc.

Dennis R. 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.

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".

Robert Singer: Ph.D., Ecology, University of Illinois; Dean, School for Field Studies.

Brad Stelfox: Ph.D., Wildlife Productivity, University of Alberta.

“We were very lucky to have two fantastic instructors: they never let up when there was work to be done, but they also allowed us the freedom to have fun. The whole experience was great!”

Suzanne Leavitt
Las Vegas, NV
University of Nevada

Jonathan Witman: Ph.D., Zoology, University of New Hampshire; Research Associate, Department of Zoology, University of New Hampshire.

Interns—1985

C. Shannon Briscoe: B.A., Biology, Mary Baldwin College; Research Assistant, Harvard University.

Morgan Hardwick-Witman: Ph.D. candidate, Botany, University of New Hampshire.

David Leptich: M.S. candidate, Wildlife Management, University of Maine.



Photo by Barth Anderson

Deborah Roberts demonstrating techniques for determining oxygen concentration in water samples from remote lakes in the Adirondack Mountains.

Processes and Requirements

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, 1985. All acceptances after May 1 will be on a rolling admission basis for any remaining openings. Applications for January 1986 courses will be reviewed on October 15, 1985. 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 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 for January and month-long courses, \$500 for semester programs (\$250 for financial aid candidates) is due no later than 14 days following your acceptance to reserve your place. Tuition balance is due no later than:

April 15	for teams departing in June	October 15	for spring semester courses
May 1	for teams departing in July and August	December 1	for January Term courses
July 1	for fall semester courses		

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

Open Houses

A series of open houses for those interested in learning more about the SFS experience will be held in New York, Washington D.C. and Boston in early 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

In order to insure the best possible group fares as well as orderly arrivals to the departure site, we work with one agency which handles all SFS travel. We strongly recommend that you utilize this travel agent. 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	\$700	Oahu, Hawaii	\$525
Panama City, Panama	\$570	Rome, Italy	\$750
Quito, Ecuador	\$550	Nairobi, Kenya	\$1300
Belize City, Belize	\$475	Zurich, Switzerland	\$750
St. Thomas, Virgin Islands	\$330		

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 hopefully 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. Aid is awarded by need until funds are exhausted. Semester participants may be able to apply federal financial aid monies toward their tuition accounts.

Academic Credit

Academic credit may be arranged through Northeastern University (there is a \$75 registration fee for 8 quarter credits) or possibly your home institution. 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 Mt. Vesuvius.
- 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.

Career plans (if any): _____

Publications you read regularly: _____

Parent(s)/Guardian _____ Telephone # _____

Address _____

Street

City

State

Zip Code

Occupation(s)

☐ Do you wish to be identified as a member of a minority group? If so, which one?

☐ Afro-American
☐ Asian-American
☐ American Indian

☐ Hispanic
☐ other: _____

Height _____ Weight _____ Sex _____ Date of Birth _____

Please detail any physical handicaps, medical requirements, or dietary needs: _____

Previous accidents, injuries, or health problems: _____

How did you first learn about SFS?

☐ SFS poster (where?) _____	☐ science teacher/professor
☐ SFS catalogue (where?) _____	☐ other teacher/professor
☐ SFS alumnus/a (who?) _____	☐ guidance/career office
☐ SFS campus meeting	☐ friend
☐ newspaper/magazine (name?) _____	☐ other: _____

Have you attended an SFS presentation on your campus? _____

Attach a 300-word personal statement (please type) of your reasons for wanting to participate in this course, what you hope to gain from it, and what you expect to contribute. **SEND THIS FORM, YOUR ESSAY, AND YOUR \$25 (NON-REFUNDABLE) APPLICATION FEE TO:** Admissions Department, School for Field Studies, 196 Broadway, Cambridge, MA 02139. Upon receipt of your materials and application fee, we will send you a reference form which must be returned to SFS to complete your application.

Semester Applicants: Please request that an up-to-date transcript be forwarded from your school to SFS to complete your application.

I have read the SFS catalogue thoroughly and feel that I understand and would enjoy and benefit from the experience it describes.

Applicant signature

Date

I approve this application (if applicant is under 18).

Parent/Guardian signature

Date

Please send another catalogue to the person(s) listed below:

Name _____ Name _____

Address _____ Address _____



APPLICATION FOR ADMISSION

014

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

Name _____ Home Telephone # _____ Soc. Sec. # _____

Permanent Address _____
Street _____ City _____ State _____ Zip Code _____

School/College _____ Class/Year _____ School Telephone # _____ ext. _____

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/interests/clubs or organizations: _____

Special skills/ certificates/licenses/awards: _____

Outdoor/camping experience: _____

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

Organization

Board of Trustees

Terry Herbert-Burns, Chairman
Trustee
The Trinity School
New York, New York

Francis W. Hatch III, Treasurer
Staff Specialist
G.T.E. Service Corporation
Stamford, Connecticut

Richard B. Wilson, Secretary
Boston, Massachusetts

James L. Elder, Jr., President
School for Field Studies
Cambridge, Massachusetts

Cordelia Kelly
Private Placement Group
Morgan Guaranty Trust
New York, New York

Margaret Klein
Vice President
Chase Manhattan Bank
New York, New York

Rolando Perez
Vice President
E.F. Hutton
New York, New York

Susanne LaC. Phippen
Wenham, Massachusetts

James B. Rogers, Jr.
Investor
New York, New York

Board of Advisors

David Hales
Director
Wildlife Management Center
University of Michigan
School of Natural Resources
Ann Arbor, Michigan

Thomas Kunz, Ph.D.
Associate Chairman
Biology Department
Boston University
Boston, Massachusetts

James Millinger, Ph.D.
Dean
Sea Education Association
Woods Hole, Massachusetts

Arthur Page, LL.B.
Attorney
Boston, Massachusetts

Timothy Perkins
Assistant Dean
College of Arts and Sciences
Northeastern University
Boston, Massachusetts

Richard St. Onge, M.D.
Pentucket Orthopedics
Bradford, Massachusetts

Ala Reid
Grants Management Associates
Boston, Massachusetts

Michael Wright, LL.B.
Vice President and General Counsel
World Wildlife Fund, U.S.
Washington, D.C.

Members of the Corporation

Inez Andreas, Ph.D.
Bal Harbor, Florida

Sandra Andreas
Bethesda, Maryland

G. Randolph Bevis, LL.B.
New York, New York

Astra Davis
Bal Harbor, Florida

Travers Evans
New York, New York

Gale Hunt
Boston, Massachusetts

Roy A. Hunt, III, Ed.D.
Boston, Massachusetts

Sara Jenkins
New York, New York

Charles McKee
Portland, Maine

Arthur Phillips
Ipswich, Massachusetts

Susan Reitman
New York, New York

Walter Wood
Southampton, New York

Administrative Staff

James Elder, Jr., B.A.
President

Robert Singer, Ph.D.
Dean

Andrea Walgren, B.A.
Director of Admissions

Elizabeth Gibson, Ph.D.
Program Manager

Timothy Stout, B.A.
Public Relations/Publications
Manager

Amy Wales, B.A.
Program Assistant

Susan Rundell, B.A.
President's Assistant

Teresa O'Neill, B.A.
Marketing Assistant

Lisa McLaughlin, B.A.
Admissions Assistant

Printing: Bradford & Bigelow, Inc.
Photography: SFS students, faculty,
and staff
Editorial Assistance: Tony Balis

The following are considered
founding institutions in view of
their substantial contributions
toward the School's development:
Andreas Foundation
Cabot Family Charitable Trust
Digital Equipment Corporation
The Hunt Foundation
Richard King Mellon
Foundation
Merck Family Fund

SFS is a member of the International Union for the Conservation of Nature (IUCN).

SFS is a private, 501(c)(3) non-profit, educational corporation.



"As my course came to an end, I realized that the skills and knowledge I had acquired far surpassed those of any other course I had taken. Other courses have not presented so much material while at the same time maintaining such a good balance between lectures, field work and personal time." Kirsten Turner-Marlboro, Vermont-Marlboro College.

Photo by Geoff Levner

"By providing an opportunity to experience first-hand, SFS increases the effectiveness of those who go into the natural resource field and prevents the expenditure of non-productive energy which would otherwise occur for those who find it not to their liking."

R. Michael Wright
Vice-President & General Counsel
World Wildlife Fund, U.S.



School For Field Studies
 196 Broadway
 Cambridge, Massachusetts 02139
 (617) 497-9000



THE WORLD IS YOUR CLASSROOM