

THE SCHOOL FOR FIELD STUDIES



Center for Sustainable Development Studies-Costa Rica

Center for Marine Resource Studies-Caribbean

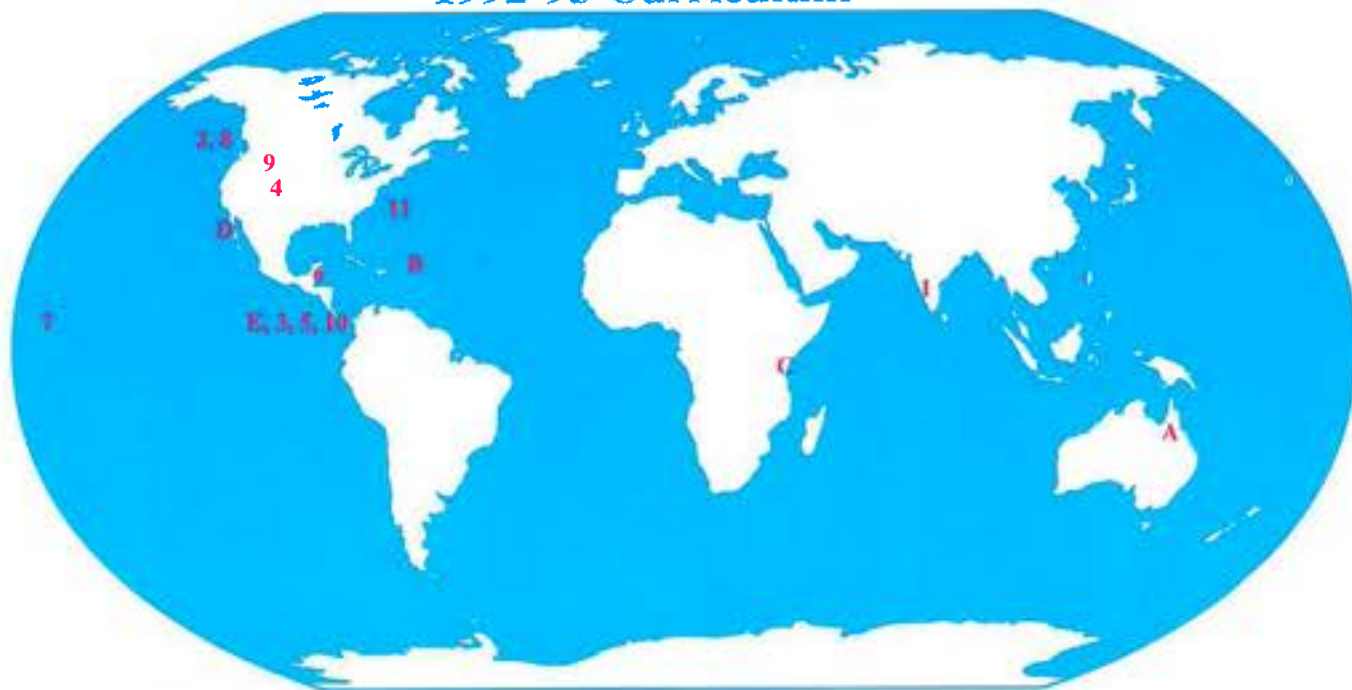
Center for Marine Mammal Studies-Baja, Mexico

Center for Wildlife Management Studies-Kenya

Center for Rainforest Studies-Australia

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C O U R S E C A T A L O G U E

1992-93 Curriculum



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A Letter from the President

Dear Reader,

Thank you for your interest in *The School for Field Studies*.

Right away, let me tell you that our courses are not for everyone. Nor are they only for students majoring in environmental sciences or those who seek a career in that area.

But if you want to learn about (and see) more of the world... understand how your own decisions affect the environment... challenge yourself, physically and mentally... make a real difference in how the world manages its natural resources... *SFS* may be ideal for you.

In fact there may be no better way to achieve your goals than to spend a semester or summer with *SFS*.

You see, I began *SFS* eleven years ago with several of our Trustees to do one thing: give bright, talented students—no matter what their academic focus or career aspirations—a unique opportunity to study environmental problems firsthand, contribute immediately to their solutions and carry a heightened awareness of environmental issues to the world.

Today, there seems to be no lack of environmental interest. People recycle. Governments are moving to limit some pollutants. "Green consumer" is the latest marketing buzzword.

But fundamental environmental crises won't be solved just because people recycle cans. Preserving ecosystems, balancing development and conservation, finding ways to manage and maintain wildlife and marine resources—these problems have been growing for years. Finding the answers will require time, commitment, and a thorough understanding of these very complex issues.

SFS offers you a way to take the time, make the commitment, and gain an understanding of the issues. In return, you will be richly rewarded. You'll work with others who share your desire to contribute. You will have the opportunity to obtain a practical education in the best possible laboratory—the real world. In the end, when your course of study is successfully completed, you will have a sense of achievement and a deeper understanding of the complex aspects of the environmental issues facing us today.

If our curriculum intrigues you, I urge you to apply soon because enrollment is limited. And don't let financial concerns stop you. Scholarships and loans are available.

The challenge awaits you. We invite you to accept.

Sincerely,

Jim Elder

James L. Elder, Jr.
President





About SFS

What The School for Field Studies Does.

SFS provides motivated young people—from secondary schools, colleges and universities nationwide, and from a variety of academic backgrounds—with an action-oriented, experience-based education in environmental issues. At the same time, students are able to make immediate contributions toward sustainable management of natural resources.

In doing so, we seek to make tomorrow's leaders more environmentally literate, aware and able to recognize the environmental effects of how they choose to live.

Since our founding in 1980, we have given more than 4,500 students a unique opportunity to conduct hands-on field studies and research addressing some of the most critical environmental issues facing the world. SFS is the largest private educational institution exclusively offering courses and field-work for undergraduates in the increasingly important field of conservation biology.

In an SFS program, you'll be face-to-face with the issues.

Rainforests don't fit under a microscope. Giraffes don't graze in a test tube. That's why SFS courses don't take place in a classroom. We'll take you to the best possible laboratories for environmental studies, the actual ecosystems where problems are occurring. This provides dramatic, real-life illustrations of the issues that can only be imagined through lectures and textbooks. We provide an educational experience which fully integrates theory and practice.

SFS operates five Centers where you can participate in 13-14 week **semester programs** (part of ongoing, year-round studies). Most Centers also offer month-long **summer courses**. These campuses include:

- The Center for Rainforest Studies in Australia
- The Center for Marine Resource Studies in the Caribbean
- The Center for Wildlife Management Studies in Kenya
- The Center for Marine Mammal Studies in Baja, Mexico
- The Center for Sustainable Development Studies in Costa Rica

SFS also operates 11 **satellite sites** at environmental "hot spots" around the world. At these sites, you can spend a month examining a critical problem, such as loss of biodiversity, in the context of a traditional academic discipline, such as ecology.

For SFS students, the rewards can far exceed academic credit.

You will have an opportunity to learn.

We will teach you how to approach a problem, how to formulate and test a hypothesis. You will work within a team, building on individual strengths to reach a common goal. You'll gain skills in research methodology, teamwork, outdoor living and a scientific discipline—a breadth of training unmatched by any other program.

In short, you'll tackle and solve serious problems under real-life conditions. Many former students tell us the skills learned here stay with them, helping them to succeed in school, in their careers, in their lives.

You will have the opportunity to contribute.

The research that results from your work will become part of databases and management reports for use by wildlife officials, government organizations and other environmental agencies. You can make a unique, personal contribution to science and humanity.

You'll have opportunities rarely available to undergraduates.

For science majors, SFS is a chance to obtain field training before graduation. For students with little or no scientific background, but interested in a career as a field scientist, SFS is a unique way to see what it's really like. For those simply intrigued by environmental issues, SFS is a practical way to study them.

You will have the opportunity to live where few others are allowed to go.

Our courses address timely and sensitive issues. Much of our work is carried out in spectacular places—game ranches, pristine coral reefs, rainforests—that provide dramatic illustrations of the issues under study. Access to these areas often requires special permits not available to the public.

You can establish lasting friendships.

A strong comradery builds among team members as you share daily challenges—setting up camp, cooking, tackling a tough aspect of the research—and as you share thoughts at the end of each day. The experiences you share as you work toward a common goal form the basis of friendships that endure over the years.



SFS students have the opportunity to conduct hands-on research on real world issues. Here team members radio-track elk while investigating the return of plant and animal species to Mt. St. Helens. (Photo: Gary Braasch)



Of course, you'll receive college credit.

Upon successful completion of an SFS program, all students receive credit through Northeastern University. For information on academic credit and a partial list of over 250 colleges and universities who have accepted/awarded credit for SFS programs, please see page 36.

Academics and personal growth go hand in hand in an SFS course.

Academic study, research and the development of practical skills are the three components of any SFS course. Though separated here for the sake of clarity, these components are integrated within the course structure.

Academics

Though we utilize many traditional methods of instruction (lectures, seminars, assigned readings, critical reviews of current research papers, presentations, papers and exams), we constantly seek creative ways to enhance learning through hands-on experience and direct application. For instance, a marine species identification exam is given underwater, with living examples; in one Resource Management course, the "midterm paper" is an Environmental Impact Statement.

Research

It is here that the opportunity arises for you to make a personal contribution to science and—because of the kinds of issues addressed—to humanity.

You will engage directly in real-world problem solving across a wide range of questions: how to control loss of species diversity... feed an expanding world population... strike a balance between development and preservation. While taking part in team research efforts, you will also have the opportunity to test out the career of a field scientist by designing and carrying out a directed research project, either independently or in a small group.

A few of our current research projects include the effects of human activity on whales and seals; the variability in giraffe feeding behavior on a Kenyan wildlife ranch; the ecology of a tropical river system in Belize.

Practical skills

Students routinely receive training in field methodology. Field techniques, which may include tracking, censusing, capturing, mapping, wilderness living and a dozen other skills, are also presented. You will gain experience in teamwork and cooperative problem solving.

Team building is the essence of the SFS experience.

SFS teams range from 15 students and two faculty on a month-long course to 30 students and three to four faculty for semester programs.

SFS students come from public and private high schools, colleges and universities. They major in everything from science to liberal arts. They come from across North America and from many foreign countries. They're as young as 16 and as old as 25-26. **About 25% receive SFS financial aid** (see page 38 for financial aid information). The one thing that everyone shares is a desire to learn more about the natural world.

As an SFS team member, you are actively involved in all aspects of our research and day-to-day living. In fact, with so much to accomplish in the limited time available, there is little time for individual ventures. This team approach to learning and problem solving is at the heart of the SFS educational philosophy; it is one of our greatest strengths.

Working with people from many different backgrounds, under demanding conditions, you will learn a lot about your-

self, how you relate as a member of a team, how you adapt to new people and surroundings. Students often say they learn as much about themselves as they do about the environment. To us, that means the program works.

You provide the enthusiasm, we provide the experience.

Since one of our goals is to introduce students to field training methodology not found in most traditional classroom settings, SFS program participants do not need previous camping experience, field training or, in most cases, a science background.

Summer courses are offered at the college introductory and intermediate level. Our low student to faculty ratio and interactive teaching approach allows us to adjust course pace and content to suit the needs of the team. While most summer participants have completed at least one college biology or ecology course, talented and motivated students with no ecology background have had comparable academic success. Summer participants must be at least 16 years of age and have completed the junior year of high school.

SFS semester programs require successful completion of one college level ecology or biology course. Applicants to semester programs must be at least 18 years of age and should have completed at least one semester at a college or university.

In all cases, the Admissions Committee carefully screens students to insure that they have the potential to contribute to and be successful in an SFS program.



"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: Jim Elder)



The SFS Educational Philosophy

SFS is developing a unique synthesis of the **case study** method linked with **field studies** and **research**. We seek to find an ideal balance between teaching theory and engaging students experientially in practice, on the premise that neither first hand experience nor theoretical study is sufficient by itself for real understanding of environmental problems.

All our programs begin with an investigation of one or more environmental problems in the field and an exploration of the complexity of these issues from numerous human points of view. We then study the theories that are relevant to understanding these problems, usually including some combination of the disciplines of biology, ecology, resource management, resource economics, applied anthropology, and political science. These disciplines are **integrated** by a common focus on the particular case study at hand and are taught with the common objective of understanding **sustainable development** (the use of natural resources for economic development in a manner which can be sustained indefinitely).

All SFS programs include a field **research** component. This research component provides students with an opportunity to make an immediate contribution to the improvement of a local environmental issue and, at the same time, to put the theories learned in the SFS classroom into practice.

We consider this combined educational approach to be the essence of a **practical** education. It is designed to be action-oriented, capable of being put to good use, manifested in practice, experience-based, and concerned with voluntary actions and ethical considerations.

Semester Programs

Each semester program enrolls 28-30 students, and is comprised of four carefully integrated courses. Three of these courses (usually an ecology course, a resource management course, and a socioeconomic or applied anthropology course) focus on theory through the use of local examples. All involve the traditional elements of undergraduate study including more than 40 hours of lecture per course, readings, written assignments, field trips, oral and written evaluations. The fourth course, Directed Research, involves over 150 hours of coursework including instruction in research design and completion of an individual research project

addressing a component of the research objective of that particular semester. Together, these four courses carry 21 quarter credits, which usually convert to 16 semester credits. Since we compress a 15 week semester into 13 weeks (by working on weekends among other methods), be prepared for an intensive learning process.

Faculty

Semester programs are usually taught by three fulltime resident faculty (one of whom is the Education Director) who all live on-site for the duration of the program. Additional staff include a Program Coordinator and occasional part-time faculty and guest lecturers. This level of staffing provides SFS students with a remarkably low student to faculty ratio (no higher than 10:1). Resident faculty all hold an advanced degree (usually a Ph.D.) and usually have at least several years experience in the semester topic at the location of the Center.

Schedule

Semester programs run for at least 90 days not including a four day midterm break (the only time students are free to travel on their own). On average, 3-4 weeks of each semester are spent off-campus on field trips. (Students at the South Caicos Center spend significantly less time off-campus). Courses are taught six days per week.

Prerequisites

Applicants must be at least 18 years old by the time the program begins, must have successfully completed at least one college level ecology or biology course, and should have completed at least one semester at a college or university. Other prerequisites may apply to individual semesters; please check individual semester descriptions.

Preparation

SFS faculty prepare a detailed syllabus for each program. The syllabus contains academic and research objectives, reading lists, and a course schedule, as well as information on the site, necessary personal equipment and medical information. Students may be assigned pre-course readings and will be expected to complete these assignments before the start of the course. When possible, a faculty member will contact students prior to the course to discuss his/her participation in the program. SFS Admissions Counselors are available to answer or refer pre-course questions.

Summer Courses

Summer courses are offered both at SFS Centers and at independent locations, called Satellite sites. Thirty day summer courses depart in June and July and carry 8 quarter credits (which usually convert to 6 semester credits). SFS also offers several 42 day summer programs that run from late June through early August. These six week programs are comprised of two courses: a theory course (5 quarter credits) and a Directed Research course (6 quarter credits).

Summer courses enroll 15-18 students, and are taught by two faculty members. Activities are held seven days a week, with only one or two days off during the course or program.

Applicants to summer courses must be at least 16 years of age and have successfully completed the junior year of high school by the time the course begins. Please check individual course descriptions for additional prerequisites.



"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: Tom Kleinert)

Evaluations

Faculty will conduct oral and written evaluations of students based on classwork, field work, examinations, papers, presentations and other aspects of the course. Students will be requested to evaluate both their course and their faculty. Upon successful completion of the course, students will receive a grade card from Northeastern University (or from SFS if the student attends an SFS Affiliate School) and may then request a transcript from the Northeastern Registrar (see pages 36 and 37 for additional information).



SFS faculty are special people. Selected for their extensive teaching and field experience, knowledge of research and strong inter-personal skills, they are carefully chosen from hundreds of applicants worldwide. Complementing their strong backgrounds in the sciences 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. (Please see individual Center sections and page 24 for additional faculty information.)

Faculty Profile Dusty Becker



Dusty Becker's (left) commitment to conservation has provided inspiration for many SFS students. (Photo: Tom Kleinert)

Senior Faculty: Primate Ecology and Conservation/Costa Rica

Education: B.S. (Secondary Science Education) University of Virginia, 1977. M.E.S. (Environmental Studies) Yale School of Forestry and Environmental Studies, 1984. Ph.D. Candidate (Zoology) University of Alberta.

Teaching Experience: Birmingham, Alabama Public Schools, Peace Corps, Kenya; The School for Field Studies: Wildlife Management Course/Kenya, Reintroduction of Endangered Species Switzerland; University of Alberta

Field Research: Alberta, Canada: Reproductive physiology and ecology of red squirrels. Athi-Kapiti Plains, Kenya: Behavioral studies of wild ungulates on a game ranch. Samburu Game Reserve, Kenya: Mother-infant behavior of Grevy's Zebra.

Other Professional Experience: Researcher/writer for the Royal Society for the Protection of Birds, Great Britain. Natural History Tour Leader, Kenya.

Published: Articles by Ms. Becker have appeared in over a dozen publications including *British Birds*, *Journal of African Ecology*, and *Appalachia*. She has presented papers at conferences in the U.S., U.K. and Kenya.

Personal: A veteran SFS faculty member, Dusty's versatile talents and evolving interests have taken her to SFS programs in Switzerland, Kenya, and now Costa Rica. Dusty enjoys carpentry, writing, canoeing and scuba diving. She is a committed conservationist who spends a considerable amount of her free time giving talks on the environment to young people. Dusty's guitar and fiddle playing have enlivened many SFS campsites after a long day in the field.

Faculty Profile Paul Robertson



Students benefit from Paul Robertson's (left) dynamic teaching style (he was voted "Teacher of the Year" by his former students in Texas) and extensive experience in field research.

Director: SFS Center for Rainforest Studies/Australia

Education: B.S. (Zoology) Louisiana State University, 1966; M.A., 1970 and Ph.D. (with honors) 1975, Kansas State University.

Teaching Experience: Associate Professor, Trinity University; Visiting Professor, Texas A&M University; Faculty Member, Organization for Tropical Studies, Rocky Mountain Biological Laboratory.

Field Research: Oaxaca, Mexico: Community structure of small rodents. Southeastern and Western United States: Ecology of mammals and birds. Australia: Ecology of flying foxes. Additional field research in Costa Rica, Belize, French Guiana, and Brazil.

Other Professional Experience: Executive Director & Associate Director of Science, Bat Conservation International; Program Director for Environmental Studies, Trinity University; Field Coordinator, Rocky Mountain Field Laboratory.

Society Affiliations: American Society of Mammalogists, American Institute of Biological Sciences, Association for Tropical Biology, Society for Conservation Biology.

Published: Dr. Robertson's work has appeared in a variety of technical and popular publications and abstracts including *Encyclopedia Britannica*, *Journal of Mexican Society of Mammalogists*, *U.S. Fish & Wildlife Service Biological Report*, *Mammalia*, and *Condor*. He has lead and participated in dozens of formal presentations, lectures and seminars.

Personal: Paul grew up in Louisiana at the edge of Atchafalaya Swamp where he developed an intense love for natural history. He has a strong interest in environmental and conservation issues and has been an active member of The Nature Conservancy and The Audubon Society for many years. Paul's wife, Diana Swan, is also a biologist and teacher. While ecology is their primary interest, they both enjoy travel, cooking, camping, hiking, reading movies, scuba diving and dancing.



Center for Rainforest Studies

Site: North Queensland,
AUSTRALIA

Curriculum:

Semester Program

**Biogeography: Patterns
of Ecological Diversity**

Summer Course:

Tropical Reforestation

Staff:

Field Director: Paul Robertson,
Ph.D., University of Kansas
(Zoology).

Resident Faculty: David Bathgate,
Ph.D., University of Colorado
(Ecological Anthropology).

Tony Cummings, M.E.S., Yale
University (Environmental Studies).

Site Manager: David Wilson,
Diploma, Technical College
(Human Relations).

Facilities: The Center is located in North Queensland, on 153 acres of secondary growth forest and rainforest on the Atherton Tableland. A farmhouse serves as our Administrative Center, complete with lecture hall, modern kitchen facilities, refrigeration, washing machines, a small library and periodicals collection, and computer center. Students live in one of four dormitory cabins on the property. Faculty housing is now under construction. The nearest town is Yungaburra, approximately 12 miles from the Center.

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



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 South America and Antarctica 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 high incidence of endemism—the evolution of species found nowhere else on Earth—the botanical and faunal riches of this area are exceptionally unique. North Queensland rainforests have been subjected to an array of intensive land uses in the past century—



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

deforestation for agriculture, logging, and mining. Most of Australia's remaining rainforests are protected as a World Heritage site. We will conduct our studies and research in protected areas and in a number of modified habitats, as we attempt to assess the impacts of human activities on the unique rainforest biota. SFS students have a rare opportunity to participate in research on this "frontier of ecology." Semester participants will explore the extent to which endemic species—including birds, possums and other marsupials—can serve as indicators of ecological disturbance. Summer participants will focus upon a specific conservation problem such as assessing the impacts of rainforest fragmentation on native plants and animals.

Research focus

Given the realization that rainforests worldwide are being felled, logged, burned and altered at astonishing rates, our research focuses on understanding the ecological processes and communities that characterize intact rainforests and which may be lost as the forests are destroyed or modified. A second goal is to develop strategies for regenerating and rehabilitating formerly degraded tropical communities. These topics have direct relevance for rainforest conservation in a world which will probably lose much of its rainforest during the next few decades.



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Center for Rainforest Studies-AUSTRALIA



The Center's 153-acre property is comprised of a mosaic of logged rainforest, rainforest regrowth, and cleared pastures. Our research attempts to illuminate the composition of plant and animal communities in these modified habitats. We will also study assemblages of species in "corridors" of regrowth vegetation along streams; similar corridors may be used to provide avenues for animal migration between isolated forest fragments and nature reserves. Finally, we are investigating the use of "key indicator species" such as lemuroid ringtail possums and Lumholtz's tree kangaroos, birds such as the logrunner, and other species to indicate the "health" of the rainforest ecosystem.

Site

Northern Queensland has the greatest biological, climatic, and social diversity in all of Australia. Jutting some 400 miles toward New Guinea from the rest of the continent, it separates the Coral Sea from the Gulf of Carpentaria. A narrow strip of Australia's largest remaining tropical rainforest runs down to the water along the shoreline fringed by the magnificent 1,200 mile long Great Barrier Reef.



"I have never felt so attuned to the matter I was studying. In a traditional classroom, the material ends when the book is closed. In the rainforest, it lived and breathed and rustled and photosynthesized all around me like a big, fantastic machine."
M.K. Crabb, Richmond, KY—University of Massachusetts (Photo: Jennifer Seavey)

Living and Working Conditions

Be prepared for wet weather, especially during the rainy season from January to May, when rainfall may average 400 mm/month. Rainfall and thunderstorms occur sporadically during other times of the year. The dry season months of September through December are often quite warm, with temperatures in the 80's and low 90's. We conduct field work at all times of the year, regardless of the weather.

The SFS Center for Rainforest Studies is located on 153 acres on the Atherton Tableland, a mid-elevation plateau, and provides ready access to rainforest and modified habitats on and adjacent to our property. On our frequent forays into the rainforest, we

encounter hundreds of species of trees and highly diverse animal communities including wallabies, lorikeets and cockatoos, tree kangaroos, pythons, and monitor lizards. Large groups of flying foxes (huge bats) often fill the evening skies near the station. Streams wind their way through dense, lush vegetation and occasional waterfalls fill the air with the persistent hum of crashing water.

Students live dormitory-style in modern cabins surrounded by forest, and can expect to be awakened by a "dawn chorus" of myriad birds and the hopping and scurrying sounds of small animals. Fresh fruits, vegetables, fish and meat are readily available in nearby Yungaburra to embellish our culinary endeavors.

Many of the species we will encounter in the rainforest are found nowhere else on Earth. Here students and faculty examine a lace monitor lizard.
(Photo: Jennifer Taylor)



The Center for Rainforest Studies, called "Warrawee"—'you are welcome here' in the local Aboriginal tongue, is located on 153 acres of rainforest and secondary growth forest.
(Photo: Mark Noble)

Financial Aid is available.
Please see page 38.



Semester Program-Center for Rainforest Studies-AUSTRALIA

Semester Program: *Biogeography: Patterns of Ecological Diversity*

Site: Center for Rainforest Studies—
AUSTRALIA

Course Titles and Numbers:

Rainforest Ecology
(BIO 1825)

Principles of Forest Management
(BIO 1845)

Ecological Anthropology (SOA 1910)

Directed Research (INT 1191)

Departure Point: Cairns, Australia

Program Dates:

September 9 - December 12, 1992
January 29 - May 4, 1993

developing nations will be presented, with particular emphasis on multiple land use, sustainable development and inter-cropping strategies.

In **Ecological Anthropology** we will use the ecosystem model and current anthropological theory to explore the complex interaction of humans and tropical rainforest environments of Australia, Melanesia and Southeast Asia. The archaeological record and ethnographic data will be presented to detail the evolutionary processes leading to this adaptation. Aboriginal and Euro-Australian views of the rainforest, its use, management, and preservation will be presented in light of current social involvement and natural resource policy formation. Field trips and guest lectures will constitute important aspects of this applied learning experience.

In **Directed Research**, we will develop skills needed to address crucial eco-

logical questions while emphasizing modern scientific methods. The formulation of testable hypotheses, sampling strategies, data analysis, as well as written and oral presentation of results will be practiced. With faculty consultation, students will devise and implement an original research project designed to address a significant problem in rainforest ecology. Special emphasis will be placed on assessing the impacts of deforestation, habitat fragmentation and logging on Australian wildlife. Likely topics include censusing of bird and mammal populations in secondary vegetation and forest fragments, assessing the habitat requirements of critical "indicator species" such as logrunners, rodents, and marsupials, and assessing the utility of "corridors" for wildlife dispersal. We will present our findings in a public meeting before interested local residents. Government scientists are also often in attendance.

Through four distinct but interrelated courses, we will investigate the biological, political, economic and historical issues that must be considered in determining strategies for rainforest conservation.

Rainforest Ecology provides the ecological background to understand the tremendous diversity of Australian tropical ecosystems. We will focus to a large extent on the rainforest, but field trips to a variety of other ecosystems will enrich our studies.

Lecture topics will include the ecology, evolution, taxonomy, and natural history of rainforest animals, as well as rainforest ecology, biogeography and conservation. Field activities will include spotlighting for animals at night, live-trapping small mammals, mist-netting birds, dawn choruses (identifying bird calls), bird watching, trapping terrestrial and aquatic insects, and measuring forest vegetation.

Concepts developed in the preceding course will be applied to real-life problems in **Principles of Forest Management**. Case studies emphasize the ecological impacts and yield optimization of tropical forestry, and include field trips to forest plantations and reforestation projects. Focusing on problem solving skills—environmental impact assessment, forest surveys, the design and management of nature reserves—this course will be applicable throughout the world. Resource management policies in



"I felt so small next to all the gigantic trees and fields of grass several feet high. No space was wasted; plants grew all over and around one another creating webs of shade and mystery."

Dina Strachan, Brooklyn, NY—Harvard/Radcliffe College
(Photo: Chip Isenhardt)

**The School
For Field Studies**



Tropical rainforests are among the Earth's most ancient, diverse, and ecologically complex communities. Covering only 7% of the planet's land surface, tropical rainforests may sustain half the world's plant and animal species. Many of these ancient forests are being burned, logged, fragmented and overhunted on a scale that lacks historic precedents. At current rates of deforestation, two-thirds of the Earth's rainforests will disappear by early next century, leading to the extinction of up to 600,000 species.

SFS students will set out from the Center for Rainforest Studies to investigate whether tropical rainforests are renewable, an issue that has great significance in Queensland. A 1988 Australian government decree preserved much of Australia's rainforest through the establishment of World Heritage sites. This policy has been hotly contested by the state government of Queensland, and by foresters, miners, dairy farmers and others whose livelihoods depend on forest development. The degree and speed at which forests can be regenerated could influence how much neighboring land must be preserved. Little data on this subject exist at present.

The questions we will address are designed to help us understand the resilience

of rainforest species to disturbance and optimal strategies for reforestation. How are marsupials impacted by fragmentation? Which birds, mammals and reptiles are most prone to extinction? How does logging alter the rainforest's structure and microclimate? What combination of tree species should be planted first and in what spatial pattern? In light of the unique research opportunities presented here, we have elected to extend our studies over a six-week period. Students will participate in two integrated courses, carrying a total of eleven quarter credits. Although presented in an integrated format in the field, we have separated our studies into discrete courses below to facilitate the awarding of credit.

Tropical Reforestation (5 credits) will provide an introduction to fundamental ecological concepts. Emphasis will be placed on demographics and community ecology, and on the relevance of these concepts to the structure and function of rainforests and other Australian biomes. Lectures by faculty and guests will address rainforest ecology and tropical resource management. We will compare and contrast different forest types with special emphasis on identifying centers of tropical endemism.

Summer Course: *Tropical Reforestation*

Site: Center for Rainforest Studies—AUSTRALIA

Purpose: to determine which methods of reforestation are most effective from the perspective of growth rates, human subsidy requirements, sustainable use, and conservation of forest biotas.

Course Titles and Numbers:
Tropical Reforestation
(BIO-number to be announced)
Directed Research (INT 1191)

Departure Point: Cairns, Australia

Course Dates: June 25 - August 6

Directed Research (6 credits) will offer a thorough grounding in how to design, conduct and communicate scientific research. Our group research will focus on the design of reforestation strategies and the assessment of their effectiveness. Faculty will introduce field techniques for conducting biological surveys including vegetation transects, quadrat measurements, canopy and forest floor cover estimates, the mist-netting of birds and live-trapping of small animals, and spotlighting for rainforest animals at night. We will apply these skills while conducting individual directed research projects on topics of critical interest in conservation biology. Topics may include questions such as which bird and mammal species can survive in disturbed vegetation and which are most easily lost? How does the microclimate of degraded forests differ from intact rainforest? Which vertebrate species can use "corridors" of regrowth forest along streams for dispersal?

Our days will pass quickly as we orient ourselves to the intricacies of the 100-million-year old rainforest where the canopy of tree crowns tower 60 meters above and vines and epiphytes (rootless, attached "air plants") stream about us. During the final days of the course, we will compile the results of both our team and directed research projects. Our findings will be summarized in a "rainforest symposium" before park managers, government scientists and interested local residents.



SFS students caring for an orphaned bandicoot, a small rainforest marsupial.
(Photo: Bill Laurance)



Center for Marine Resource Studies-CARIBBEAN

Center for Marine Resource Studies

Site: South Caicos Island,
BRITISH WEST INDIES

Curriculum:

Semester Program:

***Marine Ecology and
Management***

Summer Courses:

***Mapping Marine Ecosystems
Coral Reef Management***

Staff:

Field Director: David Young, Ph.D.,
University of Hawaii (Zoology).

Resident Faculty: Shelly Raven,
Ph.D., University of California at
Davis (Anthropology).

Site Managers: Helen Ball, Ph.D.,
University of Massachusetts
(Anthropology). M. Dennis Bates,
B.S., University of Massachusetts
(Exercise Science).

Summer Course Faculty:

Lori Buckley, Ph.D. candidate,
American Museum of Natural
History (Vertebrate Zoology).

Kathleen Sullivan, Ph.D., Scripps
Institute of Oceanography (Marine
Biology).

Additional Faculty to be announced.

Facilities: The Center is based in a former hotel on the southern edge of South Caicos Island. From its perch atop a small bluff, the Center overlooks clear Caribbean waters, offshore cays, and the town of Cockburn Harbor. The main facility has a large, brightly muraled classroom/dining area, a kitchen, laboratory and study areas. There are 14 residence rooms, each with a bath and an often necessary ceiling fan. We are fully equipped for marine operations with a private dock to support our boats and a dive shop with a commercial SCUBA compressor. A rainwater cistern supplies water, which is a most precious commodity here. One of our goals is to introduce as many renewable and sustainable resource options as possible at the Center.

Background

The Turks and Caicos Islands and their surrounding Caribbean waters offer us an unparalleled classroom/laboratory in which to study marine resource issues. Here one finds one of the last remaining pristine refuges for inshore marine life. Throughout the Caribbean, tourism and development are exerting extreme pressures on the linked and delicate coastal ecosystems. If the Turks and Caicos area is to escape the detrimental environmental effects brought on by the increased tourism, population growth and urbanization now being evidenced in other parts of the Caribbean, studies that will lead to management plans for conserving precious marine resources must be initiated without delay.

The Turks and Caicos Islands were once the world's largest exporter of conch and an important exporter of lobster; both shellfish are important as local food sources. South Caicos has been the Island's most important port for the local fishing industry. This industry, once the economic mainstay of the area, has reported that catches of both conch and lobster have dropped drastically in recent years. The depletion of the fishery is of major concern, with impacts on employment, nutrition and social structure.

Growth and development present three primary threats to the local coastal ecosystem. These are: 1) the direct impacts of overfishing and destructive fishing practices, 2) the direct impacts of tourism, and 3) the general impacts of the increased pollution and waste disposal that accompany increases in human populations. Confounding the relatively simple relationship between human population size and environmental stress, is the issue of a culture attempting to move from a simple artisanal lifestyle toward a more wasteful and inefficient lifestyle characteris-



"I cannot say enough about the beauty of the underworld. What made it even better was that, by the second week, I was able to identify the majority of corals and fish."

Thomas Angelicola, Waterbury, Ct—Northeastern University (Photo: Chris Neefus)

tic of urbanized, industrialized western societies. The possible negative ecological effects of these processes are magnified in island communities because of limited locally produced resources and options for waste disposal. The relatively high cost of obtaining resources and/or disposing of wastes off island make it much more expensive to support a western lifestyle on a remote island than in a continental setting. Yet today, inhabitants of these islands seek to make these changes in order to be able to compete for the highly valued tourist dollars on which their fragile economies heavily depend.

Faculty and students at the SFS Center for Marine Resource Studies at South Caicos are in a unique position to influence the policies and decisions that will ultimately influence the course of growth and development here. The local government has actively solicited our input in such areas as basic resource assessment, resource management strategies, and training in fisheries enhancement methods. In providing these research data and recommendations, we may have the opportunity to help guide the processes in such a way that the Turks and Caicos might become a model for other developing Caribbean island nations.



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Research Focus

Our research efforts will focus on three aspects of the island economy and their effects upon the ecosystem: the conch and lobster fisheries, the fin fishery; and the tourist industry, which includes the future development of Admiral Cockburn Land and Sea Park. To a great extent, these three activities are linked, and the future configuration of the island economy will depend upon their interrelationship. The decline in lobster and conch stocks may force a shift in emphasis to either or both of the other activities. We will



In our first year at South Caicos, SFS students and faculty identified over 60 species of corals and 150 species of fish on the nearby reefs. (Photo: Tim Stout)

examine the implementation, costs and benefits of proposed changes from the perspectives of marine ecology, resource management and anthropology.

Students will participate in ongoing joint research now being conducted under the auspices of SFS, the local Fisheries Department and the Tourist Board. Our efforts can assist in the development of long-term environmental protection strategies which are sensitive to and incorporate the needs of the local community.

From its perch atop a small bluff, the Center looks out over clear blue waters with nothing but open ocean all the way to the African coast. (Photo: Jim Elder)

Site

The Turks and Caicos Islands lie at the southern most edge of the Bahamas chain, approximately 100 miles north of Haiti. The islands represent the surface exposure of two vast platforms, the Turks Bank and the Caicos Bank. The two banks plunge some 7000 feet into the deep ocean abyss, making the area a world class diving site. In addition, a vast shallow bank area, averaging 10 to 12 feet deep, stretches for nearly 60 miles. With expansive seagrass beds and scattered coral heads, this area is highly productive and is the source of the area's premiere shellfish product, Queen Conch. A five minute boat ride from our base provides access to shallow expanses of turquoise waters or to the deep blue of the open sea.

Most of the residents of South Caicos live in Cockburn Harbor, a small fishing port and the only town on the island. In the face of the declining fish catch, almost half the island's residents have moved in recent years. The town, which has very limited shopping facilities, is the site of the island's only industry, three small fish processing plants.

In order to develop viable resource management strategies, we must understand local perceptions regarding resource use and potential impacts of conservation. The Center's close proximity to town allows us frequent interaction with local residents, also known as "Belongers". (Photo: Jim Elder)

Living and Working Conditions

A true tropical climate prevails here with hot (90's) days and warm (80's) nights. Temperatures range from the 70's to 80's in the winter months. The strong, steady trade winds off the ocean help keep the site comfortable and insect free throughout most of the year. Ocean temperatures range from the 70's to 80's. Much of our data will be collected via SCUBA and snorkeling. Most dives will be in waters under 20 feet deep although we will try to visit the drop off for deeper dives during each program.

We will utilize locally produced seafood as much as possible; basic staples (rice, beans, fruits and vegetables) will be provided via regular shipments from the U.S.





Semester Program: *Marine Ecology and Management*

Site: Center for Marine Resource
Studies, CARIBBEAN

Course Titles and Numbers:

Tropical Marine Ecology
(BIO 1824)

*Principles of Resource
Management* (BIO 1846)

Ecological Anthropology
(SOA 1910)

Directed Research (INT 1191)

Departure Point: South Caicos Is.

Program Dates:

September 9 - December 12, 1992

January 29 - May 4, 1993

Through a four course sequence, SFS semester students will investigate first-hand the scientific, economic, political and historical issues involved in managing marine resources in the Caribbean. These courses are designed to enhance our understanding of and contribution to a plan for sustainable development of South Caicos Island through the establishment of the Admiral Cockburn Land and Sea National Park.

Tropical Marine Ecology will orient us to the marine environment and provide an overview of the biology of the major groups of organisms. The distribution and diversity of marine organisms in response to their environment will be explored. Fundamentals of reproductive strategies and population growth will be presented. The classic principles of ecology are discussed and applied to the tropical environment using field work to illustrate local examples. Mutualism, competition, predation and succession will be studied with respect to how these interactions structure marine communities. Nutrient cycling, energy flow and organization of the major coastal communities including pelagic, seagrass, mangrove and reef systems will be discussed. Field and laboratory work will be integrated with the Directed Research course; students will have the opportunity to learn the essentials of underwater data collecting, computer-aided data analyses and report writing. The field work will include supervised snorkeling and

SCUBA exercises designed to investigate the distribution and interactions of near-shore marine organisms.

In **Ecological Anthropology** we will consider the role of humans in the marine ecosystem and in the global economy. General models drawn from human ecology will serve as a basis for examining human/environment interactions in the Caribbean in general and South Caicos in particular. We will seek to maximize anthropology's relevance to studies of marine conservation by developing an understanding of the ways in which people use the environment to make a living. An overview of local history and culture will be presented and students will be encouraged to meet with local people in order to develop a better understanding of local perceptions as well as an appreciation of ways of life different from their own. This course will provide insight into the complex social, cultural and economic considerations that must be addressed in developing policies regarding the conservation of marine resources.

In **Principles of Resource Management** we will develop an in-depth understanding of marine resource utilization and conservation by reviewing resource use in the coastal zone and conservation strategies to reduce or avoid impacts from resource utilization. Our goal will be to understand sustainable development in the context of marine resources utilizing case studies from around the world with a close examination of issues in the Turks and Caicos Islands. We will explore conservation strategies including coastal land-use planning, fisheries management, aquaculture, environmental impact

assessment and marine park design. Our focus will be on the optimum design for the proposed national park and adjacent coastal development so that local needs are met while ecological processes and environments are maintained in their near pristine condition.

The **Directed Research** component of our program will complement our over-all objective of quantifying the impact of fisheries and tourism on the Island ecosystems. The opportunity to integrate perspectives developed in the preceding courses becomes evident here as students work with faculty to design independent projects from coordinated parts of the overall research effort. The initial part of the course will introduce field identification of organisms, experimental design and field methods. Workshops will be presented on computer-aided data analyses and statistical methods. Students may choose from research topics in marine ecology, resource management or cultural ecology. Sample projects include the role of human-induced stress on the diversity and structure of coral reef and seagrass communities, changes in conch distribution and abundance, and coastal zone management. Results will be presented orally to the group and to guest speakers at a seminar and also will be submitted to local government officials.

Note: Students must be certified in SCUBA prior to the program. Please contact the SFS Admissions Office for assistance in arranging certification. Students must provide their own SCUBA equipment except weights and tanks, which may be rented on-site.



After studying coral reef management, I found myself really caring about what is happening to the reefs. Never in my academic career have I found myself wanting to learn all I can about a particular subject.
Thomas Angelicola, Waterbury, CT—Northeastern University
(Photo: Shaun Bennett)



Because much—over 70%— of the earth's surface is covered by water, many people have the mistaken notion that the ocean is a vast, almost limitless, resource, readily available for human use. Ocean resources are just as vulnerable as the land to exploitation, pollution and disturbance, and scientists have not developed the sophisticated means of assessing potential impacts to marine ecosystems that are available to monitor changes in terrestrial ecosystems. Resource managers dealing with marine ecosystems worldwide need affordable, reliable means to monitor changes in shallow-water marine habitats. Satellites have been used to monitor habitat changes but, the cost of utilizing these transmissions is often prohibitive and satellite imagery cannot always provide the resolution needed for evaluating habitat degradation. One promising alternative involves combining aerial photography and a computer-based modeling system to produce high-resolution habitat maps on a biologically-meaningful scale. In order to develop this remote sensing technique, scientists will need to rely on accurate ground truthing to identify species of benthic invertebrates, seagrasses and algae that make up discrete optical fields.

Resource managers for the Turks and Caicos Islands, confronted with a declining conch and lobster fishery as well as development from an expanding tourism industry, are eager to implement policies that will protect the islands' remaining resources. This summer, at the request of the Department of Fisheries, SFS students will have the opportunity to test the effectiveness of using remote sensing techniques to map the marine habitats surrounding South Caicos and East Caicos Islands. Questions we will seek to answer include: What invertebrates and fishes make up the discrete communities on the Caicos Bank? What animals do we expect to find together? Can we predict the inhabitants we will find in a specific habitat? Can remote sensing be used to detect changes in the nearshore environments that result from human impact or storms?

Looking out the window of the plane as we approach South Caicos, the waters below us appear as a patchwork of varying shades of blue and green. This mosaic effect is caused by the variety of marine habitats—seagrass beds, sandy shoals, coral reefs, rocky platforms and mangrove swamps—that surround the island. After settling in at the Center, one of our first tasks will be to refine

our snorkeling and/or SCUBA skills. Students in Session I will collect data using snorkeling and SCUBA while students in Session II will concentrate their data collection in areas where only snorkeling will be utilized. Each student will be given a map, based on aerial photographs of the Caicos Bank, taken by faculty at an earlier date. With the exception of black lines used to outline the habitats appearing in the photographs, the maps will be blank. Team members will be assigned territories and we will proceed to "ground-truth" these maps. Using snorkeling and/or SCUBA, we will survey assigned areas to determine their characteristics and inhabitants, and whether they are accurately represented on our maps. In order to conduct an accurate census, it will be necessary for us to learn to identify all of the brightly colored fish and invertebrates we find within our transects.

Our data collection will take us away from the Center for a portion of each course. During these field trips, we will use a large research vessel as our base and will camp along the shore. We plan to start off most mornings with field work, usually snorkeling to survey near-shore habitats. Mid-day lectures will address invertebrate biology, community ecology, remote sensing and statistics. Afternoons will be devoted to additional field work and will provide students with an opportunity to work on individual or small group directed research projects. Potential



Using snorkeling and SCUBA in the clear turquoise waters off our Center, we will identify all the fish and invertebrates we encounter in our efforts to ground-truth data provided by aerial photographs.
(Photo: Shaun Bennett)

Summer Course: *Mapping Marine Ecosystems*

Site: Center for Marine Resource Studies, CARIBBEAN

Purpose: to test the potential of using remote sensing techniques to map the marine habitats surrounding South Caicos and East Caicos Islands; to produce high-resolution habitat maps on a biologically-meaningful scale to assist resource managers in identifying habitats suitable for nurturing lobster and conch populations and habitats potentially impacted by proposed development on South Caicos Island.

Course Number: BIO 1847

Departure Point: South Caicos Island

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

projects include an assessment of the distribution of sponges or the locations of hard and soft corals on the Caicos Bank, and a study of which territorial fish are associated with specific habitats?

Each day we will enter data recorded during fieldwork onto our maps and into a computer. Once we have collected sufficient data, we can determine if similar habitats are homogeneous. Do all seagrass or mangrove habitats contain the same inhabitants and, if not, how do they differ? We can then build statistical models that will help us predict the composition of other similar habitats. In the future, resource managers can utilize remote sensing as a quantitative means of measuring and/or predicting impacts of fishing or development.

This summer, we expect to complete habitat descriptions for 1,000 square meters of seagrass beds, coral reefs, sandy shoals and mangrove channels. Our data will be presented to the Department of Fisheries resource managers for use in identifying habitats most suitable for nurturing juvenile populations of lobster and introducing conch, and habitats potentially impacted by proposed development on South Caicos Island.

Note: Students in Session I must be SCUBA certified prior to the course. SFS will provide students in Session II with snorkeling instruction. All students must provide their own SCUBA/snorkeling equipment with the exception of weights and tanks which may be rented on-site.



Summer Course: **Coral Reef Management**

Site: Center for Marine Resource Studies, CARIBBEAN

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

Course Number: BIO 1805

Departure Point: South Caicos Island

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

Coral reefs comprise one of the most beautiful, diverse and highly specialized ecosystems on earth. Thousands of species of plants and animals exist side-by-side on Caribbean reefs where they display a fascinating variety of adaptations that enable them to survive in this highly competitive environment. 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.

Human activities are affecting coral reef ecosystems worldwide at an alarming rate. Local impacts such as boat damage, diver damage and dredging, for instance, can cause long-lasting impacts to coral reefs. Regional impacts may be even more critical to the long-term health of these ecosystems. Such impacts include sedimentation as a result of coastal deforestation, thermal pollution, salinity changes, oil pollution, and eutrophication resulting from nutrient overloading. Recovery of disturbed coral reefs may take anywhere from several decades to several centuries.

The coral reefs at South Caicos Island are in nearly a pristine condition. Diving into the clear turquoise waters, where visibility averages 100 feet, one is amazed at the beauty and variety of fish and invertebrate species. SFS students and faculty have identified over 60 species of corals and 150 species of fish on the nearby reefs. Much of this diversity is the result of the variety of reef

types found at South Caicos including fringing, patch and deep reef habitats. Partly as a result of this reef diversity, the area in and around our Center has been proposed as Admiral Cockburn Land and Sea National Park, as part of the fledgling national park effort of the Turks and Caicos Islands government.

Coastal development at South Caicos, however, could significantly affect these coral reefs. Potential impacts from such development include the dredging of reefs, sedimentation, and diver and boat damage. If such impacts are to be minimized, it is imperative that the structure of the local reefs be understood and that the reefs be monitored after development begins. These data are critical if environmental impacts are to be accurately assessed and effective management plans are to be developed.

Our course will examine the potential impact of coastal development at South Caicos and the role of the proposed national park in light of lessons drawn from similar case-studies worldwide. We will spend the first two weeks of the program learning the basic ecology of the coral reef in order to



"This course provided me with a chance to learn by thinking and by doing, not just listening and watching. I could spend long hours discussing issues with professors and peers on a one to one basis. I find this setting infinitely better than sitting in a musty lecture hall."

Patrick Zoellner, Lansing, MI—University of Michigan (Photo: Olaf Ehrenstrom)

understand the structure of the ecosystem and the processes that shape that structure. Faculty lectures will emphasize marine ecology and will include oceanography, invertebrate and vertebrate zoology, and the distribution and function of coral reefs. During the second half of the course, we will focus on coral reef management strategies and lectures will address human impacts on coral reefs, coastal zone management, and the role of marine parks in coral reef conservation.

"My interests and goals weren't matched to my financial situation and I felt I might not be able to afford a course. I kept in touch with SFS, and with their help, I was able to participate."

Dave Stemper, Minneapolis, MN—
University of Minnesota

Our field research will focus on the community structure of the coral reef in Cockburn Harbor and the proposed Admiral Cockburn Land and Sea National Park. Our first step will be to learn the identities of all of the organisms on the reef. Second, we will learn how to measure the reef environment using quadrats and transect tapes. Our goal is to describe the base condition of the coral reef ecosystem so that impacts can be accurately assessed and management plans developed for coastal development and the proposed park. Dive teams will gather baseline data on fishes, corals, other invertebrates and algae. Students will also partake in directed research projects focusing on reef organisms of particular interest to the individual.

We will spend the final days of the program analyzing our data in the Center's computer facility and writing up our findings as independent research papers. These papers will be presented to resource managers in the Turks and Caicos government for use in coral reef management.

Note: Students must be SCUBA certified prior to the course. Students must provide their own SCUBA equipment except weights and tanks, which may be rented on-site.



Background

It is a time of high drama on the plains of Kenya. This country of enormous physical beauty—from the rugged scar of the Great Rift Valley and 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 protein, in particular, has led to extensive ranching of beef cattle. Many of 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 glance, seemed a radical solution: the practice of ranching game. In game ranching, populations of native ungulate species (hoofed mammals) are strictly managed in a protected environment and periodically cropped to be served as food.

Substituting native wildlife species for domestic cattle offers an ecological alternative that lowers water and energy demand. If properly applied, this may allow more protein production per acre than crop farming in East Africa, and may potentially

lead to increased food production. Yet game ranching itself may pose ecological threats. How do harvested populations differ from natural herds? Only carefully coordinated research including population and habitat studies will provide the answers.

We must find a way to satisfy the needs of both wildlife and humans on shared land, rather than assuming that the presence of one excludes the other. SFS students will have the unique opportunity to become directly involved in this dilemma.

Our research is part of a continuing analysis of the ecological viability of game ranching. The results of our research will be integrated with ranch management programs to serve as a model for other initiatives in Kenya and elsewhere in East Africa.

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 the 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.



SFS students in Kenya will examine the pros and cons of game ranching, a promising experiment that may address the conservation of native ungulate species and provide a sustainable means of feeding the people of Kenya. (Photo: Jim Elder)

Center for Wildlife Management Studies

Site: Athi-Kapiti Plains, KENYA

Curriculum:

Semester Program

Wildlife Ecology and Management

Summer Course

Wildlife Management

Staff:

Education Director: Richard Garstang, M.Sc., University of Pretoria (Zoology).

Resident Faculty: Susan Cooper, Ph.D., University of Witwatersrand, R.S.A., (Ecology).

Tolumbaye Tadingar, Ph.D., University of Nebraska (Range Science).

Marjorie Franken, Ph.D., University of California at Riverside (Cultural Ecology).

Facilities: "International Wildlife Ranching and Research, Ltd.", the site of our Center, consists of 81 square kilometers of fenced rangeland on the Athi-Kapiti Plains. The Center is approximately 40 kilometers southeast of Nairobi. Accommodations are in thatched "bandas" and/or walled tents beneath thatched roofs. Additional facilities include a kitchen area, outhouses, solar water heater, gravity showers, and a dining/lecture/library building. We will sleep on foam mattresses at the Center and on foam pads while on safari. We will have access to the Ranch's laboratory and slaughterhouse. There is no electricity at the Center.



Center for Wildlife Management Studies-KENYA

Our base of operation will be "International Wildlife Ranching and Research, Ltd.", established by Dr. David Hopcraft 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, zebra, finge-eared oryx, impala and giraffe roam freely.

"I've gone from a raving environmentalist to a raving environmentalist who can present an issue clearly, factually, calmly, and with a sense of direction for correcting or solving a problem. I'm more able to integrate the us and them syndrome and move people toward cooperation and problem solving."

Annie Farris, Woody Creek, CO—University of Colorado

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 tenth consecutive year of research in Kenya, we will assist in conducting applied research which is crucial to game ranch management.

For example, how much woodland habitat does a large population of giraffes need to sustain optimal growth and reproduction? What is the best way to control weeds and improve rangeland quality? How can cattle herders benefit from the presence of wildlife on their ranches? We are seeking answers to these questions at our Center for Wildlife Management Studies.

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 and chilly, days are warm to hot.

Located in its own isolated setting on the ranch, with the Ngong hills to the north and Mount Lukenya dominating the eastern horizon, our SFS basecamp includes a permanent dining/lecture hall, library, outhouses and open air showers. 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 safari tents.



"If I were to summarize the most powerful thing about my SFS experience it would be this immersion. No other learning experience could compare."
M.K. Crabb, Richmond, KY—University of Massachusetts
(Photo: Louise Matthews)



Reconstructing a skeleton helps us to understand structure and function. "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: Sue Natali)



Our off-ranch expeditions will include visits to several game parks where we will have the opportunity to meet with park officials. (Photo: Rich Ruggiero)

**The School
For Field Studies**



This 13 week semester program is designed to allow students to compare aspects of game ranching with the management of preserved herds while studying the theory of wildlife ecology. Through a series of inter-related courses, 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 justification for various conservation strategies.

Wildlife Biology will provide us with the means to study and understand wildlife populations and habitats in East Africa. We will emphasize techniques and strategies to assess wildlife habitat status and will study the requirements of native large game species with the aim of providing suggestions for their management. We will examine the effects of human disturbance and domestic livestock as well as the ability to formulate sound conservation and management policy with the overall aim of optimizing productivity while maintaining biodiversity. The lecture component of this course will be complemented by laboratory and field exercises on the Ranch and directed observation in several national parks and reserves in Kenya. Field work will include bird and mammal observation, identification techniques and methods for analyzing and classifying vegetation. The digestive anatomy and physiology will be demonstrated at the Ranch slaughterhouse and laboratory, and the practical aspects of the harvesting of game species will be discussed. We will explore some of the current controversies in wildlife conservation, and discussions of the global implications of conservation issues will help us focus our understanding of wildlife biology and management.

Population and Community Ecology is designed to provide us with the information and conceptual background to understand the underlying ecological principles of the East African ecosystem. We will focus on fundamental processes and the inter-relationship of the biotic and abiotic components of the system. Lectures, field observations, required readings and seminars will help us examine the theoretical underpinnings of the other courses in our curriculum.

In **Environmental Policy and Socioeconomic Values** we will consider contemporary environmental problems and deterioration from the standpoint of social theory, history, and political economy. We will explore how social organization and value systems, economic forces and political structure all influence policy formulation. Specific related topics include: the relationship between economic growth and policy, analysis of social choice mechanisms, dispute resolution (mediation and arbitration), environmental ethics, and transboundary issues from a social and cultural perspective.

Directed Research builds on the other three courses. A thorough research training begins with examining how key questions are formulated as experimentally testable hypotheses. Lectures are limited to basic field techniques and scientific design, sampling procedure, basis statistics, and the interpretation and communication (graphic, written and oral) of research findings.

Actual field research, consisting of group projects, begins during the second week of the semester. Teams of two to four students will either continue studies begun during previous semesters or conduct new research. Topics of key interest have been identified by SFS faculty in conjunction with other experts in the field of wildlife conservation and management in Africa. Directed research projects are designed to provide hands-on experience in the applied research

Semester Program: *Wildlife Ecology and Management*

Site: Center for Wildlife
Management Studies, KENYA

Course Titles and Numbers:
Wildlife Biology and Management
(BIO 1821)
Population and Community Ecology
(BIO 1823)
Environmental Policy and Socioeconomic Values (SOA 1909)
Directed Research (INT 1191)

Departure Point: Nairobi, Kenya

Program Dates:
September 9 - December 12, 1992
January 29 - May 4, 1993

which forms the basis for modern wildlife management both on the ranch and elsewhere in game-rich East Africa.

We will conduct field work on the ranch which supports both domestic livestock and native wildlife. The ranch and its slaughterhouse enable us to carry out a wide variety of research projects, which may range from behavioral ecology to prescribed fire experiments. Most studies apply to practical management concerns of rangeland and wildlife biologists.



SFS students studying in the classroom banda on the ranch. "I wanted to test my ability to survive in a more simple and a totally unfamiliar environment. Life in Hamden, Connecticut seemed so very different from life in Kenya. What would it be like to live with outhouses and without electricity?"

Rachael Feldman, Hamden, CT—University of Connecticut
(Photo: Jenee Colton)



Summer Course: *Wildlife Management*

Site: Center for Wildlife Management Studies, KENYA

Purpose: to compare the population dynamics, carrying capacity and economic potential of large mammals (antelope, giraffe and zebra) in hunted populations and in national parks; to assess the long term implications of game ranching as a wildlife management technique.

Course Number: BIO 1806

Departure Point: Nairobi, Kenya

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

Rising early each morning, we will begin a busy day with field observations. We will return to camp for breakfast and some camp chores, followed by either lectures or field exercises. On days that include research time, we will travel by foot or by landrover to our research sites. Our studies call for extensive monitoring of vegetation and field conditions as well as long, sometimes arduous, observations of wildlife species including zebra, antelope and giraffe. Our research activities will address questions including: Does cropping adversely affect the social organization and breeding success of antelope? What is the economic potential of various species? What is the diversity of incidental species affected by game ranching (e.g. scavengers)? What is the recovery rate of areas overgrazed by cattle and how are these areas utilized by game?

In order to answer these questions, we will need to develop our research skills, including behavioral sampling techniques and large mammal census techniques, and learn how to conduct vegetation surveys. Faculty and guest lecturers will provide us with the necessary background to begin our research. Lectures will introduce us to the general principles of ecology, animal identification and social organization, game ranching and management techniques, plant and herbivore interactions and techniques for estimating rangeland productivity.

The Ranch's weekly cropping operations provide us with unique opportunities to study the physical condition, parasite loads and commercial productivity of wildlife from both free-ranging and confined populations.

We will initiate small group field research projects early in the course. Potential topics for directed research include giraffe feeding ecology and carrying capacity, behavior and social organization of the fringe-eared oryx, fleeing distance and cropping protocol for various species on the Ranch and surrounding ranches and wildlife areas, and management of cattle bomas.

Field excursions outside the Ranch will take us to some of the more spectacular areas of Kenya. These trips may include visits to Lake Nakuru to examine the effects of the surrounding human population on one of Africa's greatest national parks, the Maasai-Mara Reserve to witness the massive concentrations of game and to examine the Maasai and wildlife interactions here. We may also visit Nairobi National Park to compare the ecology of a semi-fenced national park with that of International Wildlife Ranching and

Research, Ltd. We may also hike up nearby Mt. Lukenya to take a first-hand look at some of the factors affecting raptor conservation or visit the bustling Monday market at Machakos to interact with the local people in a thriving agricultural area. Other possible day trips include the National Museum of Kenya and the Olorgesailie National Monument, a pre-historic archaeological site.

"The measure of the success of SFS should not be the degree to which they increase interest in science per se, but the degree to which they help each of us define our appropriate roles as global citizens and protectors of a fragile planet. By this latter measure, I think they are enormously successful."

Claudia Polsky, NY, NY—
Harvard/Radcliffe College/ Fulbright Scholar



When thinking of Kenya, one often has visions of giraffe, zebra, lions and elephants. Kenya is also home to many spectacular bird species including raptors. (Photo: Rich Ruggiero)



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 surrounding 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, humans and marine mammals are becoming competitors for the same food and habitat resources, threatening fundamental portions of the marine food web.

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

Schools of anchovies, shrimps, sardines and numerous species of gamefish drawn to these waters are the targets not only of commercial fishermen, but also sportsfishermen from all over the world. Overfishing is driving fish resources to ever increasing lows, presenting the threat of a diminished food source and the loss of dependent species from their habitats.

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

The Government of Mexico has a long history of wildlife conservation and a strong interest in protecting marine mammals. Unfortunately, funds for marine mammal research are severely limited. Through a cooperative agreement with the University of Southern Baja California, and by working with the Mexican Society for the Study of Marine Mammals, SFS students will have an opportunity to make a significant contribution to future management policies as we consider the status of marine mammal populations here. Through our on-going 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



"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)



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

Center for Marine Mammal Studies*

Site: La Paz, Baja California Sur, MEXICO

Curriculum:
Semester Program
*Marine Mammal
Biology and Conservation*

Staff:

Field Director: Lorayne Meltzer, M.Sc., California State University (Teacher Education and Natural Science).

Visiting Faculty/Research Director: Jorge Urban Ramirez, M.Sc., Universidad Autonoma de Mexico (Marine Mammal Biology).

Additional faculty to be announced.

Site Manager: Henk Nienhuis, M.Sc., State University of Leiden, The Netherlands (Marine Biology).

Facilities: The Center is currently based out of a small hotel just outside the city of La Paz, at the southern end of the Baja California peninsula. Our site affords excellent access to the nearby Bay of La Paz where over 20 species of whales and dolphins have been sighted. Our facilities consist of three, large, dormitory style rooms, and access to small lecture rooms, a kitchen and dining/commons area. In addition to the small field library and computer room at the site, our affiliation with the Universidad de Baja California Sur allows us access to the university's small library. We will make trips into nearby La Paz to enjoy the cultural opportunities of the city. We will camp in tents during trips to wilderness areas.

***The Center is sponsored in Mexico by the Universidad de Baja California Sur, which offers local assistance and cooperation in the operation of Center programs.**



Center for Marine Mammal Studies-MEXICO

marine mammals as these animals are caught in the growing struggle over use and management of the region's natural resources.

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 Heerman's gulls.

Human presence is noticeably absent here. The few large cities and resort areas are separated by miles of rural coastline dotted with 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 California sea lions, bottlenose dolphins and Bryde's whales. These waters also comprise key migration routes of gray whales, blue whales, fin and humpback whales.

Research Focus

In order to manage human activities for the benefit of both humans and marine mammals, it is essential that we understand the natural history and habitat requirements of each species (including humans) within the Bay of La Paz. Our field work will directly contribute to and support ongoing work of Mexican scientists concerned with conserving the marine mammals around the southern peninsula. We will document the seasonal abundance and distribution of marine mammals in and around La Paz Bay, focusing on both resident and migratory species. Key questions addressed by our research include: How do occurring species differ in their patterns of prey and habitat use? To what extent does increased boat traffic impact whale and seal activity patterns? What are the energy requirements and feeding success rates of brown pelicans? We will use photo-identification to study individual variations in movement and behavior.



The Baja Peninsula boasts several dynamic and beautiful desert environments. Our studies will include some desert ecology, focusing on the unique interface between desert and marine ecosystems. (Photo: Lorayne Meltzer)



"In what other classroom can you listen to a lecture about sea lions and observe a sea lion pop up in the water behind the lecturer?" Mark Clements, Plymouth, IN—Butler University (Photo: Steve L. Swartz)

Travel and leisure are key elements of the economy of Baja California. Assisting Mexican scientists in assessing marine mammal occurrence and the impact of increased human disturbances will help guide future programs to increase tourism and devise policies and strategies that will preserve the natural resources of the region.

Living and Working Conditions

La Paz, the capital of Southern Baja, California, is the largest city on the peninsula with a population of over 100,000 people. Our base camp will be situated in an old hotel on La Paz Bay. Our simple living accommodations will be supplemented with a field computing facility, a darkroom, lecture and study space, and a small field library. We will have kitchen facilities and will cook for ourselves.

The site provides easy access to an extraordinary array of marine mammals in nearby crystal clear waters surrounded by rocky cliffs and sandy beaches. The city of La Paz, and all it has to offer, is accessible by a short boat ride.

**The School
For Field Studies**



This 95 day semester program consists of four courses designed to allow students to explore the scientific, economic, social and historical issues involved in the conservation and protection of marine mammals.

Marine Mammal Biology will provide the foundation of our semester's work. This course will provide an overview of the biology of the five marine mammal groups—cetaceans, pinnipeds, sirenians, polar bears and otters—concentrating on cetaceans and pinnipeds. Lectures will cover the evolution, systematics, social and behavioral ecology, anatomy, physiology and adaptations to marine environments of marine mammals. We will also discuss the history of marine mammal/human interactions, touching on the animals' ecological role in the past and present. Our research will focus on cetaceans and the California sea lion, and how they interact with the human population in the area. Guest lecturers will include leading marine mammal biologists from the area who will share their recent research experiences and ideas.

Resource Ecology and Management will complement Marine Mammal Biology in that we will continue to use pinniped and cetacean examples in our discussions of resource use and management. In Resource Management, we will expand our view to consider conservation and resource management issues more generally as we integrate concepts of marine ecology with the needs of managing marine resources. We will consider problems created by the often conflicting demands of resource use and conservation as well as how conservation policies are made on both local and global scales. The course will review the management of complex ecological communities and ecosystems. Techniques of data collection and analysis will be introduced during laboratory sessions.

In **Environmental Policy and Socioeconomic Values** we will consider contemporary marine environmental problems and deterioration from the standpoint of social theory, history, and political economy. We will explore how social organization and value systems, economic forces and political structure all influence marine policy formulation. Specific related topics include: the relationship between economic growth and marine policy; analysis of social choice mechanisms; dispute resolution (mediation and arbitration); environmental ethics; and transboundary issues from a social and cultural perspective.

**All courses
carry college credit.**

In **Directed Research** students will have the opportunity to integrate perspectives developed in the previous courses as we design independent research projects focusing on the behavior and ecology of marine mammals in the wild. These projects will support ongoing research by Mexican scientists through the University of Southern Baja California. Students will be exposed to how to identify key questions and to transform them into testable hypotheses. We will then develop the technical skills of research including statistics, behavioral observation, data collection and analysis, and marine mammal identification at sea, in order to test these hypotheses. Finally, we will work on the communication of research results. Potential projects include creating a photo-identification catalog of whales and dolphins, determining distribution patterns of whales in the Bay of La Paz, examining special relationships of bottlenose dolphin, and assessing whether vigilance behavior of sea lions is affected by group size and approach.

Note: Students are strongly encouraged to complete a course in Spanish prior to participating in this program.

Semester Program: **Marine Mammal Biology and Conservation**

Site: Center for Marine Mammal Studies, MEXICO

Course Titles and Numbers:

*Marine Mammal Biology
(BIO 1816)*

*Resource Ecology and
Management (BIO 1822)*

*Environmental Policy and
Socioeconomic Values
(SOA 1909)*

Directed Research (INT 1191)

Departure Point: La Paz, Baja, Mexico

Program Dates:

September 9 - December 12, 1992
January 29 - May 4, 1993



We will utilize boats such as the one above to gain access to the over 20 species of resident and migrating marine mammal species that have been recorded in the nutrient rich waters surrounding the Baja peninsula. (Photo: C. Shannon Goob)



Center for Sustainable Development Studies*

Site: COSTA RICA

Curriculum:

Semester Program:
Studies in Sustainable Development

Staff:

Field Director: Christopher Vaughan, M.Sc., University of Costa Rica (Natural Resources).

Resident Faculty: Moises Leon Azofeida, Ph.D., Tulane University (Cultural Anthropology).

Martha Rosemeyer, Ph.D., University of California at Santa Cruz (Biology and Agroecology)

Facilities/Living and Working

Conditions: The Center opened in September 1991 and will be based out of leased sites for at least the first year of operation. We are considering a variety of permanent site options including the southern Pacific region near the town of San Vito, and the northern Central Valley. Both areas are known for their agricultural development and natural resource protection. We also plan to travel to other regions of Costa Rica to investigate specific case studies. Our base accommodations will be rustic but comfortable and will likely include a lecture/dining hall, library, computer center, and dormitories. Costa Rica has a tropical climate. Temperatures vary depending upon the time of day, weather conditions and altitude. December through May is considered the wet season. A great variety of foods are available including beef, chicken, fish, fresh fruits and vegetables. We will prepare most of our own meals.

* The Center is affiliated with the Universidad Nacional, which offers local assistance and cooperation in the operation of the Center.

Background

Sustainable development, defined as the management of resources so that they may yield the greatest benefit to present generations while maintaining their potential to meet the needs of future generations, is thought by many to be one of the few viable, long-term conservation strategies for implementation on a global scale. Historically, the conservation movement has sometimes floundered, in part because of the "total preservation" attitude of its advocates, and the implication that conservation and economic development are incompatible. Theories underlying sustainable development propose that development and conservation are, in fact, mutually dependent, rather than mutually exclusive.

Site

Costa Rica presents some very special opportunities for case studies of the challenges of sustainable development including examples where progress has already been achieved. These include protection of forested watersheds while developing hydroelectric power; the establishment of conservation regions for the protection of biological diversity, indigenous peoples, and the culture of regional communities; control of disease; development of sustainable agricultural practices; and restoration of native ecosystems.

Costa Rica, translated "rich coast", was discovered and named by Christopher Columbus in 1502. Similar in size to West Virginia, Costa Rica is bordered by Panama and Nicaragua as well as the Pacific Ocean and the Caribbean Sea. Costa Rica has not had an army since 1948, and has a strong democratic history. While approximately 23% of Costa Rica's land is protected as national preserves, outside of these parks deforestation continues at an alarming rate. In the face of the highest per-capita debt in the world, "Ticos", as Costa Ricans call themselves, are addressing their country's environmental problems with a commitment and creativity rare among developing countries.

Costa Rica's cloud forests, rainforests, mountain plains and lowland jungles are home to over 6,000 species of plants, including 1,200 varieties of

orchids. The iridescent Blue morpho is just one of over 500 species of butterflies found here; total insect species number in the thousands. Costa Rica is home to over 850 bird species including quetzels, scarlet macaws, toucans and hummingbirds. Drenching rains—up to 300 inches per year—foster large expanses of rainforest that provide refuge for howler monkeys, capuchins, and three-toed sloths. Much of the plant and animal life exists in the uppermost reaches of the rainforest where the canopy towers 150 feet above the forest floor.

Dry, tropical forests can be found in the northwest. Condensation, rather than precipitation, provides moisture to sustain the unique flora and fauna found at the Monteverde cloud forest on the continental divide in the central mountains. To the southeast, near the border with Panama, La Amistad Park hosts a population of jaguars and pumas. The country seemingly "tilts" toward the Pacific, and the sloped terrain is etched by swift rivers, several of which have been harnessed to power electric plants. Magnificent beaches fringe both coasts, and some of the largest known nesting beaches for sea turtles are found here. Costa Rica's rich botanical and faunal diversity is fostering the development of a significant tourist industry. Many Ticos support themselves through agriculture, especially the growing and harvesting of sugar, bananas and coffee. Cattle graze on inland slopes while the coasts are the sites of productive fisheries. There is some manufacturing, usually utilizing products from the rainforest. San Jose, the capital, is a bustling, modern city.



The fact that "Ticos", as Costa Ricans call themselves, are addressing their country's environmental problems with creativity and commitment may ensure the availability of critical resources for the next generation. (Photo: Jane Marcus)

**The School
For Field Studies**



Program of Study

The study of Costa Rica's effort to protect their environment and deal with the challenges of sustainable development will be presented as a series of case studies on specific issues. Students will spend a period of time learning first-hand about scientific and social aspects of the issue, and the efforts of the Costa Rican people to address their need for development and protection of their environment. These cases will then be used to address broader issues of sustainable development in developing countries.

The overall themes of the curriculum will be to understand: what scientific information is necessary to achieve programs that support sustainable human systems; how different development issues are unavoidably interrelated; and how solutions are shaped by existing political and cultural conditions. Emphasis will be placed on having students directly involved with the communities affected by the issues, and engaged in projects that involve monitoring conditions over extended periods of time. Potential case studies include:

- Land utilization in the North Central Valley
- La Amistad Biosphere Reserve
- The Cordillera Volcanica Central Regional Wildland Unit
- Sustainable forestry at Las Esmeraldas Farm
- Ecotourism in the South Pacific Coast
- Sustainable Utilization of Wildlife Species (marine turtles, green iguanas, scarlet macaws)

Our case study approach necessitates that material be presented in an integrated fashion by faculty teaching as a team rather than breaking the curriculum into discrete courses. We will therefore integrate our studies of conservation biology, agroecology, hydrology, soil science, mineralogy, eco-

nomics, political science, social planning and organization, and Latin American culture. For the purpose of awarding academic credit, these subject matter comprise the necessary components for the following courses:

Conservation Biology of Tropical Ecosystems will explore the natural mechanisms by which biodiversity is maintained. We will study patterns of interactions among biological components of a tropical ecosystem to understand the factors controlling diversity, scarcity and ecosystem health, and how biodiversity can be protected from human disturbance.

Social and Political Systems of Costa Rica examines the human history of Costa Rica. Costa Rican democracy will be compared with that of the United States, particularly with respect to the formation and enforcement of resource policies. The high literacy rate, relatively good economic situation, and other special features such as lack of an army, will be examined and contrasted to other Central American countries. We will explore the historical and contemporary cultural composition of Costa Rica, giving attention to ways in which Costa Ricans perceive the conservation/exploitation of their natural resources.

Sustainable Development will examine the essential elements for designing and implementing sustainable rural development efforts. We will consider projects in agriculture, forestry, and energy production as well as fisheries, "ecotourism", and small scale manufacturing. The role of local people and of government and private national and bilateral aid agencies will be covered.

Directed Research will enable students to undertake an original project reflecting one or more of case studies, examples of which are described above. The group will choose a research topic addressing a conservation, social, or welfare issue and will develop research objectives and design data collection with faculty supervision. Each project will be presented in a paper and a public meeting to which local residents and/or development professionals will be invited.

Semester Program: Studies in Sustainable Development

Course Titles and Numbers:

Conservation Biology of Tropical Ecosystems (BIO 1849)
Social and Political Systems of Costa Rica (SOA 1907)
Sustainable Development (SOA 1908)
Directed Research (INT 1191)

Departure Point: San Jose, Costa Rica

Program Dates:

September 9 - December 12, 1992

January 29 - May 4, 1993

The SFS Center for Sustainable Development Studies is the result of cooperative effort between The SFS and a consortium of schools including Brown University, the University of Michigan, and Allegheny, Colby, Dickinson, and Middlebury Colleges. A portion of the spaces in each semester are reserved for students from Consortium Schools. Interested students should contact the SFS Admissions Office for information.

Prerequisites: This program will be offered at the intermediate level. Applicants must complete at least one college level ecology course and one spanish course prior to participating. Background in one of the following areas would enable students to maximize this opportunity: environmental studies, international development or Latin American studies.



SFS students will clear a field and plant banana and coffee crops as part of a case study on sustainable agriculture. (Photo: Chris Vaughan)

At one time, Costa Rica was virtually covered by forest. Today, less than 35% of the country is forested and, outside of national preserves, deforestation continues at an alarming rate. (Photo: Oscar Luke)





Introduction to Summer Satellite Courses

1992 Summer Satellite Courses

In addition to conducting research at the five SFS Centers described in the preceding pages, SFS is keenly interested in having the flexibility to mount shorter-term research efforts at environmental "hot-spots" worldwide. To this end, we offer students the opportunity to participate in 30 and 42 day summer courses at eleven satellite sites around the globe. The academic rigor of satellite courses is equal to that of summer courses offered at our Centers.

SFS sites are chosen in large measure for their dramatic illustrations of the issues under study. Satellite sites allow us to take advantage of unique research opportunities such as those presented by the oil spill in Prince William Sound, Alaska or the unprecedented rate of extinction faced by species in Hawaii. SFS research at these sites may take place over one to as many as five or six years. As is true for our Center-based programs, all research results are shared with concerned local agencies and resource managers for use in developing management policies.

Because of the shorter duration of summer courses and the fact that, in most cases, weather conditions during this period are less severe, our housing requirements are more flexible. Satellite courses offer us the opportunity to be more mobile and to move our camps, if necessary, to access the best research sites. In most instances, our accommodations for satellite programs are in tents or rustic cabins. Our curricular design for these programs fosters an intense immersion in the ecosystem under study.

1. Ecology and Management of the Asian Elephant
India
2. Ecology of Killer Whales
British Columbia
3. Primate Ecology and Conservation
Costa Rica
4. Landscape Ecology
Colorado Rockies
5. Ecology of Endangered Sea Turtles
Costa Rica
6. Tropical River Ecology
Belize
7. Conservation of Endangered Species
Hawaii
8. Ecology of Harbor Seals
British Columbia
9. Ecology of Bald Eagles and Other Endangered Birds of Prey
Montana
10. Tropical Cloud Forest Ecology
Costa Rica
11. Biology and Behavior of Bottlenose Dolphins
North Carolina



By assessing the impacts of pollutants on a river system, SFS students can contribute to the solution of a critical environmental problem.
(Photo: William McComas)



"After sharing thoughts about life, college and the future with my teammates, I don't feel so alone in a sea of indecision. They have the same uncertainties about their future as I do."—Lisa Steiner, University of Miami.
(Photo: K. Walsh)



Because we are surrounded by what we are studying, in this case a tropical river ecosystem in Belize, facts and theories come to life in a way that textbooks can't match. (Photo: Mi Kim)

1991-92 Satellite Course Faculty (Partial List)

Constance Becker, Ph.D. Candidate
(Zoology)
University of Alberta

Leonard A. Freed, Ph.D.
(Zoology)
University of Iowa

Patrick Kangas, Ph.D.
(Environmental Engineering Sciences)
University of Florida

Molly Morris, Ph.D.
(Environmental Studies)
Indiana University

Stuart L. Pimm, Ph.D.
(Zoology)
New Mexico State University

Ana Chaves Quiros
(License in Biology)
University of Costa Rica

Keith Rittmaster, M.Sc.
(Environmental Management)
Duke University

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

Raman Sukumar, Ph.D.
(Ecology)
Indian Institute of Science



In recent years, the impacts of ivory poaching have focused international attention on the African elephant. However the Asian elephant (*Elephas maximus*) faces a far more significant population crisis. Estimates place the total population of African elephants at approximately 600,000 animals, while less than 50,000 elephants are thought to survive in the wild in Asia. Even accounting for an additional 15,000 Asian elephants in captivity, the total population of Asian elephants is only about 10% of that of the African elephant.

The decline of the Asian elephant can be traced to loss of habitat to an expanding human population and to capture in large numbers for domestication. Once found from West Asia to China, the range of the elephant is now largely restricted to hill forests in South and Southeast Asia. Foraging elephants can have a tremendous impact on their habitat as they break branches, strip bark, pull over trees, and trample any vegetation in their paths. As a result, woodland may be converted to grassland. This typically occurs when the elephant population exceeds the "carrying capacity" of the area. A large elephant population can spill over into cultivated lands, endangering crops and human lives.

SFS students will travel to India to participate in a new effort assisting scientists affiliated with the Worldwide Fund for Nature in their efforts to develop management strategies to conserve remaining populations of Asian elephants. We will meet in Bangalore and spend a night here to recover from our travels. Rising early on the second day, we will head south by bus to the forests that cover the Nilgiri foothills. Elephant densities here are among the highest in Asia.

We will conduct our studies in the 874 square km Bandipur National Park and in the adjoining 321 square km Mudumalai Wildlife Sanctuary. In addition to elephants, we may encounter gaur (the largest wild ox in the world), bonnet monkeys, striped hyena, jackals, leopards and tigers, as well as a variety of birds, reptiles and amphibians.

In light of the unique research opportunities presented here, we have elected to extend our studies over a six-week period. Students will participate in two integrated courses, carrying a total of eleven quarter credits. Although presented in an integrated format in the field, we have separated our studies into two discrete courses below to facilitate the awarding of credit.

Ecology and Management of the Asian Elephant (5 credits) will introduce us to the elephant in the context of its rich and varied association with people. Lectures by faculty and guests will provide a theoretical background on elephant evolution, domestication, biology, behavior and population dynamics. In addition, we will consider the interaction of humans and elephants and captive elephant management. There will be plenty of exposure to both wild and captive elephants at both study sites. Our findings will be viewed within the overall social context of developing nations which are faced with often conflicting goals of conserving biological diversity while striving to improve living standards of human inhabitants.

Our focus in **Directed Research** (6 credits) will be on documenting the impact of elephants on their habitat. Faculty will introduce basic censusing techniques and observation skills that will enable us to identify the age and sex of individual elephants. We will

Summer Course: *Ecology and Management of the Asian Elephant*

Site: INDIA

Purpose: to study the ecology and biology of the Asian elephant (*Elephas maximus*) and its interactions with humans; to investigate demographic trends, carrying capacity, and impacts on its habitat in order to understand the factors which are endangering the species and to develop management strategies to promote its survival.

Course Titles and Numbers:

Ecology and Management of the Asian Elephant (BIO 1851)

Directed Research (INT 1191)

Departure Point: Bangalore, India

Course Dates: June 25- August 6



We will have plenty of exposure to both wild and captive elephants and may even travel into the forest on the back of an elephant to observe other members of the species. (Photo: R. Sukumar)

set up research plots in forested and other habitats where elephants are found and will proceed to inventory all woody plants in the plots. Damage caused by elephants will be recorded and used in the development of a long-term habitat monitoring system. Students will also interview local farmers to assess their perceptions of elephants and their management.

In addition to group projects, each team member will undertake a directed research project. Potential topics include the influence of the unequal sex ratio (there are many more adult females) in the elephant population on its demography, or differences in behaviors in elephants of different ages and sexes. Our results will be given to Worldwide Fund for Nature to support the development of plans for the sustainable management for the Asian elephant in southern India.

Our accommodations will be in dormitory-style lodgings where we will be served Indian food for most meals. Good raingear will be a necessity as these are peak months for rain. Temperatures should be a comfortable 60-80 degrees. This course offers a rare opportunity to spend time in the presence of a fascinating megaherbivore. In the interest of safety, students must be prepared to follow directions from faculty without discussion or hesitation.

Prerequisite: College-level ecology.

SFS Alumni are happy to share their experiences with you. Call the Admission Office for details.



Summer Course-Ecology of Killer Whales-BRITISH COLUMBIA

Summer Course:

Ecology of Killer Whales

Site: Johnstone Strait, BRITISH COLUMBIA

Purpose: to understand the impact of human activity (fishing, boating, whale watching, logging) on the ecology, behavior and conservation of killer whales (*Orcinus orca*) in the Johnstone Strait; to contribute to ongoing studies of killer whale vocalizations and associated behavior patterns.

Course Number: As this catalogue goes to press, this new course is pending approval by Northeastern University.

Departure Point:
Point Hardy, Vancouver Island

Course Dates:
Session I: June 16-July 15
Session II: July 22- August 20

Few conservation issues have engendered as much worldwide interest and support as the plight of marine mammal species. As censusing counts stabilize, and in some cases increase, efforts to protect dwindling populations of marine mammals from hunting and incidental capture may be viewed in retrospect to be among the biggest conservation success stories of the last twenty years. Although spared from threats once posed by whaling and fishing nets, marine mammal species still face loss of habitat to an increasing human presence, and competition for food sources still imperils their long-term survival.

Located at the northern end of Vancouver Island, the Johnstone Strait is an important summer feeding ground for a large, stable population of killer whales (*Orcinus orca*). This once remote area has experienced a recent surge in human activity in the form of fishing, logging, boating and whale watching. Killer whales, also known as "orca", are the largest members of the oceanic dolphin family. Averaging 25 feet in length and 8 tons for males, four tons for females, orcas are the only known cetacean to feed regularly on other marine mammals.

In the summer of 1992, after eight years of conducting research on the impacts of human activities on humpback whales in the North Atlantic, SFS research teams will

focus on the impacts of increased human activity on this pacific population of killer whales. Our research will address the following questions: Do whales alter their behavior in the presence of boats? How do behaviors, especially vocalizations, change in disturbed and undisturbed situations? Do behaviors differ among animals of different ages or sexes?

After meeting in the Vancouver Island town of Port Hardy, we will travel by van and boat to West Cracroft Island to establish our base camp. From our observation site atop a cliff, we have an exceptional view of the surrounding waters and local marine mammals including Dall porpoises, Steller's sea lions, and harbor seals.

Faculty lectures will introduce marine mammal taxonomy and evolution, behavioral ecology of marine mammals, life cycles of killer whales and other species, and marine mammal conservation issues. Research techniques including the use of theodolites and hydrophones (underwater microphones), censusing, and focal animal observations using spotting scopes will also be presented.

We expect to be conducting several projects simultaneously. For example, shore-based observation teams using a theodolite will collect data on movement patterns of killer whales when boats are with them and when they are alone, while other team members record behaviors such as breaches, spyhops and tailslaps. A team working out of a small outboard boat or sea kayaks might collect longitudinal, focal-animal behavioral data.

Our lectures and data collection will be interspersed with field trips to meet local fishermen, loggers and commercial whale watchers. In addition to contributing to the group research efforts, each student will undertake a directed research project. Potential projects include an assessment of the impacts of boat traffic on whale movements, a study of the attitudes of fishermen regarding marine mammal conservation, observations of the amount of time spent alloparenting (babysitting), or an analysis of hydrophone recordings of vocal activity by killer whales.

During the final days of the course we will analyze, write-up, and present our findings. Our results will be given to biologists and resource managers at the Pacific Biological Station and The British Columbia Department of Parks, Fisheries and Oceans, and to local marine mammalogists for use in the development of management strategies to ensure the continued presence of killer whales in this area.

Conditions at our base camp will be quite primitive. We will erect our tents on platforms and cook meals over Coleman stoves. Gas lanterns will provide illumination for evening discussions or homework assignments. The island has few human residents but we may be visited by one of the black bears that live here. The weather will be variable and bouts of cold rain and grey skies will be punctuated by days of spectacular warm sunshine.



Killer whales are easily identified and tracked due to their size and vivid black and white markings.
(Photo: Linda Nichol)

The School
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Fifty percent of all known primate species are endangered or threatened according to listings compiled by the International Union for the Conservation of Nature (IUCN). On a global scale, the single most serious threat to primates is the loss of undisturbed tropical forest habitat.

Costa Rica has a strong record of setting aside protected lands—over 23% of the country's land is set aside in national parks and reserves. However, outside of the national parks in Costa Rica, primate populations are experiencing a rapid loss of habitat as their range is fragmented and transformed into agricultural systems. There are few exceptions to this pattern of deforestation and those that exist have been poorly studied. Recently, a small but growing number of private landowners have been maintaining tropical forest patches with the aim of attracting both amateur and professional ecologists as paying visitors. These private forest reserves may provide a sustainable framework for the conservation of several species of neotropical primates.

The Curu National Wildlife Refuge was established in 1984, by private owners, with the intention of combining sustainable agriculture with wildlife conservation, ecological tourism, and environmental education. Curu offers a rich diversity of plant and animal life and is home to two species of monkeys. The endangered mantled howler monkey (*Alouatta palliata*) and the white-faced capuchin (*Cebus capucinus*) can both be readily spotted on and near trails throughout the reserve.

Our research will focus on the habitat use, competition for resources, and population biology of the mantled howler and white-faced capuchin monkeys. Questions we will seek to answer include: What are their food sources? Who gets access to these foods? Which habitats are more productive for each species? Are intraspecific competition for resources endangering these populations? What management strategies can help reduce resource competition? We will add to habitat descriptions and censusing begun by SFS research teams in 1990. Our research results will be shared with the IUCN Primate Specialist Group and presented to the managers of the Curu Reserve.

After meeting at the airport, we will spend the first night in San Jose. The next morning, we will travel west to Puntarenas, a coastal town on the Gulf of Nicoya. Here we will board boats that will take us to Curu, located on the tip of the Nicoya peninsula. The Curu reserve is owned by the Schutt-Valle family, who will be our hosts.

Approximately one week into the course, students will select and initiate a directed research project. Potential projects include studies of competition for jobo fruit among howlers and for palms among capuchins, studies of troop size and habitat preference, and documentation of seed dispersal effectiveness by each species. Additional projects may focus on local attitudes toward primate conservation.

Summer Course: *Primate Ecology and Conservation*

Site: Curu National Wildlife Reserve,
COSTA RICA

Purpose: to study the ecology and behavior of two species of New World monkeys, mantled howler monkeys (*Alouatta palliata*) and white-faced capuchins (*Cebus capucinus*), to understand how they use their environment in order to develop management plans to promote their survival, in the face of ongoing deforestation, on both public and private land.

Course Number: BIO 1808

Departure Point: San Jose, Costa Rica

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

During the second and third weeks of the course, our days will begin at dawn with field work. Most days will be spent collecting data in the forest, while others will be punctuated by faculty lectures on topics including biogeography, primate social organization, and tropical rainforest conservation. In the late afternoon and evening, we will have time for study and opportunities for relaxation including beachcombing and swimming. Occasional trips to the nearby village of Paquera, as well as an overnight field trip to Cabo Blanco Natural Reserve (Costa Rica's first national park) will provide us with a broader appreciation of natural resource management as well as a perspective on Costa Rican culture. The last week of the course will be spent compiling data in preparation for oral and written presentations of our research results.

Visits to the nearby beach will provide a temporary respite from the heat and humidity. Our accommodations consist of rustic beach cottages. Meals will be served "Tico"-style (traditional Costa Rican fare) and we will all pitch in to help with daily chores.

Prerequisite: College level ecology.

Watching for monkeys at the Curu Reserve. "It is very different collecting data on monkeys that are running from you or throwing twigs at you than it is collecting data on rats that are in a Skinner box!"
Christy Freeland, Charlotte, NC—University of North Carolina (Photo: Glen Monnelly)



Financial Aid is available.
Please see page 38.



Summer Course-Landscape Ecology-ROCKY MOUNTAINS

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

Site: Rocky Mountains, COLORADO

Purpose: to determine the quality and size of ecological land units needed to preserve species diversity in the San Juan Mountains; to evaluate the suitability of prairie dog communities as sites for the reintroduction of the endangered black-footed ferret.

Course Number: BIO 1800

Departure Point: Denver, Colorado

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

What's the difference between a national park, a national forest, and a biosphere reserve? What is the best way to preserve biodiversity for future generations? We will address these questions while gathering valuable baseline data in the remote San Juan Mountains which represent one of America's most outstanding natural areas. Here, where snow-capped mountain peaks jut skyward from green-forested valleys, elk, mule deer and the solitary black bear roam at will. The sweeping landscape encompasses alpine meadows giving way to subalpine and montane forests, which in turn grade into upland grasslands/shrublands, each with their unique community of plants and animals. This area forms one of the last intact fortresses of vast wildlife diversity in the continental U.S. Planned land-use changes throughout the southern Rockies are leading to concern that competing interests will lead to a rapid loss of wildlife habitat. In order to protect the diversity of species that naturally occur in threatened primary wildlife areas, biologists and resource managers must know where, how large, and "natural" key areas should be to sustain wildlife diversity.

The San Juan Mountains lie to the north and east of Mesa Verde National Park and the Southern Ute Indian Reservation, along the Colorado-New Mexico border. Our study area extends from grassland/sagebrush habitat below 8,000 ft. to high peaks over 14,000 ft. We divide our time between remote wilderness areas in the high mountains

where we backpack, collect data, and camp under completely primitive conditions and the upland grassland/sagebrush areas in the foothills of the mountains (a little over 7,000 feet) where camping conditions are only slightly less primitive.

Over the previous two summers, SFS research teams have studied the ecology of the Gunnison's prairie dog in the high grasslands of the Western Slope near Pagosa Springs, Colorado. Prairie dog communities were evaluated for their suitability to serve as sites for the reintroduction of the endangered black-footed ferret. Our research methodology included the live-trapping of prairie dogs in order to conduct population studies, and the use of radio-telemetry to track the underground movements of tagged dogs. We hope to continue this research in 1992.

Study areas will be selected on the basis of factors such as current use, proposed development or conservation efforts, or indications of potential as wildlife habitat. Our findings will be of use in answering critical questions such as how much development can be interspersed with natural systems of a region? How will the current system be impacted by proposed land-use changes?



We will carry out directed research projects based on our interests and observations. There are many important questions to be addressed such as how suitable are landscape units for endangered species such as grizzly bear, wolverine, lynx and black-footed ferret? Do public land-use values threaten the pristine qualities of this region? Would ranchers support the protection of Gunnison's prairie dog colonies as future reintroduction sites for black-footed ferret? Our results will be presented to the U. S. Forest and U. S. Fish and Wildlife Services in order to build support for preservation of this vital area.

Faculty lectures will address the vegetation and habitat types of the southern Rockies, the natural history and ecology of native species, conservation biology and theories of biogeography. Students will participate by discussing papers and making short presentations on animals of the region. Around the evening campfire, we will consider topics that may range from cultural differences in land ethics to personal views about conservation and wildlife protection.

You can expect primitive camping conditions. We will live in tents, bathe in streams, and often must purify our drinking water. We cook our own food over campstoves and share camp chores. Approximately half of our time is spent in remote backcountry, where we carry all supplies and gear on our backs. Weather conditions will range dramatically from mid-day heat to night-time cold. While it will be generally warm and dry at lower elevations, we can expect afternoon thundershowers, particularly along the higher mountain slopes.

Prerequisite: College level ecology.

Vegetation sampling in the Colorado Rockies. "When I signed up for the course, I was expecting to find fourteen scholastically intense researchers and me. As I talked to the other students, I found people with a variety of interests. They weren't all bio majors, there were economics and liberal arts majors, and the ever present undecided majors." Timothy Jon Van Norman, El Paso, TX—Washington State University (Photo: Donna Stockrahm)



Sea turtles are among the largest living reptiles, ranging in size up to 900 kg. Surprisingly little is known about sea turtles, since they spend the majority of their lives at sea. What little is known is fascinating. It is thought that sea turtles live an extremely long time, but no one is sure how long. The sex of hatchling sea turtles is not determined by genetics, but by the temperature at which the eggs are incubated. In sea turtles, low incubation temperatures produce males and higher temperatures produce females.

Today sea turtles face a growing number of environmental threats, many of them of human origin. Worldwide, their nesting areas are being altered or destroyed by development, they face inadvertent capture by fishermen, and both adults and eggs on or near beaches are exposed to the threat of poaching. Additional problems include survival of hatchlings through the vulnerable first years at sea, as well as nest failure due to predators, parasites, and physical processes such as seawater washout and incidental capture by shrimp trawlers.

SFS students will return to the beaches at Ostional for a second year to study the biology, ecology and conservation of the olive or Pacific Ridley turtle (*Lepidochelys olivacea*). The beach at Ostional is one of the two most important nesting areas in the world for this endangered species. Ridley turtles often use a unique nesting strategy known as the "arribada", which involves monthly mass nestings that last from three to ten days each.

Arribadas usually occur at night, mainly between July and November, and can involve up to 100,000 animals. On nights between arribadas, individual turtles nest in a more typical manner. A question that we will address is whether these solitary nesting turtles also participate in arribadas.

The two significant nesting sites for olive Ridley turtles, Playa Nancite and Playa Ostional, are located on Costa Rica's north-west pacific coast. Both sites are designated as wildlife refuges. An agrarian community of approximately 50 families live at Ostional and legally harvest turtle eggs for both subsistence and commercial uses.

After meeting in San Jose, we will travel by bus to our base at the Ostional Field Station, which is owned by the University of Costa Rica and is located adjacent to the arribada beach. Because much of our data collection must be done at night, when females come ashore to lay their eggs, our days will be devoted to lectures, studying and documenting evidence left on beaches from any turtle activity from the previous evening. Faculty and guest lectures will address the taxonomy, natural and life histories of turtles, concepts of population and physiological ecology as they apply to sea turtles, nesting biology, temperature dependent sex determination, and conservation of sea turtles.

In order to diminish the impact of large numbers of humans on the nesting beaches at any given time, we will divide into smaller research teams with two teams pa-

Summer Course: *Ecology of Endangered SeaTurtles*

Site: Ostional, COSTA RICA

Purpose: to investigate the ecology and behavior of the endangered Pacific Ridley turtle (*Lepidochelys olivacea*); to investigate the nesting beach at Ostional in order to recommend management policies that will protect the nesting habitats of these endangered species.

Course Number: BIO 1842

Departure Point: San Jose, Costa Rica

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

trolling the beach each night. Students will be introduced to field research skills including tagging, censusing, conducting thermal measurements, recording nesting activities and physical characteristics. Questions we will seek to answer include: What is the relationship between nesting activity, tides and climatic conditions? What percentage of nests are damaged by the nest-digging of other turtles? What percentage of nests are lost to humans? We will also consider the attitude of local citizens and Park officials regarding the potential increase of tourism at Ostional. In addition, students will have the opportunity to conduct individual directed research projects. Potential projects include consideration of the environmental factors affecting hatchling emergence, and the spatial variations in nest success considering mortality from humans and natural factors.

During the final days of the program, we will compile and analyze our data for use in oral presentations of our research. Our results will be shared with the University of Costa Rica and with the Ostional Association for use in developing management plans for the beach.

Our base consists of a bunkhouse/laboratory. We will all pitch in to complete daily chores and some cooking, although many of our meals will be prepared by local "Ticos", as Costa Ricans call themselves. Plan on hot weather at Ostional. Although we will be on the "dry" side of Costa Rica, we will be visiting during the wet season and mosquitoes will be plentiful. The friendly people of Ostional have welcomed us warmly. The opportunity to get to know them and to understand their perspectives regarding the turtles, tourism and conservation, are a bonus of this location.



If they survive the many perils and predators facing them as hatchlings, female turtles are thought to always return to the beaches where they were born to lay their eggs. Thus, habitat protection is essential to this already endangered species. (Photo: Tammy Wetzel)

Financial Aid is available.

Please see page 38.



Summer Course-Tropical River Ecology-BELIZE

Summer Course: *Tropical River Ecology*

Site: BELIZE

Purpose: to describe the structure and function of a tropical river ecosystem in order to evaluate the "health" of the river and, indirectly, its watershed; to develop recommendations for river conservation to protect rivers from the impacts of land-use changes.

Course Number: BIO 1848

Departure Point: Dangriga, Belize
(We will meet in Belize City and fly to our site as a group.)

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

For many Americans, a description of a tropical river might include adjectives such as mysterious, exotic, and even romantic, as one conjures up scenes of Bogart and Hepburn on the African Queen. In reality, tropical rivers do present us with a mystery as relatively little is known about their diversity, structure and function. The lack of research and management focus devoted to tropical rivers is somewhat surprising given the significant role many of these rivers play in the history, commerce, and subsistence of the countries through which they flow. In many cases, rivers are more severely stressed than any other ecosystem.

Belize, with the lowest population density and lowest relative deforestation rate of all Central American countries, offers an excellent site for the study of tropical river ecology. Since the environment has suffered less human impact than most other neotropical countries, the Belizian ecosystems retain much of their ecological value. At the same time, the rivers of Belize have had more use than other systems through commerce, fishing pressure and pollution, and effective management and conservation of river systems is critical to Belize's future prosperity.

This summer, SFS students will have the opportunity to help unravel some of the mystery surrounding tropical river systems as we study and inventory the Sittee River at critical points from the headwaters to the river mouth at the coast. The Sittee River, which flows for approximately 30 miles from the Maya Mountains of central Belize to the Caribbean Sea, has served as a main "highway" since the days of early Mayan civilization. Questions we will seek to answer include: How does the ecosystem structure and function differ as the river changes from a freshwater stream to a mainly saline/sea water system? What is the metabolism of the river?

To what extent have land-use patterns changed the river, and how can the river be managed to prevent degradation?

We will meet at the airport in Belize City and fly as a group to Dangriga. From Dangriga, we will travel by bus to our site at Possum Point, a biological field station on the banks of the Sittee River. Introductory lectures by faculty will introduce concepts of aquatic ecology to prepare us for field work. Much of our time will be spent in or on the river. Most of our field work will focus on the lower Sittee River where deforestation is taking place. We will examine headwater streams during a week-long camping trip to the Jaguar Preserve of the Maya Mountains. Here our field work will directly contribute to the management plans of the preserve.

We will develop diurnal oxygen curves for the river in order to understand the metabolism of the system. This information can yield important indications of the overall health and performance of the ecosystem. In order to understand community structure, students will utilize snorkeling and seine netting to sample fish and macroinvertebrates and to assess in-stream habitats. The fact that no taxonomic keys exist for identifying certain species in inland tropical rivers is just one indication of how little attention has been focused on this ecosystem. We can expect to encounter a range of species on our collecting forays, from anemones, crabs and shrimp at the mouth of the river to insect larvae, snails and crayfish in the freshwater upstream. The presence of specific indicator taxa as well as the diversity of species will be used to assess water quality, which will then be related to the condition of the watershed as a whole.

In the latter stages of the course we will compare the Sittee River with other aquatic systems in Belize, such as a subterranean river and polluted streams. Additional lecture topics including the natural history of Belize, taxonomy, biodiversity, energy budgets, elements of water chemistry, swamp ecology, and the role of the Maya in land-use changes, will prepare students to undertake directed research projects. Potential projects include the role of terrestrial crabs in land-water interactions, aquatic feeding by birds, or impacts of bankside erosion. If time permits, we will visit nearby Mayan ruins to gain insight into the extensive use of rivers by early Mayans.

At the end of the course, we will compile written and oral reports with recommendations for river conservation strategies. Our reports will consider the utilization of buffer strips, corridor preserves, in-stream and floodplain habitat restoration and other options. This data will be submitted to government resource managers, the Belize Audubon Society and the Programme for Belize.

Our camp at Possum Point will be rustic but comfortable. We will sleep in platform tents along the river. A large screened building will offer protection from insects and serve as our lecture room and dining hall. Kerosene lamps will light our picnic tables for nighttime study. We can expect warm and humid weather. We will look to the river for food, recreation and transportation, and can expect almost daily encounters with Belizians as they make their way along this aquatic highway. Brightly hued flowers, birds and butterflies provide splashes of color along river banks shrouded in lush green vegetation.

Prerequisite: College level ecology.



Faculty member Pat Kangas works with an SFS student to try to unlock some of the mysteries surrounding the structure and function of the Sittee River. So little research has been conducted to date that we may be unable to identify some of the invertebrate species we collect from the river. (Photo: Mi Kim)

**The School
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Hawaii, the only U.S. state with tropical rainforests, is home to more than 10,000 species found nowhere else on Earth. These species include spectacular birds, colorful plants, and the world's only carnivorous caterpillar. A report issued in 1991 by the US Fish and Wildlife Service and the Hawaii Department of Land and Natural Resources asserts that major conservation efforts have failed to stem an escalating tide of extinction. As a result, the Hawaiian Islands are losing species to extinction at a rate thousands of times faster than normal. There are now more species of endangered birds in Hawaii than in all of the rest of North America.

A combination of forces has spurred the alarming rate of extinction here. Wholesale habitat destruction has slowed but not stopped. Overhunting and overharvesting has led to the elimination of countless plant, animal and bird species. Many native plants and animals have been threatened by introduced herbivores (pigs, goats), predators (mongooses), disease and plants. And secondary extinctions of species have occurred following the extinction of other species necessary to their survival.

Beginning in 1992, SFS research teams will travel to Hawaii to contribute to ongoing efforts to develop management strategies for endangered species in fragmented habitats. In Hawaii counts exist for very few species. There has been only one island-wide inventory of Hawaiian birds, and no continuous census of any bird species. In addition to collecting valuable census data, we will try to determine if the rare species are declining progressively in numbers? If so, what are the causes of this decline and what can we do to prevent it? If not, are the populations merely

fluctuating? If they are, what are the population numbers and are they near the point from which recovery is unlikely?

We will meet in Honolulu and spend five days in University of Hawaii dormitories. Morning lectures by faculty will introduce the ecology and history of the Hawaiian Islands and to bases for the research we are about to undertake. Afternoons will be devoted to field trips and evenings will include orientations to research equipment.

Our research will take place at two sites. First, we will fly to Kauai and spend eight days near the Koke'e State Park, a 1500 hectare area near the Alakai Swamp. Here we may encounter up to seven species of non-endangered birds, including the spectacular 'Iiwi, easily recognized by its red plumage and salmon pink beak. The park is also home to three endangered species including the 'akikiki. Any or all of these birds may appear in our mist-nets.

Midway through the course, we will travel to Hawaii and base our studies near the Hakalau Forest National Wildlife Preserve. This 8,000 hectare former cattle ranch is now dedicated to the conservation of native Hawaiian forest birds. Here we will find ohia-koa forest in which 4 species of endangered birds and 5 non-endangered bird species are permanent residents. In addition to the 'Iiwi, we may sight an 'akiapola'au. Although very rare, this endangered bird is easily identified by its long, curving beak.

We will study bird populations using serial mist-nets erected near the top of the canopy. Captured birds will be fitted with unique bands that enable future identification using binoculars. Before release, birds will be sexed, aged, weighed, measured, and inspected

Summer Course: *Conservation of Endangered Species*

Site: HAWAII

Purpose: to understand the ecology of endangered tropical forest species, their habitats, and factors causing their extinction; to establish long-term monitoring of endangered, non-endangered and alien species of birds in two locations in the Hawaiian Islands; to study the impact of introduced species on this tropical forest habitat.

Course Number: BIO 1850

Departure Point: Honolulu, Hawaii

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

for fat condition and health. Through continuous mist-netting, we will be able to monitor the community structure of birds within our study sites. We will try to assess what factors determine whether introduced species will invade a community and what impact these species will have when they get there?

In addition to working on the group project, students will participate in individual directed research projects under faculty direction. Potential projects include recording songs and calls as a means of comparing social behavior among different related species of birds, comparing the duration of parental care in bird species, or various projects on a range of animals and plants.

We will return to Honolulu to compile and present the results of our research. By summer's end, we hope to have a picture of the relative abundance of various species and the fraction of each community that is composed of alien species, as well as provisional estimates of the age structure of the endangered species. Our results will be shared with local conservation organizations, state and federal agencies to support their efforts to save endangered species.

Be prepared for a true tropical experience complete with lush vegetation, heat and humidity as well as cold rain and mud in the mountains. Our accommodations will afford varying levels of comfort ranging from dormitories in Honolulu to cabins on Kauai and to tents on Hawaii.

Prerequisite: College level ecology.

*Some of Hawaii's most endangered and spectacular bird species may show up in our special mist-nets designed by the faculty.
(Photo: Leonard Freed)*



**The World
Is Your Classroom**



Summer Course-Ecology of Harbor Seals-BRITISH COLUMBIA

Summer Course: *Ecology of Harbor Seals*

Site: Vancouver Island, British Columbia, CANADA

Purpose: to study the population biology and ecology of a population of pacific harbor seals (*Phoca vitulina richardsi*) in waters surrounding Vancouver Island; to monitor and understand the impact of human activities, especially boating and fishing, on seals; to help predict the potential impact of an oil spill on seals.

Course Number: BIO 1809

Departure Point: Vancouver Island

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

The pacific harbor seal (*Phoca vitulina richardsi*) is widely distributed in temperate and arctic waters of the Northern Hemisphere. The total population of harbor seals from California to Alaska has been estimated at over 300,000 animals, and is considered to be stable outside Alaska. Throughout their range seals are subject to disturbances at their breeding grounds. Unlike other seal species, harbor seals do not migrate. They haul-out on sandbars, rocks and beaches where females give birth to a single pup from mid-June until August. Mothers nurse their young on or near shore for a period of 4-6 weeks, and during this time vulnerable seal populations are highly concentrated at breeding rookeries. Encroachment by boat traffic, and recreational or commercial activities may cause seals to abandon their haul-out sites. This increases the potential for pup thermoregulatory stress and mother-pup separation. Additional threats to the harbor seal population are posed by fishermen, who consider seals to be a nuisance as well as competition for the salmon and shellfish catch. Finally, the shallow waters frequented by harbor seals are also the habitat of killer whales, the largest member of the dolphin family. Killer whales are the world's largest predator of warm-blooded animals and marine mammals are their preferred prey. A permanent population of killer whales live in the waters off Vancouver Island.

Previous SFS teams have conducted research on the population dynamics of harbor seals in Glacier Bay and in Prince William and Puget Sounds. This summer SFS students will travel to an area north of our

study site in Puget Sound to continue research on the ecology and behavior of harbor seal populations in northern Pacific waters. The questions we will seek to answer may contribute to an understanding of why northern populations of pinnipeds, including harbor seals, have been declining in recent years. Our questions will include: What is the pupping rate of seals in our study area and how does this number compare with previously collected data? What factors influence haulout and bolting behaviors? What are the impacts of vessel traffic on seal behavior? What effects do potential impacts from fishing have on seal survival?

The nutrient rich waters that surround Vancouver Island attract a large and varied population of marine animals. We will most likely establish our research base amid the Gulf Islands where a unique combination of physical factors, including quiet waters and well protected harbors, provide an ideal setting for studies of a marine ecosystem. In addition to harbor seals, we can expect to encounter and study minke whales, Steller sea lions, and numerous species of sea birds, fish and invertebrates. We will utilize small boats or sea kayaks to access some study sites and will reach other sites via Island ferry or van.

From high bluffs overlooking the rocky coastline, we have a clear view to several favorite haulout sites for seals. After setting up our tent camp, we will begin our observations of local marine animals. Faculty lectures will introduce pinniped biology and behavior, the ecology of Vancouver Island, global threats to marine ecosystems, field research methods, community ecology and population growth models.

Students will use binoculars, spotting scopes and photography to collect data. In addition to censusing the population, we hope to work with radio-tagged animals to determine home-range, daily movements, and foraging patterns. Habitat analyses will provide information on habitat requirements for the population. This data can help us determine how a seal population might be affected in the event of an oil spill. We will conduct investigations of dietary habits that we can then relate to potential for competition with the fishing industry. In addition to contributing to the group research goals, students will conduct individual or small group directed projects. Potential projects include mother-pup behavior of hauled-out seals, the effects of tide, boats and weather on bolting behavior, and seal behavior during the molting period. While our goal will be to divide each day between lectures and research, our actual schedule will be determined by the weather.

During the final days of the course we will compile our data and present our findings in oral presentations. Our results will be shared with resource managers at the Canadian Department of Fisheries and Oceans and the British Columbia Department of Parks. Our census data will be presented to researchers at the Pacific Biological Research Station for use in their studies of marine mammal populations in these waters.

We will camp in tents and/or live in rustic cabins. The weather here varies. We can expect overcast, fog and rain interspersed with days of spectacular sunshine. The beautiful views and abundant marine life will provide diversion during the long hours we spend counting and observing seals.



From the base and top of cliffs along the shore, we will have clear views to several haulout sites favored by harbor seals.

(Photo: Gary Miller)

Summer Course-Ecology of Bald Eagles-MONTANA



Some of the most dynamic and controversial conservation challenges of this century have centered around the impacts of human disturbance and habitat contamination on birds of prey. Populations of bald eagles (*Haliaeetus leucocephalus*), ospreys (*Pandion haliaetus*) and peregrine falcons (*Falco peregrinus*) have declined precipitously in recent years. Currently, some populations of predators, including bald eagles, are evidencing signs of recovery. Other species, such as the northern spotted owl, the northern goshawk, and the ferruginous hawk are apparently declining and are the subject of escalating controversy and concern. The attention of the conservation community is likely to continue to focus on raptors in light of their potential to serve as indicators of environmental change and the health of an ecosystem. This is the result of their dependence upon the entire biological community in which they exist and the fact that the home range of raptors often encompasses large expanses of landscape.

Previous SFS research teams conducted studies of bald eagles in Alaska from 1988 to 1991. This summer, we will broaden our focus to include other endangered raptor species and will examine the complex interactions that occur between these predators and their environment. We intend to establish our research base at Flathead Lake in northwestern Montana, the state's second largest lake. This area is home to more than 60 nesting pairs of osprey and several breeding pairs of bald eagles. It is likely that we will observe other relatively rare raptors here in-

cluding ferruginous hawks, Swainson's hawks, short-eared owls and northern goshawks.

We will meet at the airport in Missoula and travel to our study site by van. Our first task will be to set up camp in a public campground on the shores of Flathead Lake. We will then begin exploratory surveys for nesting bald eagles and ospreys. Our research will focus on the foraging patterns of raptors in this area. Where do they forage? For how long? In what depth of water and for what prey species? We will monitor populations of eagles, ospreys and hawks and map their nest locations. In addition, we hope to be able to provide insight into differences in foraging patterns before and after fledging. This information is currently unknown.

Faculty will introduce field research techniques including survey methods, mapping, field identification and observation, and capture and marking techniques. We will collect data from shore-based observation points and from small boats on the lake and nearby rivers using binoculars and spotting scopes. Compasses and stopwatches will enable us to determine the direction and timing of foraging trips. Field work will be interspersed with lectures covering raptor diversity, reproductive strategies and mating systems, social and population biology, hunting and foraging ecology, migrating patterns and conservation.

In addition to working on the group research projects, students will conduct directed research under faculty supervision. Potential topics include behavioral interac-

Summer Course:

Ecology of Bald Eagles and other Endangered Birds of Prey

Site: Flathead Lake, MONTANA

Purpose: to study the foraging behavior and ecology of bald eagles (*Haliaeetus leucocephalus*) and ospreys (*Pandion haliaetus*) in northwestern Montana; to understand the impact of human activities on these raptors; to identify and protect critical foraging habitats used by endangered raptor species.

Course Number: BIO 1803

Departure Point: Missoula, Montana

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

tions between fledgling ospreys, interspecific competition between bald eagles and ospreys, and the effects of human activities on eagle and osprey behavior. During the final days of the course, we will analyze, compile and present our research results. Our data will be shared with the Montana Department of Fish, Wildlife and Parks, the U. S. Forest Service, and the Bureau of Land Management to support efforts to manage raptor populations in the face of increasing human activity in this area.

Flathead Lake is bordered by public and private lands and by the Flathead Indian reservation. In order to collect data from as much of the raptor's home range as possible, we will move our base several times, staying at public campsites near the lakeshore. We will cook over camp stoves which will also provide heat on cold nights. Most days should be warm and dry and intrepid souls will find the cool lake water refreshing.



We will search out previously identified nests of eagles and osprey and map new nest locations. (Photo: Brian Kirsch)



Summer Course-Tropical Cloud Forest Ecology-COSTA RICA

Summer Course: **Tropical Cloud Forest Ecology**

Site: Monteverde, COSTA RICA

Purpose: to document the diversity of plants and insects in mature and regenerating cloud forest; to explore the interactions between plants and animals that generate biodiversity; and to examine rural cultural and economic factors that lead to deforestation or forest conservation.

Course Number: BIO 1807

Departure Point: San Jose, Costa Rica

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

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 and 10 to 30 million species of insects on earth, the majority exist only in rainforests. Only a small fraction of these have been described. The tropics and subtropics contain only 7% of the earth's land surface but possess 50-80% of all living species. Just as scientists are beginning to unveil their secrets, rainforests are being destroyed at a rate of 25-50 acres a minute.

Before it was settled, virtually all of Costa Rica was covered by forest. Today that area has been reduced to less than 35%. Little is known about the process of forest regeneration. What happens to the biological integrity of a tropical forest when its area is significantly reduced? How is regeneration of plant diversity affected by size of disturbance and distance from mature forest? To what extent does restoration of animal diversity depend on regeneration of plant diversity? We will begin to answer these questions by documenting abundances of key species of plants and animals found in the primary forests and in secondary growth areas.

Monteverde, our base, is located in northwestern Costa Rica. Just above Monteverde the crest of the continental divide is covered with cool wet cloud forest. To

the east verdant wet forests extend down to the Atlantic lowlands; to the west drier seasonal forests cover the slopes of the Pacific side. With this unique combination of wet and dry forest, Monteverde supports an exceptionally high diversity of plants, mammals, birds and insects. We will study this diversity in the Monteverde Cloud Forest Reserve, a private preserve that attracts many biologists.

Our research will focus on a fundamental aspect of biodiversity: interactions between forest plants and the animals that eat, pollinate and disperse them. We will assess species composition, species richness and relative dominance of trees in regenerating and mature forest areas. We will then measure diversities of insects in these areas. Insects are critical to the maintenance of plant diversity due to their critical role in pollination. They are thus useful indicators of community integration. Ongoing projects will examine pollination of flowers and bird dispersal of seeds in the context of forest regeneration, as well as the dispersal behavior of an insect pest of pastures that contributes to the clearing of forests to replace pastures in this area.

Lectures will focus on the nature and conservation of tropical biological diversity. Faculty will discuss species interactions, community and ecosystem dynamics, nutrient cycles, succession, and plant and animal identification. Also emphasized will

be causes of habitat destruction, economics of reforestation, and principles of natural resource management. Integral to the program is a series of classes that examine land use by Central American inhabitants, including historical, political and social roles. During these classes we will visit local fincas and interview Ticos (as Costa Ricans call themselves). Our interactions with local people will help us gain a greater understanding of the difficult decisions involved in conserving tropical resources while attempting to promote improvements in the quality of life for people in tropical regions.

Faculty-directed student research projects may include topics such as a comparison of epiphyte loads in forest and pasture trees, seed dispersal by birds in regenerating areas, or pollination biology of a flower species.

We will live in a rustic cabins and work in a remarkable range of ecosystems: one of the most luxuriant cloud forests in the New World tropics; remote premontane moist forests; and low-land deciduous forests. Tall trees dripping with epiphytes and a large array of animal life—including howler monkeys, sloths, toucans, and spectacular butterflies—create an unforgettable tropical world. Temperatures at these locations vary from cool and wet at higher elevations to hot and muggy at lower elevations. Rain showers are short but frequent.



Documenting key plant species at Monteverde... "I yearned for the opportunity to apply my knowledge in the real world, not just in the laboratory where results are often known before the experiment has even begun."
Larry Boles, King, NC—University of North Carolina
(Photo: Tom Kleinert)

**Financial Aid is available.
Please see page 38.**



From June 1987 to March 1988, unprecedented numbers of dolphins began washing up dead along beaches that fringe the eastern United States. While the cause of this die-off remains unknown, a red tide and/or marine pollution are thought to be at least partially responsible. It is clear that the die-off has now ended and our challenge is to see if, and how, the population will recover. Research conducted by SFS teams indicates that the calving rate has doubled over previous years and the percentage of calves may be returning to previous rates. This may represent a healthy response to the die-off. Surprisingly, the number of dolphins encountered in the Cape Lookout National Seashore estuary during survey transects has not changed significantly. Fishermen report seeing fewer dolphins further offshore than in previous years, so perhaps more animals have moved inshore to reproduce and rear their young.

Previous SFS research has identified preferred habitats for specific dolphin activities such as feeding, travelling and socializing. We have tracked the movement of pods in order to understand movement and residence patterns. The Beaufort area is becoming increasingly subject to the pressures of tourism, development, and a nearby expanding shipping port. In addition, the waters surrounding Beaufort support a large commercial fishing industry. Our research will provide important baseline data to help environmental managers understand how development and specific human activities

affect aspects of dolphin biology, behavior, movement patterns and residence times. Our results will be made available to the National Marine Fisheries Service, Duke University Marine Lab, the North Carolina State Aquarium, and a number of local agencies who have expressed interest in our work.

Individual dolphins are identified by scars and notches on their dorsal fins. We will use dorsal fin photography to verify resights of individual dolphins. This process, called photo-identification, is also used on the flukes of humpback whales, the dorsal fins and saddles of killer whales, and on other cetacean species. We will continue to photograph the animals to understand short term movements, social affiliations, and long term residence times. Additional data will be collected on environmental parameters (temperature, water depth, salinity, tidal state, etc.), the presence of other species (fish and birds), and the presence of and reactions to human activities (fishing, boat traffic and development).

All our field data collection will be made from small boats and land observation posts. Weather permitting, we will spend approximately 6 hours on the water daily. Each time groups of dolphins are approached, team members will begin pre-assigned tasks of photographing dorsal fins, recording data on behavior, location and habitat characteristics. Notes on group composition and social activities will be made. We will use

Summer Course: *Biology and Behavior of Bottlenose Dolphins*

Site: Beaufort, NORTH CAROLINA

Purpose: to document through observation and photo-identification the social ecology, movement patterns, and pod composition of bottlenose dolphins (*Tursiops truncatus*) in the estuarine and coastal waters around Beaufort, NC; to collect population data to understand how dolphins are responding to the catastrophic die-off in 1987; to expand upon an existing catalog of identified dorsal fin photographs for comparison with other researchers in the Southeast.

Course Number: BIO 1802

Departure Point: New Bern, North Carolina

Course Dates:

Session I: June 16 - July 15

Session II: July 22 - August 20

hydrophones to record changes in echolocation clicks and whistles associated with observed behaviors. Shore-based spotting teams will use binoculars and spotting scopes to monitor activity in pre-determined areas.

Lectures will cover marine mammal taxonomy and evolution, cetacean anatomy and physiology, sensory and communication systems, whaling, and cetacean environmental issues. Material on quantitative analysis, cetacean research techniques and general principles of ethology will also be presented. Each team member will participate in a directed project that may address questions on pod composition and size, calf percentage, daily movement patterns, percentage of identifiable animals in pods, and variations in acoustic patterns. As time and opportunity permit, we may visit nearby marine labs, aquaria, and government agencies.

We will live in a large house on Core Banks Island, approximately a half mile from the beach. The weather on the island is hot, humid and sometimes breezy, and insects can be a nuisance. We will prepare our own meals and share in housekeeping chores, highlighting our evenings with occasional barbecues on the beach.



An SFS teammember uses a hydrophone to listen to the dolphins. "The first time I saw a pod of dolphins, I forgot to breathe. They were so graceful, sliding in and out of the water, yet so powerful slapping the surface with their flukes. The excitement never abated, and the last time I saw the dolphin was as awe-inspiring as the first time."

Melanie Wilkins,
Delmar, DE—Gettysburg
College
(Photo: Jim Elder)



Academic Credit and Research Papers

Academic Credit

All SFS participants are registered at Northeastern University in Boston, which accredits all SFS courses. Students receive an official transcript from Northeastern at the conclusion of their program. The only exceptions are students from SFS Affiliate Schools (see * below), who receive credit directly from their home schools. Semester programs incorporate four courses and carry a total of 21 quarter credits in biology, sociology/anthropology and independent study. Summer courses carry either 8 or 11 quarter credits in biology or Interdisciplinary study. Many students have arranged to either transfer credit from Northeastern or receive credit directly through their home school.

The following is a partial list of the home schools of previous SFS participants. The majority of these schools have accepted or awarded credit for SFS participation. As the final decision regarding credit transfer rests with the home institution, students should check with their advisor/registrar before going into the field.

Albion College
Allegheny College
Alma College
American University
Amherst College
Augsburg College
Barnard College
Barry University
Bates College
Bennington College*
Berea College
Boston College
Boston University
Bowdoin College
Brandeis University
Brown University
Bryn Mawr College
Bucknell University
California Lutheran University
Calvin College
Carnegie Mellon University
Case Western Reserve University*
Clarion University
Clark University*
Colby College*
Colgate University
College of the Atlantic
College of St. Thomas
Colorado College
Colorado School of Mines
Connecticut College
Cornell University
Dartmouth College
Davidson College*
Denison University*
Dickinson College*
Drake University
Drew University
Duke University
Eastern Michigan University
Emory University
Evergreen State College
Fort Lewis College
Framingham State College
Franklin and Marshall College
Franklin Pierce College
Gettysburg College
Green Mountain College
Guilford College
Hamilton College
Hampshire College
Harvard College
Haverford College

Hiram College*
Humboldt State University
Huntingdon College
Huron College
Indiana State University
Indiana University
Ithaca College
Kansas State University
Kent State University
Kenyon College*
Knox College
Lang College, New School for Social Research*
Lehigh University
Lewis and Clark College
Macalester College
Marlboro College
McGill University
Merrimack College
Miami University*
Middlebury College
Mitchell College
Mount Holyoke College
Mount Union College
Muhlenberg College
New York University
North Carolina State University
Northeastern University
Northern Kentucky University
Northwestern University
Oberlin College
Ohio State University
Ohio University
Ohio Wesleyan University
Oregon State University
Pacific Lutheran University
Pennsylvania State University
Pomona College
Prescott College
Providence College
Purdue University
Randolph Macon College
Saint Lawrence University
Saint Michael's College
Saint Olaf College
Salem College
Scripps College*
Shimer College
Simon's Rock of Bard College
Skidmore College
Smith College
Southern Connecticut State University
Stanford University
Stockton State College
S.U.N.Y. College of Environmental Sciences and Forestry*

Trenton State College
Trinity College
Trinity University
Tufts University
Tulane University
Union College
University of Alberta
University of California/Berkeley
University of California/Los Angeles
University of California/Santa Cruz
University of California/San Diego
University of Cincinnati
University of Colorado
University of Connecticut
University of Iowa
University of Kansas
University of Maine
University of Maryland
University of Massachusetts
University of Miami*
University of Michigan
University of Minnesota
University of New Hampshire
University of North Carolina
University of Pennsylvania
University of Pittsburgh
University of Puerto Rico
University of Rhode Island
University of Southern Indiana
University of Southern Maine
University of Utah
University of Vermont
University of Victoria
University of Wisconsin
Vassar College
Villanova University
Virginia Polytechnic Institute and State University
Washington University
Wellesley College
Wells College*
Wesleyan University
Whitman College
William Smith College
Williams College
Wittenberg University
Xavier College
Yale College

* SFS Affiliate School



"From the very start, SFS demanded that we step out of our comfort zone and do things that we weren't used to doing. The first night we cooked on a portable Coleman stove, and set up and slept in tents." Lucia Whitman, Brookline, MA—Brookline H.S. (Photo: Philippa Richards)

Selected Research Papers Resulting from SFS Field Courses

Biogeography: Patterns of Ecological Diversity, Australia, 1990
LAURANCE*, W.F.

Rainforests in the Land Down Under, *Wildlife Conservation Magazine*, July/August: 26-45, 1990.

LAURANCE*, W.F., and E. YENSEN

Predicting the impacts of edge effects in fragmented habitats. *Biological Conservation*, Vol. 55, 1990.

PUTZ*, F.E.

Growth habitats of climbing palms (*Calamus* spp.) in North Queensland rainforest. *Australian Journal of Botany*, 1990.

Endangered Monkeys: Social Ecology of Stumptail Macaques, Mexico, 1989

RASMUSSEN*, D.R., R. BIGGS**, and R. GORENA**

Increased Area of Daily Range is Associated with more use of Natural Foods and Decreased Affiliative Interactions within the Catemaco Troop of Stumptail Macaques. Paper presented to the Annual Meeting of the American Society of Primatologists, July 11-14, 1990, Univ. of CA, Davis. Abstract: *American Journal of Primatology*, 20, 224.

Dolphin Biology and Behavior, North Carolina, 1990, 1991

RITTMASER*, K.A., and THAYER*, V.G.

Reproductive Rates of Bottlenose Dolphins (*Tursiops truncatus*) Near Beaufort, North Carolina Following 1987-1988 Die-off. Poster presented at the 9th Biennial Conference on the Biology of Marine Mammals in Chicago; December 3-9, 1991.

Center for Wildlife Management Studies, Kenya, 1982-1987

STELFOX*, J.B.

Thompson's and Grant's gazelle in relation to seasonal environments and resource use. *African Journal of Ecology*, 24:111-120, 1987.

MADDEN*, D.

Thorns, browsing mammals, and the management of an East African rangeland. Presented at meeting of the Association for Arid Land Studies and Western Social Science Association; Albuquerque, New Mexico; April, 1989.

Marine Ecology and Management, St. John, USVI, 1988-1989

EDMUNDS*, P.J., D.A. ROBERTS*, and R. SINGER*

Reefs of the Northeastern Caribbean I. Scleractinian populations. *Bulletin of Marine Science*, 46(3):780-789, 1990.

* SFS Faculty ** SFS Student

The School
For Field Studies



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 admission process.

Admission to SFS courses is open to eager, motivated students. A strong background in science is *not* required to be a part of an SFS experience. Participants are screened by the Admissions Committee to insure that they are choosing the right course for the right reasons. We encourage students who are willing to commit their emotional, intellectual, and physical energies to working toward a better understanding of crucial environmental issues to join us.

All applicants for admission are required to submit an SFS application form, a 300 word essay describing their reasons for participating, a \$35 application fee and an SFS reference form before the application will be reviewed.

Applicants for semester programs should be 18 years of age and have completed at least one college-level ecology or biology course and one semester of college. Semester applicants must submit an official, current transcript to complete their application.

Applicants for summer courses should be at least 16 years of age and have completed at least the junior year in high school. Applicants who have not entered college must submit a transcript.

For further information regarding admission, please call the SFS Admissions Office at (508) 9277-7777.

Acceptance

Applications for all programs are reviewed on a rolling admission basis, as soon as all required information is received. The Admissions Committee meets on the 1st and the 15th of every month.

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

All acceptances are contingent upon medical approval. Course syllabi will be sent to all accepted applicants. Whenever possible course faculty will call accepted students to discuss their participation in the program.

Academic Credit

All students, except those from SFS Affiliate Schools, receive academic credit for their SFS course from Northeastern University in Boston, Massachusetts. A non-refundable registration fee of \$150 for semester programs and \$100 for summer courses is due 10 days after acceptance into the program. All summer courses carry Biology Department credit at Northeastern. Semester students will receive biology, sociology/anthropology and Interdisciplinary course credit from Northeastern. Upon completion of the course, students may request an official transcript from Northeastern University. Over 200 colleges and universities have accepted or awarded credit for SFS courses. Applicants should consult their Registrar or the SFS Admissions Office for details. Students from SFS Affiliate Schools (see page 36) will receive a transcript from SFS and credit directly through their home school.

All SFS courses are approved and assigned course numbers by Northeastern University. As this publication goes to press, several new courses are undergoing the approval process at Northeastern. Course numbers are usually assigned at the end of this process.

Changes

SFS programs are obviously different from travel or adventure programs. We have tried to give accurate portrayals of every program in this catalogue. All course descriptions have been written in consult with a current or past faculty member. However, 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 Kenya and Mexico.
- Some projects depend on the goodwill and generosity of individuals and institutions which lend support.
- Tenuous weather situations, natural disasters or changes in political conditions in another country may require last-minute changes in sites or research plans.

Applicants are advised that these or other variables (including staffing) may result in changes before or during a course. Indeed, part of the challenge is in adapting to changing conditions and overcoming the obstacles they may present. In other words, the whales are not always where we want them to be, so please be flexible.

Student Conduct

Participants are expected to conduct themselves in a mature and responsible manner. SFS reserves the right to require any participant to withdraw from any program at any time if the faculty deem the student's conduct to be detrimental to or incompatible with the interest, 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 and return the student to the point of course departure, at which time any and all responsibility on the part of The School for Field Studies will cease.



"Arriving as an unknown, closed-minded, unsuspecting Long Island armchair traveller, I experienced SFS with wide eyes as an intense new world offering rich opportunities for self-challenge in the outstretched arms of instructors and students; I left with a greater self-esteem, world awareness, and very special friends."

Michelle Weideman, Melville, NY—Union College
(Photo: Stephanie Clapes)

Responsibility

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

SFS reserves the right to refuse any applicant admission to any program if he/she is deemed unsuited for the project for any reason. All courses, fees, and dates are tentative until verified and confirmed in writing by The School for Field Studies.

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



Processes, Requirements, Tuitions and Costs

Tuitions

SFS Fall 1992 and Spring 1993 Semester Programs	\$9,150
(all programs have additional \$150 registration fee)	
Summer 1992 Courses (30 days)	
(all programs have additional \$100 registration fee)	
Marine Mapping/Caribbean	\$2,490
Coral Reef Management/Caribbean	\$2,490
Wildlife Management/Kenya	\$2,750
Ecology of Killer Whales/British Columbia	\$2,410
Primate Conservation/Costa Rica	\$2,380
Landscape Ecology/Colorado	\$2,160
Endangered Sea Turtles/Costa Rica	\$2,380
Tropical River Ecology/Belize	\$2,380
Endangered Species/Hawaii	\$2,490
Ecology of Harbor Seals/British Columbia	\$2,410
Ecology of Bald Eagles/Montana	\$2,160
Tropical Cloud Forest Ecology/Costa Rica	\$2,380
Biology and Behavior of Bottlenose Dolphins/No. Carolina	\$2,520
Tropical Reforestation/Australia (6 weeks)	\$3,210
Conservation of Asian Elephants/India (6 weeks)	\$3,210

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

Transportation and Travel Arrangements: To insure the best possible fares as well as orderly arrival at the site, we work with one travel agency to handle SFS travel. This agent will arrange travel to the course, with any special arrangements students require. Any student not using the SFS agent must have their travel plans approved by the SFS Admissions Office. Specific details will be forwarded upon acceptance. Students are responsible for passport/visa fees as well as all transportation costs and arrangements to and from the site.

Clothing and Equipment: SFS will provide food, cooking equipment, tents and all scientific and research equipment. Students are responsible for personal gear including sleeping bags, backpacks, clothing, and SCUBA gear (if applicable). Stu-

dents may find they already have much of what they need, and we encourage students to borrow as much gear as possible from friends.

Physical Examination and Medical Insurance: Students must present a completed SFS Medical Form, signed by a doctor, no later than 30 days prior to course departure. All medical forms must be approved by the SFS Medical Committee. Students must be able to meet the physical challenges presented by SFS courses without undue risk. Academically qualified individuals may be disqualified from participating on medical grounds. Students will not be allowed to join an SFS program without proof of up-to-date medical coverage and a signed medical release.

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 1991, over 180 of our participants received financial aid totalling more than \$200,000.

We encourage students who will need financial assistance 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 to qualify for assistance, please call the Admissions Office at (508) 927-7777.

Deposits, Tuitions 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 for summer courses or \$500 for semester programs is due no later than 10 days following acceptance in order to reserve a place in the program. All students will be registered for academic credit with Northeastern University. The non-refundable registration fee of \$100 for summer courses or \$150 for semester programs is due with the deposit. (Deposits and registration fees for financial aid candidates are non-refundable 10 days following financial aid offer. Students must complete and return their financial aid application within 10 days of acceptance to qualify for refund status.)

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

Note: The tuition fees listed in this catalog 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 program is tentative until confirmed in writing by SFS.

Refunds

Summer courses:

Registration fees are non-refundable and non-transferable. If a student withdraws prior to 21 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 21 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. Deposits are non-refundable. 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 course 30 days prior to the 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 or to students asked to leave the program.

SFS Reference Form



REFERENCE FORM

To the Applicant: Please complete the top section of this form and give it to a teacher/ professor or academic counselor who is well acquainted with you.

Under the provisions of the Family Educational Rights and Privacy Act of 1974, you may have the right to review your educational records. The Act further provides that you may waive your right to see recommendations for admission. Please indicate below, by checking the appropriate phrase, whether or not you waive this right.

Applicant Name _____ Social Security # _____

SFS Course _____ Level _____ Dates _____

I waive _____ do not waive _____ my right of access to this recommendation form.

Applicant's signature _____ Date _____

To the Reference: The student listed above has applied to participate in an intensive, environmental field study program offered by The School for Field Studies. Students and faculty work, camp, and live together within remote ecosystems, totally immersed in coursework and research. Field work, research, academics and inter-personal dynamics all pose rigorous challenges that promote growth and learning. Each participant will receive university credit for successful completion of the program.

The applicant need not be a scientist, but must be sufficiently motivated and mature to live and work productively in the setting described above. Your comments, in response to our questions below, would be extremely helpful in our efforts to provide optimal learning experiences for our students. Your comments will be used to evaluate the student for admission and provide information for the faculty on student abilities.

1. How long have you known the applicant? _____ In what capacity? _____

How well do you feel you know the applicant? _____

2. What strengths do you think the applicant will bring to this program?

3. What are the applicant's weaknesses, and how would you expect these to affect his/her performance on this type of educational experience?

(over)



SFS Reference Form

Compared to all of the students you have known, please rate the applicant as indicated below:
(Please circle.)

Applicant Information	Superior (5)	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
current academic performance	5	4	3	2	1
potential academic performance in SFS type of learning situation	5	4	3	2	1
maturity	5	4	3	2	1
sensitivity to others	5	4	3	2	1
judgment capabilities	5	4	3	2	1
flexibility in coping with unpredictable circumstances	5	4	3	2	1
ability to cooperate with others to accomplish group goals	5	4	3	2	1
ability to accept authority, discipline, and structure	5	4	3	2	1

5. If you were the faculty member responsible for teaching this course, would you want the applicant to be a participant? Please explain.

6. If there are any additional data about the participant that you feel we should know, please feel free to make additional comments on this form or attach additional sheets if necessary.

Please forward this form directly to this address as soon as possible:

Admissions Office
The School for Field Studies
16 Broadway
Beverly, MA 01915

Signature _____ Date _____

Name _____ Title _____

(printed)

Institution _____ Phone _____

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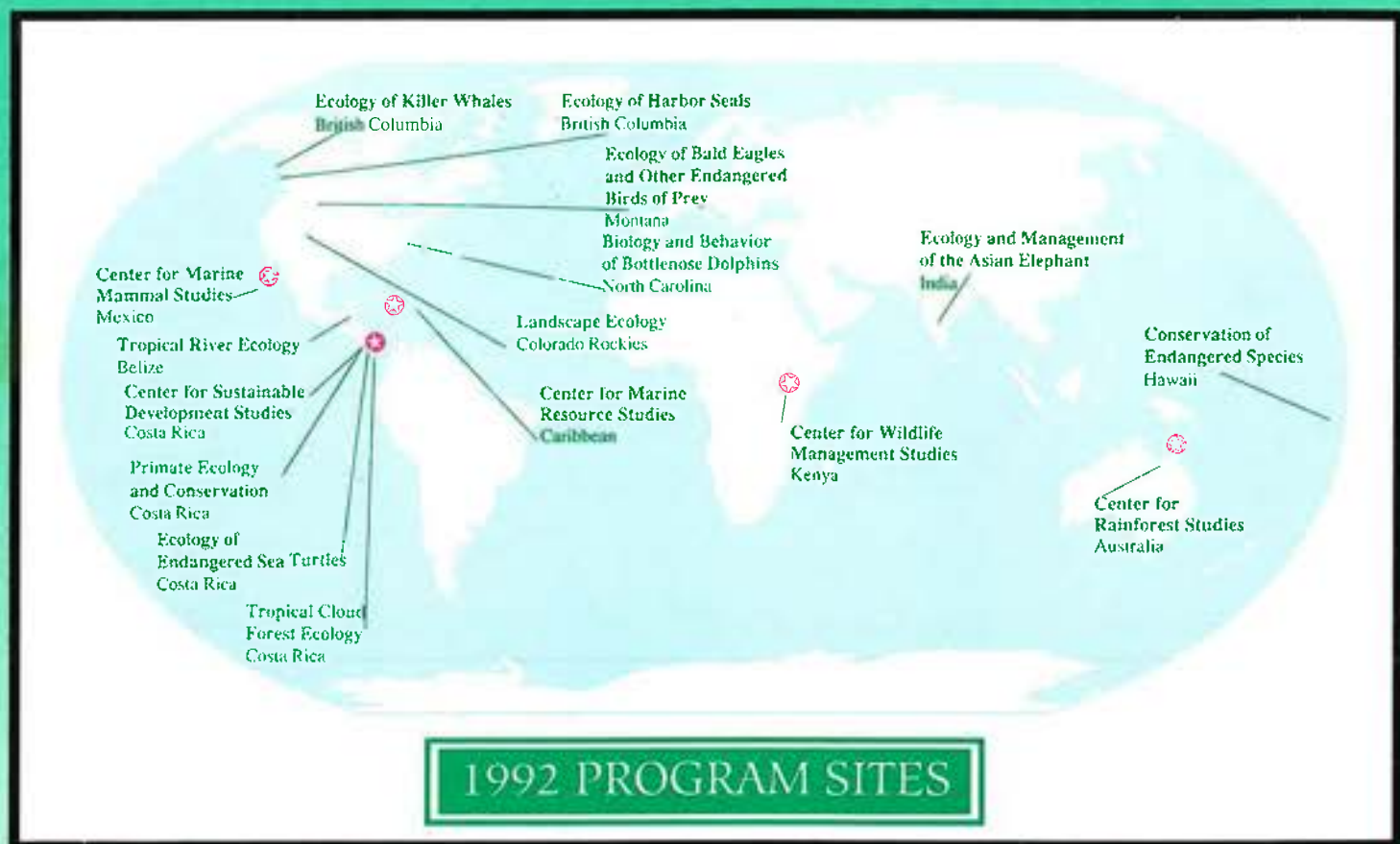
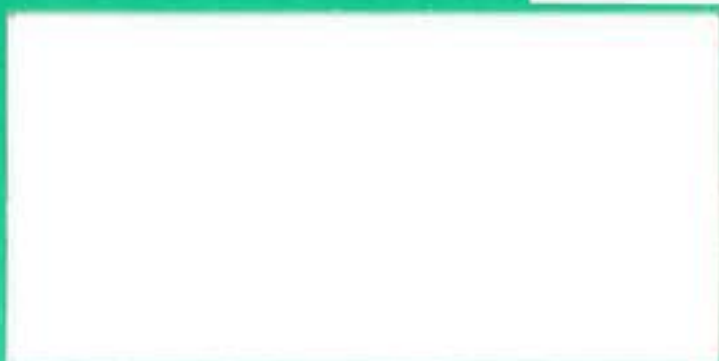
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