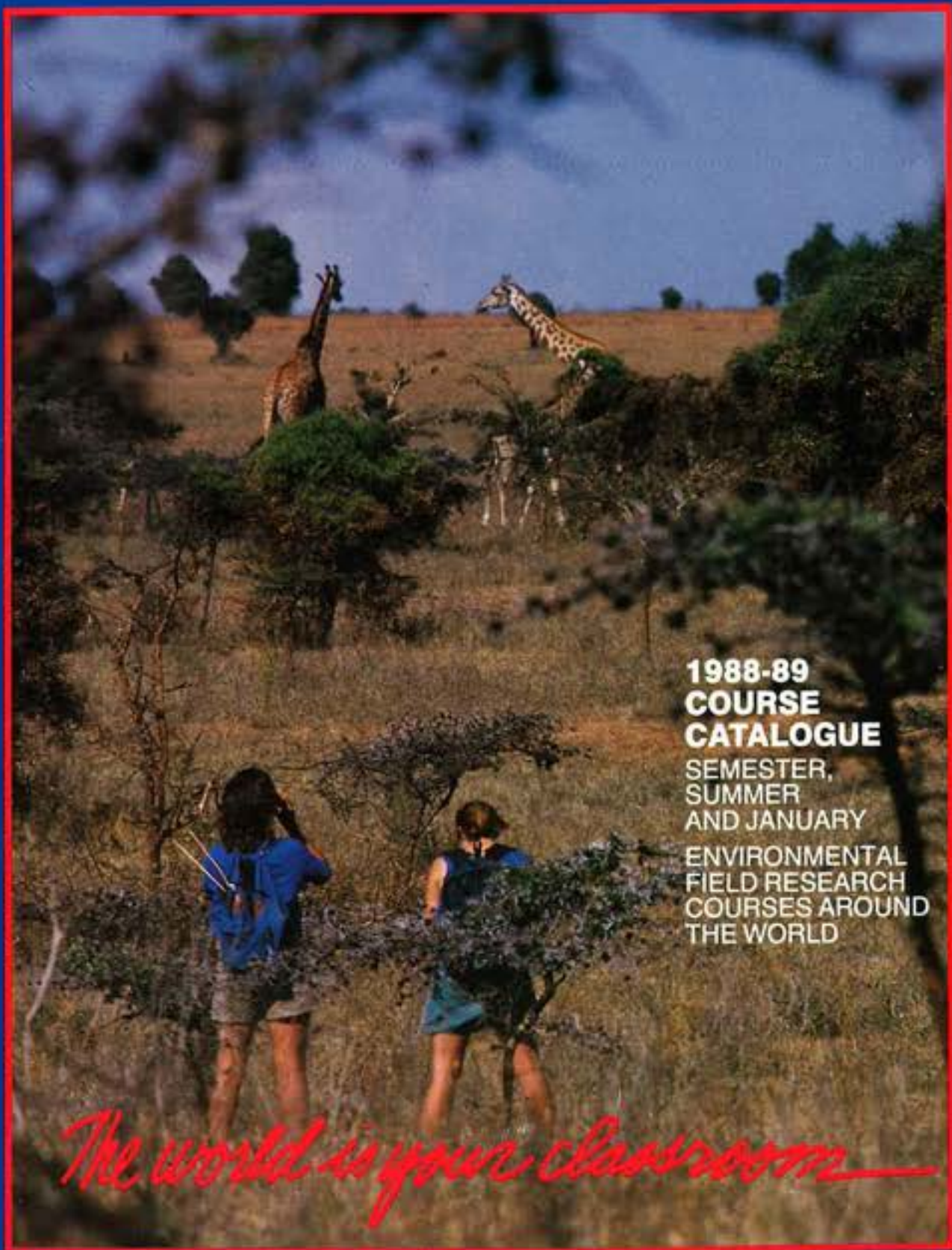


THE SCHOOL FOR FIELD STUDIES



**1988-89
COURSE
CATALOGUE**

SEMESTER,
SUMMER
AND JANUARY
ENVIRONMENTAL
FIELD RESEARCH
COURSES AROUND
THE WORLD

The world is your classroom

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Elsen Karstad

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Anne Busse

1988-89 Curriculum

Wildlife Ecology and Management

SFS Center for Wildlife Management Studies/Kenya

Wildlife Ecology and Management	■	■				
Wildlife Management						
Ecology of Bald Eagles/Alaska						
Veterinary Ecology: Pronghorn Antelope						
Population Collapse/Wyoming						
Cultural Ecology: Conflicts in Ecological Management/Himalayas						

Marine Biology and Management

SFS Center for Marine Ecosystem Studies/Virgin Islands

Marine Biology and Management	■	■				
Coral Reef Ecology						
Marine Parks Management						
Ecology of Toxic Reef Fishes						
Conservation Biology: Sea Turtle Survival/ Gulf of Mexico						
Coastal Ecology: Habitat Assessment for Monk Seal Recovery/Sardinia						
Marine Pollution: Impacts on Seabird Ecology/Scotland						

Plant Community and Ecosystem Ecology

SFS Center for Rainforest Studies/Australia

Biogeography: Patterns of Ecological Diversity	■	■				
Tropical Species Diversity						
Tropical Ecology: The Dynamics of Deforestation/ Costa Rica						
Ethnobotany: Discovering New Plant Medicines/Ecuador						
Acid Rain: Changing Aquatic Ecosystems/Adirondacks						
Landscape Ecology: Designing Parks for Preservation/ Colorado Rockies						

Center for Northern Studies/Vermont

Resource Management: The Changing Environments of the Circumpolar North

Animal Behavior and Conservation

SFS Center for Marine Mammal Studies/Baja, Mexico

Marine Mammal Biology and Conservation	■	■				
Biology and Behavior of Bottlenose Dolphins/ Gulf of Mexico						
Endangered Monkeys: Experimental Social Ecology/Panama						
Social Ecology of Spinner Dolphins/Hawaii						
Dynamics of a Recolonizing Species: Alpine Ibex/Switzerland						
Humpback Whale Ecology/North Atlantic						

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Level B: June 6 - July 5
Level A: July 1 - 30
Level B: July 26 - August 24

Courses

We have built our educational model on the examination of a particular environmental problem or issue—such as acid rain, wildlife management or deforestation—while structuring our courses around traditional academic disciplines including wildlife biology, tropical ecology, animal behavior, and marine biology. Each problem we investigate exceeds the limits of a clear, text-book case as we consider a complex network of interrelated social, biological and technological processes. All SFS courses offer participants the opportunity to observe and participate in local issues while our semester programs expand that opportunity as we situate these issues within their global context.

SFS courses are structured, intense academic endeavors. All SFS programs are accredited for college credit (for information on college credit see page 46). Each course incorporates lectures, assigned readings, critical reviews of current research papers, independent projects and presentations, and exams. Training in field research methodology leads to long, often arduous hours of data collection using SCUBA diving, tracking, censusing, capturing or any of a dozen other methods.

Research

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

'Doing' science is more challenging than reading about science. We think of science as a verb—an action word—not a noun. Each course concludes with a final report, many of which have been published in scientific literature (see page 46). Examples of research projects include: the effects of human generated activity on whales and seals, the impacts of hazardous waste on shellfish populations, the variability in giraffe feeding behavior on a Kenyan wildlife ranch, and the ecology of pharmaceutical plants growing in the Ecuadorian Andes.

"Thank you SFS for a 24 hour a day learning experience—from learning how to brush my teeth in the woods to identifying trees and plants to a lecture on lotic systems to making pizza on a Coleman stove—it was a real lesson in immersion." Kristin Steinmetz, Trenton, NJ • Haverford College (Photo: © Gary Braasch)

What Is SFS?

Since 1980, The School for Field Studies has launched more than 125 student *research teams* in unique *field-based courses* throughout the world, immersing students directly in the *ecosystem* they are studying and teaching them the *skills* they will need to address critical environmental issues.

SFS operations span five continents. SFS faculty and students conduct research year-round at the SFS Center for Marine Ecosystem Studies in the Virgin Islands, the SFS Center for Rainforest Studies in Australia, and the SFS Center for Wildlife Management Studies in Kenya. The SFS Center for Marine Mammal Studies will begin operations in the Fall of 1988. These sites offer opportunities for longterm, ongoing research studies for both short term and semester participants. In addition, over a dozen SFS month-long courses operate from mobile bases, affording an unparalleled opportunity to locate our studies in ecosystems offering the most dramatic illustration of the issue we are considering.

Field Based Curriculum

The world is your classroom—and the best of all possible laboratories. By situating our courses in the midst of carefully chosen ecosystems, we have an unequalled opportunity to immerse ourselves in real-life illustrations of what we only imagined in classroom lectures. Facts and theories come to life in a way that textbooks can't match. Much of our work—our wildlife management research in Kenya, our behavioral studies of primates in Panama—requires special permits, affording us access to sites and experiences not available to tourists. Living within the ecosystem we are studying affords us an opportunity to experience firsthand the ecosystem's delicate balances and interactions.

Skills

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



Teams

SFS team sizes range from 14 students and two faculty on month-long courses to 24 students and four faculty on semester programs.

As an SFS participant, you become an active member of the team, involved in all aspects of our research and day-to-day living. This team approach to learning and problem solving is at the heart of the SFS educational philosophy and is one of our greatest strengths. Working with new people from many different backgrounds under demanding conditions teaches us something about ourselves, how we relate as members of a team, how we adapt to new people and different environments. Living and traveling together, whether for 30 days or 12 weeks, presents many challenges. As we have a great deal of work to accomplish in a limited time, there is little opportunity for extended ventures on your own yet you will have time to yourself for personal reflection.

A sense of comradeship builds daily as we share tasks—setting up camp, cooking, tackling a challenging aspect of the research or sharing thoughts at the end of a long day. Not the least of the benefits of an SFS course is the strong network of friendships that grow from sharing special experiences and working toward a common goal.

Students from public and private high schools, colleges and universities, from science as well as liberal arts majors, and from across North America and many foreign countries have contributed to the success of SFS research teams. Approximately 30% of these students are recipients of SFS financial aid awards (see page 47 for financial aid information). Ranging in age from 16 to 27, all share a desire to learn more about the natural world.



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



"I expected some of the awkwardness of getting to know new people, and envisioned the silence that is present in a group that doesn't know what to say to each other. There was not a trace of that, only an air of eagerness and excitement." David John Cornet, Olmstead Falls, OH - Cleveland State University (Photo: William McComas)

Team Profile

July, 1987

Faculty:
Deborah Roberts,
Ph. D.

School/Major:
Rensselaer Polytechnic
Institute (Biology)

Robert Singer, Ph.D.

University of Illinois
(Limnology)

Students:

Darryl Beasley
Boston, MA

Hampton University
Sr./Marine Science

Cyrus Boga
Karachi, Pakistan

Hamilton College
Jr./Chemistry

Cheuk Kwong
(Stephen) Choy
Brooklyn, NY

Edward R. Murrow H.S.
Junior

Heather Knight
W. Greenwich, RI

Lincoln School
Junior

Carolyn Muller
Stonham, MA

Framingham State College
Sr./Environmental Biology

Philip Nolan
Dayton, OH

Wright State University
Soph./Geology, Geography

Jane Payeur
Portland, ME

University of Southern Maine
Jr./Earth Science

Kristin Steinmetz
Trenton, NJ

Haverford College
Soph./Religion

David White
El Paso, TX

Tulane University
Sr./Political Economics

"Acid Rain/Adirondacks"

Interests:

Resident Faculty—SFS Center for Marine Ecosystem Studies: SFS Acid Rain faculty for 5 years. Interests include running, camping and sailing.

Former SFS Dean; Field Director—SFS Center for Marine Ecosystem Studies; Head of EPA Review Panel—Long-term Acid Rain Monitoring Program. Enjoys windsurfing, running and sailing.

Boy Scout; joined SFS to gain competence in the field.

Academic award winner; member Hamilton Economic Council; seeking hands-on experience.

Honor roll; Junior Academy of Science; conducted acid rain research at school.

Member Natural Science Field Club, writes for school literary magazine; cross-country runner.

Interests include SCUBA, horseback riding; SFS will allow her to "live and work outdoors."

Cyclist; member Sierra Club, Greenpeace; interested in potential connection between Ohio coal and acid rain.

ROTC; Amateur meteorologist and astronomer; hopes to continue her research after SFS course.

American Friends Service Committee; avid gardener; wants to learn how she "can make a difference".

Explorer, camper; works at college radio station; sees SFS as a means of getting ahead in his career.

Lisa Ballance, M.Sc. (California State) Ph.D. candidate (University of Arizona) Marine Science. *Dolphin Biology and Behavior, Ecology of Spinner Dolphins.*

Dusty Becker, MFS (Yale), Ph.D. candidate (Cambridge University) Wildlife Biology. *Wildlife Biology and Management, Recovery of Endangered Species.*

Ilze Berzins, Ph.D. (University of California-Berkeley) Zoology. *Coral Reef Ecology.*

Douglas Boyce, M.S., Ph.D. candidate (Brigham Young University) Zoology. *Ecology of Bald Eagles.*

Kevin Chu, M.S., Ph.D. candidate (Boston University) Biology. *Humpback Whale Ecology.*

Frank Cipriano, M.S. (California State) Ph.D. candidate (University of Arizona) Marine Science. *Dolphin Biology and Behavior, Ecology of Spinner Dolphins.*

Geoffrey Clarfield, M.A. (University of Toronto) Anthropology. *Wildlife Ecology and Management.*

Robert Dickey, Ph.D. (Southern Illinois University) Psychology and Plant Biochemistry. *Sources of Reef Fish Toxins.*

Gordon Duff, Ph.D. candidate (James Cook University) Botany, Biochemistry. *Biogeography: Patterns of Ecological Diversity.*

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

Paul Garber, Ph.D. (Washington University) Anthropology. *Endangered Monkeys: Experimental Social Ecology.*

Nicky Goudberg, Ph.D. (James Cook University) Zoology. *Resident SFS faculty. Biogeography: Patterns of Ecological Diversity, Tropical Species Diversity.*

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

Donald Hazlett, Ph.D. (University of Washington) Forest Ecology. *Deforestation-Tropical Rainforests.*

Jim Heimlich-Boran, M.S., Ph.D. candidate (California State) Marine Science. *Dolphin Biology and Behavior.*

Stuart Innes, Ph.D. (University of Guelph) Environmental Physiology. *Dolphin Biology and Behavior.*

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

Patricia King, Ph.D. (University of Georgia) Zoology. *Deforestation-Tropical Rainforests.*

Chris Kohler, Ph.D. (Virginia Polytechnic Institute) Fisheries Management. *Sources of Reef Fish Toxins.*

Robert Lehman, M.Sc. (University of California) Wildlife Biology. *Ecology of Bald Eagles.*

Suzanne Macy Marcy, Ph.D. (University of Washington) Animal Behavior. *Behavioral Dynamics of Harbor Seals.*

1987-88 Faculty

(Partial Listing)

SFS faculty are special people. Selected for their extensive teaching and field experience, knowledge of the research and strong interpersonal skills, they are carefully chosen from hundreds of applicants worldwide. Complementing their strong backgrounds in the sciences (the majority hold Ph.D.s) are a broad range of skills and experiences that qualify them to lead SFS courses. Research conducted by members of our faculty has resulted in hundreds of published scientific articles documenting research funded by National Geographic, NATO, the National Science Foundation, U.N.E.S.C.O., and the EPA. The success of SFS programs in effectively challenging you intellectually, physically and socially, and in building your self-confidence and self-reliance, can in large measure be attributed to our outstanding faculty.

Beth Mathews, M.S. (University of California) Marine Science. *Humpback Whale Ecology.*

A.V. Milewski, Ph.D. (Murdoch University) Ecology. *Resident SFS faculty. Wildlife Ecology and Management, Wildlife Management.*

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

Sharon Nieukirk, B.S. (Guilford College) Biology. *Humpback Whale Ecology.*

Mark Noble, Ph.D. (Australian National University) Biogeography. *Field Director, SFS Center for Rainforest Studies. Biogeography: Patterns of Ecological Diversity: Tropical Species Diversity.*

Reed Noss, M.S., Ph.D. candidate (University of Florida) Wildlife Ecology. *Parks for Preservation.*

Jan Ostman, M.S., Ph.D. candidate (University of California) Marine Science. *Dolphin Biology and Behavior.*

Erv Peterson, Ph.D. (University of Michigan) Natural Resource Management. *Biogeography: Patterns of Ecological Diversity, Tropical Species Diversity.*

Kristine Plowman, Ph.D. (University of Queensland) Zoology. *Biogeography: Patterns of Ecological Diversity.*

Tony Povillitis, Ph.D. (Colorado State University) Wildlife Biology. *Parks for Preservation.*

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

Shelly Raven, M.A. (California State) Ph.D. candidate (University of California) Anthropology. *Marine Biology and Management.*

Deborah Roberts, Ph.D. (Rensselaer Polytechnic Institute) Biology. *Resident SFS faculty. Marine Biology and Management, Acid Rain: Changing Aquatic Ecosystems. Marine Parks Management.*

Paul Siegel, Ph.D. (University of California-Santa Barbara) Population Biology. *Field Director, SFS Center for Wildlife Management Studies. Wildlife Ecology and Management.*

Bob Singer, Ph.D. (University of Illinois) Limnology. *Field Director, SFS Center for Marine Ecosystem Studies. Marine Biology and Management, Acid Rain: Changing Aquatic Ecosystems. Marine Parks Management.*

Geoffrey Smith, M.S. (University of Queensland) Zoology. *Biogeography: Patterns of Ecological Diversity.*

Susan J. Staniforth, M.Sc. (Simon Fraser University) Environmental Education. *Biology and Behavior of Bottlenose Dolphins.*

Janet Stein, M.A. candidate (Moss Landing Marine Laboratory) Marine Biology. *Population Dynamics of Harbor Seals.*

Michael Stuwe, Ph.D. (University of Bielefeld) Ecology. *Recovery of Endangered Species.*

Steven Swartz, Ph.D. (University of California) Biology, Marine Science. *Humpback Whale Ecology.*

Ward Testa, Ph.D. (University of Minnesota) Ecology. *Population Dynamics of Harbor Seals.*

Josef Treggor, B.S. (Central Connecticut State University) Biology. *Humpback Whale Ecology.*

Werner Wilbert, Ph.D. (University of California) Anthropology. *Medicinal Botany.*

David Wilkie, Ph.D. (University of Massachusetts) Wildlife Biology. *Wildlife Ecology and Management.*

John Winter, Ph.D. (University of Queensland) Zoology. *Biogeography: Patterns of Ecological Diversity.*

Bernd Wursig, Ph.D. (State University of New York) Behavioral Biology and Ecology. *Ecology of Spinner Dolphins.*

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

Day Wilkes, Picayune, MS - Mount Holyoke College.



(Photo: Dave Jolly)

Faculty Profile Dennis Rasmussen

**Course Director: Endangered Monkeys:
Experimental Social Ecology.**

Education: A.B. (Psychology) with high honors, Humboldt State University; M.A., Ph.D. (Comparative Psychology) University of California—Riverside; Post-Doctoral Fellow—Darwin College, Cambridge University.

Teaching and Research: Humboldt State University; University of California—Davis; California State University; Smithsonian Tropical Research Institute, Panama; University of Wisconsin Primate Research Center.

Field Research: Olive and yellow Baboon study, Tanzania (with Dr. Jane Goodall); Social/sexual behavior of Bonnet Macaques, California Primate Research Center; Panamanian Tamarin Monkey study, Panama.

Published: Over a dozen scientific research papers on Primate Behavior and Ecology in journals including *Animal Behavior*, *Folia Primatologica*, *International Journal of Primatology*.

Personal: Age 38, married; 2 sons. Dr. Rasmussen initiated the SFS Panamanian Tamarin study in 1985. He was selected for a 3 year N.I.H. Senior National Research Service Award to study Macaque behavior and biology at the Wisconsin Regional Primate Research Center. Dennis now lives in Madison, Wisconsin, just a short walk from the zoo that he and his sons visit regularly when he's not in the jungles of Panama.



(Photo: Chris Galligan)

Faculty Profile Deborah Roberts

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

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

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

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

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

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

Personal: Married; Dr. Roberts grew up on a farm in the Adirondacks on the edge of Lake George and is an avid sailor, camper and skier, and an accomplished runner. Deb holds the record for longest teaching tenure with SFS—6 years.



(Photo: Kim Kamborian)

Faculty Profile David Neill

Senior Faculty: Ethnobotany:
Discovering New Plant Medicines/
Ecuador.

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

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

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

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

Personal: Dr. Neill resides in Quito, Ecuador but spends much of his time at Jatun Sacha, the tropical rainforest preserve he is developing as a research station. He is a member of numerous professional societies in the U.S. and Latin America; is fluent in Spanish, and has a working knowledge of several other languages.

Curriculum

SFS programs allow you first hand study of an international environmental issue through the mastery of essential field techniques. Learning is intensified as we work closely with faculty while we live day to day in the ecosystem we are studying.

The SFS curriculum addresses four areas of critical environmental concern; Animal Behavior and Conservation, Marine Biology and Management, Wildlife Ecology and Management, and Plant Community and Ecosystem Ecology. We have established four research centers which provide the facilities and support necessary for students and faculty to engage in longterm ecosystem studies within these disciplines.

The SFS Center for Marine Ecosystem Studies/Virgin Islands

The SFS Center for Marine Mammal Studies/Baja, Mexico

The SFS Center for Rainforest Studies/Queensland, Australia

The SFS Center for Wildlife Management Studies/Kenya

The SFS Centers are the site of two 12 week semester programs as well as month-long summer courses. In addition, month-long courses are taught at over a dozen mobile locations which offer dramatic illustrations of the issue under study. Semester participants have the unique opportunity to actively integrate semester coursework in a global context, placing the environmental issue under study within a larger framework of social, economic and political concerns. Month-long participants examine these critical issues in a local context, focusing on a specific research problem relevant to the ecosystem.

Each SFS course is designed to match or exceed the academic content and rigor of an equivalent course taught on a college campus. A detailed syllabus, prepared for each program, describes academic and research objectives, and includes information on the site, necessary personal equipment, medical, visa and travel information. At the end of your course, we expect you to have the skills—and the questions—to continue your own search for answers.

One of the goals of SFS courses is to develop your ability to implement methods of observation, measurement, recording, interpretation and analysis in the

biological sciences. SFS courses offer exposure to some or all of the following methods:

- ☐ plant/animal identification
- ☐ remote sensing
- ☐ LANDSAT photo-imagery
- ☐ quadrat and transect analyses
- ☐ computer modeling
- ☐ experimental design
- ☐ resource sampling and assessment
- ☐ scientific report writing
- ☐ behavioral observation techniques
- ☐ statistical analyses
- ☐ population modeling
- ☐ survey and census techniques
- ☐ photographic recording
- ☐ hydrophonic recording
- ☐ standing crop measurement

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

SFS Semester Programs

Each SFS semester program enrolls 18-24 students in a series of five rigorous, carefully designed courses, fully equivalent to any college-level course on the same subject. Courses are linked by a common focus on the flora, fauna, and human populations comprising the critical ecosystem under study. These must be considered together in any plan to evaluate or preserve natural habitats and wildlife populations. This link is explicit in **Directed Research**. Within this capstone course, students integrate all coursework with independent (or small team) investigations focused within key environments.

You will complete the equivalent of 22-23 quarter hours (16 semester hours) of college studies through a series of five courses, involving lectures, discussions, assigned readings, papers, literature critiques, training in field techniques, and extensive first-hand experience. There also will be ample exposure to the people and culture of the area, as well as training in field anthropology.

"I now have an appreciation of what its like to be a field biologist. I no longer feel what scientists do is alien and unreachable to me. I don't even think I saw scientists as regular people until this course."
Rima McCoy, Bronx, NY - Oberlin College
(Photo: William McComas)

Courses

Each SFS semester program incorporates five of the following seven courses:

- 1) Introduction to Exotic Ecosystems
- 2) Population and Community Ecology
- 3) Wildlife Biology and Management
- 4) Cultural Ecology
- 5) Environment and Society
- 6) Principles of Resource Management
- 7) Directed Research

Although course titles, context and itineraries vary by program, the general structure of the courses is similar. Each course includes approximately 48 hours of formal lecture/discussion sessions. All courses have reading assignments, written and oral evaluations of the students, laboratory and field projects, and many periods of informal discussion. The structured part of the laboratory/field projects totals about 16 hours per week, but the nature of the program is such that learning often takes place in impromptu settings; thus the figures listed above are minimum contact hours.

Faculty

Semester programs are usually taught by a Field Director, 3 senior faculty, and one or more teaching assistants. This insures an unusually low student to faculty ratio, averaging less than 7 to 1. Faculty members and the Director will hold a Ph.D. or its equivalent and have substantial teaching and research experience at the program location. (See pages 3 and 4 for further faculty information).



Schedule

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

Courses are taught six days a week, excluding Sundays, which are usually free for recreation and travel. We will also have a break of four days between weeks 6 and 7. 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 lecture material is presented and assigned reading discussed and the field exercise for the afternoon is planned. Three hours or more in the afternoon will be occupied with field work and training, which complement the morning's lectures and reading material. Evenings will include films, guest speakers, and cultural events. The field library will be available for research and assigned reading. You may participate in planning evening programs in your own areas of interest.

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

Evaluations

The faculty will conduct oral and written evaluations on the basis of class work, field work, examinations, papers, presentations, and group participation at the midpoint and conclusion of each course. Each student will receive a grade card and may request an official transcript from Northeastern University (see page 47 for additional information on academic credit). Evaluations and academic work will be forwarded to your home institution as requested.

Prerequisite: A minimum age of 18 is required; one college-level biology/ecology course is highly recommended/required depending upon the program.



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

January Term and Month-Long Summer Courses

SFS January term courses (4 quarter credits) depart in late December. Month-long summer courses (8 quarter credits) depart in June, July and August. Teams are usually comprised of 14 students and two faculty. You can expect a complete, intense learning experience, exposing you to issues that will engender thought and reflection long after your course has ended.

Course Levels

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

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

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

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

Schedule

Activities are planned seven days a week and usually ten to twelve hours every day with a one to two day break in the middle of the course.

Phase One: Introduction and Preliminary Evaluation.

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

Phase Two: Lectures and Field Work

- ☐ faculty presentations on general comparative ecology, ecosystem organizations, environmental issues, local natural history and peoples.
- ☐ topical lectures on course material
- ☐ overview of research problem and research design
- ☐ student critique of scientific papers
- ☐ description of scientific method, research methodology, field tools and techniques, successful hypothesis testing
- ☐ introduction to laboratory methods
- ☐ field data collection
- ☐ field trips as appropriate

Phase Three: Mid-term Evaluation

- ☐ faculty evaluation of student progress
- ☐ student evaluation of course progress
- ☐ mid-term break

Phase Four: Implementation of Directed Research Projects

- ☐ continuation of data collection: lectures/discussions
- ☐ lab work, data processing and analysis
- ☐ independent directed projects

Phase Five: Conclusion

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

All participants will receive an academic grade for their coursework. An official transcript will be issued upon request by Northeastern University. (See page 47 for additional credit information).

SFS Wildlife Ecology And Management Programs

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

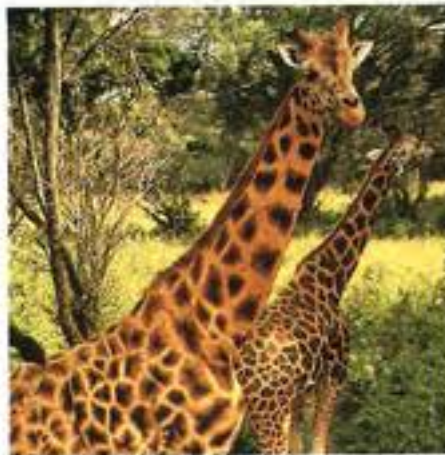
The World Conservation Strategy defines conservation as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations." For many, including the over 800 million destitute or impoverished peoples in developing countries who, in their day to day struggle for survival, are compelled to destroy the very resources that can free them from poverty and hunger, this objective has little relevance. In other cases, the needs of one group or species may conflict with those of another.

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



(Photo: Geoff Levner)

The SFS Center for Wildlife Management Studies (see page 8-9) in Kenya is an ideal laboratory in which to study the conflicting needs of humans and wildlife and to examine proposals that may insure ongoing species diversity, optimum food production, and economic viability. As a promising experiment in wildlife management, students in the Wildlife Ecology and Management (see page 10) semester will compare aspects of game ranching with the management of protected herds.



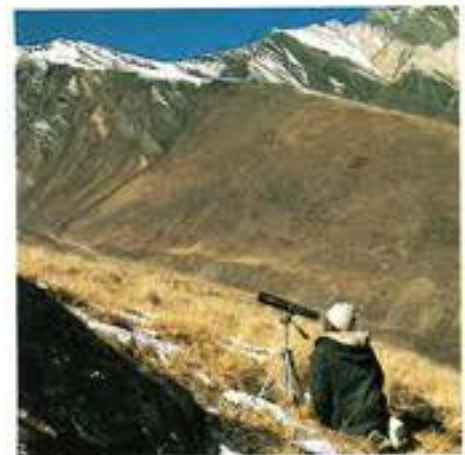
(Photo: Patti Lemay)

Wildlife Management (see page 11) students will focus their investigations more specifically on giraffe ecology.



(Photo: James Fraser)

Projects to reintroduce bald eagles are now underway in several states. SFS Ecology of Bald Eagle (see page 12) participants will travel by kayak along the coast of southeastern Alaska, documenting habitat requirements of the thriving but little studied eagle population there to assist reintroduction efforts elsewhere.



(Photo: Joseph Fox)

A proposed dam to bring needed irrigation to Buddhist farmers struggling to raise crops and livestock in the Northern Himalayas may mean loss of habitat for species such as the endangered snow leopard. Research conducted by Cultural Ecology: Conflicts in Ecological Management (see page 14) participants will examine the growing competition for habitat and prey between domestic herds and endangered wildlife, and possible solutions for fruitful coexistence. A once thriving population of pronghorn antelope in Wyoming is now in the throes of a rapid population decline for which scientists have no answer. SFS Veterinary Ecology (see page 13) participants will observe this pronghorn population to identify the stress or stresses on the community and possible resolutions that will allow restoration of the population rather than its now threatened elimination.

Center For Wildlife Management Studies:

Background

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

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

Kenya

Curriculum:

- ☐ Wildlife Ecology and Management Semester Program.
- ☐ Wildlife Management Summer Course

Substituting native wildlife species for domestic cattle offers an ecological alternative that lowers water and energy demands, and allows more protein production per acre than crop farming in East Africa, potentially leading to increased food production. Yet game ranching itself may pose ecological threats. How do harvested populations differ genetically from natural herds? Only carefully coordinated research including population and habitat studies will provide the answers.

Mankind must find a way to satisfy the needs of both wildlife and humans on shared land, rather than assuming that the presence of one excludes the other. SFS students will have the unique opportunity to become directly involved in this dilemma, conducting research to examine first-hand impacts of game-ranching in Kenya in a 30 day Wildlife Management course, or expanding this research, placing it within a larger, global framework of social, political and economic considerations in the 12 week semester program.

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



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



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

Site

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

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

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

approximately 40 kilometers southeast of Nairobi on the Athi Kapiti Plains, the ranch consists of laboratory facilities, a slaughterhouse, a small library, and 81 square kilometers of protected and fenced savanna where wildebeest, giraffe and gazelle roam freely

Research Focus

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

How are plant defenses—such as thorn production—induced following feeding by ungulates? What decisions do giraffes make in selecting foraging locations

and preferred plant species? To what extent do the reproductive rates among the ranch's wildlife population vary from year to year?

Living and Working Conditions

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

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



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



"This course let me know that I can make a difference and it's our responsibility to do so. Yes, the course lived up to my expectations." Joseph Trumpey, Indianapolis, IN - Wabash College (Photo: Jack Shea)

Center For Wildlife Management Studies: Kenya

This 12 week semester program is designed to allow students to compare aspects of game ranching with the management of preserved herds as a promising experiment in wildlife management while studying the theory of wildlife ecology. Through a series of four interrelated academic courses, complemented by a capstone course, Directed Research, we will seek to learn about organisms, habitats, peoples and cultures of East Africa; to understand the ecology of East Africa; and to increase our awareness of the philosophical, social and economic justifications for various conservation strategies.

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

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

Cultural Ecology will introduce us to the varied cultural heritage of Kenya. The first week includes an introduction to basic Swahili, which will help us communicate with local Kenyans. We will then review the East African evidence for human evolution and concentrate on the traditional cultures of major indigenous

Wildlife Ecology and Management

SEMESTER PROGRAM

Courses:

- ☐ Wildlife Biology
- ☐ Population and Community Ecology
- ☐ Cultural Ecology
- ☐ Environment and Society
- ☐ Directed Research

tribes of the area. The social, political and economic impact of the colonial and post colonial era will be examined during the last week of the course. The course will consist of classroom lectures and field trips to areas or events of particular cultural interest including local Masai villages.

Environment and Society will allow us to synthesize information on wildlife biology, ecological and evolutionary principles and human cultural, political and economic forces into a general understanding of the role of people in the environment and their options for conserving the unique species and environments of East Africa. Our safaris will allow us to examine a number of approaches to land utilization and their impact on the natural communities of organisms. We will discuss the goals of various conservation programs both globally (such as the World Conservation Strategy) and locally, and justifications for these goals. The course will present options for preservation, from the level of the individual organism to entire ecosystem. Management required at each level will be emphasized. Students will be exposed to elements of environmental impact statements.

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

Actual field research, consisting of group and independent directed projects,

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

Field work will take place within the Ranch and in various National Parks, enabling us to conduct comparative studies across a broad spectrum of habitats. The laboratory and slaughterhouse on the ranch will facilitate our investigation of the form and functioning of keystone species.

Tuition: \$7360 + \$100 Registration Fee
Departure Point: Nairobi, Kenya
Prerequisite: College level biology/ecology course

Dates: September 4 - December 2, 1988
January 1 - March 31, 1989

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

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



"Trying to find answers to complicated issues forced me to be more than a camera-happy tourist. My experience gave me a valuable perspective on how my college studies can be applied to the real world."
Day Wilkes, Picayune, MS - Mount Holyoke College (Photo: Reed Stewart)

Center For Wildlife Management Studies: Kenya

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

Arriving at the ranch, we will stow our gear in bandas, the thatched huts that will serve as our homes when we are not conducting off-ranch research. Introductory lectures will include a brief orientation to the local language, Swahili. A tour of the facilities will allow us to meet with local specialists to discuss the major wildlife management objectives of the ranch and learn about the cropping methods used here.

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

Rising early each morning, we will travel either by foot or in landrovers to specific sites in the ranch to begin our field survey. By careful observation we will collect detailed population records for

Wildlife Management

SUMMER COURSE

Purpose:

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

wildebeest, gazelle, zebra, and giraffe. We will also monitor food preference, the ratio of males to females and pregnant females. Though not subjects of our research, we may see cheetahs, spotted hyenas, aardvarks and warhogs during our days in the field, where the shade of intermittent acacia trees is always a welcome sight.

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

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

In addition to participating in the team research efforts, each student will have the opportunity to conduct a directed research project. Giraffes will be the focus of much of our research attention and topics of interest may include a comparison of sex ratios on and off the ranch or observations of foraging strategies in water stressed conditions.

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

Tuition: \$2290 + \$100 Registration Fee

Departure Point: Nairobi, Kenya

Dates: Level B: June 15 - July 14

Level A: July 21 - August 19



"I have been like a sponge—absorbing sights, sounds and experiences." Eileen Tucker, Dayton, OH - Allegheny College (Photo: Bob Singer)

Populations of bald eagles have been nearly eliminated throughout most of the lower 48 United States, as their habitats, once constituting some of the most spectacular wilderness areas of the world, have been decimated. The SFS study site on Admiralty Island in Southeast Alaska is one of the few remaining, relatively undisturbed, summer nesting areas for the American Bald Eagle. Here, adults spend the summer feeding on spawning salmon while newly-fledged young test their wings in the Alaskan summer skies. Nesting and roosting sites are vitally important in providing shelter during harsh weather. Certain tree species and particular ground-cover conditions appear critical for providing adequate sites. Habitat changes that threaten the food supply or availability of protection from the rigors of a hostile climate have a quick and disastrous effect on population size.

Our research focuses on two questions important for bald eagle recovery plans in other parts of the United States. First, biologists need to understand the ecological characteristics of undisturbed eagle populations in order to determine whether a previously decimated population has recovered fully. Second, the vegetation associated with preferred nesting trees, and differences from vegetation characteristics associated with roosting trees, must be understood to protect vital aspects of the eagles' habitat during periods of land development.

Kayaks will serve as our primary means of transportation. After practicing

Ecology of Bald Eagles

Admiralty Island, Alaska

SUMMER COURSE

Purpose:

To study the ecology and behavior of nesting and newly-fledged bald eagles in Southeast Alaska; to identify differences in habitat requirements of nesting and roosting trees; to develop baseline ecological data required to determine the natural status of undisturbed populations in order to assess the success of reintroduction programs in other areas of the United States.

maneuvering our two-person ocean kayaks, we will head south from Juneau to Admiralty Island, setting up our base camp on Seymour Canal. In the distance, white peaked mountains rise above endless stands of coniferous forest, while Alaskan wildlife ranges freely through the woods and the waters we will call home for a month. Brown bears, deer, porcupine and field mice abound on shore, while the near-shore waters are home for killer whales, feeding humpbacks, and stellar sea lions.

After establishing our base camp, and becoming familiar with the study area, we will review safety measures and practice using topographic maps and compasses. Our field research will begin with kayak trips along the shore, as we acquire the difficult skill of spotting eagle nests. Upon locating a nest, we will document the species and condition of nest tree, status of the nest, surrounding vegetation, and distance from the water. When nests are occupied, we will use telescopes and binoculars to observe newly-hatched nestlings. How do nest trees differ from roosting trees? How do eagles select certain trees, and not others? How often do parent eagles visit the nest? What kind of food do they bring their young? In addition to the group research project, students will undertake directed study independently or in small groups. Topics last summer included observations of bald eagle vocalizations, the study of tidal effects on foraging behavior, temporal differences in foraging activity, and perch site preferences. Our results will be presented to Forest Service, National Park Service, and Alaska wildlife management personnel.

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

Our campsite requires us to practice minimum-impact camping. We will leave little behind but our footprints. We will prepare our meals under rustic camp conditions, encouraging great leaps of creativity in the preparation of culinary delights on Coleman stoves and campfires.

Tuition: \$1710 + \$100 Registration Fee

Departure Point: Juneau, Alaska

Dates: Level A: June 15 - July 14

Level B: July 21 - August 19



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

A population of pronghorn antelope that once thrived in the badlands of Northwest Wyoming, near the Montana border, appears to be dying out. Wyoming Game and Fish biologists have noted a consistent decline in the number of fawns seen in late summer but have not determined the reasons for the decline, or the segment of population most affected. It is unknown whether there is a low number of reproductively active females, an overall low birth-rate, a high post-partum mortality rate, or a high infant mortality rate in the first few months of life. The reasons for the population decrease may include a shortage of water or forage due to competition with other species, the effect of high predation, or stress induced by fence construction along traditional migratory routes.

This summer, in co-operation with the Wyoming Game and Fish Department, SFS students will begin systematic surveys of pre-determined portions of the known summer range to document percentage of live births and look for evidence of predation on new-born fawns. Additional surveys will be conducted to estimate the abundance of predators, including coyotes, bobcats and eagles, and competitors such as wild horses. We will document the availability of water and forage type in this arid habitat.

We will also attempt to determine susceptibility to ectoparasites (such as ticks), measure hormonal levels through analysis of blood samples, determine body-fat levels and coat condition, and measure other variables that indicate the general health and potential for reproductive success. This work requires shooting animals with drug darts, and will be carried out in conjunction with Game and Fish biologists once our protocols are approved.

The Wyoming badlands offer a unique study in contrasts. By day this landscape of little water and less vegetation can appear harsh and forbidding. The setting evening sun paints the land in a tapestry of searing reds, rich violets, and the deep blue of a darkening western sky. We will begin our journey in Cody and travel west by van to our first basecamp. After setting up tents

Veterinary Ecology: Pronghorn Antelope Population Collapse

Wyoming

SUMMER COURSE

Purpose:

To determine why a population of pronghorn antelope has been decreasing in number during the last five years; to develop a monitoring system for measuring the reproductive "health" of wild populations as one basis for making informed land management decisions.

and camp facilities, we will begin our daily regimen of observations and surveys. Early in the summer we may find does with their newborn fawns somewhat isolated from other groups, necessitating considerable mobility on our part. As the summer progresses, antelope tend to form larger, more cohesive groups. We will depend on pre-course aerial surveys by the faculty and Game and Fish biologists to determine the most heavily populated areas of our study site. Since water

availability is limited, watering holes will be central areas for our behavioral observations.

Faculty lectures will address comparative physiology, biochemical processes, parasitology, population dynamics, interspecific competition, predation, recruitment rates, quantitative models for estimating population size and viability and statistical analyses of survey data. Student directed research projects may investigate age and sex differences in susceptibility to key parasites, correlations between biochemical indices of stress and a variety of environmental factors (e.g., forage availability, plant growth rate, rainfall) or the energetic demands of foraging in this harsh environment.

We will share our data with the Wyoming Game and Fish Department and the Bureau of Land Management. Our studies can help determine if human activity plays a role in the population decrease and provide assistance in formulating appropriate land use policies.

Daytime temperatures here can be high and we expect no rain. Nights under clear, starfilled skies are cold. We will warm ourselves and cook over open fires and Coleman stoves. This is difficult terrain for hiking, but very accessible to vehicles, as we move our camps in pursuit of the ranging antelope.

Tuition: \$1660 + \$100 Registration Fee
Departure Point: Cody, Wyoming
Dates: Level A: June 15 - July 14
Level B: July 21 - August 19



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

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

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

Conflicts between development and preservation are not uncommon in the practice of conservation biology. Yet here the parameters are unusual. Will the area be conserved? How will the cultural attitudes of the Buddhists impact plans for such a recovery? What are the ecological factors that might be expected to help or hinder the protection of the snow leopard?

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

Cultural Ecology: Conflicts In Ecological Management

Ladakh, Northern Himalayas

SUMMER COURSE

Purpose:

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

We will assemble in Delhi, then fly to the city of Leh in the northern Indian province of Ladakh, at an elevation of 11,000 ft. After acclimating for several days near a small village, we will trek into the mountainous regions north west of Leh, passing through deeply scarred narrow passages to set up our tent camp in a protected valley. Occasional fields of green vegetation watered by melting glaciers dot the sharp, putty colored landscape. Our field work will consist of vegetation mapping and documenting the occurrence of ungulate species and plant species on which they feed. Concurrently, we will be conducting baseline surveys for signs of the elusive snow leopard.

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



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

competition for forage between domestic and wildlife ungulates?

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

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

Tuition: \$2090 + \$100 Registration Fee

Departure Point: Students will be responsible for fare to Leh; the group will meet in Delhi and fly to Leh together.

Dates: Level B: June 15 - July 14

SFS Marine Biology And Management Programs

The World Conservation Strategy suggests that one way to consider living resources is to "regard them as biological capital available for human use. If we use up this capital, it will no longer produce interest: the food, raw materials and life-supporting services we need to survive." Because much—over 70%—of the earth's surface is covered by water, many people have the mistaken notion that we have a vast, almost limitless, resource at our fingertips. In reality, less than 0.2% of the earth's oceans are productive, and this resource is just as vulnerable as the land to exploitation, pollution and disturbance.

We are rapidly depleting our "capital." In recent years, overfishing has led to subsequent depletion of fish stocks and a drop in the world's fish catch. Fishing practices and industrial debris have led to death or dismemberment for countless non-target species including sea turtles, seals, birds and fish, pushing some species close to extinction. Pollution is rendering critical spawning grounds and estuaries uninhabitable.

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



(Photo: Chris Neefus)

The colorful and productive reef communities that surround the Virgin Islands offer an unparalleled classroom where students at the SFS Center for Marine Ecosystem Studies (see page 16-17) can learn and do research. Marine Biology and Management (see page 18) semester students are assisting the National Park Service by documenting species composition of stressed and undisturbed reef ecosystems for use in formulating management policies. Students in Coral Reef Ecology (see page 19) will contribute base-line data on structure and function of the reef to determine how reefs are impacted by stress.



(Photo: Tim Stout)

Marine Parks Management (see page 20) students contribute a different perspective on this investigation by focusing on specific impacts associated with overharvesting and boat traffic. Concern over eating certain game fish which may be carriers of ciguatera toxins has effectively removed several fish species from consideration as foodstocks. Ecology of Toxic Reef Fishes (see page 21) participants will investigate the ciguatera problem, potential solutions and explanations.



(Photo: William McComas)

Stress from pollution, fishing, and poaching has driven populations of Kemp's Ridley sea turtles to endangered status. SFS students in Conservation Biology: Sea Turtle Survival (see page 22) will assist headstart programs designed to translocate hatchlings, hopefully bettering their chances for survival. Members of the Marine Pollution: Impacts on Seabird Ecology (see page 24) research team will scan rugged coasts of Scotland to help predict potential results of oil spills and other pollutants.



(Photo: Reid Withrow)

Mediterranean monk seals have all but disappeared from their former habitats. Participants in Coastal Ecology: Habitat Assessment for Monk Seal Recovery (see page 23) will survey the coast of Sardinia to assess its potential as a preserve where the species may be reintroduced.

Center For Marine Ecosystem Studies

Background

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

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

The Virgin Islands and their surrounding waters offer us an unparalleled classroom/laboratory in which to study

Virgin Islands

Curriculum:

- ☐ Marine Biology and Management Semester Program
- Summer Courses:
 - ☐ Coral Reef Ecology
 - ☐ Marine Parks Management
 - ☐ Ecology of Toxic Reef Fishes

marine biology. Historically, the inhabitants of the Virgin Islands have grown lucrative crops—sugar cane, bananas, and coconut; raised cattle and goats, and supplemented their diets with food from the surrounding waters. Overgrazing and overplanting, however, have now rendered much of the land unsuitable for agriculture. Currently, the Virgin Islands' rapid population growth is placing severe demands on its fishery. Yields from the fishing industry have dropped substantially, giving rise to a major concern that local fisheries are rapidly being depleted. Additionally, several species of normally edible fish are being eliminated from consideration as a food

source as it is currently impossible to determine which individual fish carry ciguatera (unusually high levels of toxins which can have lethal effects on humans who eat these "poisoned fish").

While the million tourists that flock to this area each year provide a much needed economic boost, they add further pressure to an already stressed ecosystem. It is also possible that increased levels of boating and diving are impacting on delicate coral reefs that are home to fish, conch, lobster and numerous other species.

It is essential that management plans dedicated to sustaining what is left of this valuable resource be updated and improved by new research. SFS semester students can make a significant contribution toward addressing this problem as they census commercially harvestable fish populations, analyze existing policies, and explore local attitudes toward fishery management in order to assist in developing suitable guidelines for further uses of this valuable resource. Students in SFS summer courses will assist in this effort as they investigate specific aspects of this resource issue.

Research Focus

Focusing on how basic ecological processes are effected by utilization of resources of the Virgin Islands, we will utilize SCUBA to quantitatively sample



"Now I can go to college more confident that I could happily spend my life doing marine biology." Brenda Gregory, Reeds, MO - Sarcoxie H.S. (Photo: Chris Neefus)

"I always wanted to go to an exotic place to learn about different ecosystems. I wanted to work with motivated students with a common interest. SFS was the perfect solution." Chris Sutton, Avon, CT - University of Connecticut (Photo: Wendover Neefus)





"I gained something I could never get from a textbook, a deep seated respect for the environment. The beauty of the Virgin Islands did more than impress me visually, it showed me why people are trying so hard to protect the natural resources we have left." Scott Rice, Virginia Beach, VA - Virginia Tech (Photo: Chris Neefus)

coral, seagrass and conch in the nearshore Caribbean waters. Impacts of current levels of biotic and abiotic stress on these resources will be assessed in order to recommend appropriate guidelines for future management. Our reports and publications are utilized by the U.S. National Park Service.

Site

The Virgin Islands lie at the eastward edge of the Greater Antilles chain of Caribbean Islands, just east of Puerto Rico. The environments of these tropical paradises vary from lush green forests to dry, desert-like terrain. Some islands are pristine and undeveloped; others have oil refineries and industry and are plagued with pollution problems. All are characterized by sandy beaches, mangrove swamps and quiet lagoons created by the extensive coral reefs that usually fringe each island.

The majority of our research will be done on and around the island of St. John. Our home base will be the Virgin Islands Ecological Research Station (VIERS), a small, isolated field laboratory several hundred yards from the shore of Lameshur Bay. Owned by the University of the Virgin

Islands, VIERS is located deep within the Virgin Islands National Park, which encompasses much of St. John, and has been the site of seven years of SFS research.

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

Living and Working Conditions

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

our use.

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

Meals are prepared by the VIERS staff, but students assist in clean up duties. Occasionally we will sample island cuisine, which is spicy and flavorful.

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

Center For Marine Ecosystem Studies: Virgin Islands

Through a five course sequence, SFS semester students will investigate firsthand the scientific, economic, political and historical issues involved in managing marine resources in the Virgin Islands. **Introduction to Exotic Ecosystems: Marine Biology** will orient us to the marine environment and its functional groups of organisms. Study topics will include basic ecological principles of energy flow, food webs, photosynthesis and respiration, and the structure and function of tropical marine systems. We will focus upon the stability of marine and coastal ecosystems and their ability to recover from disturbance. Field work is designed to teach students to identify distributions of common nearshore marine flora and fauna. The field and lab component of the course will include supervised SCUBA exercises, demonstrating techniques for underwater observation, data analyses, and report presentation in preparation for individual projects.

Population and Community Ecology explores the behavior, distribution and diversity of marine organisms in response to their environment. Evolutionary responses are examined with respect to long term environmental change. Included in this focus are the identification, phylogeny and evolution of major marine groups and the reproductive biology of these species. Mutualism, competition and predation will also be studied with respect to how these symbioses structure marine communities. Using SCUBA, we will conduct censuses, experimental manipulations and in-situ behavioral observations. Our emphasis on comparative community ecology necessitates replicated data collection at contrasting sites in the U.S. and British Virgin Islands. On our inter-island forays, we will travel by sailboat.

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

Marine Biology and Management

SEMESTER PROGRAM

Courses:

- ☐ Introduction to Exotic Ecosystems: Marine Biology
- ☐ Population and Community Ecology
- ☐ Principles of Resource Management
- ☐ Cultural Ecology
- ☐ Directed Research

surveys within the local communities exploring attitudes regarding fisheries, the National Park and conservation issues.

In **Principles of Resource Management** we will develop an international focus on harvesting dynamics, environmental risk assessment and conservation practice. Critical case studies will introduce effective and ineffective management practices within a variety of arenas including fisheries, forests and other agroecosystems. Special attention will be focused on the management of the Caribbean

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

The **Directed Research** component of our program will complement our overall objective of quantifying the impact of fisheries on the National Park ecosystems. The opportunity to integrate perspectives developed in the preceding courses becomes evident here as students work with faculty to design independent projects from well coordinated parts of the overall research effort. Research topics may include the role of herbivory in structuring reef communities, changes in fish distribution, patterns of benthic diversity, fish species compositions within disturbed versus protected habitats. Results will be presented orally to the group and to guest speakers at a seminar and will also be submitted to the National Park Service.

Note: SCUBA certification will be offered for an additional \$100 fee.

Tuition: \$6490 + \$100 Registration Fee
Departure Point: VIERS, St. John,

Virgin Islands

Dates: September 7 - December 3, 1988
January 3 - March 31, 1989

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



Center For Marine Ecosystem Studies: Virgin Islands

The likelihood that a coral reef community will survive depends on how resources are divided among its component species. Intense competition for the two most vital resources, food and space, has led to a high degree of adaptation or specialization among the coral reef inhabitants. For example, the protruding mouth of the butterfly fish enables it to feed on algae in cracks not accessible to other species. Similarly, the parrotfish's scraping jaws are an adaptation that allows it to graze on the algae on coral skeletons.

Our ongoing studies of coral reef structure and function will continue using patch reefs as experimental units. Our first step will be to study the physical characteristics of patch reefs: reef form, surface area and volume, water currents and sedimentation rates. We will address relevant biological influences: What species define the reef community? How do occurrences of these species change seasonally? What is the structure of the reef food web? How is organic material transferred from species to species within the reef food web? How important is competition for limited space in structuring the reef community? What are the natural sequences in the colonization and development of the reef community and to what extent are these sequences impaired by human disturbance? We will compare patch reefs growing at various depths and under differing sedimentation, wave stress and pollution conditions.

Much of our time during our first days on St. John will be spent near the white dock that juts into the blue waters of Lameshur Bay. Upon arriving at VIERS, we will spend our first week taking a full SCUBA certification course. Diving into the warm, turquoise waters gives one entry into another world where a spectacular array of fluorescent fish dart between living corals and sponges. Our first week and a half will be filled with extensive lectures and long hours of diving and snorkeling to learn the names of the principal reef organisms.

Introductory lectures will expose us to oceanography, species identification, invertebrate zoology, and the distribution, structure and function of reefs. Subsequently, we will discuss evolutionary and behavioral ecology, biological growth and productivity, feeding strategies, nutrient cycling and reproductive biology.

Coral Reef Ecology

SUMMER COURSE

Purpose:

To investigate the effects of man-made and natural disturbances upon coral reef structure and function to prevent loss of diversity in these fragile ecosystems.



"This course provided me with a chance to learn by thinking and doing not just listening and watching. I could spend long hours discussing issues with professors and peers on a one to one basis. I find this setting infinitely better than sitting in a musty lecture hall."
Patrick Zoeller, Lansing, MI - University of Michigan
(Photo: Kenneth Andrasko)

Our data collection will begin with visits to a sheltered, shallow site in Lameshur Bay. Pairs of students will identify their "own" patch reef and will be responsible for all data collection from the reef. Students will also choose topics, compatible with the course research, for their own directed research. Topics may include the colonization and predation of disturbed reefs, and patterns of species recovery from reef stress.

Using SCUBA gear, we will dive onto the reefs and put our newly acquired identification skills to work as we prepare species lists. We will take detailed size measurements of the primary attached organisms of the reefs. The diverse fish community poses a special problem which will require long periods of underwater observation before we can determine species abundances and the significance of their impacts. Repeating these studies over several weeks will allow us to obtain an indication of species colonization and reproduction rates.

Initially, our investigations will focus on deeper reefs within undisturbed Lameshur Bay. We then hope to conduct comparative examinations of high sedimentation areas in other bays on St. John. Working with a team of 15 students, we will be able to examine a large number of patch reefs in any one location, enabling a good sample size. We can then recognize significant trends between locations.

Back at VIERS, we will use the computing facilities to carefully analyze our data. Teams of two or three students will write up research sections into a scientific paper. These papers will then be combined into a single report on comparative reef ecology to be presented to resource managers at the National Park Service.

Note: SCUBA certification will be offered in this course for an additional \$100 fee.

Tuition: \$1940 + \$100 Registration Fee
Departure Point: VIERS, St. John,
Virgin Islands

Dates: Level A: June 15 - July 14,
July 21 - August 19

Center For Marine Ecosystem Studies: Virgin Islands

Previous SFS research indicates that current catch limits for conch and lobster would rapidly deplete these populations, even if the fishery resources were allowed to recover. Although aware of this fact, resource managers for the U.S. Park Service do not have data to allow them to set different limits, create special seasons, designate protected zones, or employ other management strategies.

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

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

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

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

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

Marine Parks Management

SUMMER COURSE

Purpose:

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

to determine if the scar grows or recovers.

Lecture material will cover principles of population growth and control, reef ecosystem dynamics, resource planning and management theory. Between dives, faculty will present lectures on food

chain dynamics, statistical interpretation, and the ideals and actualities of fisheries management. Guest lecturers—including U.S. Park Service managers—will speak on marine resource management.

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

Note: SCUBA certification is a prerequisite for this course

Tuition: \$1940 + \$100 Registration Fee

Departure Point: VIERS, St. John,

Virgin Islands

Dates: Level B: June 15 - July 14



"I found I prefer to exercise more control over a situation. I didn't have the patience field work requires. This experience has been invaluable in narrowing my career choices." Dawn Robertson, Baker, LA - Centenary College (Photo: Chris Neefus)

Center For Marine Ecosystem Studies: Virgin Islands

Each year up to 50,000 people are poisoned by ciguatera, an extremely debilitating and sometimes fatal disease associated with seafood consumption. Little is known about ciguatera, caused by toxic, single-celled algae which are eaten by fish and then biomagnified within the food web. Ciguatera toxins occur sporadically and unpredictably, which likens eating some species of fish—especially grouper, jacks, snapper and barracuda—to a form of Russian roulette. We will focus the majority of our research on the tiny, single-celled algae called dinoflagellates and those fishes which feed upon them. To what extent is the distribution of dinoflagellates affected by chemical characteristics of the water column? Do herbivorous fish prefer or avoid areas harboring abundant toxic dinoflagellates? We will also examine the human aspect of the problem. Can fish with accumulations of toxins be recognized? If so, how? Is the local perception of areas in which toxic fish occur realistic?

Our first task will be to sharpen our SCUBA skills while orienting ourselves to the colorful and abundant marine life in the clear waters of Lameshur Bay. We will then begin our field research with several boat trips to different regions of the nearby reefs to locate sites where high concentrations of toxic dinoflagellates may be found. Using SCUBA, we will dive between spectacular coral heads accompanied by bright blue-green wrasse, butterfly fish,

Ecology of Toxic Reef Fishes

SUMMER COURSE

Purpose:

To study the distribution and origin of toxin (ciguatera) in ordinarily edible fish such as grouper, jacks, snapper and barracuda, and to examine circumventing this human health hazard in the Caribbean.

sergeant majors and majestic angelfish to record data defining the physical environments of these species. We will focus specifically on water turbulence, light penetration, temperature, dissolved oxygen and pH, to assess which variables promote dinoflagellate growth. We will also scrape surfaces of attached seaweed as well as tow plankton nets from our boats through the water column to collect samples of dinoflagellates for detailed analysis back at VIERS.

Once we have delineated those habitats which are most favorable to toxic dinoflagellates, we will document associated algae-feeding fish species. Div-

ing to the bottom and stationing ourselves to avoid disturbing the fish, we will census the abundance of prey species and their larger predators. Outside of park borders, we will catch several fish for later dissection at our lab for stomach content analyses and to determine the extent to which fish feed on dinoflagellates. By understanding the predatory-prey relationships on the reef, we can assess the stages at which toxins enter the food web.

After conducting a study of Lameshur Bay, we will travel by sailboat to several other sites in the Caribbean to explore the difference in concentration of toxic dinoflagellates between islands. We also plan to collect data that will expand our knowledge of the particular species of macro-algae most commonly harboring dinoflagellates. Returning to VIERS in the late afternoon, we will begin the preliminary analyses of our findings and test for correlations between dinoflagellate population densities and site-dependent variables.

To complement our field research, students will have the opportunity to pursue specific topics of interest through independent projects. Possible topics include dinoflagellate settling rates on different types of bottom-dwelling macro-algae, algal biomass within toxic fish, or variability of fish species response to blooms of toxic algae. Breaking up our long days of underwater research will be visits to several towns on St. John to interview local inhabitants and marine scientists to determine the frequency and severity of illnesses caused by poisoning when humans ingest affected fish.

Faculty will lecture on predatory/prey cycles, algal taxonomy and diversity, coral reef ecology, population growth and food web dynamics. We will also spend time in the VIERS laboratory observing toxic dinoflagellates microscopically in preparation to learning their ecosystem role.

We will spend the final days of the course analyzing our data and writing a report illuminating the sites of toxic dinoflagellate occurrence. This report will be submitted to the National Marine Fisheries Service and the U.S. Park Service to assist in designing regulatory policies for the fishing industry that will help reduce the potential threat of ciguatera to local people.

Note: SCUBA certification is a prerequisite for this course.

Tuition: \$1940 + \$100 Registration Fee

Departure Point: VIERS, St. John,
Virgin Islands

Dates: Level B: July 21 - August 19



"I am a religion major so I found myself developing a science phobia. I discovered science is really fun and it is the domain of everyone, not just a select group of pre-meds. Everything I learned made sense." Kirstin Steinmetz, Trenton, NJ - Haverford College (Photo: Richard Wick)

Kemp's Ridley sea turtles are the most endangered of sea turtle species. There currently exists only one known nesting colony in the entire Gulf of Mexico. Here, the number of nesting females has plummeted from tens of thousands in the mid 1940's to only several hundred today. Kemp's Ridley sea turtles are unique among sea turtles, as females nest in daylight rather than at night, making them easy targets of human exploitation for protein and as a reputed aphrodisiac.

In 1978, a joint Mexican-American program was initiated in which 2,000 eggs each year are taken from the nesting site in Rancho Nuevo, Mexico, to the Padre Island National Seashore in south Texas. They are allowed to hatch in the sand and make their way to the sea, where they are immediately captured, taken to laboratories at Galveston, fed for a year and then released into the Gulf of Mexico. Do the sea turtles survive after being released as one-year old hatchlings? Will the females return to their "adoptive" hatching sites on Padre Island, try to go back to Rancho Nueva in Mexico, or simply succumb to the dangers of life in the Gulf of Mexico? Are these "headstart" turtles prepared for their release after captivity? No one knows the age at which the sea turtle females first nest and lay eggs, but it is believed to be between seven and ten years. This is the tenth year of the program and scientists are still looking for evidence that any of the thousands of hatchlings released have survived.

Initially, we will assist Texas A&M University biologists in Galveston in-

Conservation Biology:

Sea Turtle Survival

Gulf of Mexico

SUMMER COURSE

Purpose:

To assist in the recovery of the endangered Kemp's Ridley sea turtle in the Gulf of Mexico through a headstart program (transplantation, rearing and release); to conduct autopsies on stranded sea turtles to help measure the relative impacts of marine debris and commercial fishing practices on mortality; to conduct systematic surveys of a portion of the Texas coast to monitor sea turtle stranding rates.

roduce newly hatched turtles to their temporary living quarters for the next year. We will examine swimming and eating behaviors of hatchlings to determine ways to better prepare the turtles for later release. We will also participate in autopsies of stranded turtles found in the wild, as part of an ongoing program to determine the rates and causes of mortality of sea turtles in the Gulf of Mexico.

During the second half of our course, we will leave Galveston and move south, setting up camp on sandy white beaches along the south Texas coastline. Gulf breezes that rattle through nearby salt marshes will moderate the midday heat as we survey isolated sections of the Texas coast in search of stranded sea turtles. Turtles released through the headstart program have all been tagged, so we will be able to determine if any of the tagged turtles have survived their assisted release, only to become victims of increased fishing and pollution in the Gulf.

While conducting studies of sea turtle recovery, SFS students will be introduced to the natural history of the Gulf coast. In addition, faculty will present material on the biology and behavior of marine turtles, the role they play in the marine food web, and their history of exploitation by humans. Visits with local fishermen will afford us firsthand exposure to the ongoing competition between conservation and commercial concerns.

In addition to the overall research project, students will work individually or in small groups to carry out directed research projects. Some of the questions these projects may address include a consideration of sex differences in hatchling survival, and the variables that influence these differences. Students may wish to explore alternative programs for feeding turtles in the headstart program to ensure the development of competent feeding strategies upon release in the wild. The results of our work will be submitted to the National Marine Fisheries Service to help in their search to ensure the protection and recovery of this endangered species.

While working with Texas A&M biologists in Galveston we will stay in relatively comfortable dormitories. In the field during our coastal surveys, we will construct our own base camps in sight of sculpted white dunes, prepare our food over camp stoves, and do our homework by the light of Coleman lanterns. This area is sparsely populated by humans and we will keep a close watch for members of the alligator population that makes the island their home. The Texas coast is hot and humid in the summer, and we will take every reasonable opportunity to cool ourselves with refreshing swims in the Gulf waters.

Tuition: \$1820 + \$100 Registration Fee
Departure Point: Galveston, Texas
Dates: Level A: June 15 - July 14
July 21 - August 19



"I mastered the binoculars but the first time I worked the theodolite it took so much practice just to find the group, let alone pinpoint an individual. How many times did I sight on the zodiac just because it was easy to target? When I finally caught the hang of it I felt so good!" Teresa Rec, Bloomfield, CT - University of Connecticut (Photo: Nanci Shapiro)

The world's three species of monk seal are currently on the brink of extinction. The Caribbean monk seal, believed already extinct, has not been seen for over thirty years. The Hawaiian monk seal shows no sign of recovery despite full protection. The Mediterranean monk seal is also in danger of extinction: the fewer than 1000 that remain have disappeared from most of their previous habitat. Monk seals are very sensitive to human disturbance, abandoning preferred sandy beaches as resort development and marine pollution encroach on their habitat throughout the world. Many have been hunted and killed as pests that compete with humans for fish.

A number of efforts are currently planned in the Mediterranean to define a series of natural reserves in areas determined to be suited to monk seal habitation. Human disturbances would be restricted in the reserves, and haul out sites would be protected. Before such reserves can be established, biologists must determine what areas provide the best potential for monk seal habitat.

SFS students will have the unique opportunity to participate in the exploratory stages of a long-term project to bring the monk seal back to a viable population size in the western Mediterranean. Scientists have determined that portions of the eastern coast of Sardinia constitute a suitable habitat for the recovery of the monk seal. The seldom seen monk seal has been observed in very small numbers in these waters. More important, however, is the possibility that if protected, the eastern coast of Sardinia could play a vital role in the survival of monk seals transplanted from other areas in the Mediterranean where tourists have taken over the beaches, fisherman jealously guard the fish, and pollutants taint the water.

Our research will focus on an ecological inventory of a portion of the rugged and relatively uninhabited eastern Sardinian coast. From inflatable boats, we will systematically survey the coastline to determine the locations of caves with underwater access, the availability of sandy beaches tucked inside lofty limestone and granite cliffs, the near-shore water quality and availability of preferred monk seal prey species, and the human use of the area for commercial fishing and recreational boat traffic. We will collect specimens of octopus and other marine species for later analysis of heavy metal contaminants. One important index of the viability of our study site as a monk seal

Coastal Ecology: Habitat Assessment for Monk Seal Recovery

Sardinia, Italy

SUMMER COURSE

Purpose:

To participate in a study assessing the suitability of the east coast of the island of Sardinia as a refuge for the nearly extinct Mediterranean Monk Seal.

preserve is the extent to which other marine mammals, particularly toothed whales and dolphins, utilize the area. Our pre-determined coastal transects will also allow us to log observations of common dolphins and the occasional sperm whale.

We will arrive in the Sardinian city of Olbia. Following a day of introduction and orientation, we will board inflatable boats and head out into the Tyrrhenian Sea. Sailing south, we will parallel Sardinia's eastern coastline. Periodically we will land on beaches most suitable for our temporary tent camps, and on occasion we will visit small isolated fishing villages.

Faculty lectures will provide the fundamentals of marine ecology, as well as material on marine mammal taxonomy, biology, and behavior. Guest lecturers will introduce us to the natural history of the Mediterranean area, and, as opportunity permits, we will visit local sites of cultural importance. Students will conduct directed research projects, aimed at increasing our understanding of the coastal ecology of eastern Sardinia. Projects may include a study of the marine debris found at beaches along the coast; the abundance of focal vertebrate species such as turtles and marine birds; relative abundance of fish species taken by local fisherman, or availability of octopus, a favored food of seals.

Data obtained from our coastal mapping and survey efforts will be of interest to Italian scientists planning this recovery program. We will present our results to federal officials and researchers at the Natural History Museum of Milano, a center for study of monk seal recovery.

The weather on shore will be hot and dry. Evenings can be quite cool, and days traveling by boat along the coast may be wet. We will live in a series of mobile tent camps on Sardinia's sandy beaches as we work our way along the coast. We will take turns preparing the food we purchase in small coastal towns over camp stoves.

Tuition: \$1690 + \$100 Registration Fee

Departure Point: Students will be responsible for the travel costs to Olbia. We will meet in Rome and travel to Olbia together.

Dates: Level B: June 15 - July 14



"Unlike at school where my peers can be uncooperative because of competition in a high pressure environment, I found myself in a situation where mutual support and dependability were essential to our success."
Jean Fang, Burr Ridge, IL - Cornell University (Photo: Sandra Taylor)

Despite Great Britain's long history of interest in conservation and protection for its bird species, impacts of industrial development throughout the nation are putting increasing demands on the fragile coastal habitat for marine bird species. While the effects of oil spills, industrial development, creation of fish farms, and over-fishing are rather well-known along the accessible and heavily populated east coast of Scotland, the remote island coasts of the northwest are not well-documented.

Working in conjunction with the Nature Conservancy's Seabirds at Sea Team and the Royal Society for the Protection of Birds, SFS students will explore the coastal areas of the Hebrides Islands to provide important information about aggregations of breeding sea birds, and describe the coastal habitat in which they are found. The information we provide can enable scientists to more accurately predict potential effects of oil spills in this increasingly busy area, and thereby more effectively manage oil exploration, super-tanker traffic, and clean-up procedures. Using shore stations and small boats, we will be interested in determining the patterns of near-shore movement and abundance, and the particular seabirds and other species present during the study period.

As summer progresses, seabirds begin to molt, and become flightless. Their susceptibility to oil spills increases dramatically. To date, scientists have been unable to determine the numbers of birds, or the types of species that would be decimated by an oil spill such as has occurred in other areas of the North Atlantic. Over what time period are birds most susceptible? What species are in the areas most vulnerable to the potential effects of oil pollution? What are the potential impacts of increased shipping traffic or near-

Marine Pollution: Impacts on Seabird Ecology

Scotland

SUMMER COURSE

Purpose:

To document the distribution and abundance of coastal marine birds, including the endangered sea eagle; to assist in a nation-wide program to describe and evaluate the coastal habitat of Great Britain, and its susceptibility to human impacts.

shore development?

After arriving in Aberdeen, Scotland, we will spend our first few days visiting the Aigas Field Center. Here, after an overview of the natural history of the British Isles, we will work on developing our observation skills and identifying marine birds. We will then travel to the Hebrides, off the northwest coast of Scotland, to the austere and beautiful islands with names like Skye, Rhum, and Lewis. On pre-selected portions of the island coast, we will establish our base-camps and conduct beach surveys. On elevated headlands, we will set up our scopes to document bird populations and make behavioral observations. During the latter part of our studies, we will work in co-ordination with Scotland's Seabirds at Sea research team. Our data on in-shore aggregations will be an important addition to their large vessel bird surveys further out to sea.

Faculty lectures will address the natural history of seabirds, the principles of migratory behavior, marine adaptations of seabirds; marine ecosystems and the role of seabirds in the food web, and principles of population estimation and statistical analysis. In addition to our group research, students will conduct directed research projects. The projects may address such questions as: what is the relationship between current and tidal flow and aggregation patterns for different species? What are the diurnal patterns in movement on- and off-shore? What is the relationship between distance from shore and density of populations? We will summarize the results of our work for the Nature Conservancy Council, Coast-watch, the Seabirds at Sea research team, and the Royal Society for the Preservation of Birds. Guest lecturers from these organizations will present their views on the urgency of protecting this coast line and marine bird populations from human-induced disasters.

We will travel from the heavily populated area of northeast Scotland to the ruggedly pristine coasts of the western isles. In the process, we may expect to see abundant populations of loons, auks, and guillemots. Perhaps we may occasionally see the rare and endangered sea eagle, which is currently being re-introduced to the Isle of Rhum. We will live in tent camps in relative isolation, depend on the ocean for our showers, and prepare our own meals on camp stoves. While at the Aigas Field Station in Inverness, we will live in dormitories and eat food prepared for us in the field station's dining hall.

Tuition: \$1690 + \$100 Registration Fee
Departure Point: Aberdeen, Scotland
Dates: Level A: July 21 - August 19



"If I were approached a year ago and asked about my summer I probably would have smiled and given a general 'good'. This year was different. This summer with SFS, I did something important." Tim Yarrington, Westfield, NJ - Westfield High School (Photo: Nature Conservancy, Seabirds at Sea Team)

SFS Plant Community and Ecosystem Ecology Programs

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

Dr. E. O. Wilson
Harvard University

More species of plants and animals are found in forests than in all other ecosystems combined. There are an estimated 5 to 10 million species on earth; to date less than 2 million have been named. Tropical rainforests are felled on a daily basis for lumber, for roads and buildings, for crops and livestock. Elsewhere, forest plant communities face threats from damming, erosion, and products of industrial societies such as hazardous waste and acid rain. If current rates of disruption and degradation continue, by the year 2000, nearly 20% of all species may be extinct.

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



(Photo: © Chip Isenhardt)

SFS students have the rare opportunity to be at the forefront of research initiated at The SFS Center for Rainforest Studies in Australia (see page 26-27). Participants in the "Biogeography: Patterns of Ecological Diversity" semester program (see page 28), and the Tropical Species Diversity course (see page 29) will be among the first to explore the extent to which endemic species can serve as indicators of biological disturbance.



(Photo: © Chip Isenhardt)

The lush tropical forests of Costa Rica and Ecuador are sites of ongoing SFS rainforest research. Tropical Ecology: Dynamics of Deforestation (see page 30) participants will investigate species diversity in regenerating forests and reproductive success in key plant species. Identifying, cataloging, and preserving the knowledge of plants used for their medicinal properties by Yumbo Indians is the subject of our research in Ethnobotany: Discovering New Plant Medicines (see page 31).



(Photo: William McComas)

Amid green meadows, forests and snowcapped mountain peaks, students in Landscape Ecology: Designing Parks for Preservation (see page 33), will help determine the ecological requirements of a preserve to protect Colorado's magnificent wildlife in the face of impending development.



(Photo: Emily Porath)

Previous SFS research on the remote lakes that dot the Adirondack Mountains indicates that insects have become the top predators in lakes now devoid of fish. Participants in Acid Rain: Changing Aquatic Ecosystems (see page 32), will explore how communities of these altered systems function to help predict future impacts of acid rain or neutralization.

Center For Rainforest Studies

Background

Tropical rainforests are complex ecological arenas within which intricate evolutionary scenarios have been unfolding for over 100 million years.

The tropical forests that span northern Queensland are the most diverse in all Australia and are inhabited by the greatest diversity of wildlife found anywhere on the continent. The greatest concentration in the world of primitive flowering plants—thirteen of the known original nineteen families—are found here in an area botanists claim to be “a priceless world heritage.”

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

As a consequence of the exceptionally high incidence of endemism—the evolution of species found nowhere else on Earth—the botanical and faunal riches of this area are irreplaceable. The degradation of this resource is one of Australia's most critical environmental issues. This is truly a unique area just now being recognized for its significance. SFS students have a rare opportunity to be at the forefront of the research being initiated here. Semester participants will be among the first researchers to explore the extent to which endemic species—such as possums—can serve as indicators of biological disturbance. Month-long participants will continue this work which may eventually lend support to the creation of new protected areas for threatened species.

Research Focus

Initial data indicate that key marsupial species vanish from forests with increased disturbance due to clear-cutting and other logging procedures. How is species diversity and composition affected by size and age of a logging clear-cut? Of

Australia

Curriculum:

- Biogeography: Patterns of Ecological Diversity Semester Program
- Tropical Species Diversity Summer Course

particular concern are the arboreal folivores, vertebrates such as the tree kangaroo that consume and range through tree foliage. Our investigations will focus on the extent to which sequences of possum occurrence are indicators of ecosystem stress. This work has particular merit in northern Queensland where plans to preserve much of the area's land (including the SFS homebase in Millaa Millaa) are being hotly contested.

Site

The Cape York Peninsula of far northern Queensland has the greatest biological, climatic, and social diversity in all of Australia. Jutting some 400 miles towards New Guinea from the rest of the continent, it separates the Coral Sea from the Gulf of Carpentaria. A narrow strip of Australia's largest remaining tropical rainforest runs down to the water along the shoreline fringed by the magnificent 2,000 kilometer-long Great Barrier Reef.

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

Michael Boyle, Gaithersburg, MD - University of Maryland



“I felt so small next to all the gigantic trees and fields of grass several feet high. No space was wasted; plants grew all over and around one another creating webs of shade and mystery.”
Dina Strachan, Harvard/Radcliffe College (Photo: © Chip Isenhardt)



"I learned about subjects I didn't expect to like but enjoyed so much I changed my fall schedule to take related courses." Jane Payeur, Portland, ME - University of Southern Maine (Photo: Zadya Lundgren)

The town of Millaa Millaa sits on the Atherton Tableland approximately two hours southwest of the resort city of Cairns. Situated at an elevation of 800 meters, Millaa Millaa abuts the western edge of Palmerston National Park. To the north, east and south, rainforest abounds, while to the west, the land has been cleared for dairy farming. Millaa is a small dairy town, home to approximately 350 people. On the edge of this true Australian farm community, SFS will make our base in two rented houses complete with vistas of nearby ridges, rainforests and a stream inhabited by platypuses.

Access to the nearby rainforests is outstanding from our site, with a good diversity of forest types nearby. On our forays into the rainforest we may encounter over 500 species of canopy trees, and an equal number of animal species including the cuscus, pandemelon wallaby, tree kangaroo, lorikeets, 2-foot long forest dragon lizards, and frogs and toads. For example, the entire worldwide populations of the five species of possum we will study can be found within our study site. Flights of up to 2,000,000 flying foxes (which are actually bats) cloud the evening skies. Crystal-clear streams wind their way through dense, lush vegetation and occasional waterfalls fill the air with the persistent hum of crashing water.

Living and Working Conditions

Be prepared for wet weather. The

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

Our two house base in Millaa Millaa, affectionately called "Platypus Haven" will also serve as our library and classrooms. Our base is small but comfortable with modern cooking facilities, and appliances to wash and dry our clothes. Millaa is a small town with four stores and a gas station, our presence hardly goes unnoticed. Fresh fruits, vegetables, fish and meat should be available in abundance to embellish our culinary endeavors.

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



This experience should be an integral part of every student's education whether they want to study business or life sciences. We all need to understand you cannot totally separate the worth of a Cervus elephas from yesterday's Dow Jones." Hau Le, West Jordan, UT - University of Utah (Photo: Zadya Lundgren)



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

Center For Rainforest Studies: Australia

Through five distinct but inter-related courses, we will investigate the biological, behavioral, economic, political and historical issues that must be considered in determining strategies to preserve the endemic wildlife of Australia. **Introduction to Exotic Ecosystems** provides the ecological background to understand the tremendous diversity of Australian ecosystems. We will focus to a large degree on the rainforest, but field trips to the savanna "outback" as well as eucalyptus and acacia woodlands will enrich our studies. A field trip to the Great Barrier Reef, perhaps the world's largest and most spectacular reef, will also introduce us to the incredibly diverse marine life off the Australian coast including over 1,500 species of fish and 400 species of coral. Lecture topics will include plant and animal diversity, energy flux, nutrient cycling, soil structure and life cycle variability. Field work will take place regularly, as we explore habitats, measure resource use by colonizing species, and study the distribution of Australia's unique biota.

Building on these foundations, **Population and Community Ecology** will enable us to sharpen our natural history skills while providing a theoretical overview. Emphasis will be placed upon population growth and the processes by which it is limited, including predation, parasitism, disease and competition as they arise in rainforest habitats and within our study sites in particular. Genetic load, drift, adaptation via natural selection and principles of population genetics will also be presented. Processes of dispersal and colonization will be explored as they relate to Australian biogeographic patterns of both genetic and species diversities. Laboratory sessions and field demonstrations focus upon sampling techniques for ecological diversity, demographic computer models, plant/herbivore co-evolution and the quantification of both plant and animal distribution and abundance.

Concepts of population growth, resource depletion and steady-state dynamics developed in the preceding courses will be applied in **Principles of Resource Management**. Case studies emphasize yield optimization in tropical forestry, fisheries and farming practices and include field trips to Queensland logging sites, the Great Barrier Reef and agro-ecosystems of the Cape York Peninsula. Although coursework develops problem solving tools with respect to Australian rainforest issues, newly acquired

Biogeography: Patterns of Ecological Diversity

SEMESTER PROGRAM

Courses:

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

techniques—such as environmental impact assessment—will be applicable throughout the world. International resource management policies will be presented, with particular emphasis upon strategies of multiple land use, inter-cropping and the design of biotic reserves.



"I was never homesick or ready to give up—we were always too busy or I was just too busy soaking up all this place has to offer." Eileen Tucker, Dayton, OH - Allegheny College
(Photo: © Chip Isenhardt)

Man's impact upon local, regional and global geographics will be examined in **Environment and Society**. Terrestrial, aquatic and aerial modes of pollutant dispersal (from both point and diffuse emission sources) will be investigated, with particular emphasis on Australian examples. North American environmental risk perception, policy and pollution control technology will be considered. We will devote particular attention to issues such as deforestation and hazardous waste storage, which span global and local scales and discuss attitudinal variation among citizens of undeveloped and developed nations with respect to land use and the consequences of these perspectives upon landscape ecology. Political, social and economic implications will be presented in order to develop a predictive overview of the societal impacts upon environmental quality. Elements of the design of environment impact statements will be discussed.

In **Directed Research**, we will investigate how to address key biogeographic questions using the scientific method. Effective hypothesis formulation, experimental procedures for testing such hypotheses, data analyses, presentation skills and the use and misuse of data will be discussed. Using this training in consultation with the faculty, we will each develop independent research projects pertaining to the maintenance of biological diversity. Likely topics include tests of competitive hierarchies among plants competing for sunlight or for soil nutrients, successional predictions from forest seedling distributions, possum territoriality in response to resource availability, tree kangaroo foraging behavior within disturbed and intact habitats, and elevation gradients in bird species composition (via mist netting). We will make oral presentations of our findings to parks and wildlife service professionals. Written reports will be sent to the Australian government research organization, C.S.I.R.O.

Tuition: \$6670 + \$100 Registration Fee
Departure Point: Cairns, Australia
Prerequisite: College level biology/ecology course
Dates: September 7 - December 3, 1988
February 3 - May 1, 1989

Center For Rainforest Studies: Australia

How resilient is the tropical rainforest ecosystem with respect to recovery from increasing logging demand? Addressing this query, SFS students will set out from our Millaa Millaa base, "commuting" to work in the tropical rainforests of Palmerston National Park, 5 km away. Our first days will pass quickly as we orient ourselves to the intricacies of this 100 million year old rainforest. At first glance, we can't help notice the canopy of tree crowns towering 60 meters above and the vines and epiphytes (rootless, attached "air plants") streaming about us. At this point, our faculty become our guides, teaching us how to see beyond the obvious into the web of life that makes up the rainforest ecosystem. We will learn to look for feeding damage, feces, or even eyes peering from the foliage that indicate the presence of arboreal folivores: the lumholtz tree kangaroo, the spectacled flying fox, the spotted cuscus, the spiny bandicoot and five species of possum.

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

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

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

Tropical Species Diversity

SUMMER COURSE

Purpose:

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



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

based on the occurrence of key species within each habitat.

Armed with our questions and predictions, we will travel to several of the 5 national parks that lie within 40 km of our base. New animal species—laughing kookaburra and fluffy gliders—appear with changes in height of land, soil type or tree composition. Here we also see evidence of the large scale disturbance caused by the newcomer to the rainforest: Man. What is the relation between clearcut area and the diversity of associated plant and animal species? As we conduct replicated transects, we begin to establish whether the presences or absences of key species serve as indicators of the magnitude of disturbance.

In the last few days of the course, we will finish our independent projects—possibly assessing possum foraging distances as response to food availability, or regeneration patterns within clearcuts. We will compile a report from our team and independent findings to be submitted to Australia's Commonwealth Scientific and Industrial Research Organization for potential use in developing logging policies that will prevent further endangerment of this fragile and irreplaceable ecosystem.

Tuition: \$2190 + \$100 Registration Fee

Departure Point: Cairns, Australia

Dates: Level A: June 15 - July 14

Level B: July 21 - August 19

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

The World Conservation Strategy calls rainforests the "most exuberant celebration of genetic diversity on Earth". Of the estimated 4 to 5 million species of plants on Earth, 3 million exist only in rainforests and only a sixth have been identified. Just as scientists are beginning to unveil their secrets, rainforests are being destroyed at a rate of 25-50 acres a minute.

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

Deep in the rainforest, 8 miles from the nearest town, we will set up our camp at Rara Avis, a 1700 acre wildlife refuge owned by a former SFS faculty member. We will make several forays into mountainous terrain mapping regions deforested at different times, while also documenting all species of animals we see and noting tracks from larger mammals such as jaguar and puma. Using surveying tools we will transect deforested areas at increasing distances from intact primary forest.

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

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

Tropical Ecology: The Dynamics of Deforestation

Costa Rica

SUMMER COURSE

Purpose:

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

Faculty will discuss species interactions, biological diversity, ecosystem stability, nutrient cycles and energy flow, soil development, succession and plant and



animal identification. Additional material will focus on habitat destruction, the economics of deforestation, and the principles of natural resource management.

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

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

We will work in a remarkable range of ecosystems: remote virgin tropical rainforest, a cloud forest with an elevation of 2,000 meters, and a steamy lowland rainforest. Tall trees dripping with epiphytes, sparkling waterfalls and a huge array of animal life—tapirs, jaguars, ocelot, toucans and capuchins—create an unforgettable tropical world. Temperatures at these locations vary from cool at higher elevations, to hot and muggy at lower elevations. Rain showers are short, but frequent. Our rustic campsite consists of screened rooms under a thatched roof. A meeting room with a kitchen is nearby. We will carry in our food, purchased at local markets in Las Horquetas.

Tuition: \$1790 + \$100 Registration Fee
Departure Point: San Jose, Costa Rica
Dates: Level A: July 21 - August 19

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

Today, more than 25 percent of all pharmaceuticals are derived from tropical flora, including essential ingredients for birth control pills and Curare (a muscle relaxant used in heart surgery), which grow only in rainforests. Only one sixth of the forest's 3 million species have been identified. The greatest storehouse of information about the pharmaceutical properties of tropical plants resides not in university libraries, but in the oral traditions of indigenous peoples who have used these plants for centuries. In Ecuador, modern medicine has reduced the Indians' dependence on folk remedies, and these age-old traditions are being lost. Socioeconomic upheavals are altering tribal structure, relocating people and destroying traditional folk ways, while deforestation is eliminating vast numbers of species at an alarming rate.

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

Our base camp will be at the Reserva Biología Jatun Sacha, about 8 km ESE of Misahualli along the Rio Napo, only 1 degree south of the equator. During the first half of the course, our focus will be on the primary rainforest. One can expect almost daily encounters with mud as we hike through low-lying areas to our study site. Here we will collect herbarium specimens from undergrowth overshadowed by huge trees cloaked in epiphytic orchids, ferns and lianas, culminating in a

SFS gratefully acknowledges Cargill Incorporated for their support of this course.

"What you get out of SFS is not just college credit and knowledge, but an understanding of why we are here and what we can do to help each other and the whole world." Mark Skalny, Needham, MA - Paul Smith's College (Photo: Julie Schwantes)

Ethnobotany: Discovering New Plant Medicines

Ecuador

SUMMER COURSE

Purpose:

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

deep lofty canopy towering 60 meters above us. We will conduct systematic transects to document the diversity of endemic and often previously undescribed species of plant life in this region. These "voucher specimens" will be prepared for identification and analysis at our base camp using specially made plant presses. During the second half of the course we will travel by motorized dugout canoes along the Rio Napo to reach the home of our Yumbo Indian informant, a Yachaj runa, or shaman, with more than 50 years experience in the recognition, preparation, and administration of plant



remedies. Our informant will lead us into the forest on collecting expeditions, and will describe the Yumbo conceptions of health, disease, anatomy, physiology, and supernatural influences. We can then contrast Yumbo knowledge and classification with the systematics and taxonomy of classical botany.

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

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

The verdant greens of the rainforest are fostered by drenching rains—in this area up to 6 meters annually. Days are often clear and warm while nights, when most of the rain falls, can be cool requiring a warm sleeping bag. Our primitive base camp at Jatun Sacha will provide simple but adequate accommodations complete with a spectacular view of the snow-capped Andes rising in the distance. Our tents will be pitched on platforms to keep out rain and the ever present mud. Our close proximity to the river makes bathing each day easy. We will purchase food in Misahualli and prepare our daily meals in a covered outside kitchen.

Tuition: \$1820 + \$100 Registration Fee
Departure Point: Quito, Ecuador
Dates: Level A: June 15 - July 14
Level B: July 21 - August 19

This course will be offered in January 1989. Contact the Admission Office for details.

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

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

Our base of operation is The Fresh Water Institute field station, a turn of the century lodge on Lake George. From here we plan two extensive expeditions among the most isolated upper lakes. Our first expedition will take us through dense birch, beech and maple forests to Beaver Brook, a small stream west of Lake George. Here, in a classroom defined only by mountains and a huge sky, we will study how water reacts with the rocks and soils over which it flows and how these reactions affect the acid level of the water and the organisms it contains. We will collect water samples from pre-determined locations, as well as a variety of representative invertebrate species to better understand watershed dynamics and hydrology.

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

"Acid Rain": Changing Aquatic Ecosystems

*Adirondack Mountains,
New York*

SUMMER COURSE

Purpose:

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

Faculty will introduce theories of limnology, water chemistry, and basic principles of ecology, physiological adaptations to acid-stress, impacts on forest ecosystems, mineral weathering of igneous rock, and management implications of liming and other forms of control technology. Basic laboratory and field techniques such as stream-flow measurement, titrations, determination of acid neutralizing capacity, and collection and identification of major

plankton, plant, and macro-invertebrate species will be demonstrated. Individual directed research topics may range from the characterization of the zooplankton communities, to the determination of feeding preferences of invertebrate predators, or the description of daily migration of invertebrates in the water column.

Our long term data will allow us to determine how variations in aquatic chemistry affect distribution and adaptations of fresh-water organisms, and how new food chains develop in acidic lakes. Our final report will be submitted to state and federal agencies responsible for environmental protection and may influence future decisions concerning these watersheds.

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

Tuition: \$1480 + \$100 Registration Fee
Departure Point: Bolton Landing, New York
Dates: Level A: July 21 - August 19

*SFS gratefully acknowledges the
Boston Globe Foundation for their support
of this course.*



"Rather than being an abstraction, science became something concrete. After a lecture on aluminum I could see frothy bubbles of aluminum in the lakes on a stormy day. I was able to touch, see and experience what I was learning so everything fit together." Kristin Steinmetz, Trenton, NJ - Haverford College
(Photo: William McComas)

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

We will document the vegetation type and cover of summering areas for large mammal species such as bighorn sheep, elk, mule deer, and black bear throughout two distinct landscapes in the San Juan Mountains. Special efforts will be made to identify unique or critical habitats (old growth forests, undisturbed riparian habitats, areas of high berry productivity). We will cross-check our findings with the use of aerial photographs and the most recent data available from public and private resource organizations. Our findings will be of use in answering a number of critical questions: How much cultural land use can be interspersed with the natural systems of a region? What might be the estimated carrying capacity of the current system? How seriously will it be impacted by proposed land-use changes?

Landscape Ecology: Designing Parks For Preservation

San Juan Mountains, Colorado

SUMMER COURSE

Purpose:

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

The San Juan Mountains lie to the north of Mesa Verde National Park and the Southern Ute Indian Reservation, along the Colorado-New Mexico border. They extend from sagebrush habitat below 7,000 ft, to high peaks reaching over 14,000 ft. Following our arrival in Durango, we will familiarize ourselves with the San Juan area through maps and slides, and move on to establish our first base camp in the spectacular Animas River Canyon-Needle Mountain area. We will

first survey the area to determine types and distribution patterns of focal wildlife (large mammal species), and then carry out systematic transects to map the vegetation associated with the presence of identified species. Daily observations will be field-verified using Landsat satellite images and aerial photographs. We will note the features of greatest importance in those areas associated with particular distributions of large mammal species.

In the second phase of our study, we will travel east to the San Juan River, into the grasslands and forests of the Blanco Basin to continue our work. Comparing the two study areas will add to our knowledge of the critical features of large mammal habitats and the relationship between the area of a particular ecosystem and type and diversity of species it will support.

Students will carry out directed research projects based on their own interests and observations. There are many important questions to be addressed, such as how well do aerial photographs allow us to discern important elements of various habitats? How do various species differ in their habitat area requirements? Do public land-use values threaten the pristine qualities of this region? Our research results will be presented to park planning agencies at the local, state, and federal level, in order to build support for preservation of this vital area.

Faculty lectures will address the vegetation and habitat types of southwestern Colorado, the natural history and ecology of large mammals, conservation biology and theories of biogeography. Training in the use of landscape mapping systems and aerial photo interpretation will be provided. At the end of each day, as we relax around a glowing campfire, we will informally consider topics that may range from cultural differences in land ethics, to our personal views about conservation and wildland protection.

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

Tuition: \$1660 + \$100 Registration Fee

Departure Point: Denver, Colorado

Dates: Level B: June 15 - July 14

Level A: July 21 - August 19



"I thank SFS and my scholarship donors for a very special opportunity. We did a lot but there's still more to do. I'll be out there in the middle of the light, because, thanks to SFS, I've decided what I want to devote my life to!" Michelle Boucher, Brockton, MA - Smith College (Photo: Karen Josephson)

Center For Northern Studies: Vermont

Background

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

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

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

The natural world we see exists in time on a number of scales. The waxing and waning of glaciers and the slow change of the earth's climate mediate migrations

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

Resource Management: The Changing Environments of the Circumpolar North

SEMESTER PROGRAM

and extinctions of plants and animals, force changes on humans, while altering the shape of the land itself. Much shorter term changes are often caused by living organisms themselves (e.g., insects and fire profoundly alter forests and rangeland). Humans are responsible for many of the shorter term changes, either directly in the case of agriculture and urban construction, or indirectly in the case of introducing exotic organisms or altering the climate. Northern regions are particularly sensitive to change. Our programmatic theme is thus the changing environment, over years, decades, or millenia. Particularly important for a resource manager to understand is not only historical change but also to be able to see/uncover current changes, and through the past and present, be able to attempt predictions of future change.



"My interests and my goals were not matched to my financial situation and I felt I might never be able to afford such a course. The fact that I might never get a chance scared me a little. I made sure I kept in touch with the School, and with their help, I was able to participate." Dave Siemper, Minneapolis, MN - University of Minnesota (Photo: Steve Young)



"This course has given me an opportunity to spend time in an ecosystem that fascinates me. More important, it has helped me to understand it." Jon Rosenthal, Ann Arbor, MI - University of Michigan (Photo: Jack Witham)

Site

Located 30 miles south of the Quebec border, the Center for Northern Studies is nestled in the hill country on the outskirts of the rural northern Vermont village of Wolcott. This natural subarctic laboratory is climatically and biologically comparable to Leningrad and Anchorage, with small nearby areas of alpine tundra similar to Labrador. Every tree species native to interior Alaska occurs naturally here in an outstanding example of boreal forest and muskeg.

Students arriving for the fall semester will witness one of nature's most colorful panoramas as the lush green summer foliage assumes autumn hues. Deep green conifers provide contrast to blazing yellow and orange sugar maples. By November's end, the first snows often blanket the carpet of leaves left behind. Winter can be experienced to the fullest here—the deep snow pack that offers countless recreational opportunities is also the reason so many furbearers, usually limited to the far North, thrive here. As we ski, hike or snowshoe within the Center's 300 acre preserve, sightings of moose, sable, snowshoe hare, and even an occasional bear, will be common. Numerous northern bird species—three toed woodpeckers, Hudsonian chickadees, loons, goshawk and northern ravens—appear throughout this crystalline landscape.

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

The Center is housed in a wooden building on the edge of our study area. Facilities include seminar rooms, a laboratory, darkroom, computer room, and herbarium containing over 10,000 specimens from polar regions worldwide. Included in the library's ample holdings are more than 70 polar journals and periodicals, an outstanding collection of



"This is how learning should be. You don't have to be a biology major to love it!" Frank Lorch, Pataskalus, OH - University of Notre Dame (Photo: Steve Young)

maps, reports and volumes relating to polar research and exploration. Students will live in homes nearby in groups of 5 or 6, sharing responsibilities for housekeeping and meal preparation. From this base we can conduct our field studies in both the boreal forests of the surrounding mountains and set out on extended field trips to Labrador, Quebec, or other subarctic regions.

Research Focus

How has resource use shifted through time for the North's species, including Man? Our research in the Fall semester focuses chronometrically and involves ecological and anthropological techniques of population characterization and monitoring. Included are life table matrices, vegetation analyses, museum identifications and the interpretation of satellite photo-imagery. Our goal is to develop a knowledge of both the components and processes that shape the tundra and northern forest, their resources, people, problems and problem solving. Much of our field work will take place in Newfoundland with potential additional trips to other northern sites including the Presidential Range of the White Mountains.

During the Spring semester, the temporal scale expands as our archaeological digs enable reconstruction of past influences. Associated field work during our stay in rural northern communities of eastern Canada will have two components. We will gain critical insight into past environments utilizing paleoecological and archaeological tools of pollen analyses, the identification of and analysis of faunal re-



"I wanted to learn about all the parts that make up the wilderness by seeing them first-hand and spending time in the wilderness instead of memorizing facts and theories in a brick building so distant from the area being studied. In college, each class is totally separate and I couldn't see where all the parts were coming together or leading me in the future." Jeanne Guild, Chester, VT - Colby College (Photo: Steve Young)

mains, the preparation of specimens for radiocarbon dating and the cataloging and analysis of stone artifacts, pottery, house site remnants and similar material identifying human activity. Secondly, our social and policy issues will focus on a specific northern community (most likely a coastal fishing village in Newfoundland or Labrador). Techniques of field ethnography will be combined with an examination of the current literature available on this village and other northern communities facing similar pressures.

Fall Curriculum

Introduction to Polar Biota brings into focus the predominant vascular plants and vertebrates defining northern landscapes. Considerable emphasis will be placed on field and laboratory identification of the unexpected diversity of higher plants, fishes, marine and terrestrial birds and mammals. Evolutionary and biogeographic relationships within these taxa will also be explored using tools ranging from museum specimens to satellite photo-imagery.

Population and Community Dynamics builds upon the floristic and faunistic overviews developed in the preceding course. Tundra and boreal forest ecosystems will be "dissected" in the examination of classical ecological processes of energy flow, succession, community stability and species interactions such as competition, predator/prey dynamics, parasitism and disease transmission. Students will be introduced to the tools, equipment and methodology essential to conducting effective field work in the Arctic and Subarctic environment.

Indigenous Cultures of the Circumpolar North surveys the major features of predominant northern cultures such as Inuit, Aleut, Athabaskan, Cree, and Sami. How do these peoples differ in their adaptation to stresses and resources of the arctic and boreal environments? Exploring their responses will also reveal the major impacts such cultures have had upon the dynamics of Northern ecosystems since the height of the last Ice Age.

Management of Northern Resources integrates the three preceding courses providing fundamental tools of analysis and prediction. The means for effective environmental impact analysis will be presented. Also introduced will be the use and misuse of optimization models and their application to harvesting in forestry, wildlife, fisheries and agricultural systems. Within this course students begin developing ways of dealing effectively with the complex interactions characteristic of both environmental problems and their solutions. This will be accomplished through a combination of case studies of the social, political and legal factors operating within the area, and an examination of basic principles of social sciences.

Beyond identifying resources, peoples, issues and tools, a solid preparation in Northern Studies involves research, synthesis that furthers our understanding. **Directed Research** in the Fall semester launches student investigations which monitor and characterize the sensitive rela-

tionships and equilibria that define Northern ecosystems and their alteration. Specific topics may include: the effect of the abandonment of northern agricultural land and the regrowth of the forest; the design of sampling for use in year to year monitoring of population changes of key organisms; carrying out baseline studies and other surveys that can form the basis of environmental impact statements and management plans.



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

Spring Curriculum

Introduction to Northern Archaeology places northern cultures within a historical context, tracking their development and expansion in the changing northern environment. Both the cultures and the peoples will be emphasized together with archaeological resources and the methods of retrieving information from them. The relationship of people to their climate, flora and fauna of the Arctic and Subarctic will emerge from this approach.

To understand Arctic and Subarctic environments, they must be placed within a framework of great and recurring changes in climate, sea level, glaciation and migrations of vegetation, animals and people. The course **Ice Ages and Their Impact** forms a basic geological introduction to the processes and features characterizing the

Quaternary Period, the last 2 million years of Earth's history and the time of the spread and retreat of the great glaciers in high northern latitudes.

Many environmental changes in the north are related to long-term factors such as Ice Ages; others involve much shorter natural cycles or perturbations, and some are man-induced. **Analysis of Environmental Change** provides research tools for investigating and understanding broad spectra of variation. Environmental shifts—such as glaciation or polar ice cap melting—are mirrored by geological, biological and anthropological responses. The preceding courses initiated an awareness of these responses and how they may be detected. Here we will develop a functional understanding of hypotheses, methods and equipment widely used in reconstructing, analyzing and predicting environmental change.

The Spring semester courses described above examine the variability of northern peoples and cultures as functions of time. In **Social and Community Issues** we seek to understand current sociological forces and their recent effects. We will explore the actions being taken or contemplated by northern communities as they strive to maintain their growth and integrity in the face of tremendous pressure to change and adapt, both from the outside world and their own internal dynamics.

Directed Research during the Spring provides a further opportunity to conduct integrative investigations using tools derived from the preceding courses. Temporal dynamics provide the only other criterion defining these investigations: each research project identifies biological and/or cultural response as it varies across time. For example, what is the relative importance of marine mammals and fish in the diet of a particular culture during a selected interval? To ascertain answers, a student might work closely with a particular tool assemblage from an archaeological site. Another, investigating the use of agriculture within a prescribed area might analyze the pollen rain of that locale. Still another, focusing on glaciation, might investigate the local retreat of a glacial lobe.

Tuition: \$6300 (does not include board)
Departure Point: Wolcott, Vermont
Dates: September 7 - December 14, 1988;
February 6 - May 19, 1989

Note: Credit for this program is awarded by The Center for Northern Studies which is accredited by The New England Association of Schools and Colleges.

SFS Animal Behavior And Conservation Programs

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

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

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



(Photo: Steve L. Swartz)

The SFS Center for Marine Mammal Studies (see page 38) in Baja, Mexico will be the site of much needed, ongoing behavioral studies of both resident and migratory marine mammals by Marine Mammal Biology and Conservation (see page 40) semester participants. Our data can provide much needed information on changes in the utilization of coastal waters by marine mammals in the face of growing conflicts between renewable resources, wildlife management and human behavior.



(Photo: Steve Lee)

Ongoing SFS research in the Gulf of Mexico examines Dolphin Biology and Behavior (see page 41), specifically focusing on potential impacts of commercial fishing, gas exploration and boating on a resident population of Bottlenose Dolphins. Students participating in Social Ecology of Spinner Dolphins (see page 43) will examine potential impacts of tourism and fishing on certain behaviors particular to this dolphin population off the Hawaiian coast.



(Photo: Lars Jones)

Students in Humpback Whale Ecology (see page 45) will sail waters off New England, continuing the work of previous SFS teams documenting behavior, identifying individual whales and assessing the impact of food availability on distribution and density patterns of this magnificent mammal.



(Photo: William McComas)

Participants in Endangered Monkeys: Experimental Social Ecology (see page 42) will have the unusual opportunity to conduct hands-on primate research, observing, capturing, tagging and tracking a population of endangered Panamanian Tamarin monkeys previously undescribed in scientific literature.



(Photo: Thomas Husband)

Dwarfed by jagged peaks, participants in Dynamics of a Recovering Species (see page 44) will further evaluate the impacts of reintroducing the Alpine ibex to an altered habitat in the Swiss Alps, after facing near elimination here at the turn of the century.

Center For Marine Mammal Studies

Background

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

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

Schools of anchovies, shrimps and sardines drawn to these waters are the target not only of Mexican fishermen, but also an international fleet as Mexico contracts with other countries for a percent of the catch. Overfishing is driving fish resources to ever increasing lows, presenting the threat of a diminished food source and the loss of dependent species from their habitats, further stressing marine food webs.

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

The Government of Mexico has a long history of wildlife conservation. Unfortunately, funds for the development of management programs for her coastal waters are severely limited. Pending approval for this project by the Mexican government, SFS students will have an opportunity to make a significant contribution to future management policies as we

Baja, Mexico

Curriculum:

- Marine Mammal Biology and Conservation Semester Program

consider the status of marine mammal populations here. Through our ongoing presence, SFS can document the changing demographics of marine mammals at constant sites over several years. These baseline data can provide much needed information on changes in the utilization of coastal waters by marine mammals in the face of growing conflicts between renewable resources, wildlife management and human behavior.



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

Site

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

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

Resident populations of marine mammals include harbor seals, California sea lions, bottlenose dolphins and Gulf Harbor porpoise. These waters also comprise key migration routes of gray whales, blue whales, killer whales, fin and Bryde's whales and elephant seals.

Research Focus

In order to manage human activities for the benefit of both ourselves and marine mammals, it is essential that we understand the natural history and habitat requirements of each species within the Gulf of California. We will document the seasonal abundance and distribution of marine mammals in the coastal waters of Baja, focusing on both resident and migratory species. Key questions addressed by our research include: How do co-occurring species differ in their patterns of prey and habitat use? To what extent does boat traffic impact whale activity patterns? How are shoreline populations of pinnipeds affected by human disturbance? To what extent does marine debris impair breeding and survivorship?

Living and Working Conditions

The planned SFS Center at Bahía de los Angeles, on Baja's Gulf coast, will provide rustic living accommodations, a field computing facility and a small field library. Nearby are an extraordinary array of marine mammals and their habitats. On field expeditions we will camp in tents and cook over portable stoves and mesquite



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



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

fires. Our travels will take us into desert terrain, to the Pacific coast gray whale breeding grounds, and to meet with other researchers in the town of Guaymas.

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

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

Center For Marine Mammal Studies: Baja, Mexico

This 12 week semester program consists of five courses designed to allow students to explore the scientific, economic, social and historical issues involved in the conservation and protection of marine mammals. Our introductory course, **Biology of Marine Mammals**, emphasizes species adaptation to the marine environment. Each of the four orders of the world's marine mammals will be explored on the basis of their evolution, social ecology, physiology and anatomy. Sensory and communication systems will be compared among species with respect to the physical properties of the ocean. Ongoing discussion will focus upon how similar biological challenges have been met by different species. Field work and trips to other sites to observe seasonally present marine mammal species supplement lectures.

Population and Community Ecology presents the dynamics underlying present day species distribution and abundances. The course initially focuses upon life history analyses (birth and death schedules as they shape population survivorship and growth) and movement behaviors, including migration. From these processes, an emergent perspective will include local and global patterns of occurrence and extinction. Marine mammal distribution and abundance is thus explored in terms of: a) environmental interactions limiting abundance including, b) interspecific interactions and how these affect the structure of marine communities and, c) gene flow (and associated isolation mechanisms) within populations and its evolutionary implications.

Through **Cultural Ecology**, students will examine the economics, cultures and politics of Mexico with respect to the perception, understanding and utilization of the ocean and its resources. We will also investigate the extent to which folk traditions, partisan factions and processes of commerce have convergent impacts upon individual livelihoods and upon the state. Field trips and guest lectures will highlight these factors in the contexts of fisheries and tourism development within the region.

Marine Mammal Biology and Conservation

SEMESTER PROGRAM

Courses:

- ☐ Biology of Marine Mammals
- ☐ Population and Community Ecology
- ☐ Cultural Ecology
- ☐ Environment and Society
- ☐ Directed Research

Environment and Society builds on the biological and sociological findings of the preceding courses. Case studies of relevant environmental conflicts (such as fisheries litigation contested on local and international levels) and prospects for their resolution will be presented. The concept of sustainable yield will be explored from ecological, economic and sociological perspectives. Conservation ethics and practices will focus upon the worldwide preservation of marine mammal species.

In **Directed Research**, students will have the opportunity to integrate perspectives developed in the previous courses as they design independent research projects investigating the diversity, abundance and behavioral dynamics of marine mammal species in and about the Gulf of California. The elements of environmental impact statements will be discussed. Particular research topics will be determined by the seasonal availability of cetaceans

(whales and dolphins) and pinnipeds (seals and sea lions).

Much of our fall research will focus on Bottlenose dolphins and California sea lions. These species tend to congregate in much larger groups than baleen whales (e.g., the grays, blues, fins and Bryde's whales). We will study social behavior and mating systems of these two very different taxa, and assess their habitat utilization patterns throughout portions of their range. Small boats, photography and hydrophones will facilitate our research. Shore-based observations can provide additional data on sea lion social interactions and dolphin distribution and movement. Additional investigations may include temporal patterns of behavior and movement characteristics, documentation of mother-infant interactions, habitat descriptions of sea lion haul-out areas, or affiliation patterns between individually identified dolphins.

During the spring semester, opportunities are available to investigate the evolution of social behavior and mating systems in blue and gray whales, and to document abundance and distribution of fin and Bryde's whales. We will rely on individual photo-identification, small boat surveys, and recording underwater vocalizations to document behavioral and distributional indices of cetaceans in Gulf waters. Additional foci include differences in social patterns among large whale species or temporal differences in feeding activities within and across species.

Tuition: \$6490 + \$100 Registration fee
Prerequisite: College level Biology/ecology course

Dates: September 8 - December 4, 1988
February 3 - May 1, 1989



"I had begun to feel I had chosen the wrong field. I wasn't sure how I could survive all the courses necessary to get a marine science degree. Now when I get down in the dumps from too much school work, I think back on my SFS course and get a new perspective on everything." Lisa Steiner, Two Rivers, WI - University of Miami (Photo: Steve L. Swartz)

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

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

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

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

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

Biology and Behavior of Bottlenose Dolphins

Gulf of Mexico

SUMMER COURSE

Purpose:

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



"I learned without even trying just because it was there all the time, and it was so interesting. We had an anatomy lecture that could have been dry as anything but instead, Stu took us out to see a dolphin that had washed ashore and we could see how everything connected together." Donna Lazendorf, Schenectady, NY - Union College (Photo: Erie Taniuchi)

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

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

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

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

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

Tuition: \$1820 + \$100 Registration Fee
Departure Point: Mobile, Alabama
Dates: Level A: June 15 - July 14
Level B: July 21 - August 19

This course will be offered in January 1989. Please contact the Admissions Office for details.

The rainforests that once blanketed most of Panama were home to the rufous-naped or Panamanian tamarin monkey. Panama's growing human population has left only pockets of what was once continuous forest. Unless measures are undertaken to protect or relocate them, this ongoing loss of habitat may drive the gremlin-like tamarin and many of its neighbors to extinction. SFS Course Director, Dr. Dennis Rasmussen, has conducted research at our study site since 1981. The discovery by Dr. Rasmussen and SFS students that our study site has one of the highest population densities of any known area suggests that secondary neotropical jungle is a particularly favorable habitat for the tamarin. On the basis of this information, SFS, the University of Panama, and several conservation organizations are lobbying to make our study area a national refuge for this species.

This summer SFS students will continue to trap and mark individuals to collect data on leadership, range use, social interactions and population size. Additionally, we will continue our investigation of how resident groups react to strangers introduced in cages. Placing caged strangers of different ages and sex high in the trees within territories of known populations may help us to learn how to reintroduce tamarins to areas where their numbers have been depleted.

We will also observe the behavior and range use of a group of tamarins introduced and provisioned on a nearby island with support from the World Wildlife Fund. Is this a means of rapidly producing tamarins who can then be reintroduced into areas where populations

Endangered Monkeys: Experimental Social Ecology

Panama

SUMMER COURSE

Purpose:

To determine changes in the population density of the endangered Panamanian tamarin monkey and its impact on social organization through experimental trapping, tagging and introduction studies; to monitor the reproductive success of tamarins experimentally introduced on an uninhabited island.

are declining? The data collected by SFS students will play a major role in saving a population of monkeys previously undocumented in the literature.

After arriving at Panama's international airport, we will board a bus for the quick trip from the Pacific coast to the Atlantic coast. We will set-up camp in a rainforest clearing complete with a 20 x 30 foot covered patio (Bohio) to the accompanying cacophony of a colorful and diverse array of tropical birds. Our first few days

will focus on learning the skills essential for working safely at the site. We will then begin to capture, measure, and mark tamarins from as many groups as possible, adding to the over forty individuals we have identified during previous courses. Each monkey we capture will be weighed, censused, measured and then marked with a color-coded collar, offering students an unusual opportunity to gain direct hands-on experience with the monkeys and to examine them more closely. With the aid of radio tracking equipment we will observe and follow our main study group through dense jungle from dawn to dusk.

Following an introduction to the natural history of tamarins and a review of the scientific study of social behavior, faculty will discuss foundations of evolutionary theory, primate taxonomy and principles of animal behavior. Methods of scientific interpretation of tamarin social ecology and behavior will include reproductive and parental strategies, and territorial defense.

Shortly after the start of the course, faculty will assist students in carrying out directed research projects. Potential topics include studies of range extension, assessment of the likelihood of trapping different ages and sexes of tamarins, relationships between group members—particularly mothers and infants, and territorial behaviors. Written summaries of our group and independent research results will be sent to researchers at the University of Panama, the Smithsonian Tropical Research Institute, and the Ministry of National Resources of the Republic of Panama.

The watchword here is wet: rainfall averages 11 inches a month and is often accompanied by magnificent lightning and thunder. This is truly a "steaming jungle" where we will often be soaked with sweat, rain and sunburned all in one day. The temperature ranges from a maximum of 85° F during the day to a minimum 70° F at night. The end of the day will often find us relaxing in the cooling lake waters. Tents erected in a jungle clearing overlooking Gatun Lake will be our home for the month. We will prepare our own meals, and share in the daily camp chores.

Tuition: \$1790 + \$100 Registration Fee
Departure Point: Panama City, Panama
Dates: Level B: June 15 - July 14
July 21 - August 19

This course will be offered in January, 1989. Please contact the Admissions Office for details.



"Following tamarins through the dense canopy of the jungle was quite a challenge. The excitement of spotting a group of monkeys high above was incredible." John Beck, Grand Rapids, MI - Hillsdale College
(Photo: William McComas)

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

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

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

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

We plan to establish our base camp on the outskirts of Kilauea, an old sugar plantation town, not far from the inshore waters around the Kilauea Point National Wildlife Refuge, our primary study site. Team members based on shore will use binoculars and spotting scopes to locate dolphins. Using CB radios they will confer with boat based team members to coordinate data collection and verify each others' observations. Spinner dolphins are

Social Ecology of Spinner Dolphins

Kauai, Hawaii

SUMMER COURSE

Purpose:

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

difficult to approach under most circumstances, so care will be given to developing subtle techniques to photo-identify individual dolphins using dorsal fin shape and body markings. The boat team will also periodically record dolphin vocalizations to document relative amount of acoustic activity associated with changes in group behavior.

Our work will provide a basis for comparison with previous studies carried out in the southerly Hawaiian Islands, in an area subject to considerable levels of habitat disturbance from agricultural run-

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

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

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

Tuition: \$1890 + \$100 Registration Fee

Departure Point: Princeville, Kauai

Dates: Level B: June 15 - July 14

Level A: July 21 - August 19



"My goal has been to become a cetacean biologist but I realized this goal was based on a fantasy image, not reality. I didn't know what working in the field was like or how cetacean research was conducted. I decided the only way to learn was to experience them." Stephen Lee, Chevy Chase, MD - Tufts University
(Photo: Nanci Shapiro)

Today more than 10,000 ibex roam the spectacular but unforgiving mountain terrain of the Alps. This is somewhat remarkable considering that during the last century, the alpine ibex was all but eliminated from its native alpine habitat. In the early 1900's, a small number were secretly removed from the handful of ibex remaining on a king's estate in Italy, taken to Switzerland, bred and subsequently reintroduced into some of their original locations.

This remarkable success is not without cost. Alpine ecosystems are among the most fragile systems in the world. Easily damaged through human activity, it can take many years, even centuries, for plant and animal species to adapt to major disturbances. The ibex recovery has led to overgrazing due to increased competition with other recovering alpine species. Potential now exists for a variety of critical environmental problems including erosion, avalanches, and food shortages for many wild and domestic animals. Alpine ibex herds are now being culled in areas where their numbers are judged too high.

The recovery of the ibex population raises many issues. Why have the ibex been so successful relative to other ungulate species? What are the lessons to be learned from 80 years of efforts to conserve the ibex? Can a definitive "operating manual" be developed for the preservation of other endangered species? Is the recovery of one species necessarily at the expense of others?

Our primary research goal will be to determine the factors influencing the abundance and distribution of ibex at two different habitat sites. We will also examine current management policies to protect and control ibex, and their potential effect on the genetic stability of the overall

Dynamics Of A Recolonizing Species:

Alpine Ibex

Swiss Alps

SUMMER COURSE

Purpose:

To investigate the recovery rate and environmental impact of reintroduced alpine ibex (*Capra ibex*) in their original habitat; to develop a model for assessing the effectiveness of reintroduction programs in altered ecosystems; to assist in developing wildlife management strategies.

population. Our results may provide a basis for designing successful reintroduction programs for other endangered species.

We will first travel by train from Zurich through spectacular mountainous countryside to the Justistal Valley near Interlaken. Each day we will hike through dense fragrant forests, climbing to rocky alpine terrain above tree-line, to conduct our behavioral observations. After locating and classifying ibex groups by age and sex composition, we will collect behavioral data on both individuals and small groups. Observation will focus primarily on food preferences, social structure, and foraging behavior. We will also note the presence of other large mammals in our study area, such as red deer, chamois, and roe deer.

In addition to behavioral observations, we will describe the ibex habitat in detail. Using tapes, compasses and transects we will measure the frequency and distribution of different species of vegetation. Habitat microclimate, including humidity and sunlight levels will also be recorded.

After two weeks on the Rothorn, we will travel south, setting up camp at Dom Mountain, the highest peak in Switzerland, not far from the Italian border. Several days of observing ibex foraging behavior will give us data for comparison with information collected at our first site.

Directed student projects will provide the opportunity to explore many questions associated with our major study. What is the effect of altitude on the distribution of local vegetation, and how do component populations vary in abundance? What are the differences in energy budgets among species of alpine ungulates? How are these related to foraging success?

Faculty will introduce concepts of biogeography, biotic succession in alpine ecosystems, animal behavior and social organization, theories of population dynamics, quantitative methods for field analyses of the ecology and management of endangered species. Methods for studying plant habitats and distribution and behavior will be demonstrated. We will present our findings in a final report to the Swiss Federal Forestry Agency to aid in the design of future wildlife management strategies.

Weather conditions can be as surprising and rugged as the mountains. Our base camps will be in alpine meadows while our field work will often require challenging hikes to the playgrounds of the ibex on the sides of rugged, glaciated peaks. Temperatures within these different environments vary considerably, and we may encounter snow and freezing rain, with hot sunny days more common as the summer progresses. Pre-course physical conditioning is recommended to enable team members to handle the hikes through relatively difficult terrain enroute to our study sites.

Tuition: \$1760 + \$100 Registration Fee
Departure Point: Zurich, Switzerland
Dates: Level A: July 21 - August 19

"His mane was tattered, his summer shedding not yet complete. We followed him from sunrise unfailingly, until our daily lecture. Linley time-scanned his mother, brother and sisters. Barbara and Pat made an activity budget of his father and friends. Me, I climbed cliffs just to get a chance to observe him."
Hau Le, West Jordan, UT - University of Utah
(Photo: Susan Becotte)



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

The factors which determine the distribution and movement patterns of humpback whales on the summer feeding grounds have never been clearly understood. As their numbers increase, there have been concerns about disturbances associated with whalewatching vessels, the potential impact of increased commercial fishing, and the effects of oil exploration. During the past two years, humpbacks have all but abandoned the once heavily-used Stellwagen Bank in the northern Gulf of Maine. SFS surveys have supported speculations that they are using an area southwest of Cape Cod more heavily. This year, major oil companies have applied for permits to conduct exploration activity in this important area.

SFS studies of humpback whales over the last five years have tracked changes in distribution throughout the Gulf of Maine, added to an ongoing catalogue of individually-identified whales, and documented behaviors associated with feeding episodes. Further effort is needed to determine the habitat requirements and use patterns of humpbacks, to help clarify the degree of recovery of this species, and the implications of recovery for future management policies. Our research activities will focus on questions such as how are humpbacks distributed relative to other species of large whales such as right whales

Humpback Whale Ecology

North Atlantic

SUMMER COURSE

Purpose:

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

and fins? To what extent are whales able to communicate food availability to other members of their species? How closely are whale distribution patterns associated with movements of sand lance?

Our first week will be spent on a small island off the Massachusetts coast, preparing for the next three weeks at sea. We will have much to learn about boat safety, data collection, and team-work and will cover as much of the lecture materials as feasible to enable us to spend every available moment at sea watching our spectacular and unpredictable subject of study—the humpback whale.

Boarding the Schooner Appledore, we will divide into four watches that will rotate throughout the day and night. Our research day begins at sunrise. Once we sight whales, we will record their location, number, general activity, direction of movement, as well as general sea and weather conditions. Research activities will include censusing of humpbacks and other species of great whales along predetermined ship transects, measuring ocean characteristics in areas differing in whale density, and photo-identification of individual humpback whales. We will document behaviors, particularly with respect to social interactions among coordinated groups of feeding whales. When possible, we will use underwater recording equipment to document sounds made during various activities. We will also note the type and occurrence of boat activity during our observation periods.

Faculty will address the anatomy and physiology of whales and dolphins, the life cycle of the humpback whale, marine food webs and humpback feeding patterns, and techniques for studying and identifying cetaceans. Instruction in the use of navigational equipment and charts, how to use sextants and depth sounders may also be provided. Student directed research projects may focus on long-term associations among individually identified whales, documenting differences in behavior among calves, sub-adults and adults of different size and sex.

Our results will be sent to the National Marine Fisheries Service, while our fluke photographs will be sent to a central repository of identified whales at the Center for Coastal Studies in Provincetown. Data on sightings of other species of large whales will be sent to an ongoing monitoring project centered at the University of Rhode Island.

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

Tuition: \$1960 + \$100 Registration Fee
Departure Point: Boston, Massachusetts
Dates: Level B: June 6 - July 5
 July 26 - August 24
 Level A: July 1 - July 30



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

Beth Grieff, Beaver Dams, NY - Mount Holyoke College (Photo: Ben Baxter)

Academic Credit

All SFS participants are registered at Northeastern University in Boston, which accredits all SFS courses. Twelve week semester programs that incorporate five courses carry 22-23 quarter credits, month-long summer courses carry 8 quarter credits, and twenty-one day January term courses carry 4 quarter credits. Many students have arranged to receive credit, in most cases in the sciences, directly through their home school or college. A few of the over 100 colleges and universities that have awarded/accepted credit include:

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



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

Selected Research Papers Resulting From SFS Field Courses

Plant Community And Ecosystem Ecology Group

Community Ecology, Mount St. Helens

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

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

Ecology and National Park Planning, Atacama Desert, Chile, 1983

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

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

Hazardous Waste and Coastal Ecology, Chesapeake Bay, 1985.

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

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

Acid Rain, Adirondacks Mountains, New York, 1983, 1984, 1985, 1986, 1987

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

C.W. BOYLEN, 1983

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

Maya Archaeology, Belize 1985, 1986

GIBSON*, E., L. SHAW*, and D. FINAMORE*, 1986

Early evidence of Maya hieroglyphic writing at Kichpanha, Belize. Center for Archaeological Research, University of Texas at San Antonio. Working Papers in Archaeology, No. 2.

Animal Behavior and Conservation Group

Marine Mammal Biology and Conservation, Glacier Bay and Kenai Peninsula, Alaska. 1982, 1983, 1984, 1986, 1987.

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

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

CALAMBOKIDIS*, J., B.L. TAYLOR*, S.D.

CARTER*, G.H. STEIGER**, P.K. DAWSON*, and L. ANTRIM*, 1987

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

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

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

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

Primate Social Behavior, Costa Rica, Endangered Monkeys, Panama 1984, 1985, 1986, 1987.

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

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

RASMUSSEN*, D., In press.

Social Ecology and Conservation of Panamanian Tamarins (*Saguinus oedipus geoffroyi*). The Nature of Panama. IUCV.

Wildlife Ecology and Management Group

Population Dynamics of Endangered Species. Greek Islands, 1983, 1984.

HUSBAND*, T.P., P.B. DAVIS*, 1984.

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

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

STELFOX*, J.B. 1987.

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

Marine Biology and Management Group

Coral Reef Ecology, St. John, USVI 1982, 1983, 1984, 1985, 1986, 1987

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

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

Sources of Reef Fish Toxins, St. John, USVI, 1986, 1987

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

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

* SFS Faculty

** SFS Students

Processes and Requirements

Requirements for Admission

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

Admission to all SFS courses is open to eager, motivated students. A background in science is not required to be part of an SFS experience. (See page 6 for course levels). Participants are screened by the Admissions Committee to insure that you are choosing the right course for the right reasons. If you are willing to commit your emotional, intellectual and physical energies to working toward a better understanding of these crucial environmental issues, join us. We promise you a learning experience to last a lifetime.

Applicants for admission are required to submit an SFS application form, a 300 word essay describing their reasons for participating, a \$30 application fee and an SFS reference form. Applicants for month-long courses should have completed at least their junior year in high school. Semester applicants should be 18 years of age, have completed at least one college-level biology or ecology course and must submit an up-to-date transcript.

For further information regarding admission, please call the SFS Admissions Office at (617) 927-7777.

Acceptance

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

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

Students will be notified of the Committee's decision within two weeks of

the above review dates. All acceptances are contingent upon medical approval. Course syllabi will be sent to all accepted applicants. Course faculty will contact all accepted students to discuss their participation in the program.

Open Houses

A series of open houses for those students interested in learning more about the SFS experience and financial aid opportunities will be held in New York, Boston, Washington and Chicago in March and April. Contact the SFS Admissions Office for details.

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

Academic Credit

All students receive academic credit for their SFS course from Northeastern University in Boston, Massachusetts. A \$100 non-refundable registration fee is due 10 days after acceptance into the program. Upon completion of your course you may request an official transcript from Northeastern University at any time. Over 100 colleges and universities accept or award credit for SFS courses. Please consult your Registrar or the SFS Admissions Office for further details.

Financial Aid

We are committed to making the SFS experience accessible to everyone who wishes to participate. *Financial aid, in the form of scholarships and/or interest-free loans is available to qualified students based on need.* The School receives generous contributions from foundations, corporations and individuals to make this possible. In 1987, over 150 of our participants received financial aid totaling more than \$175,000. If you will need financial aid to participate, we encourage you to request, complete and return a SFS financial aid application as soon as possible. Aid is available by need until funds are exhausted. *Semester applicants may arrange to apply federal financial aid monies toward their tuition in addition to applying for SFS funding.* For more information on how you may qualify for assistance, please call the Admissions Office at (617) 927-7777.

Deposits, Tuition and Fees

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

A non-refundable deposit of \$350 (\$250 for financial aid candidates) for January and month-long courses or \$500 for semester programs is due no later than 10 days following acceptance to reserve your place. All students will be registered for academic credit with Northeastern University. The non-refundable registration fee of \$100 is due with your deposit. (Deposits and registration fees for financial aid candidates are non-refundable 10 days following financial aid offer.)

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

Personal gear such as packs and sleeping bags and personal equipment such as SCUBA gear are the responsibility of each student, as are medical insurance, inoculations, passports and visas. The tuition fees listed in this catalogue are based on estimates made a year in advance of departure and involve many variables — currency rate, outside project support, enrollment projections, etc. — all of which may change. The tuition for each expedition is tentative until confirmed in writing by SFS.



"Arriving as an unknown, close-minded, unsuspecting Long Island arm-chair traveller, I experienced SFS with wide-eyes as an intense new world offering rich opportunities for self-challenge in the outstretched arms of instructors and students; I left with a greater self-esteem, world awareness, and very special friends." Michelle Weidemann, Melville, NY - Union College (Photo: Stephanie Clapes)

Refunds

January and Month-long courses:

Registration fees are non-refundable and non-transferable.

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

Semester Programs:

Registration fees are non-refundable and non-transferable.

If a student withdraws more than 30 days prior to the start of the program, SFS will retain 50% of the program tuition; the deposit may be transferred to another SFS program within a 12 month period. If a student withdraws from a program 30 days prior to program commencement to 14

days after program departure, SFS will retain 75% of the tuition. No refunds are made after the second week of the program.

Changes

SFS programs are obviously different from travel or adventure programs. Each project is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- over half of our projects take place in highly regulated and sensitive environments, usually requiring special permits, such as in St. John, Kenya, Panama and Switzerland.

- 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 a course. Indeed, part of the challenge is in adapting to changing conditions and overcoming the obstacles they may present. In other words, the whales are not always where we want them to be, so be flexible.

Student Conduct

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

Responsibility

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

SFS reserves the right to refuse any applicant admission to any program if he/she is deemed unsuited for the project for any reason.

All courses, fees, and dates are tentative until verified and confirmed in writing by The School for Field Studies.

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

How To Figure the Total Cost Of Your SFS Course

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

Transportation and Travel Arrangements

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

Olbia, Italy.....	\$825	Leh, India.....	\$1499
San Jose, Costa Rica.....	\$550	Zurich, Switzerland.....	\$699
St. Thomas, Virgin Islands.....	\$330*	Honolulu, Hawaii.....	\$588
Quito, Ecuador.....	\$699	Nairobi, Kenya.....	\$1300*
Panama City, Panama.....	\$549	Cairns, Australia.....	\$1175*
		Aberdeen, Scotland.....	\$750

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

Clothing and Equipment

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

Physical Examination and Medical Insurance

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

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

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