



SCHOOL FOR FIELD STUDIES

January, Summer, and Semester Programs Around the World
1984 Course Catalogue



The World Is Your Classroom

Did you know—

that there are 5-10 million species of life on earth?
that each day another species becomes extinct?
that perhaps 50% of all plant and animal species are concentrated in tropical forest ecosystems?
that these rainforests are being destroyed at a rate of 25-50 acres per month (more than 42,000 square miles per year)?
that approximately \$8 billion worth of life-giving medicines are derived each year from plants in the U.S. alone?

These are just a few of the complex and intriguing questions hundreds of students have addressed in the School for Field Studies. Our challenge is to search for answers. And in the process, find ourselves. Don't be fooled. This can be demanding and hard. If it weren't, our alumni would not feel the tremendous sense of accomplishment and satisfaction that they do. You will get out of SFS what you put into it. To participate, you simply need a strong desire to find out more about our environment.

We are eager to train those of you with no previous field experience or scientific background through our "A" level courses. For those of you with some training, we want to help push those limits, deepen your understanding, and give you the opportunity for professional-level field experience in our level "B" courses. And our new field semesters will give you a complete and full perspective on the pressing environmental issues of today.

Don't you deserve an adventure this summer? Something completely different from anything you have ever experienced before? And you deserve credit for it, too. Think what your involvement could mean. Hundreds of other students have found an SFS experience carries meaning long after they returned home. They have continued their own search for answers in the greatest classroom imaginable — the world itself. Join us and find out just how much an adventure learning can be.



photo: Joseph Madison

SFS director Jim Elder in Patagonia

P.S. If you have the interest and motivation to make the most of our courses, we want you to be able to join, regardless of your finances. If you think you'll need financial help, apply today — we'll do our best to find you some support.

Sincerely,

Jim Elder

James L. Elder, Jr.
Director

Front Cover: SFS students
radio-tracking elk at Mount St.
Helens photo: © Gary Braasch

“Is civilization progress? The challenge, I think, is clear; and as clearly, the final answer will be given, not solely by our amassing knowledge or by the discoveries of our science or by our advance in technology, but by the effect our civilized activities as a whole have upon the quality of our planet's life — the life of plants and animals as well as that of men.” Charles Lindbergh

CURRICULUM

JANUARY TERM

January 1984 and 1985

Page
32

CORAL REEF ECOLOGY

St. John, Virgin Islands

SEMESTER PROGRAMS

WILDLIFE BIOLOGY AND MANAGEMENT

Kenya

January 3-March 28, 1985

7

MARINE BIOLOGY AND MANAGEMENT

St. John, Virgin Islands

February 4-April 29, 1985

8

SUMMER COURSES

June 16 Departure

July 24 Departure

MARINE MAMMAL BIOLOGY AND CONSERVATION

Glacier Bay, Alaska

Examining the biology and behavior of harbor seals and harbor porpoises.

Level A: June 16-July 20

Level B: July 23-August 27

Level B: July 27-August 30

10

ENVIRONMENTAL GEOLOGY

Mt. Vesuvius, Italy

Mapping and sampling the succession of lava flows and ashfall from Mt. Vesuvius into surrounding villages.

Level A: June 16-July 17

12

ACID RAIN AND LIMNOLOGY

Adirondack Mountains, New York

Studying the biological effects of atmospheric pollutants on freshwater lakes and streams.

Level A: July 24-August 23

14

PRIMATE SOCIAL BEHAVIOR

Costa Rica

Studying howler monkeys' response to changes in their environment caused by deforestation and development pressures.

Level A: July 24-August 23

16

ECOLOGY OF EXOTIC SPECIES

Mount St. Helens, Washington

Studying how native and "exotic" species of wildlife and plants recolonize after ecosystem devastation.

Level A: July 24-August 24

18

AQUACULTURE

Hawaiian Islands

Examining fish farming methods, to see how small aquatic ecosystems can be effectively managed as an economical food source.

Level B: June 16-July 17

Level B: July 24-August 24*

20

WILDLIFE CONSERVATION

Kenya

Comparing the behavior and social organization of large mammals in order to evaluate conservation strategies for them.

Level A: June 16-July 20

22

HUMPBACK WHALE ECOLOGY

Gulf of Maine

Determining how oceanographic factors influence the distribution and behavior of humpbacks.

Level B: June 16-July 15

Level A: July 24-August 22

24

TROPICAL RAIN FOREST ECOLOGY

Amazon, Ecuador

Studying the extreme species diversity and interdependence of Amazonian rain forests.

Level B: July 24-August 24

26

HAZARDOUS WASTE ISSUES

Narragansett Bay, Rhode Island

Assessing the effects of hazardous wastes on coastal shellfish and wetlands.

Level B: June 16-July 16

28

POPULATION DYNAMICS OF ENDANGERED SPECIES

Greek Islands

Analyzing the population and habitat needs of agrimi (the extremely rare wild goat of Crete).

Level A: June 16-July 16*

Level B: July 24-August 23

30

CORAL REEF ECOLOGY

St. John, Virgin Islands

Mapping, measuring, and identifying fragile coral and seagrass formations.

Level A: June 10-July 1

Level B: July 5-29

Level B: August 2-26

32

TEACHERS COURSES

BIOLOGICAL IMPACTS OF ACID RAIN

Adirondack Mountains, New York

July 7-July 21

14

ECOLOGY OF A NATURAL DISASTER

Mount St. Helens, Washington

July 24-August 7

18

*(tentative)

WHAT SFS IS ALL ABOUT

The School for Field Studies is an independent, non-profit program for field training, education, and research in the environmental sciences. The School develops and conducts a series of month-long and semester-long courses for students in special ecosystems around the world.

The Benefits You Will Receive

*Gain field research skills.

You do not need previous training or experience. Our purpose is to give you the skills you need — in research methodology, teamwork, a scientific discipline, and outdoor living. No other single program offers growth and development in all of these areas.

*Get first-hand experience in a special ecosystem.

Our teams have access to special sites and activities not available to tourists or on ordinary field trips. We make observations within the restricted zones of Mount St. Helens, conduct research on rare species of plants in rainforests of the Amazon basin, and work with endangered species such as the agri in their native habitats. These are not simulations or demonstrations, but real world experiences in which you learn by doing.

*Help a valuable research effort.

As a full member of the field research team, you can make an important contribution to solving current problems in the environment. You might document the behavior of humpback whales — investigate the effects of “acid rain” on lakes and streams —



photo: Kathy Lynch

A moment of reflection on the slopes of Mt. Kenya

research changes in a fragile coral reef system.

*Face new challenges.

These are rare opportunities. And they present many challenges. We believe this is the best way to learn: in direct contact with the natural world and total immersion in the course material. The academic challenge of the research problems, the physical challenge of the sites, and the interpersonal challenge of the expedition teams combine in a dramatic way for dynamic growth and learning.

*Meet new people who share your interests.

Our curriculum is designed for eager, motivated students. The average age is 20-21, with participants ranging from 17-26. You will be working with a group of your peers from across the country (and a few other countries as well) — people who share many of your interests and a desire to learn more about the natural world.

*Share an intensive group experience.

Working with people from many different backgrounds

under demanding conditions will teach you something about yourself. You live, work, and travel together for the entire period of the expedition. There is little or no opportunity for solo activities for several reasons: safety in the field (no one may leave the course site without clearance), making the best use of a limited amount of time, and the personal growth and development that result from group interaction. These courses exemplify the team approach to learning and problem-solving.

***Work with outstanding faculty.**

From hundreds of applicants each year, our faculty are chosen for their knowledge, teaching skill, leadership ability, field experience, and person-to-person sensitivity. They are generally in their late 20's and early 30's. Most have Ph.D.'s in a biological science and teach at the university level. They all are enthusiastic naturalists and dedicated to working with students in the field. They have spent an average of over two years each doing field research and often have published papers in prominent journals in their field. The faculty to student ratio averages 1:6, each team ranges from 10-18 students.

***Earn extra or needed credit for college.**

All SFS courses carry academic credit, available through Northeastern University in Boston. Month-long courses are accredited for eight quarter-credits through Northeastern University. Semester courses are accredited for a total of 22 quarter credits.

Many SFS students have arranged to receive credit through their home school or college. Colleges awarding credit include:

Boston University
College of the Atlantic
St. Lawrence University
University of Cincinnati
Evergreen State College
Framingham State College
Guilford College
Haverford 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

Get Financial Help if You Need It

As a non-profit institution, we keep our tuition as low as possible in order to reach as many qualified students as possible. Financial aid (scholarships and/or loans) is available to qualified students based on need. The School receives generous contributions from major foundations and corporations, and from individuals, to make this possible. In 1983, 43% of our participants received assistance totaling more than \$44,000.

Course Levels Designed to Meet Your Needs

Level A courses are taught at an introductory (college freshman) level. They assume little background in the academic discipline and few outdoor skills. They do require completion of the junior year in high school by the time the course begins.

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. an SFS Level A course or other scientific field experience. Level B courses are taught at a more advanced level and usually enroll science majors.

The Director of Admissions will be happy to answer any questions about these requirements.



Common Course Elements

The course outline has been developed in the field during the past several years.

Everything is designed to help you learn as much as possible as quickly as possible. At the end of your course, we expect you to have the skills, and the questions, to continue your own search for answers.

Orientation

- expectations meeting with expedition team
- safety and first aid lectures; outdoor living skills training
- discussion of the nature of decision-making
- lecture on general ecosystem/environmental problems, local natural history and customs
- explanation of the research project

- explanation of group journal and naturalist's journal
- initial exploration of site

Week One & Two

- topical lectures in appropriate scientific discipline(s)
- introduction of research methodology, field tools and techniques
- overview of research problem and clarification of approach
- daily research and academic lectures/discussions
- data collection in the field

Midpoint

- interim evaluations of student progress; group dynamics discussion
- diversion from field work, 1-2 days

Week Three & Four

- continuation of data collection in the field and lectures
- 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
- written evaluations, group discussion



photo: Robert Becker

"Despite the problems we faced, everyone worked together and worked together well." Steven Senator, University of Pennsylvania

SEMESTER PROGRAMS

In today's world of limited resources and rapid technological growth, it is critical that we understand the complexities of ecosystems and the relationships between man and the natural world. Without an understanding of the trade-offs involving economic growth and sustained natural resource utilization our society cannot make rational choices to maintain or improve the quality of life we now enjoy.

This situation presents us with a number of educational opportunities.

—We can build our education around the examination of a particular environmental problem that is not a textbook-clear case, but involves a network of interrelated social and scientific processes, so that we can understand the use of each discipline as we apply it to the solution of our problem.

—We can build a field-based education. This not only brings facts and theories to life in a new, clear way, but presents an expanded opportunity to learn a great deal about ourselves as well — how we relate as members of a team, how we adapt to new people and different environments, how we manage the rigors of field living.

—In this unique atmosphere, we learn how to engage in scientific problem-solving under real-life circumstances. This analytic skill becomes valuable and relevant to any career you plan to pursue.

—Finally, by involving ourselves in conducting substantive research, we have the chance to make a real contribution to crucial problems of environmental concern.

All SFS programs include these opportunities. Our one-month courses focus closely on a specific problem and the mastery of applicable field techniques. They are compact, intense learning experiences, and expose students to issues and questions which continue to evoke reflection long after the course is over.

Beginning January, 1985, SFS will offer a series of twelve-week semester programs. These programs provide additional time to develop a problem-oriented, field-based education. We can study environmental issues and field techniques in greater depth. We are able to place our scientific research within a larger framework of social, political, and economic concerns. And we can situate local issues and concerns within their global context.

The SFS semester is unlike any other off-campus semester or study abroad program. All such programs take advantage of educational resources unavailable on campus and give students a chance to meet new people, to experience a different culture, to pursue a particular area of study in depth.

The SFS program offers all of these benefits, and, very importantly, offers the additional challenge of a unique kind of education.

SFS uses the world as its laboratory. We offer the challenge of a field-based education that integrates academic and personal growth. And we offer the challenge of understanding a new and expanding field of critical importance: environmental studies. Nowhere else will you find such a powerful combination.

CURRICULUM

Each course is a rigorous, carefully designed program of academic study, the full equivalent of any college course on the same subject.

Each course is linked to the others by a common focus on the flora, fauna, or human populations that together comprise the ecosystem under study, and together must be considered in any plan to preserve natural habitats and wildlife populations. Directed Research, the capstone course, makes this link explicitly in asking students to apply all coursework in an independent (or small team) study in a particular environment.

Students will complete the equivalent of 22 quarter hours (16 semester hours) of college studies through a linked series of five courses, involving lecture, discussion, assigned reading, training in field techniques, and much first-hand experience in biology. There will also be ample exposure to the people and culture of the area, and some training in field anthropology.

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

Courses:

Weeks 1-5

**Introduction to Ecology
Local Peoples and Cultures**

Weeks 6-10

**Advanced Ecology
Man and the Natural Environment**

Weeks 11-12

Directed Research

Each semester is comprised of two sequential ecology courses (introductory and advanced) taken for five weeks each, for five quarter credit hours each. Two additional courses are taken for four credits each. The final course is four-credit Directed Research. Total quarter hour credits are 22. Twenty-two hours represent an average of 14 hours of class per week, and at least 16 hours of

lab/field work per week for twelve weeks.

INSTRUCTION AND TRAINING

Each course is designed to develop the student's ability to implement methods of observation, measurement, and recording in the fields of biology (for the study of wildlife and marine life) and anthropology (for the study of human ecology). Some specific methods demonstrated and used are:

Field Biology

- field identification
- map making
- quadrant and transect analysis
- computer modeling
- use of scientific sampling equipment
- scientific report writing
- behavioral observation techniques
- aging techniques
- population modeling

Field Anthropology

- census taking
- charting kinship
- open-ended interviewing
- participant observation

- collecting life histories
- using personal documentation
- content analysis of oral history/folklore/mythology
- using photographs as a recording device

Concurrent with academic and field training, there will be instruction in outdoor skills, planning field expeditions, safety precaution in water or wilderness settings, and emergency care procedures.

SCHEDULES

The semester program is twelve full weeks of study. Students are expected to join the program at its beginning and remain in the program until its end. Field trips to game reserves, visits to tribal communities, and occasional sight-seeing in the major towns and cities of the area are scheduled as an integral part of the semester program. Students are encouraged to plan additional travel on their own after the program has ended.

Weeks 1-10

Courses are taught six days a week, excluding Sundays, which are free for recreation and travel. We will also have two breaks of two days between weeks 5 and 6 and weeks 10 and 11. In each session, two courses usually run concurrently on a M-W-F/T-Th-S rotating basis, except when overnight field trips require changes. Each day will have a 2-3 hour classroom

component, in which we discuss assigned readings, absorb new lecture material, and set up the field exercise for the afternoon. Three hours or more of the afternoon will be occupied with field work and training which extend the morning's lectures and reading material. Evenings are unstructured but will offer a variety of options. We will schedule films, guest speakers, and cultural events, and the field library will be available for research and assigned reading. You will participate in planning evening programs in your own areas of interest.

Weeks 11-12

The last two weeks are spent in full time, uninterrupted, supervised field research on a topic of the student's choice. Your project will incorporate material from most if not all of your previous coursework to answer a specific question about preservation and utilization of the ecosystem you have been studying. Projects will be finalized by week 8. The last three days will be used to present the results of your directed research to the team and some outside guests, and also to complete final evaluations and prepare final versions of papers.

EVALUATION

The faculty will evaluate students verbally and in writing on the basis of classwork, field work, papers, presentations, and group participation at the midpoint and conclusion of each course. Evaluations and academic work will be forwarded to the parent school as requested.

STUDENT BODY

Each semester program expects to enroll 22 students from across the U.S. and one or two students from the area in which we are studying.

FACULTY

There will be two senior faculty and one assistant. Faculty members will hold a Ph.D. and have substantial experience teaching and conducting research in the region of the program location. Appointments will be finalized six months before the program begins.

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 should include a kitchen, basic lab, and library. Meals will be cooked for us; however, we will do cleanup and routine maintenance. We will camp out while in the field.

WILDLIFE BIOLOGY AND MANAGEMENT

January 3—March 28, 1985
Kenya

Global Issue: Biotic diversity, not merely in species but in the full array of genes and genotypes that make up the earth's inhabitants, can be preserved only fractionally in isolated national parks and wildlife reserves. Further, the present practices of expanding populations and developing economies render many habitats unsuitable for wildlife. We must seek a way to satisfy the needs of both wildlife and man on shared land, rather than assuming that the presence of one excludes the other.

Local Concern: Kenya offers an exceptionally dramatic illustration of this conflict, as social and economic growth lead to increased land usage, destroying the natural ha needed to sustain Kenya's comparable herds of graz ungulates. Agricultural techniques not suited to the capacities of the land are spreading rapidly through the country, while many Kenyans are unaware of the term effects of their current actions.

Program Summary

A semester-long study of the ecology and wildlife biology of Kenya, to plan for the preservation of wildlife in the face of an expanding population and developing economy.

Site: Kenya offers an enormous variety of wildlife in an equally amazing variety of terrains. Though large areas of Kenya have been set aside as national parks, these



photo: Jack Shea

photo: Jim Elder

Can modern resource needs coexist with indigenous traditions?

"islands" of natural land cannot support a diversity of species that need to migrate or establish new territory over their lifespan. We will be studying the interrelationships of vegetation, climate, environment, and animal behavior. We will also be exposed to a variety of cultures which have evolved from the nomadic groups and tribal kingdoms of

Kenya, with Arabic and European influences. Swahili is the most widely accepted of many tribal tongues, though many Kenyans are familiar with English.

Curriculum: Students will complete the equivalent of 22 quarter hours (16 semester hours) of college study through a series of five pro-

gressive, interrelated courses.

Weeks 1-5: Introduction to Wildlife Biology (5 QH)
Peoples and Cultures of East Africa (4 QH)

Weeks 6-10: Population and Community Ecology (5 QH)
Man and the Natural Environment (4 QH)

Weeks 11-12: Directed Research (4 QH)

continued on next page

continued from previous page

Courses:

INTRODUCTION TO WILDLIFE BIOLOGY: We examine the life processes of mammals and birds in relation to their environment. We will define the conditions required by various species to hunt or graze, to reproduce, and to bring up their offspring. We study methods of habitat manipulation, harvesting, and the protection of biotic communities. We will also consider problems such as poaching, wildlife as pests, and the conservation of endangered species.

PEOPLES AND CULTURES OF EAST AFRICA: An introduction to the indigenous people of East Africa through their recent history and contemporary patterns of day-to-day social life. We will examine tribal systems of kinship, marriage, subsistence, and political organization; also the world view and religious practices of tribal communities. The emphasis is on patterns of continuity and change so that we may better understand the impact of a colonial past and

the likely direction of current development programs.

POPULATION AND COMMUNITY ECOLOGY: We focus on species interaction and change within an ecological community. We examine the hierarchy of food chains, competition, and prey relationships, and the roles of symbiosis, genetic evolution, and natural selection within the ecosystem. We determine how populations grow, disperse, and regulate themselves in the development of ecosystems.

MAN AND THE NATURAL ENVIRONMENT: We examine the relationship between environmental issues and societal interests. We will investigate such issues as natural resource allocation, management policy, population growth, and industrial development in reference to economics and conservation. We will gain a perspective on how environmental decisions influence societal values and growth. We will also consider the relationship of resource exploitation to long-term human survival.

Cost: \$4800 + airfare (approximately \$1200)

Departure point: Nairobi, Kenya

“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 S. McNamara
Past President
World Bank

MARINE BIOLOGY AND MANAGEMENT

February 4—April 29, 1985
St. John, Virgin Islands

Global Issue: The vastness of the ocean often leads us to underestimate its vulnerability. Yet, out of the vast array of species inhabiting this “last wilderness” of the earth, 90 percent are concentrated near continents, where the most serious pollution occurs. Not only have we altered thousands of miles of delicate coastal wetlands, but we have used the ocean as a dumpsite for everything from sewage to nuclear waste, and then overfished its marine life. As a consequence of this onslaught from all sides, many oceanic species are endangered while populations of commercial fish are steadily diminishing.

In order to design a responsible method for sustained use of marine resources to protect endangered species and fragile marine systems, we must overcome our present ignorance of marine biology and marine ecology. We must establish guidelines to avoid future oversights which abuse the ocean's natural balance.

Local Concern: The coral reef and adjacent seagrass bed are two of the most diverse ecosystems on earth. They include species of flora and fauna that are found nowhere else on earth, are beautiful to behold, and can be harvested

for economic benefit. They are also among the least known ecosystems. These underwater gardens are extremely vulnerable to disturbances created by man, and many Caribbean marine systems have already been degraded. St. John has suffered relatively little impact to date, but change is imminent. We need to inventory the natural state of marine resources at St. John, so that we can proceed to address issues of human impact, such as tourism/recreation management, sediments and wastes from island development, oil pollution, and fishing.

Program Summary

A semester-long study of marine science, to plan for the conservation and sustained utilization of tropical marine life in a coral reef ecology.

Site: VIERS, St. John, USVI. We have access to a basically undisturbed coral reef on one of the less developed of the Virgin Islands. We have lab equipment available and are near to the College of the Virgin Islands on St. Thomas.

ND ENT

ST. THOMAS

VIRGIN
ISLANDS

JOST VAN DYKE

TORTOLA

VIRGIN GORDA

SFS
ST. JOHN
SITE

Curriculum:

Weeks 1-5: Introduction to Marine Science (4 QH)
Peoples and Cultures of the Caribbean (4 QH)

Weeks 6-10: Coral Reef Ecology (4 QH).
Man and the Natural Environment (4 QH)

Weeks 11-12: Directed Research (4 QH)

Courses:

INTRODUCTION TO MARINE BIOLOGY: Overview of the major flora and fauna of the Caribbean to develop a working knowledge of taxonomy, particularly the field identification of fishes, plants, and invertebrates. Structures and interactions in the major marine communities (coral reefs, seagrass beds, and mangrove stands) will be introduced. Roles and requirements of major components in the system will be analyzed.

PEOPLES AND CULTURES OF THE CARIBBEAN: The Caribbean is a pluralistic society of diverse and heterogeneous

people. We will examine the development of modern Caribbean societies within the world system: the impact of colonialism and economic dependence; the effect of slavery on local systems of status and honor; the cultural legacy of the Caribbean diaspora and development in the shadow of the United States. The emphasis is on understanding patterns of ethnic and national identity, and how these influence patterns of social differentiation and interaction among communities of a pluralistic society.

TROPICAL MARINE ECOLOGY: Building on "Introduction to Marine Biology", we will continue our study of species interaction and interdependence within the major marine communities with an emphasis on the coral reef system. We will investigate the role of nutrient supplies and cycling in the system and food chains. Reviewing physiological adaptations and natural selection will lead to an examination of grazing and predation, competition, and symbiosis as three of the major relationships between organisms. We will also study responses and recovery from natural and man-made disturbances.

MAN AND THE NATURAL ENVIRONMENT: We will examine society's dependence on marine resources and the assumptions regarding the inexhaustible wealth of the

ocean, its ability to regenerate life and absorb waste. We will contrast this with the actual damages inflicted on the ocean and marine life, species pressed to near extinction, and reduction in fish populations. We will examine conservationism as a mediator between the demands of society and the capacity of the ocean to recover from them.

Cost: \$4300 + airfare and SCUBA equipment.

Departure point: VIERS, St. John, U.S. Virgin Islands

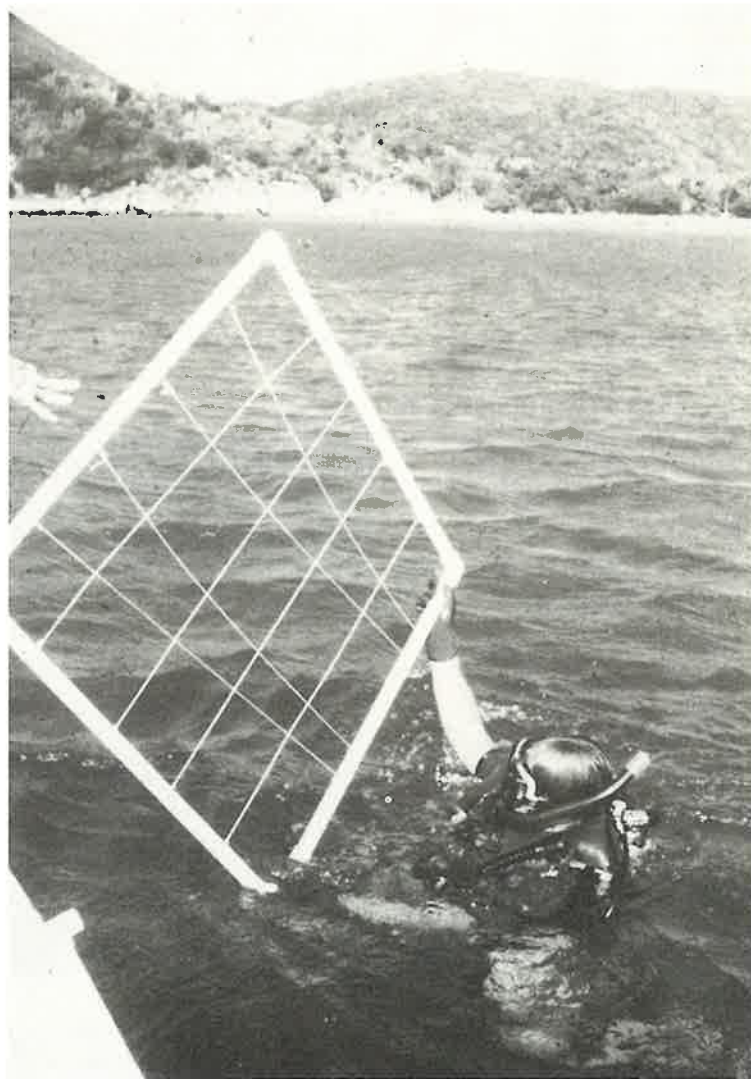


photo: Kenneth Andrasko

Descending with more equipment for our seagrass mapping project

MARINE MAMMAL BIOLOGY AND CONSERVATION

Glacier Bay supports a large population of harbor seals and

harbor porpoises. Each summer the seals “haul out” — on reefs and islands in the lower portion of the bay and on icebergs shed by glaciers in the upper bay — to give birth to their young. As the glaciers continue to retreat northward up the bay, less ice may be available to the seals. Also, it appears that porpoises and the seals may be increasingly disturbed by touring vessels that frequent the waters.

At the moment, it is unclear whether these marine mammals maintain a stable population despite such changes. We do not know if their numbers are declining as they have in coastal waters farther south. Conservation policies are needed to minimize stress on the seal and porpoise populations.

Research Focus: Are the numbers of harbor seals and pups in Glacier Bay changing in their relative locations within the park, in response to changes in the availability of icebergs to haul out on? Are harbor seals being disturbed enough in Muir Inlet to warrant new management efforts toward vessels in the area? Can harbor porpoises be identified and monitored sufficiently to determine the size and range of the Glacier Bay population?

Course Design

During our first few days at the National Park Service headquarters at Bartlett Cove, we will learn to maneuver a

Glacier Bay, Alaska

Purpose: To examine the biology and behavior of harbor seals and harbor porpoises, in order to determine the impact of human activity on them and assist the National Park Service in developing appropriate conservation policies.



photo: Donald Brewster

“It’s honestly impossible to put into words the feeling you get when you see a harbor seal ten feet in front of you, or see a bald eagle soar over your head. I can’t help feeling someone has painted a gigantic backdrop and laid it before me, but all of this is the real thing.” Liz Weis, Indiana University

kayak with skill and safety.

We will have a number of introductory lectures and discussions so that, by the time we are ready to begin our journey, everyone will have a firm understanding of the basic biology and behavior of marine mammals, and of the research conducted here by previous SFS students and others.

Traveling north in sturdy, two-person kayaks, we will proceed along the path the glaciers have gradually exposed over the last two centuries. You will move and work daily in some of the world's most awesome, untouched wilderness beauty. The bay is flanked by glacier-capped mountains rising to heights of 15,000 feet, while the lower elevations are inhabited by bear, moose, mountain goats, wolves, bald eagles, and arctic birds.

This journey up the bay by kayak takes several days. Upon arrival in the lower portion of the bay, the June team will begin to census the seal and porpoise population, gathering data on their behavior, preferred locations, and patterns of movement. This team will also study mothers, young pups, and other seals hauled out on land sites in the lower bay. Later, July team students will concentrate on the seals' molt period when the highest numbers haul out on icebergs. One July team will work in remote Johns Hopkins Inlet, which involves the most extensive kayaking and the most exploratory seal population and terrestrial studies in a very remote area. The other team continues last year's work in upper Muir Inlet amid the calving icebergs of Muir Glacier.

Lectures and discussions cover marine mammal biology and



photo: Barbara Taylor

Can harbor seals adapt to changes in their environment?

physiology, pinniped (literally, "winged feet") behavior, population dynamics, and social structure. With this academic material as our introduction, we begin training with instruments needed for our research. We learn to use a theodolite to plot the location of objects in the bay. The faculty teach censusing techniques and use of data sheets to keep an accurate count of observations. You will keep a naturalist's field journal in addition to any personal journals, to record places traveled, species seen, time and weather conditions for each phenomenon observed, etc. In addition to the seals and porpoises, you may have an opportunity to select another species to observe independently and write up in your journal.

Keeping at least 100 meters from the animals at all times to avoid disturbing them, we will note their interactions with the environment. 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 will help to determine whether vessels do, indeed, disturb the animals and provide a basis for future management decisions.

Harbor porpoises are very shy, quick animals, so little is known about them. Their natural dorsal markings make it possible to distinguish some individuals, so our study of them will build upon observations made by SFS teams last year. We still do not know how often the porpoises give birth, so if you see a porpoise whose individual markings were recorded last year, you may discover whether she has a calf again this year. We will also try to learn whether an increasing number of vessels may have been the reason porpoises abandoned Puget Sound and San Francisco Bay.

After a demanding day of field research, we return to camp, compare findings, and tell of the day's experiences. The faculty continue lectures and discussions: ecological succession, marine mammal/human interaction controversies, field identification of mammals and birds, and the natural history of Glacier Bay.

In the last few days we will kayak back out to the lush forests of the park headquarters, and work intensely for several days to compile, compute, and analyze our data. We hope to present our observations and conclusions to park rangers and other resident naturalists so that they can incorporate these results into the process of

managing the park. We will leave this contribution to protecting these vulnerable marine species, while we take with us a new understanding of the realities of field work and memories of Glacier Bay's stark beauty.

Living and Working Conditions

This is a demanding wilderness experience and you must be in good physical condition. The work is sometimes repetitive and requires both patience and dedication. The weather will vary dramatically from warm, sunny stretches to cold, dim days with pounding rain or thick fog. Except for a few days at the beginning and end of the expedition, we will be camping out far from civilization, and our shelter and meals will be quite simple. Even so, it will take a commitment from everyone to keep the camp running smoothly.

Sixteen active glaciers are still moving down the mountain slopes, shedding chunks of ice that rumble into the inlets. Our June camp will be on the forested edge of lower Glacier Bay, while both July camps will be on austere slopes bordering the glaciers, overlooking icebergs covered with seals.

Faculty: Dawson, Taylor

Course Levels, Dates: Level A—June 16-July 20 (35 days)
Level B—July 23-August 27 (35 days)
July 27-August 30 (34 days)
Tuition: Level A—\$1450.
Level B—\$1490.

Departure Point: Gustavus, Alaska

ENVIRONMENTAL GEOLOGY

The historian Will Durant wrote, "Civilization exists by geological consent, subject to change without notice." Nowhere 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 live with the effects 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, next to Vesuvius, is built on a layer of ash. As recently as 1971, 10,000 residents were evacuated from the old district of the city during volcanic unrest. Almost two million people live in mapped geological danger zones here. In fact, scientists now realize that this is one of the most hazardous volcanic regions anywhere on earth due to the frequency of small surges and ashflows.

What is the relationship between the series of eruptive events at Vesuvius and other volcanoes in the region? Can the sequence and severity of events at one formation help us predict magma massing at another? Perhaps there are areas around Vesuvius that are relatively safe to develop. Or must we view the entire region with caution?

Research Focus: The extent, range, and chemical composition of ash layers over the 2,000 year recorded history of volcanic activity in the area offer adequate data, in combination with recent studies

Mt. Vesuvius, Italy

Purpose: To map and sample the succession of lava flows and ashfall from Mt. Vesuvius into surrounding villages, in order to help develop models that predict eruptive activity and guide regional land use planning.



photo: Winton Cornell

and monitoring of Mount Vesuvius, to extrapolate potential eruptive events in the decades ahead. When is the next eruption likely to occur, and in which districts of the area will its effects be most strongly felt?

Course Design

We will camp out in rolling fields at the 2500-foot elevation level on the slopes of Mount Vesuvius. It is easy to see why

Neapolitan settlers try to coexist with the volcano. The land is extraordinarily fertile and productive all around the cone, which rises to 4200 feet only four miles from the ocean. As we make our daily treks over the terrain, we will see evidence of basic geologic processes at work.

As magma rises from the depths of the earth's crust in the first stages of a volcanic eruption, the ground above it also rises. If the magma stops and solidifies, the ground swelling stops. The town of Pozzuoli, across the Bay of Naples from Vesuvius, rose approximately two meters bet-

"As we mapped out the geologic units, I was amazed at the secrets we unlocked in those hunks of lava. There was history in those features!" Michael Silverstein
University of Colorado—
SFS Geology Course
Iceland—1983

ween 1969 and 1972, and is still rising at a rate of about 2-4 millimeters per day. Many volcanologists believe this indicates that massive quantities of magma are accumulating once more. In the short term, however, the area is safe to visit and study, as long as close contact with local monitoring agencies is maintained.

As students have done in SFS geology courses in Iceland for the past three years, you will study the full range of volcanic features in the field. We will learn to identify major types and their approximate magma composition. Most of our time will be spent in the field, hiking and driving among various formations, which we will then sample by digging test pits and collecting layers of ash and pumice. Working with detailed geologic and topographic maps, we will



photo: Winton Cornell

Layers of rock and ash encase historic ruins dating back over 2000 years.

draw in the results of our analysis of tephra layers from our ash profile pits.

We will begin our survey of the area with a climb to the top of Vesuvius. Lectures will cover the basics of volcanism, plate tectonics (continental drift), earthquakes, ocean basin development, and structure of the earth, as well as specific information on field research methods, tephrochronology (the history and mapping of ash layers over broad areas), and the geochemistry of local volcanoes. Volcanic eruptions affect global weather and climate 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 see active craters, ash deposits, and lava flows.

Examining a number of quarries that have been carved in the area, we will dig profile pits, then sample and map more than 2,000 years of volcanic history encased in layers of rock and ash. The immense variations in stratigraphy, particularly during the last 100 years, indicate far more volcanic activity than had been previously realized. Not surprisingly, the world's oldest volcanologic observatory is on these slopes. We will have an opportunity to discuss its work with some of the resident scientists.

Later, traveling by train from Naples south along the coast, and by ferry to Sicily, we plan to visit 11,000-foot Mount Etna to observe this huge, more explosive volcanic cone more similar to Hawaiian volcanoes than Vesuvius. We also expect to examine local volcanic gas analysis

techniques that will give clues to changes within the earth, and recent engineering efforts to divert dangerous lava flows.

In addition, we may have time to survey ash and lava

deposits at Roccomichino. This 200,000-year-old broad shield volcano has a series of huge, spectacular, explosive craters with unusual basalt features.

Living and Working Conditions

The Mediterranean is blessed with a near-perfect, temperate climate most of the year. Hiking over Vesuvius and digging through ash layers will be hot work, however. We will stock up on local supplies of fresh foods and vegetables and occasionally enjoy Neapolitan seafood as well. Since our camp will be in a remote, rural area, showers and other amenities will be few and far between.

Course Level: A

Dates: June 16—July 17 (32 days)

Tuition: \$1390.

Departure Point: Naples, Italy



photo: Winton Cornell

Mt. Vesuvius has been threatening surrounding communities since the first century A.D.

ACID RAIN AND LIMNOLOGY

Evidence suggests that pollutants in the atmosphere raise the acid level of some of the rains that feed our lakes and streams. How does this "acid rain" affect a lake ecosystem? Perhaps there is a direct correlation between the number of species inhabiting a lake and the pH level of the water. If some acid-tolerant species proliferate and dominate a lake ecosystem, how does this affect the food chain of the larger ecosystem dependent on the lake? Before we can attempt to restore these lakes to their original states, we have to understand the chemical and biological changes they have undergone.

Research Focus: What measurable factors such as local geology, forest cover, and watershed drainage determine the ability of a lake or stream to buffer the effects of acidification, and to change the degree of acidity as water flows downhill through a watershed?

Course Design

To determine the effect of acid rain, we need a controlled site isolated from other sources of artificial contamination, so that we know rain water alone produces the phenomena we are observing. Even in a natural setting, the soil around a lake has a varying capacity for "buffering" or alkalizing the water that flows into it, so the lake's pH level does not reliably reflect the influence of acid rain.

The lakes of the Adirondack Mountains, however, are relatively uninfluenced by in-

Adirondack Mountains, New York

Purpose: To study the biological effects of long-range transport of atmospheric pollutants ("acid rain") on freshwater lakes and streams.



photo: Kenneth Andrasko

"The hike was about three miles and steep, but our crew emerged almost blister-free and had lunch on the summit. The view of Indian Lake and the surrounding mountains was stupendous, with the hazy silhouette of Vermont's Green Mountains in the distance." Claudia Polsky
Hunter College High School

terfering factors and offer an outstanding opportunity for field studies in limnology (the science of freshwater ecology).

In Adirondack Park, the largest state park in the country, dramatic peaks of sheer granite jut up from the sur-

rounding sedimentary terrain to heights of 5,000 feet. In the depressions and crannies of this bedrock, delicate lakes of snowmelt and mountain streams have developed, unprotected by buffering layers of soil. Many of these lakes, once teeming with sportfish, have proven so vulnerable to the effects of acid rain that now all but a few are essentially devoid of fish. This does not mean they are dead lakes, though, by any means. They support a new ecosystem of primitive life forms characteristic of 'acid lakes,' which we will explore and analyze in our field work. Last year, SFS students documented the rate at which the number of species in a given lake decreased with an increase in acidity.

From our base at the Freshwater Institute (the field station of Rensselaer Polytechnic Institute) on beautiful Lake George, our expedition will make two extensive expeditions into the field. We will hike to remote regions of these mountains and canoe as necessary to set up camp amid the most

isolated, upper lakes. Surrounded by the alpine beauty of this wilderness and the ascending peaks of the range, you will attend thorough lectures on the theories of limnology, biochemistry, basic ecological principles, and methods of research. These lectures will focus on a lake's biological communities, chemical interactions, cycles and reactions to temperature, water movement and light, and how to assess these factors in the field. You will practice with specialized instruments for taking samples and readings, and eventually perfect your technique so that wading into cold lake water and thrashing around in small boats does not interfere with your control.

We bring the samples gathered on this first trip back to the Freshwater Institute for testing and analysis. With the extensive biological and chemical laboratories of the Institute at our disposal, we test our theories and develop our first findings. With more lectures and explanations from the instructors to pinpoint any faults in our collecting or analyzing process, we begin to acquire a more thorough comprehension of the elements and processes of limnology, as theory and experience begin to mesh into concrete results. We are now ready for a second and more extensive expedition to test the waters of a system of lakes and streams spanning an entire watershed.

On this trip, you join in the field research with more expertise and efficiency, collecting biological, chemical, and physical data as before. As part of a team you gather samples to identify macro-

phytes, phytoplankton and zooplankton inhabiting the water, and to determine levels of phosphorus, chlorophyll, and other chemicals. You also measure clarities, depth, and temperatures throughout the system of lakes. You share responsibilities and tasks, working together to extract controlled, high quality data. Finally, you will bring these samples and readings back to the Freshwater Institute and work for several days to reduce and summarize your data. You will formulate correlations and conclusions about the ecosystems of the lakes and the variations among lakes within the watershed. With a few other students, you will prepare an independent project and present it to the group in the final days of the course. For example, you might want to investigate which species of zooplankton appear to be more tolerant to acidity than others, and compose a graph showing the survivors of graduated levels of acidity. Your findings will contribute to an ongoing, largescale research project at the Institute.

Along with the satisfaction of contributing to the pool of knowledge concerning acid rain, you will gain the rare experience of exerting yourself both academically and physically in a beautiful wilderness setting. Your appreciation of the Adirondack lakes will grow not only from seeing their beauty but from understanding the complex components and interactions that comprise them.

Living and Working Conditions

We will be camping out at high altitudes, so while most

days will be pleasantly warm, the evenings and nights will be chilly and the rain unpredictable. Since we will be constantly working with, around, and in the water, getting wet is inevitable. The hiking will be physically demanding and our campsites will be primitive. Conditions at the Freshwater Institute, a converted turn-of-the-century hunting lodge, will be comparatively comfortable, with rooms and plumbing available.

Faculty: Singer, Roberts, Crane

Course Level: A

Dates: July 24—August 23 (31 days)

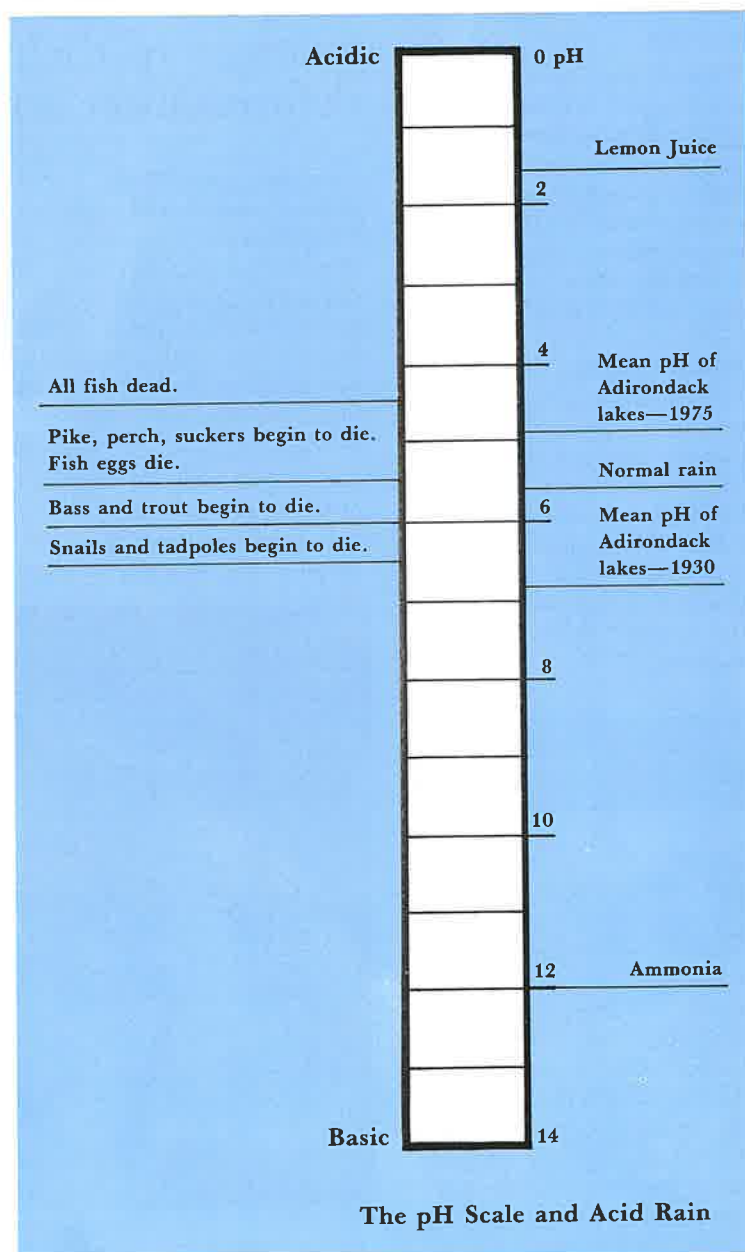
Tuition: \$1140.

Departure Point: Bolton Landing, New York

TEACHERS COURSE Biological Impacts of Acid Rain

Dates: July 6—July 20

Tuition: \$900.



PRIMATE SOCIAL BEHAVIOR

Non-human primate species all over the world are threatened with extinction due to loss of their natural habitats. Howler monkeys (*Alouatta palliata*) inhabiting the tropical forests of Costa Rica lose territory each year as farmers clear land to grow crops or raise cattle. The monkeys are forced to compete for available resources in a smaller area and adapt to deforested environments where limited regrowth has occurred.

How do these pressures affect the howler? Are the monkeys able to compensate for the scarcity of resources? They appear to adjust to maintain a stable population in an altered or limited environment, but we do not know how effectively and for how long.

Research Focus: In moderately and extensively deforested areas, does howler monkey behavior change (relative to that in virgin habitat) to incorporate new foraging behaviors and social groupings? What do these changes, if any, suggest about the howler's ability to survive?

Course Design

Costa Rica offers a richer variety of topography and exotic wildlife than any other country of comparable size. No point of the land is more than 62 miles from either the Atlantic or Pacific Ocean, yet the landscape varies from 12,000 foot volcanic peaks to moist coastal lowlands, and from dry, deciduous forests to dense, tropical cloud forests

Costa Rica

Purpose: To study howler monkeys' response to changes in their environment caused by deforestation and development pressures.

burgeoning with ferns, mosses, orchids and vines. These habitats support a multitude of rare and endangered species such as the three-toed sloth, puma, harpy eagle, three-wattled bell bird, and the bare-necked umbrella bird, to name just a few.

Fortunately, over the past twelve years, the government of Costa Rica has set aside over a million acres in national parks, refuges, wildlife

sanctuaries, and protected zones, comprising the finest park system in Central America. This biological richness plus the nation's long-standing democratic government and friendship with the United States make it a greatly favored study site of American tropical biologists. Costa Rica's lack of an army and its neutrality have earned it a reputation as "the Switzerland of Latin

America", and have provided a stability conducive to long-term scientific research.

Our team will arrive in the capital city of San Jose. We will then drive northwest to our main study site, La Pacifica, a privately owned ranch in the agricultural province of Guanacaste with a large section of remnant forest. The forest in which we will be working is semi-deciduous and dry, covering gently rolling hills, with a moderately high canopy that allows for relatively free movement. We will also have the advantage of vegetation maps of the forest site from previous research by others, which will help us become familiar with the many species of plant life. Some areas in the province remain untouched while others have been timbered for years, allowing a comparison of primate populations in disturbed and undisturbed conditions.

Out of the population of howler monkeys, 300 individuals have been marked for identification from earlier studies. Howlers are not as skittish as many other primates. They have



photo: Margaret Clarke

Several hundred aptly named howlers inhabit our study site



photo: Margaret Clarke

How do tree dwelling howlers adapt to the reduction of their habitat?

beautiful, rich coats, strong prehensile tails, and another fairly obvious distinction: they howl. For ten- to fifteen-pound creatures, they produce an amazing volume of sound.

We will spend the first week in the forest of La Pacifica, familiarizing ourselves with the monkeys and learning

how to formulate, execute, and analyze a behavioral research study. The faculty will provide training in observational methods and sampling techniques for animal behavior, compiling data sheets, and keeping a field journal. Introductory lectures will help us to understand the

“When I was finally in the forest and observing the monkeys, many times I felt I should pinch myself to make sure I wasn’t dreaming. I was actually experiencing all that I read about animal behavior and heard about field research. It was so exciting the first time I saw the monkeys behave in ways I had read about.”

Angela Landsberg, Southern Connecticut State College
SFS Primates Course
Nepal—1982

physiology of howlers, their population dynamics, tropical rainforest ecology, and some basic principles of primatology, anthropology, and psychology.

In the field, we will perform population censusing for the study tracts, watch for signs of competition among species, and learn the fundamentals of ecological niches and species competition. The howlers’ preferred foods will be identified as we observe their foraging behaviors. We will collect data on feeding behavior, size of territory, and activities such as grooming, resting and playing, and note how these behaviors change from one type of habitat to another.

After beginning our work at La Pacifica, we will travel to two other research sites that provide contrasting habitat extremes. One is a highly deforested area where we can see how the monkeys function with what may be a limited selection of food and cover. Elsewhere in the province, we can study the howlers in an unaltered primary forest.

These comparisons will give rise to a number of questions. Do variations in forest cover affect the monkeys’ reactions to us? Does changing availability of food make the monkeys more aggressive or

more sedentary? What types of areas do the monkeys seem to prefer? What does this indicate about their behavior at La Pacifica?

Returning to our base, we will compile our observations and distinguish any trends we have uncovered. The faculty will help us to interpret our information and recognize the impact of deforestation on howler behavior. Then we will focus on developing a group research project comparing social or feeding behavior in riparian forest down by the river to upland forest on other parts of the ranch. We will develop a set of questions comparing howlers in these two habitats and then have individual students or small groups work on specific parts of this project. The results of this study may be applicable to other forests, helping forest managers to better support primate populations.

Living and Working Conditions

On the ranch, we will be staying in small cabins with rustic facilities. Elsewhere, we will be tenting, cooking our own meals and taking care of all our other needs. The weather will be tropical, generally sunny and warm, with brief showers almost daily.

Faculty: Clarke, Zucker

Course Level: A

Dates: July 24-August 23
(31 days)

Tuition: \$1450.

Departure Point: Liberia, Costa Rica



ECOLOGY OF EXOTIC SPECIES

Mount St. Helens, Washington

Purpose: To study how native and “exotic” (non-native) species of wildlife and plants recolonize after ecosystem devastation, and how exotics tend to outcompete local species through major population outbreaks.



photo: © Gary Braasch

The power of nature to destroy and create is exemplified by Mount St. Helens

On May 18, 1980, Mount St. Helens erupted with a force 500 times greater than the nuclear explosion at Hiroshima. A vast mushroom cloud shot up into the air, eventually dusting the entire Midwest with ash. Around the volcano, 195 square miles of lush forests and splendid alpine meadows associated with all levels of wildlife were transformed into a desolate, gray wasteland, though many species of plants did survive.

During the past four years of relatively stable conditions, what animals and plants have reappeared in the blast zone, and how are they adapted to the unusual environment? How do “exotic” animals and plants (those that have been introduced by man from other regions or countries) shape further developments within the ecosystem? Exotics may force out native species of greater economic value, such as Douglas fir. During the recolonization of the blast zone by animals and plants, indigenous species that survived the blast will probably reestablish themselves to the extent that they are not in direct competition with exotics whose preferred food is in abundance in the zone.

Research Focus: Will population outbreaks of exotics greatly influence the recolonization process, and tend to inhibit the reestablishment of deer, Roosevelt elk, small mammals, and some plants, by inhibiting the growth of preferred forage?

“We had some incredible ‘gee whiz’ days that seemed to enhance all our hours counting shrubbery. No one told us we would tread on soil that no human had previously visited.” Team journal entry

Course Design

The eruption of Mount St. Helens was one of the most

spectacular in history and constituted the first major volcanic event in the 48 contiguous states in 63 years. This is our third season of original research in recolonization after natural disasters. Two years ago, SFS students set out permanent vegetation plots, and counted and identified plant cover and food sources for elk and deer; last summer, this work was

continued by students who recounted the plots, then focused on Roosevelt elk in the area, radio-tracking their movements, observing foraging activities and what the elk preferred to eat, and taking regular censuses. Continuing our work this year, we expect to resume our observations and tracking of elk, livetrapped small mammals, and set up new study plots to begin work

PROCESSES AND REQUIREMENTS

ACCEPTANCE

The Admissions Committee will review completed applications for summer courses on February 1, March 1, April 1, and May 1, 1984. All acceptances after May 1 will be on a rolling admission basis for any remaining openings. Applications for January 1985 courses will be reviewed on October 15, 1984. Semester applications will be reviewed on a rolling admission basis beginning February 1984.

Teams fill quickly. We strongly urge you to apply early in order 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 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 (\$200 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
May 1	for teams departing in July and August
October 15	for semester courses
December 1	for teams departing in January

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

OPEN HOUSE

A series of open houses for those interested in learning more about the SFS experience will be held in New York and Boston during the coming months. Call 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. Every student is essentially receiving a partial scholarship. 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 \$75 registration fee for students receiving academic credit through Northeastern University. 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 that are nearly a year in advance of expedition departure dates and involve many variables — currency rates, outside project support, enrollment projections, etc., — all of which may change. *The tuition for each expedition is tentative until confirmed in writing by SFS.*

FINANCIAL AID

Financial aid is available to qualified students in the form of scholarships and/or loans. Students in need of financial assistance should request and complete an SFS Financial Aid Application and return it as soon as possible. Aid is awarded by need, until funds are exhausted.

ACADEMIC CREDIT

Academic credit may be arranged through Northeastern University 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.

TRAVEL ARRANGEMENTS

In order to insure orderly arrivals and departures to the project site as well as to arrange the best possible group fares, SFS works with one travel agency to handle all details. Plane, train, bus, and boat travel reservations should be handled through the agency. Details will be sent to all applicants. To help with your planning, here are some representative round-trip fares from New York City:

Gustavus, Alaska	\$800.	Oahu, Hawai	\$ 500.
San Jose, Costa Rica	\$550.	Rome, Italy	\$ 750.
Quito, Ecuador	\$700.	Nairobi, Kenya	\$1300.
St. Thomas, Virgin Islands	\$300.		

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, as in St. John, Kenya, Mount St. Helens, and Glacier Bay.

—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.

TEACHER'S COURSES

Two of our projects, "Acid Rain/Adirondacks", and "Ecology of Exotic Species/Mount St. Helens", have a special two-week course for teachers only. Presented at an accelerated pace, the days as well as evenings are full in these courses. In two weeks, we cover all the material with slightly less field time. The courses are challenging, rigorous, and intensive. One minor change: we use one-person tents for a little extra privacy. There may be a few hours each day for quiet time to do as you please, but the same rules of conduct apply, and there is no opportunity during the course to head off on your own.

Course Credits

The 4-6 graduate credits for each course awarded by Northeastern University have been determined by the number of pre-assigned papers and articles to be read and reported on prior to the course opening, amount of lecture and seminar class hours, and directed independent field study hours contained within the course. The course credits are full quarter credits based on 24 instructional hours.

Course Limits

We require at least 15 participants to operate these courses. At least 21 days notice is given should we find it necessary to cancel any section.

• • • •

Northeastern University, 360 Huntington Avenue, Boston, Mass., is accredited by the New England Association of Schools and Colleges. The university offers degrees on both graduate and undergraduate levels. Courses offered on the graduate level presume the holding of a bachelor's degree. Those who wish to apply these credits toward a degree or salary advancement should check in advance the transferability of credit with the receiving institution or district. Qualified students may enroll in these courses to the established limits without regard to sex, race, creed, or color. These courses offer full quarter credits.

• • • •

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.



APPLICATION FOR ADMISSION

1 2 3

School for Field Studies • 50 Western Avenue • Cambridge, Massachusetts 02139

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

Permanent Address _____
Street _____ City _____ State _____ Zip Code _____
School/ _____ Class/ _____ School _____
College _____ Year _____ 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?

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

Academic honors/awards:

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

Extracurricular activities/interests/clubs or organizations:

Special skills/ certificates/licenses:

Outdoor/camping experience:

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

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?) _____

☐ SFS catalogue (where?) _____

☐ SFS alumnus/a (who?) _____

☐ SFS campus meeting _____

☐ newspaper/magazine (name?) _____

☐ science teacher/professor

☐ other teacher/professor

☐ guidance/career office

☐ friend

☐ 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, 50 Western Avenue, 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 _____



Lectures illuminate how exotic and native species are reinvading the blast zone

photo: © Gary Braasch

on exotic species introduction problems.

Each day we will drive or hike from our base camp, in relatively undamaged territory, into the "red zone" — the area of maximum destruction from the eruption — where a multitude of seedlings, sprouts, and shrubs are now emerging, and the magnificent Roosevelt elk, deer, and a host of other species are returning to graze.

Hiking from one area to another, we will be working on several plots and studies simultaneously. We will monitor our plots for small mammals, elk, deer, birds, moths, and butterflies to determine which animals occupy various areas, what they eat, how long they stay there, and how they affect each other and the ecosystem in general. Lectures in basic principles of ecology and botany will equip us for this work.

Parallel field lectures will describe the foraging strategies of ungulates (hoofed mammals like deer and elk) and rodents, their responses to wide-scale habitat disruptions, and their dispersal rates in the blast zone. We will also devote several days to conti-

nuing our past years' study of elk migration and foraging, tracking about 15 of these beautiful beasts with radio telemetry equipment, observing their grazing and movements. In a new project, we hope to live-trap small mammals in plots for study. We will need to study the interactions among species along the full length of the food chain in order to comprehend the full story of how a disturbed habitat regenerates.

This year, we will also examine the problem of sudden population outbreaks in a disrupted environment. When exotics are introduced to a new habitat, they often outcompete indigenous animals and plants and lead to major changes in the composition of species present. Successful exotics tend to lower the diversity of species in an area, driving some to extinction and creating monocultures. Lectures on population modeling and outbreak theory will address these problems and confront the issue of how we might control the consequences of such trends produced by human interference.

One example of exotic invasion at Mount St. Helens is the cinnabar moth (*Tyria jacobaeae*), introduced in the 1930s to control the spread of ragwort, an exotic plant which is its exclusive food. These weeds grow waist high and spread rapidly, choking out conifer (evergreen) seedlings. Moreover, they contain toxins that destroy the livers of animals that graze on them, especially ungulates such as deer, elk, and cows. To gauge the rate of introduction of ragwort and cinnabar moths, we will introduce marked moths into study plots and monitor their dispersal to see what microhabitats they seek and how fast they reach them. This exciting work has never been attempted here.

On some days, we will travel to unspoiled forests of huge evergreens, draped with moss and surrounded by a luxurious undergrowth of delicate ferns and leafy thickets, a striking contrast to the relatively sparse conditions of regrowth in the red zone. We may also climb ridges and look out to the ominous crater of the volcano.

By the end of the course, we should be able to identify dozens of plant and animal

species, and describe the trends characteristic of community responses to natural disaster, and the conditions that make a disrupted area vulnerable to exotic population outbreaks. With the help of a computer at the University of Washington, we will compile and analyze our data, which will contribute to large-scale studies on the recovery and management of the blast zone, and to agricultural efforts in nearby valleys.

Living and Working Conditions

When we are working in ash-covered areas, dry weather can create dusty conditions. However, the Northwest has a deserved reputation for long rainy spells, particularly in the early summer. Our work will involve a good deal of hiking, requiring stamina. We will be camping out in a rustic setting near the study site, with no running water. The group will make an occasional trip to small towns for showers and to do laundry. If there is any change in the safety status of the volcano, the course will be relocated to our contingency site outside the area.

Faculty: Adams

Course Level: A

Dates: July 24—August 24 (32 days)

Tuition: \$1140.

Departure Point: Toutle, Washington

TEACHERS COURSE Ecology of a Natural Disaster

Dates: July 24-August 7

Tuition: \$900.

AQUACULTURE

Hawaiian Islands

Purpose: To examine fish farming methods, to study how small aquatic ecosystems can be managed to improve the economics of producing fish and shellfish as a human food source.

Some futurists forecast that, by the end of this century, food supplies may not be able to keep pace with population increases, resulting in widespread famine. Others say only that there will be regional shortages. Food from the ocean has long been thought to be one possible solution to this problem. Fish, for example, has a higher protein value than red meat, is about one-third lower in calories (with no carbohydrates), and has a higher proportion of edible tissue to total body weight. But the supply of food from the ocean no longer appears inexhaustible. New methods are needed to bring more food from the sea without overfishing some areas or upsetting the dynamics of ocean ecosystems.

Are there ways to manage intermediate-scale aquatic ecosystems efficiently enough to help provide adequate food for the future? Our new SFS aquaculture course will concentrate on this question.

Research Focus: Given a traditional Hawaiian fish farming pond, what mix of species in what ratios will produce the highest economic yields, and how do we stock ponds so that they operate as stable, productive ecosystems? Under what water column conditions do Malaysian prawn and other fish grow fastest and healthiest?

Course Design

Kauai is the most beautiful, isolated, and least developed island in the Hawaiian chain. It supports nearly every

biome type in the Pacific, from alpine to rain forest. It is also an important center of aquaculture research and production. The island of Oahu has the highest density of aquaculture farms in the world, with both ancient and modern sites. These farms abound on the lower slopes of ancient volcanoes that are distinguished by lush rain forests that give rise to spectacular waterfalls and rivers.

We will spend our first week examining ancient and modern fish culture technologies on Oahu. These are simple in terms of management, but ecologically complex. The first explorers from

Polynesia arrived in Hawaii about 300 A.D., bringing their aquatic technology with them. Modifying it for local conditions, they would create ponds by simply walling off a small portion of the sea. These ponds would be stocked with fish, prawn, and plants they had brought with them in outriggers thousands of miles through open seas. Over the centuries, through trial-and-error, they found that certain combinations worked better than others.

We will see many of the ponds that were developed more than 700 years ago still in use today. At this stage of our understanding of aqua-

culture, we know that ancient methods seem to work well, but we do not know why. Determining which species to use in what combinations and how they interact is the key.

After the short flight to Kauai, we will settle in at our main research site, where 21 aquaculture ponds, each 200 meters square, have been established for about ten years. They are stocked with different combinations of several species including Malaysian prawn, carp, and *Tilapia*, or channel catfish. These Malaysian prawns

"I've learned so much about the human capacity for understanding and appreciation of one another. We can joke with each other, be solemn and awestruck together, and work with the intensity of professional researchers."
Elizabeth Herman
University of Iowa



photo: Barry Costa-Pierce

Aquaculture was brought to Hawaii by Polynesian seafarers in the 4th century.

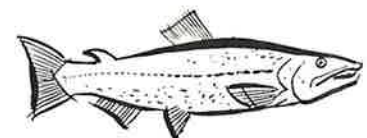




photo: Barry Costa-Pierce

Can modern aquaculture contribute significant food production?

(*Macrobrachium rosenbergii*) are one of the largest crustaceans in the world, with huge legs adapted for climbing waterfalls in their original habitat. They are light blue in color and average one-fifth of a pound in weight, with a high proportion of edible tissue to body mass.

Introductory lectures will help to explain the biology and taxonomy of these various species, as well as the processes of nutrient cycling and the basic biochemistry of salt and freshwater pond systems. Throughout the course, we will see fundamental principles of ecology in action: the carrying capacity of a given micro-environment, population dynamics, and factors af-

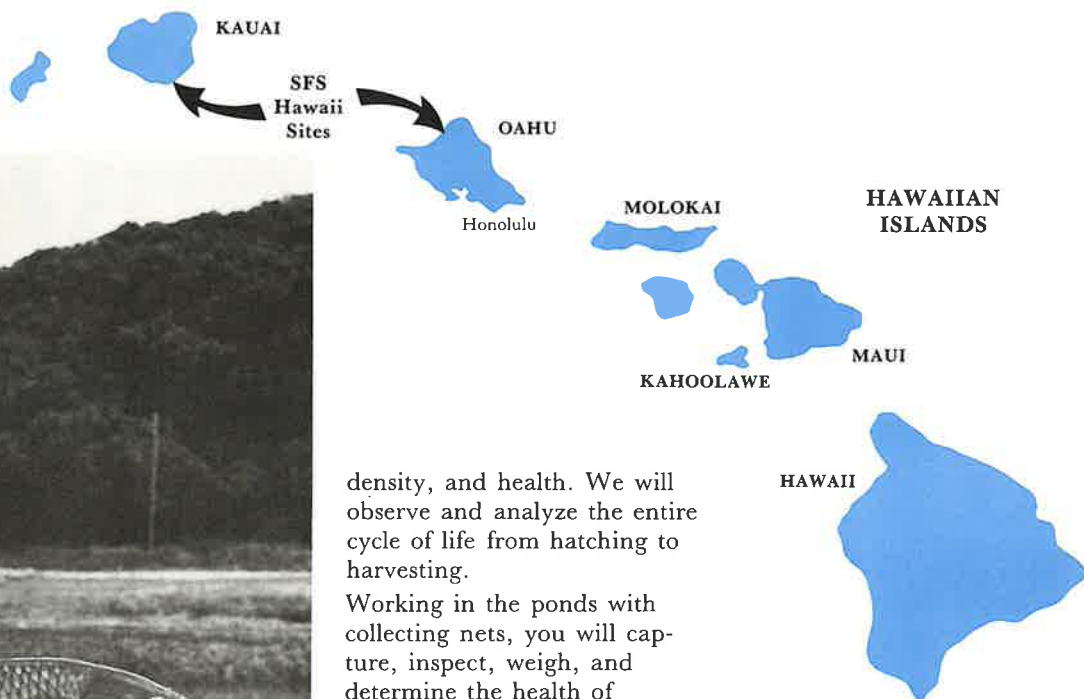
fecting successful aquaculture — soil, water, topography, climate. We will also examine the specific economics of modern, intermediate scale aquaculture by helping to analyze which combination of species in a pond produces the greatest harvest of several different species.

In our day-to-day work among the ponds, we will see how all of these elements fit together as we involve ourselves in all aspects of aquaculture management — monitoring the ecology of each closed ecosystem, testing water quality, and capturing fish and prawn by *huikilau*, or seine netting, to sample size,

density, and health. We will observe and analyze the entire cycle of life from hatching to harvesting.

Working in the ponds with collecting nets, you will capture, inspect, weigh, and determine the health of prawns and fish. How they are faring in the pond will be an indicator of the health of the mini-ecosystem as a whole. You will also sample all of the life in various zones of the water column using specially rigged bottles; introduce new species or more of ones already present to experimental ponds; help harvest a pond for shipment of the catch to packing plants; measure growth rates of shellfish, fish, and algae; and take biochemical measurements at regular intervals around the clock.

Later we will discuss population fluctuations and dynamics in an enclosed system — birth and death rates, ratios of sexes, and reproduction cycles. You will then be trained in taxonomy and morphology of species used in aquaculture; in pond monitoring and harvesting skills performed by aquaculture technicians; in the biochemistry of enclosed aquatic systems; and measurements of salinity, pH, sedimentation, and the benthic mat. This will allow us to experiment with varying the pond environment in order to explore relationships among factors affecting prawn growth.



Living and Working Conditions

We will live in the field, camping on the edge of an *ohia* forest. Kauai is perhaps the wettest spot on earth, called Waialeale by the Hawaiians, averaging 470 inches of rain per year. Although we will be relatively far away from the mountain peak and wettest areas, we can expect short showers almost every afternoon to break up the normal sunshine, with temperatures in the low 80s during the day and low 70s at night. The long, strenuous days of seine netting, collecting specimens in ponds, and studying water column experiments will require stamina, but we will enjoy ample quantities of fresh fish and crustaceans, plus exotic fruits and vegetables as the reward for our labors.

Faculty: Costa-Pierce

Course Level: B

Dates: June 16—July 17 (32 days)

July 24–August 24* (32 days)

Tuition: \$1480

Departure Point: Honolulu, Hawaii

*tentative

WILDLIFE CONSERVATION

This course will take you to one of the most remarkable places on earth, a land that hosts perhaps the greatest assortment of wildlife still to be seen in its natural habitat. Kenya has enormous geographic and geologic diversity with terrain ranging from harsh, dry desert to sunny grasslands, tropical rainforests, coral reefs, and snow-capped high mountain peaks. The Rift Valley, the most impressive geologic fault on this planet, runs like a great scar through East Africa. The region is known for its deep soda lakes teeming with bird life — including clouds of pink flamingoes — and its active volcanoes.

Large areas of the country have been set aside as national parks and game reserves where a tremendous variety of flora and fauna can be found in their natural habitat. Even so, many native species of wildlife are being threatened as man alters or invades their territory to accommodate rapid population growth and a significant rise in tourism. In addition, poachers continue to slaughter rare animals for hides and trophies, driving several species even closer to extinction.

Public and private agencies such as the Kenyan Game Department face difficult conflicts and problems: the need for increased agricultural and livestock production versus the severe damage they inflict on natural habitats; the economic importance of tourism versus the impact of humans on animal behavior. Must human populations necessarily be in conflict with wildlife? What ecological considerations allow wildlife to use available food and water

Kenya

Purpose: To compare the behavior and social organization of large mammals (gazelle, giraffe, wildebeest, zebra, etc.) in a hunted population on a game cropping ranch, with conserved populations in protected national parks, in order to evaluate wildlife conservation strategies for them.

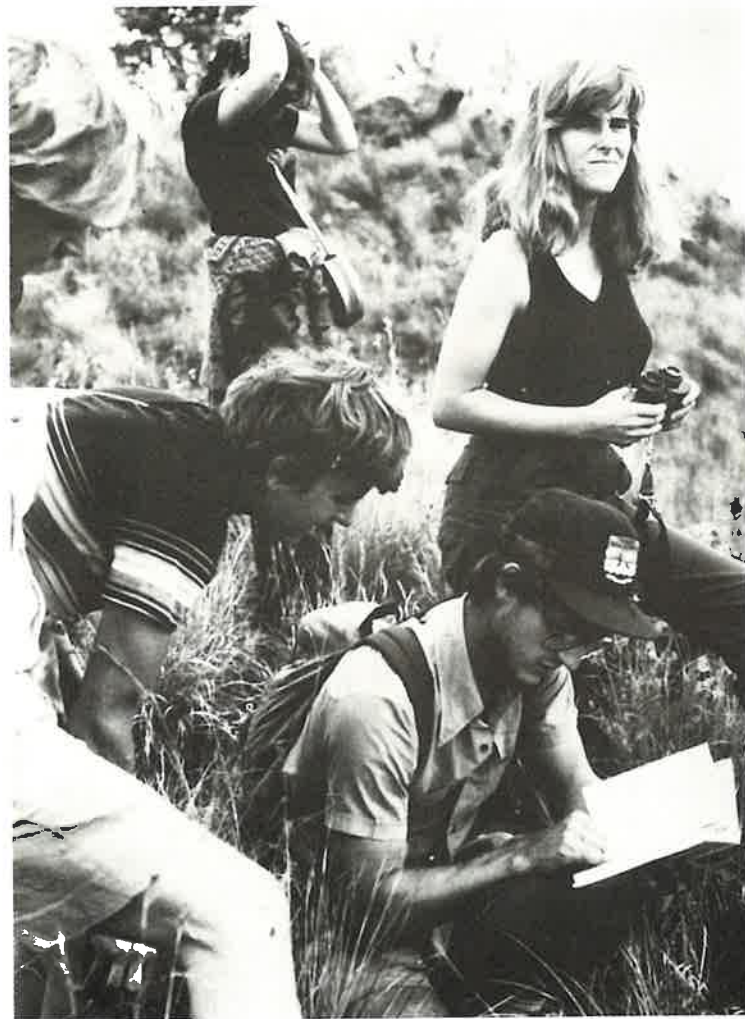


photo: Jack Shea

Observing giraffe behavior on the ranch

sources more productively than domestic herds?

Understanding this unique ecosystem means more than simply appreciating the obvious attractions of wildlife and spectacular terrain; it means learning about the interrelationships of vegetation, climate, environment, and animal life and behavior. In this fourth consecutive year of SFS courses in Kenya, you will have a rare opportunity to live and work in the country as a serious student of wildlife biology and conservation.

"Another resource of this program was the personnel involved. Brad Stelfox had been on the ranch doing research for two years and his knowledge of ecology, land use systems, the animals, plants, and people of the area was so vast. He was enthusiastic about everything and seemed to enjoy the teaching as much as we enjoyed learning from him." Andrea Diss, Mt. Holyoke College

Research Focus: Do newly introduced pressures on large ungulates (hoofed mammals) such as gazelle, giraffe, wildebeest, and zebra — especially hunting on cropped ranches and heavy tourism in game parks — introduce new behaviors, potentially altering social organization among preserved populations?

Course Design

Before Nairobi's skyline is even out of sight, you will feel the excitement of the savannah. Magnificent lions stalk and fell stragglers from enormous grazing herds. Proud elephants roam free and giraffes nibble at the tops of trees. Any impressions you may have formed of these splendid beasts in captivity will be radically changed when you encounter them wild in this incomparable setting.

One of our principal research sites will be Wildlife Ranching and Research Ltd., an experiment in game ranch management founded by Dr. David Hopcraft. Once we have set up our base camp on the ranch grounds, we will explore the area in light of basic ecological principles, discussing how animals and plants are related to each other and their surroundings.

Following the first few days of orientation, we will begin working in the field, systematically collecting data on the animals we are studying, their behavior patterns, habitat selection, and foraging strategies. In field lectures and slide talks, we will discuss ungulate anatomy, taxonomy, resource use patterns, social

structure, and conservation in East Africa. Some lectures will be given by guest professionals in wildlife disciplines. Then we pack our gear into Land Rovers and head into the field to observe both free-ranging ungulate populations and the vast diversity found in the parks.

In last year's course, students worked largely with a hunted population on the game ranch and observed giraffe and gazelle behavior, especially in relation to cropping operations. They also helped determine that indigenous East African wildlife species are far more efficient in their utilization of grasslands than domestic livestock, and secondly, that hunted populations seem to evince changed behavior immediately before and after cropping sessions.

Following a preliminary analysis of our field data from the game ranch, we will set out for comparative studies in two of the national parks in central Kenya, such as Amboseli and Masai Mara. The annual migration of 100,000 head of wildebeest from the Serengeti to Masai Mara presents an awe-inspiring vista we hope to see once again.

Throughout the course, there will also be group and individual instruction in field study organization and planning, safety in the bush, outdoor skills, and the geography and human ecology of East Africa. Each evening, we will review our progress during the day, relating what we have learned to some important research questions.

How do ungulates respond to human disturbances? Are these behaviors likely to be temporary and situation specific, or will they lead to new feeding strategies and socialization? How can we

design park systems and habitat reserves that accommodate all of the species and animal behaviors we have observed? How do we compensate for natural population fluctuations from disease and drought?

Occasionally we will visit local markets to purchase food, mixing with peoples such as Kikuyu, Luo, and Wakamba. We anticipate several opportunities for observing village methods of farming and raising livestock, practiced for thousands of years, to see how these tribal methods compare to modern game ranching.

Toward the end of the course, there may be opportunities for individual or small-group projects to supplement the primary research objectives. Some areas of investigation might include tracing a specific type of species behavior in several different habitats or stress situations.

As the course winds up, we hope to discuss our observations with officials of the Kenyan Game Department and others who are engaged in wildlife conservation efforts. Their years of working with and trying to save the

magnificent wildlife of East Africa should help us to understand local, regional, and global conservation strategies.

Living and Working Conditions

We will sleep in tents on the ranch outside Nairobi and in game parks, cooking our meals on open safari fires. Our day will usually begin before sunrise. Travel will be hot and dusty, but there will be sufficient cold showers.

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

Faculty: Stelfox

Course Level: A

Dates: June 16-July 20 (35 days)

Tuition: \$1780.

Departure Point: Nairobi, Kenya



Zebra and wildebeest roam the landscape

photo: Jack Shea

HUMPBACK WHALE ECOLOGY

Except for a limited catch of bowheads allowed to native Alaskans, the United States is not now among the nations that slaughter whales, but we may be endangering them in other ways. We still lack so much knowledge of the whales' basic life processes that we may not recognize the effects of our actions on their populations. Our fishing, oil, and chemical industries in particular seem to have a major impact on marine mammal populations.

We need to discover, for example, what variables influence their feeding cycles. Do certain tides, currents, and oceanic conditions facilitate optimal feeding situations? What developments could potentially disrupt whale activities and how can we manage our waters to control these elements for the whales' benefit?

Research Focus: Do localized effects of ocean currents, sea bottom topography, and the presence of preferred food tend to cause humpbacks to feed at certain locations at certain times? Do humpbacks vary their feeding behavior and social structure to take advantage of these local variations in their habitat?



photo: Lars Jones

A breaching humpback propelling its 40 ton body out of the water

Gulf of Maine

Purpose: To help determine how oceanographic factors influence the distribution and behavior of humpback whales, and how we can best conserve endangered marine mammals.

Knowledge of humpback preferences and movements will assist in our understanding their needs.

Course Design

Most of us are aware of the plight of the whale. One of the most magnificent and graceful creatures of the earth, its ranks have been rapidly reduced to a tragically small remainder. From the

waters of the Caribbean, where it appears they breed each winter, humpback whales totaling between 1,500 and 3,500 migrate to the North Atlantic to feed from May to September. Like other baleen whales, humpbacks live off small fish and plankton they filter from the sea water through a sieve-like arrangement of horny baleen plates in their mouths. Some of the best feeding spots for baleen whales are located in the Gulf of Maine. When the cold undercurrents are forced upward there by an underwater hill, they bring submerged nutrients to the sunlit surface, providing a rich foundation for the plankton foodchain that the whales depend on.

Our expedition will center around Stellwagen Bank, an underwater extension of Cape Cod that attracts an abundance of humpbacks, finbacks, and even the near-extinct right whale. Each day we will head out to our study site aboard the *Lelanta*, a 65' schooner that will become our home at sea.

As we sail to and from the study sites, the faculty will provide on-deck lectures and discussions. Level A students will concentrate on the evolution and taxonomy of whales, their migrating patterns, their senses, and feeding behavior. Level B students will also study diving physiology, respiration rates and diving cycles, cooperative feeding strategies and social structure, and intraspecific competition. The faculty will train you to use a depth sounder, a current meter, and other equipment you may be using to gather and analyze data.

Fortunately for us, whales do not show much fear of our boats. In fact, many are curious about us and "spy-hop" along the side of the ship, standing vertically in the water so they can take a look at us, or slapping their fins on the water and ducking under the hull from one side to another. When a whale comes to the surface to breathe it blows the used air from its lungs with a high billow of spray, and then dives again with a slow,

graceful flip of its flukes (tail). By photographing or sketching the unique fluke patterns, we can recognize individual whales and keep track of their presence in various areas.

Two years ago, SFS students in the course graphed humpback vocalizations during feeding periods by recording them with a hydrophone. Last year, they focused on feeding strategies, respiration rates, and ocean conditions during feeding.

We will study the whales by two methods. On some days, we will follow any sighted whales and on others we will follow a predetermined course and take note of when and where whales are sighted along this transect. When we are following a set course or transect, we will stop on a timed basis and take measurements of water salinity, depth, temperature, densities of fish, plankton and other elements, and correlate our whale sightings with this material.

At the same time, we continue our lectures and discussions on more complex topics such as whale intelligence, social behavior, songs and mating. Level B students may have an opportunity to use hydrophone equipment for analyzing and recording feeding sounds, or use video equipment to film feeding behavior and help identify individuals. Some possibilities for independent projects might include analyzing breaching behavior and its correlation with sea conditions, dive times and collective feeding, and humpback distribution compared to short-term fish densities.

At the end of the course, you will organize your findings to give an oral presentation to the group and visiting whale



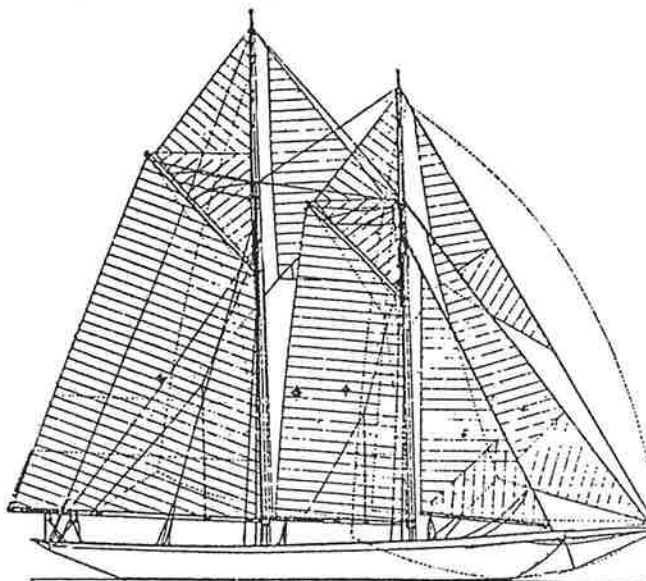
photo: Lars Jones

"...and you're trying to take data and say 'wow' at the same time!"

researchers. All the data you gather will contribute to larger research projects analyzing the conditions whales seek for feeding purposes. Thus, the work requires strict attention to detail and consistency to insure precise measurements. The chores for maintaining a 65'

schooner are also demanding. But when the sails are snapping in the wind overhead and you see your first whale breaching off the bow, you will recognize that every aspect of the course is an essential component of this unforgettable learning adventure.

"I felt a great sense of accomplishment when I presented my results, knowing I was the first person to perform that particular research study! There is so much we don't know about whales. I feel extremely fortunate to have gotten to know this beautiful and unusual animal." Kathleen Quindlen, Duke University



Living and Working Conditions

Most days we will be up before dawn and sail out for several hours, in time to witness the early morning whale activities. The boat is equipped with bunks for naps or overnighting on our all-night watches, but we will usually camp on shore, most likely on a small island in Boston Harbor. We will cook our own food at our campsites or in the ship's galley, and plan to make a few stops in seaport towns such as Gloucester and Provincetown for showers, laundry, etc.

The weather at sea is cool and almost always breezy, but we will avoid setting out in harsh or dangerous weather.

Faculty: Baxter
Course Levels, Dates: Level B—June 16-July 15 (30 days)
 Level A—July 24-August 22 (30 days)
Tuition: \$1290.
Departure Point: Boston, Massachusetts

TROPICAL RAIN FOREST ECOLOGY

The Amazon, the longest river in the world, flows 4,000 miles from the high Andes to the sea. It holds the lure of adventure and the unknown. Three million different species of plants and animals exist in tropical rain forests drained by the Amazon, although only about one-sixth of them have been identified and recorded. Twenty percent of all fresh water on the planet flows down it through Brazil. Ecuador, where the headwaters begin, is the size of the state of Colorado. Here, there are approximately 16,000 species of flowering plants — more than in all of the United States. Many endangered animals survive deep in these rain forests — monkeys, splendid tropical birds, thousands of frogs and other reptiles, and big cats such as the jaguar, ocelot, and panther.

However, a committee of the National Academy of Sciences has recently reported that “the tropical forests of the world are being altered so rapidly that most will not exist in their present form by the close of the century.” As a result of cutting down forests to build plantations and extract minerals, we are losing what we do not even know we have.

Perhaps even more importantly, changes in the rainforests affect the rest of the world. Tropical forests — covering much of Central and South America, Central Africa, South and Southeast Asia — help to maintain global temperature by controlling the amount of carbon dioxide in the atmosphere. Many of the rare trees and plants that are found only in these forests are the source of life-saving medicines.

The Amazon, Ecuador

Purpose: To study the extreme species diversity and interdependence of Amazonian rain forests, in order to assess the seriousness of erosion, deforestation, and species loss caused by encroaching human colonization.

At the moment, we can only guess the probable results if widespread deforestation continues. How long it takes for a type of forest to reestablish itself after clearing, and how local environmental factors (soil, erosion, humidity, wind) affect recovery rates, is still being investigated. The effect this cutting and burning of the forest has on species diversity seems quite damaging, however,

Research Focus: Which of certain environmental factors — slope angle, altitude, or drainage — are the most important determinants of how successfully forest dwelling birds, reptiles, primates, and plant and tree species are recovering from deforestation disturbances?

Course Design

The complexity of the rain forest is almost indescribable. We



photo: George Zimmerman

How do rain forests recover from widespread deforestation?



photo: Calvin Sperling

Penetrating a remote tributary of the Amazon in search of new species

are likely to encounter unknown plants, several hundred species of birds, numerous small mammals, tree ferns 70' tall, and minute orchids adapted for pollination by tiny mosquitoes. We will hear monkeys chattering in the treetops day and night, and giant frogs booming off in the distance. This new SFS course offers a rare opportunity to experience the inter-relatedness of plants, animals, and man — the web of life.

Upon arriving in Quito, Ecuador, high in the Andes, we will visit local markets to stock up on their unusual fruits and vegetables. Traveling by local bus, we will cross through the dry highlands and begin our descent down the east slope of the Andes toward the lush Amazon basin. Making a large transect from northwest to southeast, we will pass through an incredible diversity of habitats, from mountain peaks capped by glaciers down through wet, cool cloud

forests, and on to the high canopy rain forest of the Amazon lowlands in the Cayambe-Coca region.

This amazing diversity should trigger innumerable questions and encourage us to grasp the connections among species and systems. The rapid destruction of these different ecosystems by farmers, by road builders and loggers, and a huge oil pipeline running through the jungles to the sea, is readily apparent and obviously tragic. Finally our team will arrive at the study site deep in the forest. We may see an occasional thatched hut along the river, evidence of friendly local colonists or tribal peoples, but the area is sparsely populated. Beginning lectures will introduce plant and animal in-

teractions, ecological zonation, plant speciation, diversity of species, the effects of deforestation on forest ecosystems, history of exploration in the Amazon, and the concept of "refugia". The biology of rare plants at our main study site in the rain forest becomes deciphered through our early survey work, looking at altitudinal variation in plants and comparing the effects of deforestation on different species at different altitudes. Cutting trails through the dense brush and climbing trees to take samples, we will set out plots on the forest floor, and record the species present.

You will be trained to identify and press plants for return to botanical collections in the U.S., perform experiments on

forest erosion rates and sediment loads, do comparative studies of how a single species adapts to different disturbed habitats, and possibly undertake independent projects on the topics of recolonization of forests disturbed by man.

Although lowland forests may return within 100 years after clearing, high forests generally do not, because the mountains on which they grow erode rapidly due to lack of sufficient ground cover, causing the loss of valuable topsoil nutrients and creating wastelands. We will attempt to gather data on pollination and species diversity in areas that are recovering from deforestation, helping to compare highland habitat changes in the western Amazon to research conducted on plots in the Amazon basin 500 miles downstream.

Living and Working Conditions

At the higher elevations of our expedition, cool rains are common. Driving down through the highlands to the lowlands, the temperature and humidity will increase, with hot days and warm nights. We will make camp in protected clearings or farmlands, possibly spending a night in a native hut along the way, and establish a base camp for our study near one of the newly created national parks.

Faculty: Sperling

Course Level: B

Dates: July 24-August 24 (32 days)

Tuition: \$1450.

Departure Point: Quito, Ecuador

"By providing an opportunity to experience field work first-hand we increase the effectiveness of those who go into the natural resource field and prevent the expenditure of non-productive energy which would otherwise occur for those who find it is not to their liking." R. Michael Wright
World Wildlife Fund, U.S.

HAZARDOUS WASTE ISSUES

Hazardous waste issues are relatively new and highly complicated. In the past 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 sewerage, are not broken down naturally and absorbed by organisms. However, relatively little attention has focused on the buildup of toxins in marine ecosystems. This is the particular problem that will concern us in our new SFS course.

It is difficult to believe that Narragansett Bay is an endangered ecosystem. It is a place of tranquil beauty, favored by vacationers and naturalists alike. Approximately 15 miles wide by 25 miles high, it is an extremely productive estuary, lined with salt marshes, beaches, and dotted with rocky, forested islands. About 25% of the nation's shellfish and millions of pounds of the commercially taken whitefish come from Narragansett Bay.

Normally, these marshes and river mouths are the most biologically productive areas of the entire bay. But as one proceeds north up the bay from the open sea toward the old industrial city of Providence and the estuarine river system that feeds the bay, this purity dramatically shifts at about the three-quarters point where the waters have lost most of their oxygen. The number of species present in the waters drops off quickly, apparently the result of chemical and metallurgical industries dumping their effluents into the bay.

Narragansett Bay, Rhode Island

Purpose: To assess the effects of hazardous wastes on coastal shellfish and wetlands, in order to learn how regional planners can chart a safe but feasible course for future development around Narragansett Bay.



photo: Eric Klos

The idyllic New England coast is threatened by mounting toxic waste

Providence is often called the jewelry capital of the world, and is home to more than 1,000 jewelry shops and factories. This industry produces huge waste quantities of heavy metals (gold, silver, cadmium, nickel) from the electroplating process and discharges them into local rivers. One chemical plant in the area is estimated to discharge 1 ½ million gallons of toxic waste (including 130

exotic, inorganic chemicals) into the bay each year.

Research Focus: By analyzing the population dynamics of clams or shrimp as indicator species, can we determine where these populations are most reduced, and use that information to evolve a feasible and appropriate policy for economic development and marine resource use in Narragansett Bay?

Course Design

About 20 years ago, scientists found that heavy metals and many inorganic chemicals accumulate in various species at the lowest levels of the food chain, eventually passing them along to man. When

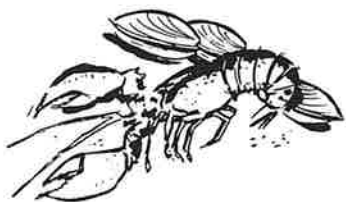
regulatory agencies set standards for safe and unsafe levels of toxic substances, they concentrated on monitoring buildup in the tissues of a number of "indicator" species — generally common clams or mollusks that are widely distributed, abundant, and easy to capture.

Recently, scientists have found that a different way to measure the effects of various sorts of pollutants on natural systems is to develop computer models representing the population dynamics of indicator species in particular habitats and locations. Now, in addition to knowing whether or not toxins are accumulating, we are interested in knowing what effects these toxins are having on species populations — especially those of economic importance to man.

Do these species effectively indicate different zones of toxicity within the bay, and if so, can these zones be managed accordingly? Are our models of how heavy metals circulate through several species in an estuary system accurate enough to allow us to formulate regional resource policy, or should other criteria be developed?

Early in the course, from our campsite on one of the rocky, forested islands in the bay, we will set out in motorized skiffs to make daily surveys of the bay, conducting a complete cross-section of its diverse makeup: rocky intertidal areas, mud flats, deep channels, shallow salt marshes, freshwater systems along riverbanks.

Lectures will cover marine taxonomy, coastal ecology, land use and marine resource planning, statistical analysis, population modeling, oceanography of estuaries and bays, public policy formation



and decision-making, and how political coalitions are built around an environmental issue.

Each day, we will work at established experiment sites to collect marine organisms (shrimp, mollusks, algae, whitefish) by netting, and record environmental data such as water temperature and salinity, wind, etc. We will carefully record our catch and take some of it to local laboratories for analysis by ourselves and technicians.

Narragansett Bay is one of the most heavily studied estuaries in the world. However, scientists at Federal government laboratories and at the University of Rhode Island have been working on

the bay's toxins for only a decade or so. At URI, huge water columns have been assembled that replicate conditions in the bay and contain representative samples of its life forms. By studying these unique "mesocosms" for several days, we can predict what changes would occur in the bay if and when various levels of pollutants enter the system.

The question we face in the mid-80s is not whether heavy metals accumulate in these systems, but rather, what can be done about it? This moves us beyond the realm of pure biological science into the arena of public policy issues during the second half of the course.

Once dangers to a system have been identified, how can

changes be brought about? For instance, how to encourage the reduction of heavy metals being dumped into the bay, and how to clean up materials already deposited there? Should the thriving fishing industry be controlled, since some of these animals are contaminated, and should they be banned from the market? Can even the huge \$1.3 billion "Superfund" legislation adequately address this type of regional problem? What role should the Environmental Protection Agency play here, relative to local agencies and non-governmental organizations? Lastly, what is the best regional policy to put into effect for the Narragansett Bay region at this time, to help it recover and become safe once again?

Living and Working Conditions

New England is justly famed for the beauty of its coastline. But throwing out nets and hauling in the catch from our small boats in every kind of weather will be hard work. And the weather is highly changeable, even in summer, from hot sun to cool rain and wind. Most of our time will be spent near or on the water, and in labs talking to researchers and policy-makers. We will sleep in tents on an island or on shore, preparing all of our meals from the supplies we bring with us, emphasizing low-impact camping.

Course Level: B

Dates: June 16-July 16 (31 days)

Tuition: \$1080.

Departure Point: Narragansett, Rhode Island



photo: Kenneth Andrasko

Experimenting with water columns that simulate conditions in the Bay

POPULATION DYNAMICS OF ENDANGERED SPECIES

Halfway between Greece and the shores of North Africa, the fabled island of Crete rises from the Aegean Sea. The large island provides a transition of biotypes from rugged mountain peaks down to olive groves and sandy beaches. Just off the north-west coast of Crete is the tiny island of Theodorou, home of the agrimi.

This wild goat permeates Mediterranean art and culture. For centuries it has been the symbol of Crete and is thought to be the prototype of all domestic goats. Its range once extended from North Africa to Afghanistan but today the agrimi barely holds onto survival. Folk tradition says that eating agrimi meat guarantees strength and long life. The horns, ground to a fine powder, are believed to be an aphrodisiac. These beliefs have resulted in poaching of the animals. Compounding this problem, the agrimi have overgrazed their habitat and now are on the brink of extinction.

Greek Islands

Purpose: To analyze the population and habitat needs of agrimi (the extremely rare wild goat of Crete), in order to assess survival strategies for the animal and retain viable genetic stocks.

Today, 100 pure-bred agrimi live on Theodorou Wildlife Reserve. Only one other band of agrimi is known to exist, in the Samaria Gorge National Park of mainland Crete's White Mountains. New

habitats are essential now, to relieve population pressures on Theodorou and to attempt establishing a second, protected herd.

Research Focus: Given our knowledge about the popula-

tion structure and carrying capacity of the agrimi habitat on Theodorou, can we select individuals for successful relocation to a suitably similar island, thereby establishing a new healthy and viable herd? What are the precise requirements of such an agrimi habitat?

Course Design

Studies conducted by our 1983 faculty in 1973-75 established baseline information on the ecology of agrimi on Theodorou. These studies found a population which, although adequately protected from poachers, is destroying its limited food source by overgrazing the plant community and altering the ratio of species present. For the



photo: Tom Husband

Can we find a habitat that will insure the agrimi's survival?



photo: Tom Husband

Censusing the population is the first step in saving the endangered agrimi

agrimi to survive, management of the population should be undertaken, with some animals translocated to other suitable habitats.

To help provide the information needed for successful management, students in the SFS course last summer conducted a comprehensive study of the agrimi population on Theodorou. A major element of our course this year will be to assess the suitability of Sapienza, an island near the Greek mainland, for the relocation of agrimi and possible park status. Following up on last year's highly successful project, we are seeking permission from the government of Greece to transport some of the animals from Theodorou to this potential new habitat some 20 miles south of Athens.

Though quite small, Theodorou and Sapienza are perfect laboratories for

measuring the effects of overgrazing in arid climates. This is a critical global problem resulting in erosion, desertification, and species diversity depletion. Therefore, while our work may contribute to a solution of the agrimi survival problem, it also addresses this larger issue.

Introductory lectures will explain concepts of demographic analysis, estimation of population parameters, and factors limiting abundance. Then, after reviewing the data from last summer on the agrimi population structure (distribution of its members across age and sex, numbers of newborn and fertile females, etc.), we will be ready to evaluate the potential alternative translocation site.

To begin, we conduct a thorough vegetation analysis

of Sapienza to determine its carrying capacity (how many animals its flora can support), species composition and numbers, and environmental characteristics. You will be trained in the habitat analysis techniques necessary for this work. We will lay out transects then count, collect, weigh, and measure plant biomass throughout the entire island. If the island does appear suitable, and the government approves, we will begin translocating the agrimi.

Traveling to Theodorou on local fishing boats, we train as a team for the round-up. We capture, tranquilize and carefully restrain the agrimi, then weigh, mark, sex, and age each individual, and place them in special cages provided by the government for this purpose. We then carefully move them by boat or plane from Theodorou to the mainland and then out to Sapienza. Releasing the animals under supervision, we observe how they begin to utilize their new home, and help insure that they have what is necessary to survive.

This is a critically small population of an endangered species. We will take every precaution to insure that no animals are lost in the translocation process.

Interspersed with our field work will be daily lectures and discussions. These will cover concepts of density, natality, mortality and ratios of sex, age, immigration and emigration; life tables; models of population growth, population cycles, energy flow and bioenergetics, factors limiting distributions; and current and potential management policy. Potential independent projects include the physiological ecology of agrimi, and this animal's unique ability to desalinate sea water.

"To this day nothing stands out more in my mind than the memory of standing there in the moonlight after the capture session, with sweat pouring out of my body, muscles aching, grinning from ear to ear. This was why I had come. My heart and head are in wildlife biology."

Paul Ricard
University of Rhode Island

Living and Working Conditions

The climate of these islands is true Mediterranean, with almost no rainfall from spring through fall. Temperatures in summer often exceed 100°F near sunny coastal areas, although sea breezes help to moderate the heat. As fresh water is naturally absent from the islands, we will cache drinking supplies throughout their craggy landscapes.

Vegetation analysis can become tedious at times but the work with the animals will require strength, speed, and skill. There may be some time to visit mainland villages to buy supplies in their markets, or a foray to archaeological ruins. In this course, flexibility is particularly important, since our proposed work depends on the cooperation of Greek officials.

Course Levels, Dates: Level A—June 16-July 16* (31 days)
Level B—July 24-August 23 (31 days)

Tuition: \$1420.

Departure Point: Chania, Crete

*tentative

CORAL REEF ECOLOGY

Coral reefs are incredibly complex formations, supporting a tremendous variety of plant and animal species playing out the endless cycle of predators and prey. Vast schools of multicolored fish swim among corals of every shape and size. A single coral can grow to 20' tall while others are almost microscopically tiny.

The reefs, calcified skeletons of the living coral animal, have been built up over centuries. They appear massively solid, but are actually extremely fragile. In some areas, reefs appear to be rapidly degrading due to commercial development pressures and damage from boat traffic, tourists and divers, and man-made pollutants. Because of the unique role they play in sustaining life in the sea, determining what factors affect the health of coral reefs, and how well they recover from damage, have become serious concerns.

St. John, Virgin Islands

Purpose: To map, measure, and identify fragile coral and seagrass formations in an underwater national park to aid in their protection.

Some scientists have recently suggested that light intensity is one of the most significant factors in determining where and how corals grow. Soil runoff and sludge associated with development seem to limit the amount of light penetrating the sea, and tend to prevent corals from feeding efficiently.

Research Focus: Is competition among coral species on patch reefs in Lameshur Bay affected by varying available

light intensity and by increased siltation and water murkiness? Would less sediment from erosion runoff, and would higher levels of light encourage full recovery of coral polyps and colonies?

Course Design

Our base of operations on St. John will be VIERS (the Virgin Islands Ecological Research Station), a small research station on Lameshur Bay at the isolated southeast corner of the island. VIERS is on the edge of a tropical forest ringed by sandy beaches. Upon arrival, June team students will be offered a full SCUBA certification course, while July and August students will refresh their SCUBA skills.

The first few days' dives and hikes around the area will introduce everyone to the many different environments of this island paradise: mangrove stands, exposed shores, sandy lagoons, and coral reefs, as well as the jungle forests where hibiscus, frangipani, and bougainvillea make a brilliant display. Following the appropriate snorkeling or

diving instruction, you will immediately set out to survey a nearby reef. Swimming through the turquoise waters, you begin to comprehend the scope and extraordinary beauty of this unusual undersea park.

After talking over your initial reactions and questions, the faculty will outline methods for studying organisms underwater. The June team will study feeding behavior, habitat preference, associations with other organisms, and morphology (form and structure). The July and August teams will examine all of these as well as locomotion and coloration, photosynthesis in corals and algae, and community and colony systems organization.

Daily blackboard talks and field lectures throughout the course will be divided into three sections: taxonomy, habitat description, and ecology. Following lectures, we move into the field to observe and experiment — charting the growth or decay of massive brain corals, exotically shaped staghorns, lacy fans, all in vibrant hues of pink, blue, green, yellow, and red; and armies of sea urchins spreading slowly but inexorably over corals and seagrasses, devouring them bit by bit.



Hands on learning underwater

photo: Christopher Neefus

"This has been a great learning experience for me as a student and as a person. I've learned about coral reefs, tropical species, mangrove swamps, and island ecology."
William Connors, University of Pennsylvania



Our research team setting off on an underwater study

photo: Kenneth Andrasko

By the second week, we will resume work on a baseline study begun by SFS teams last summer for the National Park Service. In this survey, we are seeking to ascertain the natural state of the reef area. This enables us to see the effects of events such as hurricanes as well as how the increase in human activity has an impact on the ecosystem.

Two years ago, we studied algal and seagrass photosynthesis. Last year, we mapped out and surveyed areas of coral reef, thalassia, (turtle

grass), and sand flats, and the rate of sea urchin invasion of Little Lameshur Bay.

Building on our previous transect work, we will place meter-square quadrats at specific intervals along the transect lines. Working closely as an underwater team, some students record the type and percent of bottom cover while others photograph or lay out the route ahead. Everyone will be trained to use the tools

and equipment as well as special hand signals and underwater communication.

The Park Service has recently shown increased interest in determining how best to study the effects of increasing siltation in Lameshur Bay. We expect to determine the best sites for new study plots to compare pristine and heavily sedimented patch reefs and sea grasses. These new plots will require tagging of species, accurate species maps, and measurements of how much light reaches the ocean floor, using underwater photometers for our calculations.



As the course progresses, you may have an opportunity to develop an independent project, either as an individual or with a small group. July and August students in particular may engage in projects supplementing the primary research project, possibly concentrating on coral competition under different light conditions, sedimentation effects, or the growth of a single species.

As we come to the end of our work, each team will analyze its results and try to determine what effect heavy siltation has had on our test plots. We will make recommendations to the park service for more specific, in-depth experiments on particular coral species. The results of our light intensity study, combined with those of the baseline survey, should indicate which areas of the bays are most

susceptible to further damage, and therefore need care and attention.

Living and Working Conditions

The mean annual temperature is 79°F, ranging from extremes of 65°F-95°F. Most of the rainfall occurs during the summer, but water shortages are frequent since the non-porous clay 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.

Faculty: Brody

Course Levels, Dates: Level A—June 10-July 1 (22 days)
Level B—July 5-29 (25 days)
or—August 2-26 (25 days)

Tuition: Level A—\$1490. + \$100 SCUBA fee
Level B—\$1540.

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 course.

JANUARY 1985: To meet the needs of students who want academic credit or valuable experience during the January intersession, SFS offers a course on marine science on St. John following the above outline. Details are available upon request.

FACULTY—1983-84

A.B. Adams
Ph.D., University of Washington

Kirtland M. Barker
M.S., Environmental Studies,
Yale University
Consultant in Micrographics
Biology Department
Yale University

Benjamin A. Baxter
M.Ed., Secondary Science
Education, University of Maine

Michael J. Brody
Ph.D. (in progress), Science
and Environmental Education,
Cornell University
Teaching and Research Assistant
Cornell University

Jill L. Bubier
J.D., University of Maine Law
School
Instructor
Outward Bound

John Calambokidis
B.S., Biology, The Evergreen
State College
Research Biologist
Cascadia Research Collective

David Bruce Campbell
Ph.D., Zoology, University of
Rhode Island
Zoology Instructor
University of New Hampshire

Carole Carlson
M.A., Biology, Bridgewater State
College
Assistant Scientist
Provincetown Center for
Coastal Studies

Kevin Chu
Ph.D. (in progress), Boston
University
Biology Instructor
Boston University

Margaret Clarke
Ph.D., Anthropology, University
of California, Davis
Adjunct Professor
Environmental Studies
Rollins College



photo: Kenneth Andrasko

Ellen Crane

Barry A. Costa-Pierce
Ph.D., Oceanography, University
of Hawaii
Aquaculture Consultant
Waimanalo, Hawaii

Ellen Elizabeth Crane
B.S. *magna cum laude*, Botany,
University of New Hampshire
Fisheries Technician
Massachusetts Cooperative
Fisheries Research Unit.

Phillip B. Davis
Ph.D., Resource Development,
Michigan State University
Assistant Professor
Natural Resource Management
University of Nevada



photo: © Gary Braasch

A.B. Adams

Pierre K. Dawson
B.A., Biology, The Evergreen
State College
Research Biologist
National Marine Fisheries

Ned Fetcher
Ph.D., Range Science, Colorado
State University
Research Associate
Botany Department
Duke University

Thomas P. Husband
Ph.D., Wildlife Ecology,
Michigan State University
Assistant Professor
Natural Resources Science
University of Rhode Island

Don R. Levitan
Ph.D. (in progress), University of
Delaware
Staff Scientist
Sea Education Association

Donna Manders
B.A., The Evergreen State
College
University of Oregon Marine
Biology Institute

Margaret Mayer
M.S., Botany, University of
Rhode Island

Evelyn Merrill
Ph.D. (in progress), University
of Washington
Wildlife Research Biologist
Bureau of Land Management

"We feel that this has been the best teaching experience in our careers. All the students have a better understanding of what it's like to actually be a scientist working in the field, and the glamour of a Cousteau special has given way to a more realistic, mature understanding." Bob Singer, Faculty, Acid Rain and Limnology

Peter S. Meyer
Ph.D., Geological Oceanography,
University of Rhode Island
Research Assistant
Woods Hole Oceanographic
Institute

Karen L. Oakley
M.S., Biology, University of
Alaska
Research Analyst
Alaska Department of Natural
Resources

Kenneth J. Raedeke
Ph.D., Wildlife Ecology,
University of Michigan
Research Assistant Professor
College of Forest Resources
University of Washington

Deborah Ann Roberts
M.S., Rensselaer Polytechnic
University
Teaching Assistant
Rensselaer Polytechnic Institute

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



photo: Jim Elder

Carole Carlson

Haraldur Sigurdsson
Ph.D., Petrology and Geology,
Durham University, England
Professor of Oceanography
University of Rhode Island

Javier A. Simonetti
Ph.D. (in progress), University of
Washington
Instructor
Dept. of Environmental and
Population Biology
University of Chile



photo: Kenneth Andrasko

Ben Baxter

Robert Singer
Ph.D., University of Illinois
Research Associate
Syracuse University

Calvin R. Sperling
Ph.D. (in progress), Harvard
University
Teaching Fellow Biology
Harvard Botanical Museum

Brad Stelfox
Ph.D. (in progress), University of
Alberta
Environmental Consultant

Barbara L. Taylor
B.A., Biology, The Evergreen
State College
Research Biologist
National Marine Fisheries

Krag Unsoeld
B.A., Political Economy, The
Evergreen State College
Journalist

Joanne Young
B.Sc., The Evergreen State
College
Field Biologist
Point Reyes Bird Observatory

Evan Zucker
Ph.D., Psychobiology/Psychology,
Emory University
Visiting Assistant Professor
Psychology
Rollins College

ORGANIZATION

BOARD OF TRUSTEES

Terry A. Herbert-Burns, Chairman
Trustee
The Day School
New York, New York

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

Roy A. Hunt, III, Ed.D., Secretary
Clinical Psychologist
Boston, Massachusetts

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

G. Randolph Bevis, LL.B.
President
Interactive Data Services, Inc.
New York, New York

Susanne LaC. Phippen
Wenham, Massachusetts

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

Richard B. Wilson
President
Wilson Laboratories
Boston, Massachusetts

BOARD OF ADVISORS

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

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

Christopher Neefus, Ph.D.
Office of Biometrics
University of New Hampshire
Durham, New Hampshire

Arthur Page, L.L.B.
Attorney
Boston, Massachusetts

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

Ala Reid
Director
Theodore Edson Parker
Foundation
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

Astra Davis
Bal Harbor, Florida

Travers Evans
New York, New York

Gail Hunt
Boston, Massachusetts

Sara Jenkins
New York, New York

Charles McKee
Portland, Maine

Rolando Perez
New York, New York

Arthur Phillips
Ipswich, Massachusetts

Lisa Rosenbaum
Cambridge, Massachusetts

Jay Stack
Cambridge, Massachusetts

Robert J. Stapleton
New York, New York

Walter Wood
Southampton, New York

ADMINISTRATIVE STAFF

James L. Elder, Jr.
Director

Kenneth Andrasko
Program Director

Michael Calmes
Public Information Director

Andrea C. Walgren
Admissions Director

Louisa Peck
Admissions Assistant

Anne M. Shuhler
Program Assistant

Printing: Bradford & Bigelow, Inc.
Photography: SFS students, faculty,
and staff
Editorial Assistant: Louisa Peck

Special thanks to the staff of Epsilon
Data Management, Inc.

The following are considered founding institutions in view of their substantial contributions toward the School's development:

Andreas Foundation
Cabot Family Charitable Trust
Roy A. Hunt Foundation
Richard K. Mellon Foundation
Merck Family Fund

These organizations have made contributions to the School's scholarship fund or to SFS students:

CIGNA Corporation
Explorers Club
Lakeview Fund
Morehead Foundation
Polaroid Foundation
TRW, Inc.



SCHOOL FOR FIELD STUDIES

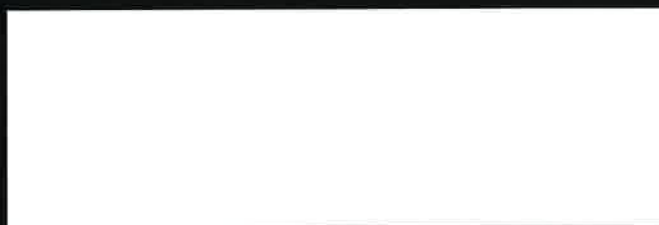
50 Western Avenue • Cambridge, MA 02139 • (617) 497-9000

SCHOOL FOR FIELD STUDIES

50 Western Avenue
Cambridge, MA 02139
(617) 497-9000



NonProfit Org.
U.S. Postage
Paid
Permit No. 50592
Cambridge, MA



1984 Course Sites

SCHOOL FOR FIELD STUDIES

50 Western Avenue • Cambridge, MA 02139 • (617) 497-9000