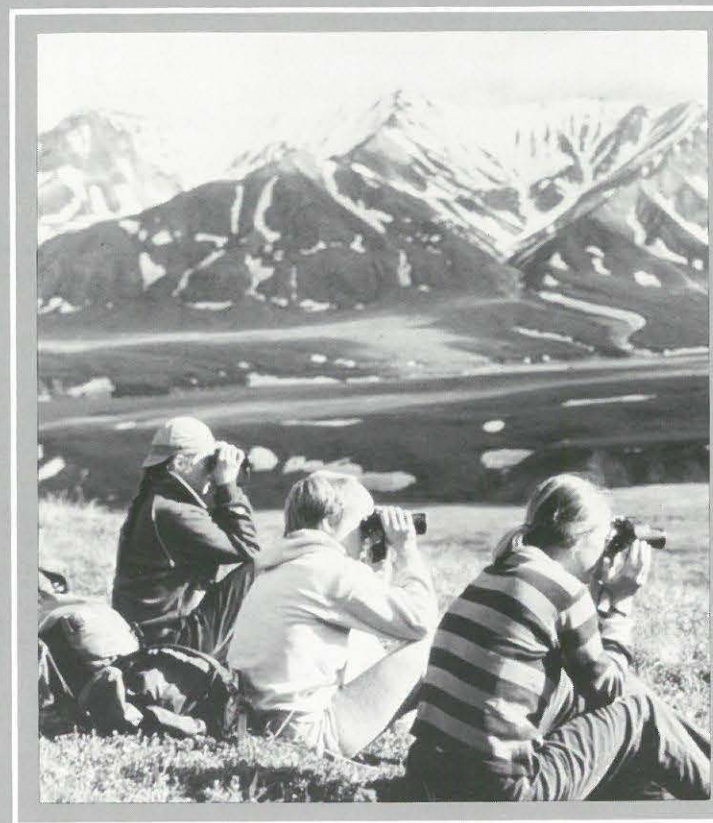
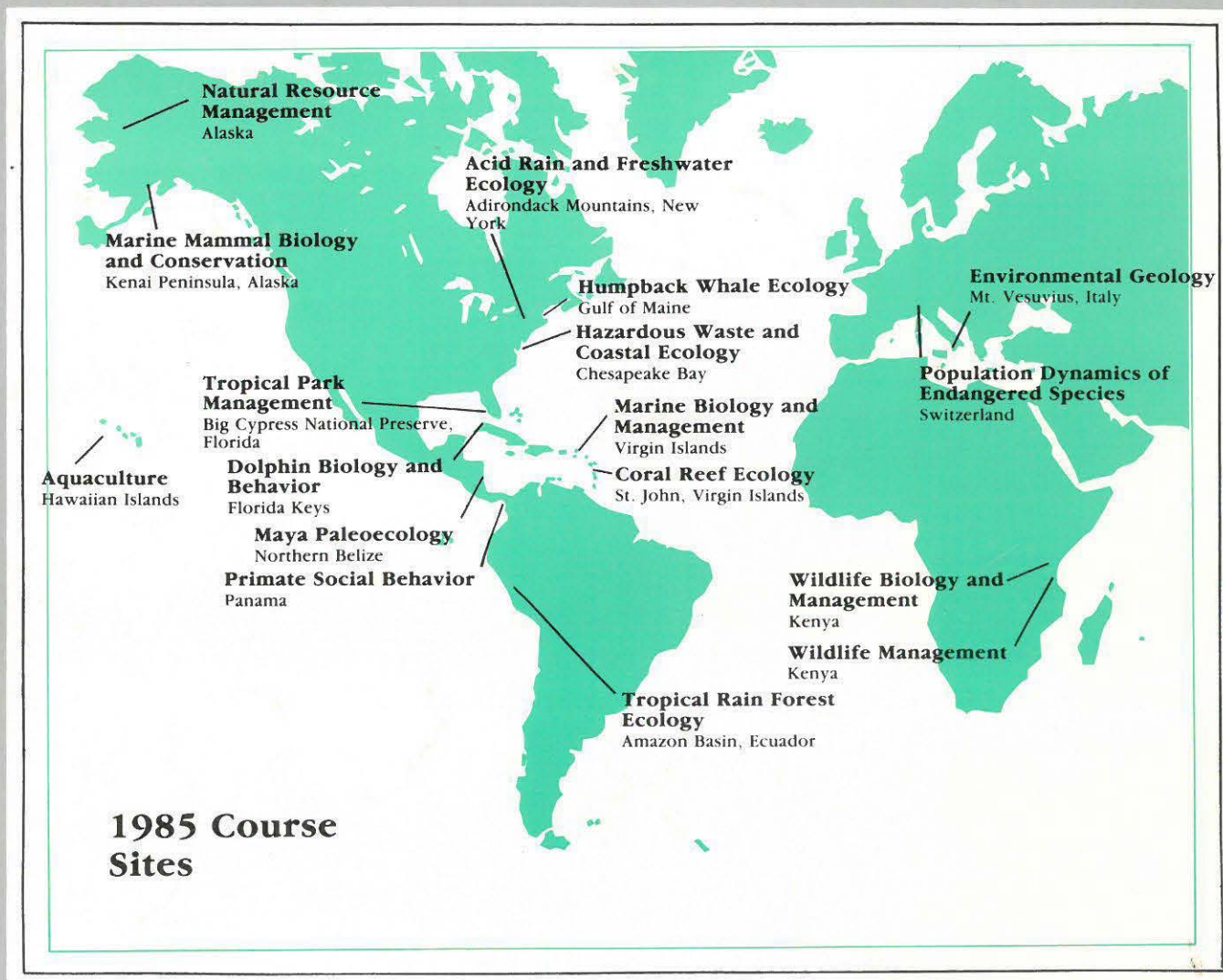


SCHOOL FOR FIELD STUDIES

1985 Annual Report



School for Field Studies
196 Broadway, Cambridge, MA 02139 • (617) 497-9000

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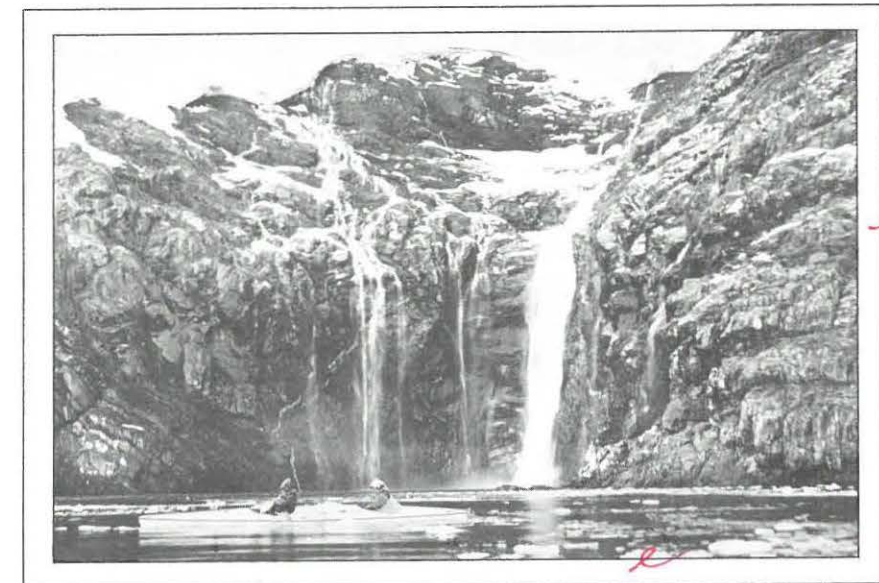
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SCHOOL FOR FIELD STUDIES

1985 Annual Report



SFS students kayaking on Prince William Sound to study harbor seals.

BARBARA BARTON

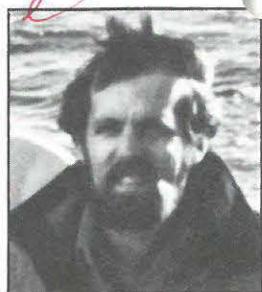
CHAIRMAN'S AND PRESIDENT'S REPORT

THE CONCEPT OF LEARNING principally through reading and intellectual discussion is relatively new in the world's history; before that everyone learned through apprenticeship, or "field studies." At SFS we believe that the value of this book-learning movement is limited, and often loses connection with the real world. Memorization of facts and concepts is of little value if there is no first-hand experience of how those facts and concepts can be applied. The process of trying to apply them brings them to life. And in turn, this bringing-to-life is what fuels curiosity; and from curiosity arises the true will to learn. An intellectual curiosity alone — with no emotional aspect to it — is merely an interest in play, or in manipulation. It has little meaning. However, engaging emotion and the senses along with intellect can, with luck, bring meaning and purpose to one's life. This is SFS's business.

SFS might be better called the School for International Environmental Field Studies. Environmental studies are the focus of our business for several reasons. They are global in nature, and also local in their applicability. They are expanding as sources of career opportunities, yet few schools have substantial environmental studies programs. Perhaps most importantly, they are an essential part of an undergraduate liberal arts education, for environmental and natural resource issues touch, and are touched by, each one of us every day.

1985 was an exciting year for us. SFS continues to be the most comprehensive (and largest) academic institution in the country teaching field courses in environmental sciences. Our unique focus on academic instruction and serious scientific research sets us apart from the many other off-campus opportunities.

- Student enrollment reached 310, and student field days grew 80%, from 6,200 to 11,500.
- Fourteen month-long courses were run (up from twelve last year) involving 22 teams of students. Half of those courses had applicant waiting lists.
- The total number of colleges and universities awarding credit for SFS courses, predominantly in biology or environmental studies, rose to nearly 50.
- SFS continued its record of no major injuries or accidents since its founding in 1980.
- Contributions were up 30% to \$305,682 — a testimony to the loyalty and strong faith of our small but growing body of supporters, most notably the Andreas Foundation.
- The New York Times and the Boston Globe both ran their second articles on SFS, the former noting that "learning by doing, long neglected in the back to basics boom, is still thriving outside the regular school establishment."
- Inquiries about SFS are now coming in at a rate of 10,000 a year as our program becomes known on campuses across the country.
- Financial aid support increased nearly 100% to \$54,030 in scholarships and \$50,000 in loans.



JIM ELDER, PRESIDENT

upper + lower case



TERRY HERBERT-BURNS, CHAIRMAN

- This year we began a scholarship program for students in Third World countries or areas which host SFS courses, with a student each from Panama, St. Lucia (West Indies), Belize, and Ecuador.

We also embarked on a new challenge in 1985. For the first time in SFS history, we offered three new semester programs, involving our permanent sites in Kenya and the Virgin Islands, and a summer mobile program studying resource management in Alaska. Our semester programs were a total success, allowing students to become truly immersed in the scientific and cultural study of an area. Students received full summer academic credit through Northeastern University.

Maintaining academic and scientific excellence as a program substantially grows is costly. We hope those who have so generously supported SFS in the past will continue to do so, and will be joined by others who see the value and potential of our curriculum, so that we can effectively meet the challenges before us.

While all SFS courses maintain a high standard for academic, scientific and personal challenges, each student benefits in different ways. They may enroll to try out a potential scientific career, supplement classroom learning with field research, learn more about the natural world, meet new people with whom they will work toward a common goal, or travel to a new environment to study a new topic of interest. Each student comes with different objectives and each leaves with individual accomplishments. So rather than try to summarize what our alumni/ae have gained from each of our courses by using administrative staff or ghost writers to create this report, we thought we would let students (and faculty on occasion) speak to you directly this year, telling you the aspects of the program that meant most to them.

In closing, we must pay tribute to the hundreds of people — staff, Trustees, faculty, donors, and students themselves — who had the extraordinary confidence to allow the School for Field Studies to reach its fifth birthday this year. The product of your support, and our task, is perhaps best put by one student who summarizes,

"... You may arrive [at an SFS course] apprehensive and alone, and ultimately leave alone to return to your own lifestyle; yet, in your departure you are not the same. You leave fulfilled and satisfied that your life has been touched and forever changed. Changed by the active forces of the personalities of twenty other lives; changed by the exposure to the scientific research; changed by the need to know more... Changed, different... changed for the better, changed for the future."

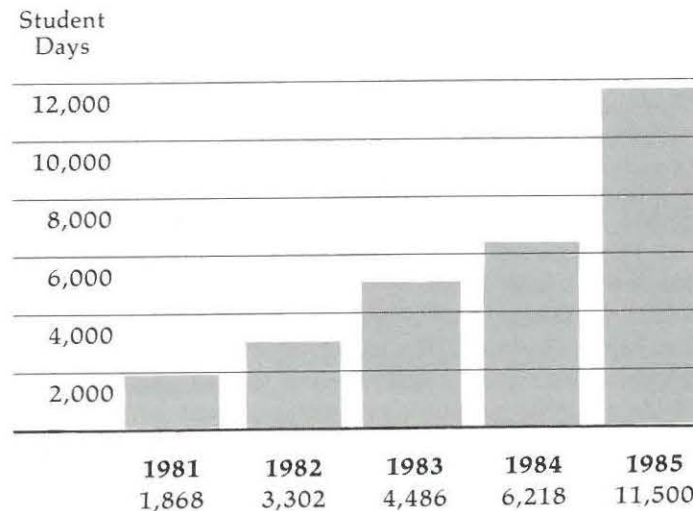
— Alicia Hinkle, about her experience in Kenya, summer 1985

James Elder
JAMES L. ELDER, JR.
President

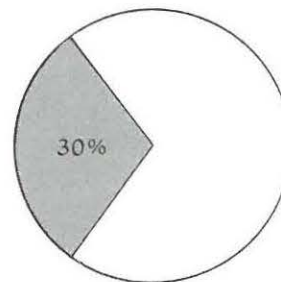
Terry Herbert-Burns
TERRY HERBERT-BURNS
Chairman

SFS: A RECORD YEAR *bold*

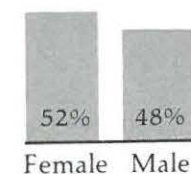
Number of Program Days



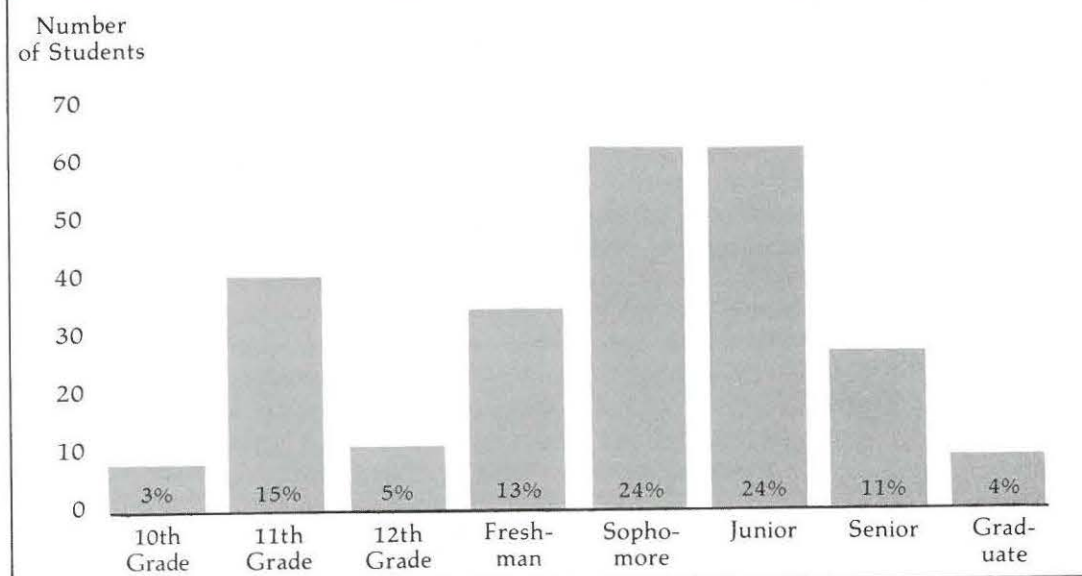
Scholarship



Male/Female Ratio



Grade Level of Participants
(Month-long courses)



WILDLIFE BIOLOGY AND MANAGEMENT *with bold*

Kenya

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

January 3 to March 28, 1985

Faculty: Jessica DiMuzio, Tim Halverson, Douglas Paterson, Brad Stelfox. Interns: David Leptich, University of Maine

Students:

Jennifer Atkinson
Connecticut College
Lizabeth Brickle
University of Vermont
Ian Campbell
University of New Hampshire
Christine Champe
Tufts University
Susan Cooper
Dartmouth College
Carol Culpepper
Kent State University
Joan Daviau
Western Connecticut State University
Heather Eves
University of New Hampshire
Patti Fitzgerald
University of Maine — Orono
Mark Hart
Dartmouth College
Katy Heinzel
University of Pennsylvania
Gavin Joffe
Swarthmore College
Lisa Klein
University of Vermont
Claudette Lane
Humboldt State University
Teri Lippold
Ohio State University
Laura Nesbet
University of California — Davis
Lisa Robinson
Smith College
Monica Roeder
University of New Hampshire
Danielle Sedlak
Boston University
Laurie Smith
Western Maryland College
Michael Szumski
Purdue University
Michele Young
Northeastern University

lower case
THE SPRING 1985 program in Wildlife Biology and Management held at the Hopcraft ranch in Athi River, Kenya, was the first SFS full semester program. Program objectives were: to introduce students to the organisms, habitats, and peoples of East Africa; to provide students with an understanding of and appreciation for ecological principles in general and the ecology of East Africa in particular; to train



BOB SINGER

students in the general research methods of hypothesis formulation, research design, data collection, and data analysis; to provide students with hands-on experience with specific techniques used in ecological research and wildlife management; and to increase the students' awareness of the philosophical, social, and economic justification for various conservation strategies. In addition to meeting these objectives the program provided a thorough introduction to the pleasures, difficulties, and dangers of camping, food preparation, travel, and social interaction in a developing African nation.

The academic portion of the Kenya semester program consisted of four separate, college-level courses and a series of independent, directed research projects. All four courses as well as the research were required of each student. Courses were given concurrently, two at a time with Introduction to Wildlife Biology and Peoples and Cultures of East Africa encompassing the first portion of the semester, and Population and Community Ecology and Man and the Environment being taught in the last portion. Guest speakers were used throughout the semester. Each student in the semester program was required to conduct or participate in a directed research project.

Dr. Timothy Halverson
Course Director

Wide-open grasslands; diverse wildlife species; sitting in class in a three-sided hut; safari traveling and learning how to camp; getting to know professors, fellow students and native Africans — these are the vivid memories I picture in my mind when I recall studying Wildlife Biology and Management during the first three months of this year in Kenya, Africa.

Once we settled in, a schedule was established but basically was used as a guideline of what we tried to accomplish during each day. Mornings began at 6 a.m. — a culture shock in itself for some.

Classes occupied most of the mornings and all lectures were given in the main building — the only building, which I called "the slab" because it was approximately a 20-foot-by-60-foot concrete slab with a roof and three walls. After lunch, we may have had a couple more lectures, a guest speaker or, on occasion, field work such as taking a short walk to observe the black-faced velvet monkeys.

Living on the Hopcraft ranch and seeing such things as the lights of Nairobi in the distance, star-filled skies, and of course, wildlife, made me feel that there was no other place in Kenya that I'd want to be. Studying the specific courses of Wildlife Biology, Population and Community Ecology, Man and His Environment and Peoples and Cultures of East Africa tied in well with the reasons behind the ranch. I would not have wanted to stay or study anywhere else.

Because of my keen interest in animals, I chose to do a parasite study of the animals which were brought in after cropping on the ranch. Three other students and I did our independent project on *paramphistoma*, a rumen fluke previously found in the wildebeests and kongoni. Although we found no earth-shattering findings, I was introduced to designing and working on my own research which greatly enhanced my biological background.

Ever since I can remember I have been extremely interested in all types of animals; the more unique the creature, the more interest I had. So, for me, going to East Africa in the heart of the wilderness was a realization of a dream of mine; it felt like I was a child experiencing the joys of Christmas for the very first time. Yet I was able to test my science background in a real-life setting, and become immersed in work that might eventually be my career. And I also lived with 27 other students and faculty members whom I learned to work with as a team, live with as a family, and share with them my most vivid dreams.

Lauren Smith
Student Report

NATURAL RESOURCE MANAGEMENT - *utlc bold*

Alaska

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

June 7 to August 22, 1985

Faculty: Jim Ebersole, Jack Shea, Nancy Shea, Chris Waythomas

Students:

David Albert
University of Colorado — Boulder

Meg Ashforth
University of Vermont

Jim Farley
Southern Connecticut State University

Jeanne Guild
Colby College

Linda Jekel
Wesleyan University

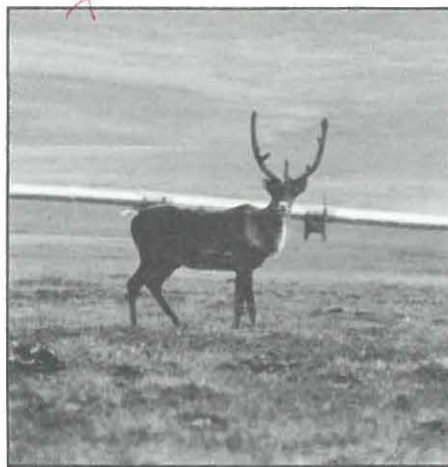
Elizabeth Maher
Tufts University

Julie Noffke
University of Colorado — Boulder

Anne West
University of Colorado — Boulder

THIS YEAR'S Alaska semester program was the first attempt by SFS to run a mobile semester program, and it was an outstanding success. In addition to the research goal there was a strong emphasis on teaching using an interdisciplinary approach covering the vegetation, mammals, birds, geomorphology and traditional native peoples of each of the four major ecosystems of Alaska. These topics were covered in the courses: Introduction to Alaskan Ecosystems, Wildlife Biology, Human Ecology and Resource Management. We travelled over 4,000 miles and covered 10 degrees of latitude to study coastal forests of southern Alaska, spruce taiga of the interior, alpine areas in the Alaska and Brooks Ranges, and the arctic of northern Alaska.

After meeting in Anchorage we drove south to the Kenai Peninsula for course orientation. When completed we began to learn about the vegetation and animals of the coastal forests and received an introduction to glacial geomorphology at the Portage Glacier. During our ferry ride through Prince William Sound to Valdez we discussed marine mammal ecology as we observed harbor seals, sea otters, Dall's porpoises and also bald eagles. At Valdez we visited the Trans-Alaska Pipeline System (TAPS) terminal where oil is collected from the pipeline and loaded onto tankers. By the end of this part of the semester we had, in addition to faculty lectures, 20 guest lectures from such people as managers of wildlife refuges, biologists from Alaska Fish and Game, lobbyists working to maintain subsistence



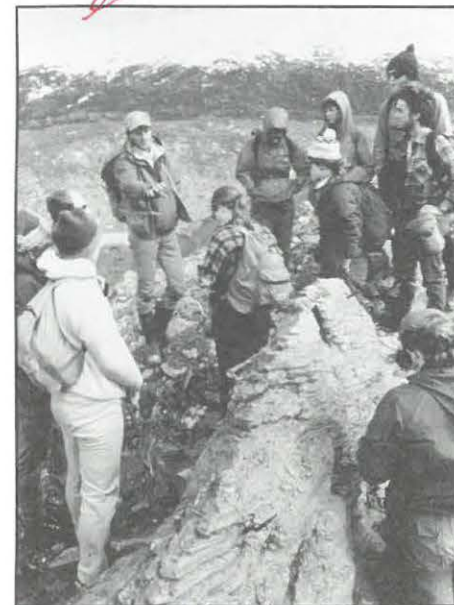
JACK SHEA

hunting rights for natives, federal oil and gas permit reviewers, and oil company environmental officers. From Valdez we traveled north into the taiga. Here in addition to surveying vegetation and animals we had our first opportunity to study glaciers in detail by mapping and gathering relative age data on moraines of the Worthington Glacier and by walking onto the snout of the Castner Glacier. We spent two weeks in Denali National Park where we took full advantage of the opportunity to study alpine vegetation and wildlife — grizzly bears, caribou, Dall's sheep, and moose.

We continued on to Fairbanks where we loaded supplies for a month in the northern half of the state. This part of Alaska had no roads before the TAPS was finished in 1974 and public travel into the Brooks Range and beyond is not allowed without a permit. During our travel we saw the largest oil field in the U.S. The 60-mile-wide field has spawned growth of a large industrial complex in the tundra where shorebirds and waterfowl once nested. We learned about the oil development; its effect on vegetation,

wildlife, and birds; and regulatory attempts to mitigate its effects.

Our group project during this part of the program focused on assessing the effects of road dust on northern Alaskan plant communities. At four sites along a latitudinal gradient from the Arctic Ocean to the northern taiga, we sampled vegetation on transects perpendicular to the gravel highway to determine if species composition had been changed in the eleven years of operation of the road. We found significant and even dramatic effects on plant communities as dust continues to



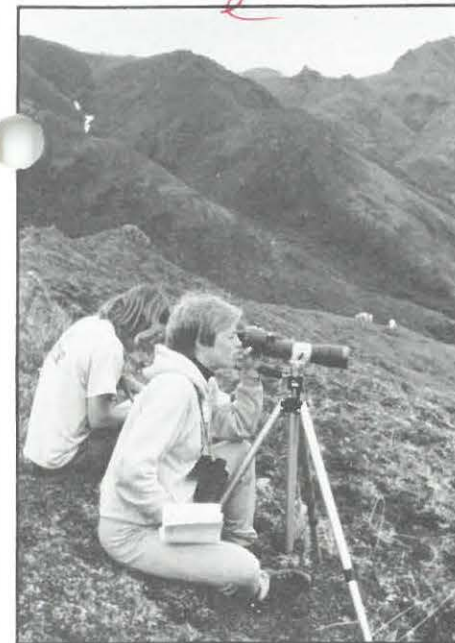
JACK SHEA

fall on vegetation. If changes in the vegetation are to be minimized, management changes in dust control on gravel roads in northern Alaska must be made.

Dr. James Ebersole
Course Director



JACK SHEA



JACK SHEA

I began thinking about doing a field studies course after becoming frustrated and bored with classroom lectures at college. I was tired of spending my days walled-in, looking at a blackboard and listening to a professor tell me what was outside but not being able to see and know for myself what was really there. I wanted to learn about all the parts that make up the wilderness by seeing them first-hand and spending time there instead of memorizing facts and theories in a brick building so distant from the area being studied.

On my first day in Alaska I was excited that the instructors knew so much and were so excited about what they were teaching. Driving along the Kenai coast, Jack was looking out one window of the SFS bus telling us those white dots on the mountains were goats, Nancy was looking for birds out the other window, Chris was explaining the 1964 earthquake, and Jim was pointing out vegetation changes in the avalanche tracks — all at once! After a few days things settled down a bit. Every time the bus stopped Jack jumped out with the scope to look for the elusive wolverine, grizzly bear or caribou. Nancy liked to stop near any pond filled with ducks and tell us the name of different species. Jim could find a new plant to tell us about every time

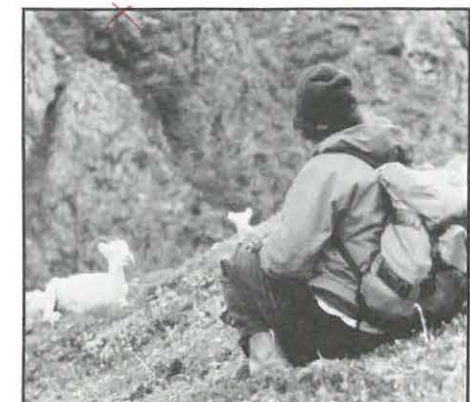
If changes in the vegetation are to be minimized, management changes in dust control on gravel roads in northern Alaska must be made.

we had a chance to crawl around the ground for a while. And Chris never ran out of land forms that he could tell us about. Apart from all of these "impromptu" lectures we had formal scheduled lectures in the campgrounds or on mountain tops, and several guest lectures by people working in several different areas of wildlife/resource management. We also completed individual research projects and

took part in a group research project as well.

At the end of the semester, I had learned what field studies include and how one goes about doing research, from the planning and grant-seeking stage, to the data collection and analysis, to final write-up and management implications. After all of the lectures, studies, and sights I felt like I knew Alaska as a whole ecosystem. I understand how geology, plants and animals affect each other, and the conflicts between the developers wanting to use the resources and the preservationists; between the natives and the government. I now know how beautiful and fragile the Alaskan wilderness is and how people are stressing it. I saw how important it is to preserve in its most pristine state one of the last pure wilderness areas in the world.

Jeanne Guild
Student Report



JACK SHEA

SFS SEMESTER PROGRAMS

"One of the outstanding strengths of an SFS Semester Program is its ability to provide a cohesive program of interrelated academic components; it is a program in which the whole is greater than the sum of the parts. It is unusual for a student to experience a semester where each academic component has been designed to complement and support the other components. A second advantage is immediate access to the ecological systems being studied. In designing the curriculum for the Marine Biology and Management Semester Program, we have made every effort to take full advantage of these unique opportunities. Through a combination of classroom, laboratory and extensive field work, students are able to develop an understanding of current marine ecological research, and to design and carry out an individual component of a significant research program."

DR. CHRISTOPHER NEEFUS
Program Director, Marine Biology and Management Semester Program

MARINE BIOLOGY AND MANAGEMENT

St. John, U.S. Virgin Islands

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

February 4 to April 29, 1985

Faculty: Chris Neefus, Jon Witman.
Interns: Morgan Hardwick-Witman, University of New Hampshire

Students:

Alex Bernhardt
University of North Carolina
Mary Ellen Bull
Lake Forest University
Ruby Crummie
University of North Carolina at Chapel Hill
Christine Densmore
Gettysburg College
Marc Frischer
Washington University

Elin Griesbach
Clark University

Rick Martinson
Iowa State University

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University of Arkansas

Catherine Weisman
Haverford University

Christopher White
Washington University

Anne Zaldastani

TROPICAL MARINE ECOSYSTEMS are among the most beautiful and complex on earth. Coral reefs, seagrass beds and mangrove stands support unique communities of marine organisms which are exceedingly intricate and diverse. These underwater gardens are extremely delicate and vulnerable to disturbances created by man and nature, and many Caribbean marine systems are being seriously degraded. Although abuse of the marine environment of St. John has been lessened by its inclusion in the Virgin Islands National Park, park boundaries do not create an impenetrable shell. The area continues to be a superb natural laboratory for SFS's Marine Biology and Management course.

Our semester program on St. John had three components: academics, research and personal growth. Five interwoven courses challenged us. Marine Biology provided a foundation for students to understand the ecology of marine communities, the interactions between organisms, and the effects of environmental changes on the marine ecosystem by presenting an introduction to the marine environment and the major groups of marine organisms. In Marine Ecology we looked at the physiological responses of organisms to their physical and biotic environments by examining the ability of individual organisms to acclimate to short-term environmental changes and the way in which species adapt genetically to long-term environmental pressures. The students then formulated ideas for Directed Research projects which were designed to elucidate one aspect of the overall group research goals centering around a comparison of rock wall

community structure between sheltered sites and exposed sites which are periodically subject to storm impact. While the research projects were under way, we began the Man and the Marine Environment course which utilized regional experts as guest lecturers who discussed marine management with respect to economic, social, and political perspectives.

Typically, morning lectures were followed by afternoons in the field. While we worked on SCUBA certification, we carried out most of our field analysis in intertidal and shallow subtidal zones. Snorkeling, though, soon became secondary to diving in deeper waters where we are able to study coral reef areas extensively. Probably the most exciting experience of the entire semester was our first night dive. The beauty and tranquility of diving at night made it easier for everyone when we did night dives every night for two weeks to examine sweeper tentacle use by star coral in fending off competitors.

Shinn 1/2 pt
Dr. Christopher Neefus
Course Director

I joined the SFS Marine Biology and Management course for the spring of 1985 for several reasons. I have been seeking a means by which to learn more about the natural environment in all of its aspects. My ultimate goal is to become active in environmental policymaking. In order to reach this goal, I decided it was necessary to learn the scientific, sociological and political aspects of our natural environment. I felt a broad base of knowledge would enable me to assess and make decisions concerning various environmental problems. My own school

did not offer such courses in its curriculum and because my background in science was the weakest of the three areas, and SFS's emphasis on science was very strong, I believed that I would gain a stronger background in science, particularly in biology.

The emphasis on field research also attracted me. Most liberal arts colleges do not offer field work as part of their curriculum and my school is no exception. Environmental problems cannot be studied completely in the classrooms. Field work is necessary to obtain a clearer and truer understanding of the problems. Lastly, I was attracted to SFS because of its emphasis on teamwork. The typical classroom experience encourages individual effort and personal knowledge gain. While the individual experience in the classroom is very important for retaining knowledge, the concept of team work — a group effort towards a common goal — is just as important to me.

Foremost among my many activities in the semester was my academic experience. The semester consisted of a classroom component, field work, student lectures, and guest lectures. For the field work component of the course, we used the base of knowledge that we learned in the classroom as a starting point for understanding what we observed in the field. We observed and recorded the eating



CHRIS NEEFUS

patterns of fish, and the growth and abundance of algae, corals, and sponges in the rock wall community in order to create a cohesive picture of marine life in the bay. In individual projects, we presented detailed reports to the group, presenting the hypothesis, methods, and conclusions of the study.

Before I attended the SFS semester course in St. John, I had taken one biology course at school, but it lacked the excitement and the pleasure of my SFS experience. I truly believe that for one to do well in anything, and to want to learn, the subject matter must be taught in an exciting, captivating manner, involving the students every step of the way. This is exactly what the SFS semester did for me, and I now have a new joy in learning science, which I had been seeking at school but could not find.

Catherine Weisman
Student Report

PRIMATE SOCIAL BEHAVIOR

Panama

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

Level A: June 17 to July 16, 1985

Level B: July 23 to August 23, 1985

Faculty: Dennis Rasmussen, Marleni Ramirez

Students, Level A:

Ayodele Adeigbola
Trinity School

Stephanie Clapes
Wooster School

Alyson Clark
Friday Harbor High School

Kathryn Elton
Ridgewood High School

Carl Kloock
University of California — Davis

Shirley Lim
Phillips Exeter Academy

Todd Lustgarten
Riverdale Country Day School

Sam McPheeters
Doane Stuart School

Leslie Millett
Loretto Academy High School

Susan Sauvain
School Without Walls

Helen Sherk
R.J. Reynolds High School

William Stauffer
St. Olaf College

Students, Level B:

Valerie Banschbach
Pomona College

Paul Concepcion
University of Panama

Frederick Field
Swarthmore College

Thomas Gordon
Bethany College

Donna Hempel
Fitchburg State College

Ted Hoeffler
San Francisco State University

Donald Marron
Harvard College

Edward O'Brien
University of Maine, Orono

Caroline Paulson
Swarthmore College

Ione Smith
Vanderbilt University

Natasha Yates
Beloit College

OUR TEAM WAS OFF to a bright and early start the first morning of our course in Panama. It is a vivid memory, a group of strangers moving what seemed like an incredible amount of gear from hotel to van, to train station to train, to dock, and finally onto a small rubber boat and kayuka (native canoe) in a wild and wet ride across Gatun Lake to the peninsula of rain forest where we would be spending the next month.

The most unanticipated feature of this peninsula was the ubiquitous mud. Our camp was atop a small hillside that rose



TED HOEFFLER

out of the lake. The hill was only about a 45-degree slope but was almost impossible to mount without falling several times because of the slick, dark orange-brown mud that coated its surface. I had expected the rain, and thought about being wet, but I had forgotten about wet ground and the wonderful ways it could affect your life. You'd set something down and it would get muddy. Then you'd pick it up and you'd get muddy. Soon everything was muddy, nothing was clean, even your hands. Of course, you could go to the lake to wash them off, but on the way back up the hill you would slip and get them muddy again. So we gave up, and washed off what we thought were great tans in the hotel shower at the end of the course. Starting our field work made all of us forget about the mud. Purpose was given

to our hardships by the sight of the tamarins. Most of us had never before seen animals so like ourselves in the wild. Following them as they scampered from tree to tree, sometimes as high as forty feet, was a challenge. We spent a few days getting used to the jungle: learning the trail system cut by other SFS courses; figuring out how to take good field notes and use binoculars in the pouring rain; rowing around coves on our rubber boat, searching for a distant group of tamarins to introduce to our "home" group; and getting our "home" group of tamarins, or "purple" group (named after the color of their collar that they had been tagged with) habituated us to tramping around beneath them. After this initial groundwork, we were able to begin research projects which investigated specific questions about tamarin behavior.

One project was the introduction of the "strangers" (tamarins trapped on a distant peninsula) to our "purple" group of tamarins to determine their reactions to the strangers and to find any correlations between sex, age, or reproductive status of the members of the "purple" group and their reactions to the strangers. This project had important implications for conservation of this endangered species as one plausible conservation strategy was thought to be the introduction of tamarins from disturbed areas of human development to wild areas where they would have to coexist with already established tamarin groups. The overwhelmingly hostile response to strange tamarins of all ages and sexes by all tamarins in the "purple" group was a discouraging warning against employing this type of strategy.

My own individual project involved determining the home range of the "purple" group and how they utilized it. Another student and I had to cut some additional miles of trail to be able to follow the group throughout its entire range of



TED HOEFFLER

travel. We mapped our trails and began trying to follow the "purple" group from their rising at dawn to their sleeping trees at dusk. My own deepest feeling of accomplishment resulted from a day in which I followed the group to their sleeping trees by myself for half a day. It was like being a natural part of their world when I was able to follow them slowly, being noticed by them but not feared, as they groomed, napped, and played.

With help from a faculty leader, we were able to map the vegetation of the home range of the "purple" group. Thus we were able to determine not only the daily paths of travel, types of activity and relative amounts of time spent in different areas of the peninsula, but also relative amounts of time spent in different vegetation types, and thus, what type of habitat was best suited for tamarin use. Our project resulted in a good estimate of the best types of habitat for different daily tamarin activities and a calculation of percent of time spent by the tamarins in activities such as grooming, travelling, foraging, resting, and territorial conflict. All of this information was the first such data to be acquired on Atlantic coast tamarins and is applicable to conservation work on the tamarins since it is necessary to know what kind of habitat the tamarin needs for its survival.

Valerie Banschbach
Student Report

MARINE MAMMAL BIOLOGY AND CONSERVATION

Kenai Peninsula, Alaska

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

Level A: June 17 to July 16, 1985

Level B: July 23 to August 22, 1985

Faculty: Suzanne Macy, Vernon Tejas (Level B), Doug Van Etten (Level A). Intern: Carmen Clayton

Students, Level A:

David Bucs
Harrisburg Academy
Hussein Fakhry
Clark University
James Kobal
Riverdale Country School
Alexandra Landrum
Westover School
Stephanie Litman
Shawnee Mission East High School
Loretta Lure
Boston College
Michelle Parra
Stanford University
Gail Wingerd
Wittenberg University
Daniel Dorfman
Sherman Oaks, CA

Students, Level B:

Peri Acworth
University of Vermont
Barbara Barton
Michigan State University
Eric Cohen
Stuyvesant High School
Garrett Dolan
SUNY Geneseo
Michele Dupre
Dartmouth College
Jennifer Falco
Chaffrey Community College
Todd Israelite
Evanston Township High School
Penny Jeffers
University of Vermont
Deborah Lesure
North Adams State College
Mary Miceli
Oakland University
Joy Nicholopoulos
University of Texas
William Perri
Duke University
Claire Saks
Montclair High School
Jeffrey Santa Ana
Colgate University
Emily Skelton
College of Marin

DURING MY MONTH IN Alaska I realized that in field research, the subject of study is not always on hand; in fact the observer is the one who must sacrifice for his or her research. This meant crawling on rocks and climbing through rugged terrain in order to get a better view of sea lions, or bobbing up and down in a kayak looking for them. There were times when I thought I was crazy, such as the time I had to sit in the cold rain with foggy binoculars waiting for a few harbor seals to pop out of the water. But Alaska had so much to offer in the way of marine mammals and natural processes that I learned more about geological processes and animals than I had ever anticipated. I was so fascinated with the wide range of things there are to learn. We tried our best to preserve the ancient land on which we camped, but we had to



STEPHANIE LITMAN

explore the area as a child plays with a new toy. I enjoyed all of the learning; chewing on a piece of 50,000-year-old ice, hiking and climbing incredibly deep slopes to get a picture of me near a glacier, skipping rocks into an ocean.

It was difficult to keep our focus on the academics because of the beauty around us. But our faculty members were so knowledgeable about the area that they were an inspiration. I learned the importance of scientific inquiry and how to develop hypotheses, and test them. I'd never had a course in biology or a science class that went into this much depth about the origin of life as well as how to view it in a scientific manner. We were expected to be very thorough and keep research notebooks. Long hours and bad weather became known to us quickly as part of the plan, and we learned to work with them to accomplish our tasks.

We had a few lectures before we left the Anchorage area by the Director of State Parks and other officials involved in the environmental maintenance of the terrain. These made me appreciate my Alaskan experience even more and made me think about what it means to protect and conserve the available forest land in my own state. We also had a lecture by a

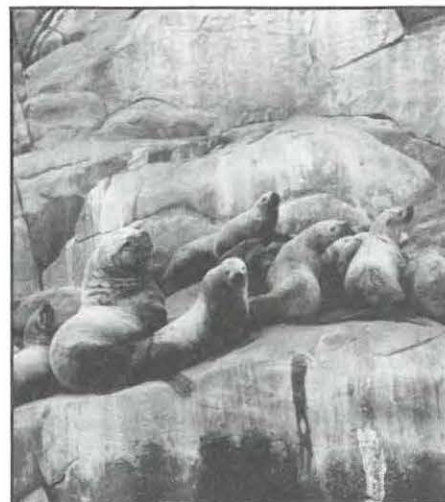
woman who deals with the abundance of marine mammals in the Prince William Sound area. This was of great value as well, for we were able to arrange our trip in the areas where there was believed to be greater populations of animals to study.

During the actual trip, we visited a place where salmon are counted as they are going up to spawn and we also visited a hatchery where salmon are being raised and released in a particular area of the sound. We participated in a debate over how the Marine Mammal Conservation Act was trying to be arranged in Alaska so that the state would have control instead of the federal government regarding the restriction of hunting marine mammals.

I experienced another type of learning other than the restricted learning one gets in textbooks. The academic portion of the course included many different topics which we were able to reinforce with daily learning in the field. The opportunities for learning were so great that I feel I was finally able to pursue an in-depth study of marine mammals. Unfortunately in my own individual project, we ran into a problem in finding a large enough sample of harbor seals and sea otters, and eventually opted to do a study of specific birds. This made me understand the importance of being flexible with research at all times.

It's not easy to look back on an experience and reiterate what one gains from it. But this was special. It was my opportunity to be free from the constrain of books and stuffy lecture halls and to look out to the beauty of the land and water as a teacher. I don't know if I'll ever pursue field research for a living, but I know I'll do it again. Perhaps appreciating what it involves and the infinite amount of information one can obtain from one tiny corner of the world is enough. As far as accomplishing my goals, I came as close as I could have hoped to, and I cannot explain it other than to say that I'm always going to try to enjoy learning what I study, for a special peace can be found in that.

Michelle Parra
Student Report



STEPHANIE LITMAN

BOTTLENOSE DOLPHIN BIOLOGY AND BEHAVIOR

Key Largo, Florida

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

Level B: June 17 to July 16, 1985

Level B: July 23 to August 22, 1985

Faculty: Team 1: Lisa Ballance, Ben Blaylock. Team 2: Beth Goodwin. Intern: (Team 2): Beth Sauerhaft, Grinnell College

Students, Level B, Team 1:

Virginia Begley
Hollins College
Michael Boyle
University of Maryland

Renee Dello
University of Toronto
Heather Gowan
University of Vermont
Donna Rose Janosek
University of Illinois — Chicago
Joe Malachowski
University of Massachusetts at Boston
Mary Ann Mastri
Wittenberg University
SUSAN O'CONNELL
University of Alaska
David Riester
Colgate University
Mark Ronquillo
Wake Forest University
Beth Sauerhaft
Grinnell College

Anne Shore
Clark University

Level B, Team 2:

Shari Bookstaff
University of Wisconsin
Martha Donohue
Santa Barbara City College
Patti Deminski
Clark University
Alex Friedman
SLINY Binghamton
Terence Hankins
Mankato State University
Deborah L'hereux
University of Massachusetts
David Logan
Franklin Pierce College
Teresa Rec
University of Connecticut
Amelia Santiesteban
Barry University
Jeffrey Selengut
Gettysburg College
Dawn Smith
Cabrillo College
Stephen Smith
Kentucky Wesleyan
Louise Stewart
Mount Holyoke College
Mario Velasco
Albright College
Gail Wellen
Western Illinois University
Rebecca Young
Wellesley College

OUR COURSE ITINERARY for studying bottlenose dolphins was based around daily two-mile hikes into the Ocean Reef Club where three captive dolphins were kept in a 100-meter channel. We studied the dolphins' activity and behavior and monitored respiration rates, surface times and social interactions. Three female

We saw wild dolphins late in the evening when two or three would approach our campsite which was situated a few feet from the ocean.

dolphins, Lady, Molly and Caesar, were not held against their will because the natural channel was separated from the ocean by a deteriorated fence. We studied the dolphins at varying times of day and then hiked back to the Angler's Club for lectures, study time, and journal paper reading assignments. In addition to this busy schedule we had to work on our individual research projects while keeping up a clean camp and planning and preparing our meals.

Part of our research project involved doing a comparative study of the wild dolphins of Card Sound. We saw wild dolphins late in the evening when two or three would approach our campsite which was situated a few feet from the ocean. The academics of the course were centered around lectures. Various topics included the scientific method, statistics, cetacean taxonomy, physiology and anatomy. We found these subjects were supported by extra learning in the field when we could actually utilize these skills.

I found the independent project was one

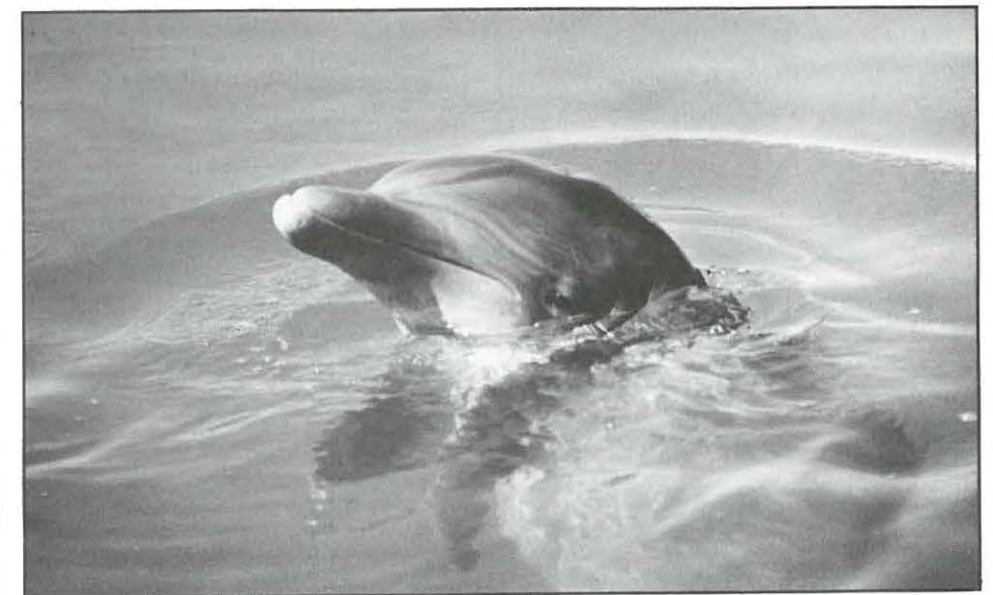
of the most valuable learning experiences of the course. Another student and I devised a course of study of the social interactions of the three captive dolphins with the people who frequently stop to observe them. I enjoyed that part of the course because it was very interesting to develop my own hypothesis, efficiently collect the data, apply the proper statistical test (in this case a 2 factor Analysis of Variance Test) and finally come to a conclusion, which supported my theory. We reported our findings in research, journal paper format and made oral presentations to the group. Interested local experts attended our final presentations.

Through our study of the bottlenose dolphin I discovered that I would like to pursue further behavioral studies and migrational studies, as well. As a whole, this course taught me a great deal about biology and observational methods. It also

gave me a great opportunity to work closely with experts in the field, a chance to be part of a research team working toward a common goal, and a chance to experience a different part of the country, while meeting many new friends. The course was a challenge that I met, achieved, and will never forget.

Heather Gowan
Student Report

Special thanks to: Bob Slater, Henry Farfan, Sonny Vasquez, the staff of The Dive Shop and Purdue Dean (Ocean Reef Club, Key Largo); Nick Lanni and staff of the Angler's Club, Key Largo; Dr. Greg Bossart (Ocean World Aquarium, Fort Lauderdale); Dr. Jeremy Montague (Barry University, Miami); Joy Hampp (Dolphin Research Center, Marathon Shores); and Dr. Berud Wursig, Moss Landing Marine Laboratory.



BOB SINGER

AQUACULTURE

Oahu, Hawaii

This course was sponsored by the Archer Daniels Midland Company, Decatur, Illinois, processors of agricultural products.

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

Level A: July 23 to August 22, 1985

Faculty: David Brune, Kim Harrison

Students:

Magdalena Arguelles
Massachusetts College of Pharmacy

Mary Beth Bishop
Northwest Missouri State University

Jim Chih Chou
California Polytechnic Institute

Luz Claudio
University of Puerto Rico

Ramon A. Diaz
Whittier College

Geoffrey Johnson
University of Kansas

Vicki Lowden
University of Miami

Andy Roberts
SUNY Geneseo

Karl Wagner
University of Kansas

MY ORIGINAL INTEREST in the SFS Aquaculture course stemmed from a desire to expand my knowledge of the field of Marine Sciences. My studies had begun to appear as an endless spiral of research and experimentation with no room for the practical application in which I was interested. This month-long, in-depth look at the current status of aquaculture on the Hawaiian island of Oahu enhanced my personal and educational interests through travel, academics, and practical application.

During our studies we visited and studied many different aquaculture sites ranging from very inefficient Brigham Young University ponds to high-tech Marine Culture Enterprises producing up to 600,000 pounds of paneid (saltwater) shrimp per year. Our first trip was to the Oceanic Institute; a grant-funded program out of the University of Hawaii specializing in environmental biological oceanography and applied aquaculture for commercial use. The site had a run-down look, yet their laboratories and research facilities were employing the newest in technology for aquatic research. They had several projects in progress including work on an alternative food source for shrimp that would be produced locally to decrease feed costs.

We took several trips to the Brigham Young University farm, an 80-acre farm



MAGGIE ARGUELLES

raising *Macrobrachium rosenbergii*, commonly referred to as the freshwater or Malaysian prawn. They had two major grow-out ponds (where young adult prawns are put until growth to full market size) no more than twenty feet apart. One was lacking in algae growth, infested with catfish, and had a high mortality rate, yet the other pond was "fine." We tried to discover what the photosynthetic productivity and major algal species were in both ponds, but were unable to pinpoint any specifics as to what was actually happening.

We spent several days analyzing operations at the Kahuku Prawn Company. Here we were given a positive outlook on the success of the aquaculture industry in Hawaii. Kahuku was production-oriented, trying to improve pond conditions and monitor actions occurring there in order to obtain better

Through this course I gained a renewed faith that many opportunities for persons interested in the science-based business aspects of marine science exist.

yields in their harvests. They worked in close conjunction with researchers at the University of Hawaii to gain a better understanding of the physiology and morphology of *Macrobrachium*.

Group lectures and classes were a major part of our course. Our two faculty members were each involved in completely different areas of aquaculture. Through Kim we learned about the physiology and morphology of *Macrobrachium*; its life cycle,

optimum growth conditions, diseases, nutritional requirements, and evolution as the most widely cultured freshwater shrimp today. Dave's work involved pond dynamics and computer modeling of pond ecosystems to better monitor and predict their conditions and aid production. Discussions included engineering concepts and chemical formulations of interactions occurring in pond systems. Practical problem solving was also a large part of our studies.

We each worked on independent projects encompassing all different sectors of aquaculture. I investigated the economics involved in an aquaculture business and found a variety of problems existing. I learned that it is extremely important that a person interested in entering the aquaculture business fully understand all costs and benefits involved before beginning such an adventure.

Through this course I gained a renewed faith that many opportunities for persons interested in the science-based business aspects of marine science exist. The aquaculture industry is a prime example of a scientific business which needs improved communication between researchers, managers and engineers. These people must be approached for help and information if any possibility of success is to be present. My feeling is that with increased interaction among industry members themselves, aquaculture can grow not just as separate profit-seeking ventures, but as an agricultural industry able to produce high-protein foodstuffs for a world desperately in need of such potential.

Victoria S. Lowden
Student Report

ENVIRONMENTAL GEOLOGY

Mt. Vesuvius, Italy

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

Level A: June 17 to July 16, 1985

Faculty: David Buesch, Richard Hazlett

Students:

Sarah Ali
Horace Mann School

Barry Baram
Framingham State College

Michelle Dunn
University of Vermont

Ben Lampert
Brooklyn College

David Rossi
Highland Park High School

Kathryn Sposato
Wellesley College

Eliza Vaillant
Concord Academy

Rebecca Wood
Wells College

Karen Yoshida
Grand Valley State College

AS A NEWLY DECLARED Geology major, my interest in the School for Field Studies' Environmental Geology course was two-fold. I was eager to apply the knowledge I had gleaned through lectures and lab study to actual work in the field, and the course provided the opportunity to further explore my major against the backdrop of Italian landscape and culture. The nine students and three staff members of our team were drawn together almost immediately by a sense of shared misery and joy. Our backs ached from packs that were too heavy and our feet cried out from constricting boots, but we were united by a common awe of Mt. Vesuvius itself which silently loomed over us as if it were studying our team rather than we studying it.



DAVID BUESCH

Much of the work at Vesuvius involved mapping flow deposits from the 1944 eruption. Working with a partner, we would traverse the perimeter of a flow, constructing and numbering cairns at regular intervals and recording the distances between each station. By using a Brunton compass we also determined the direction and inclination from one cairn to

the next. After this data was recorded and the perimeter was completed, traverses were made across the width of the flow and off the sides, in order to obtain a more detailed and accurate mapping of the lobe.

Once the skeletal map was completed,

The bright orange color of molten lava flying up from one of the cinder cones within Stromboli's crater could be seen against the dark sky. I just stared, unable to believe that I was actually sitting on the site of a volcano watching it erupt.

we carefully searched the flow for fumaroles, holes from which hot gases are issued during the cooling of the molten material. Using Brunton compasses again, we sited the location of each fumarole from the nearest cairn, then measured its diameter, and recorded the color and composition of the surrounding rocks. The fumaroles were found in two bands along the length of the flow, mimicking the contour of the perimeter.

Final work on a flow deposit involved identification of the mineral composition of xenoliths. It was this work which proved to be the most fascinating for me. Amid a sea of jagged, vesicular, and highly unstable aa blocks, the smooth surfaces of xenoliths could quickly be detected. To obtain a fresh surface the xenoliths were cracked open; a process much like opening oysters, for the value of the minerals was always a surprise. The interiors revealed sparkling cumulates rich in olivine, amphibole, and micas. We also found marl, a pure white

quartz, many dunite and lucite-rich rocks, and even a few scattered books of biotite lying beside fumaroles.

The most memorable event of our course was the night we spent studying Stromboli, a volcano in the Aeolian Islands which is still actively erupting. Carrying day packs, sleeping bags, and a minimum of food and equipment, we began our ascent at four in the afternoon. Hiking up the steep, densely vegetated and often treacherous "trail" was the most physically demanding segment of the course. To my



DAVID ROSSI

fatigued body and mind it seemed as if Stromboli were angrily protesting our intrusion. The sight which greeted us made the suffering worthwhile. The bright orange color of molten lava flying up from one of the cinder cones within Stromboli's crater could be seen against the dark sky. I just stared, unable to believe that I was actually sitting on the side of a volcano watching it erupt. We quickly divided into teams and took shifts throughout the night to monitor the time at which each eruption occurred, as well as its duration and relative intensity. Each thundering boom of an eruption was followed by a shower of lapilli; a pattern continually repeated throughout the night.

These four weeks in Italy were an exploration of the spectacular. From the minute detail of newly discovered minerals, and the beautiful simplicity of wizened Italian women shrouded in black, to the grandiose view at the crater of Vesuvius, and the excitement of Italy's chaotic cities, working and exploring under the brilliant canopy of the Italian sky not only heightened my fascination for geology but also awakened my senses to the beauty in both the natural and man-made world.

Kathryn Sposato
Student Report

Special thanks to: Dr. Roberto Scandone, Givseppe Mastrolorenzo of the University of Naples, and Dr. Maruo Rosi of the University of Pisa.

HAZARDOUS WASTE AND COASTAL ECOLOGY

Chesapeake Bay

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

Level B: June 17 to July 16, 1985

Faculty: Walter Hatch, Dick Snyder

Students, Level B:

Martha Hurley
Harvard College

Pedro Malave
Louisiana State University

Beverly Winkler
University of Texas at Austin

Krishnan Kannan
McGill University

THE CHESAPEAKE BAY is the largest estuary in the contiguous United States, with approximately 4,500 square miles of water. Even today in its relatively impoverished condition, the bay is the largest producer of blue crab (*Callinectes sapidus*) in the world, and yields about one half of the total of all crabs harvested in the U.S. More than a quarter of the nation's oysters come from the bay and the Chesapeake ranks third in the nation's fisheries production. The bay is also an enormous habitat for wildlife, including



PEDRO MALAVE

year-round residents and millions of migratory birds that use the bay as a wintering area.

In juxtaposition to all this natural splendor, the bay also has major industrial, shipping, and military importance. Hampton Roads and Baltimore are both highly industrialized areas which contribute large quantities of hazardous materials to the Chesapeake. Baltimore alone ranks among the top three shipping centers of the East Coast.

Initially, we spent considerable time examining relatively pristine areas of the bay in southern Maryland to establish a basis for comparison with both Baltimore Harbor and Hampton Roads, the two most highly impacted areas of the bay. A study of Baltimore Harbor conducted fifteen

years ago gave us a chance to make some time comparisons of that area by repeating some of the sampling. The main project of our course involved the collection and analysis of populations of the salt marsh snail, *Littorina irrorata*, which is found in the middle and lower reaches of the bay. We wished to evaluate this mollusc as a potential biological indicator of toxic pollution stress, and to that end, we sampled populations in southern Maryland and compared them to populations from the impacted area of Hampton Roads.

At our first camp in southern Maryland we began to develop an academic and first-hand understanding of the estuary, its physical and biological processes, so that we could begin to understand the distribution and potential impacts of hazardous pollutants in the bay. We spent most of the first week covering as much lecture material as possible, covering elements of physical oceanography, estuarine circulation, microbial dynamics, plankton, benthic processes, examinations of methodologies and practice with instrumentation used to measure various parameters of the estuary. The bay and nearby marshes made excellent practice locations.

The drastic differences found in Littorina populations . . . suggests these organisms may indeed be good indicators of environmental stress due to pollutants.

Our second week we camped next to a 1,000-acre expanse of pristine marsh located on the tip of a peninsula formed by the mouth of the Potomac River. Here we explored the marsh by boat and collected *Littorina* for analyses. We mapped an area of the marsh surrounding our collections site with bearings from a hand-held compass and surveyor's flags. Collecting fish with a hundred-foot beach seine gave us numerous specimens for practice using identification keys. We spent several days in Baltimore, sampling fish with the beach seine, and with the Coast Guard, sampled the benthic sediments of the harbor. Despite trepidations about wading in the harbor, we all became excited at the quantities and diversity of fish we were catching in the beach seine. Benthic sampling, however, showed that the harbor bottom was as dead as it was fifteen years ago. When we spent several days in the Hampton Roads area, our samples came from a highly impacted area and it was difficult to even find marshes from which to collect *Littorina*.

The last week of our course was spent analyzing data, running snail tissue samples through the gas chromatograph and working on individual projects at the



PEDRO MALAVE

Natural Science Department at St. Mary's College. Students' projects provided some essential information about *Littorina*. One project focused on the relationship between shell size and the number of growth rings of juvenile snails which will allow us to better estimate the age of adults. Another project looked at the total calcium content of the shells compared to body weight and found the opposite of what is known for other molluscs living in impacted areas. Still another project involved the degree of shell deformity, both predator induced and a curious asymmetry which appeared to be more prevalent in the impacted populations.

The gas chromatograph analysis showed high levels of hydrocarbons and several potentially dangerous cyclic compounds in the Hampton Roads snails. These populations also exhibited abnormalities in age structure and size of the individuals. An almost total lack of juvenile snails suggests that either the larvae or the young are particularly sensitive to toxic compounds in the area. The drastic differences found in the *Littorina* populations between clean and impacted sites suggests that these organisms may indeed be good indicators of environmental stress due to pollutants. The information collected on both clean and impacted sites



PEDRO MALAVE

will be published and will constitute a substantial addition to the scientific knowledge of *Littorina irrorata*.

Walter Hatch, Ph.D.
Faculty

Special thanks to: Maryanne Chapman, member of the Maryland Department of Natural Resources Staff; Lt. Commander Tom Corelli, Captain Michael Smith, and Commander Higgins of the U.S. Coast Guard; Dr. Robert Paul; and Deborah Santavy, USDA Statistics Laboratory.

ACID RAIN AND FRESHWATER ECOLOGY

Adirondacks, New York

Purpose: To study biological effects of long-range transport of atmospheric pollutants "acid rain" on sensitive Adirondack lakes and streams in order to understand the communities of the altered systems and to determine the advisability of restoration attempts such as liming.

Level A: July 23 to August 22, 1985

Faculty: Debbie Roberts, Claudia Swain

Students, Level A:

Sara Abraham
Brandeis University

Reed Berkowitz
Tolland High School

Margit Brazda
Colgate University

Katie Collins
Greenbrier Community College

Barrie Greene
The Brearley School

Jennifer Hyman
MIT

Albert Luppens
Northwest Missouri State University

Daniel McDermott
SUNY — Plattsburgh

Scott Parsons
Oberlin College

Lisa Pierce
Clark University

Emily Porath
University of Vermont

Tom Sinski
Northwestern University

Susanna Spikol
Edward R. Murrow High School

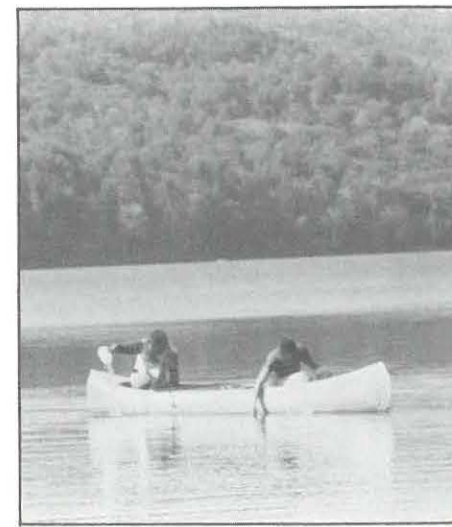
Heidi Zimmerman
Brandeis University

THE RESEARCH GOAL of our course was to determine some of the important impacts of acid deposition on the non-fish animal communities in several acidic Adirondack Lakes. Contrary to popular notion, the plants and animals in the lakes are not "dead," but their species composition and abundances are severely altered. Our work was a direct outgrowth of the 1983 and 1984 SFS expeditions to the same area. During those courses, the communities in eight lakes along with relevant chemical characteristics, were described. This year our research focused on the populations of large predatory insects that have taken over as the top predator in fishless, acidic lakes.

We drove to Indian Lake, New York, after spending a few orientation days at the Fresh Water Institute (FWI) of Rensselaer Polytechnic Institute, and hiked a mile up along Beaver Brook, a stream that drains Snowy Mountain in the south central Adirondacks. We set up camp along the brook. This stream is one of the three in a study which is designed to determine what happens to the biology and chemistry of streams receiving acidic deposition as they interact with watersheds in their courses down the mountains. Dr. Charles Driscoll, a leading research scientist in the field of chemistry of acidic systems, Mike Smith, Chris Cosentini and two other graduate students arrived loaded down with equipment. We set up flow gauges, nets, and a field chemistry lab under much-needed rain tarps. The next 24 hours were an intense teaching, learning and data collection period. The purpose of this study was to investigate the normal daily cycling of nutrients in a stream and its relationship to the downstream movement of insects (invertebrate drift). The data collected actually documented the response of the chemical and biological factors under study

to a rain event due to the inclement weather we were faced with. Although not the original aim of the study, this data was extremely valuable to the ongoing stream research.

Collecting some stream samples on our way out, we headed home to FWI for more lectures and laboratory work. After five days of studying and preparing oral presentations on research papers we were all anxious to pack up and head back into the field. A three-hour drive, five-mile canoe trip and a mile hike brought us to our new home on the shores of Salmon Lake which had a lean-to, fireplace, picnic table and even an outhouse. Starting most days with an early breakfast and morning lecture, we traveled to the lakes throughout the watershed working on our research projects. At each lake we came to, we launched canoes or inflatable boats and people collected water samples for water chemical analyses, data on water clarity



DEBORAH ROBERTS

and samples of the microscopic animals of the open water (zooplankton) for individual projects. One of the teams developed two new techniques for collecting and quantifying the numbers of large insect predators in the open water. Using a series of lines and weights, they set up transects on the bottom of the lake, and at 15-minute time intervals, swam over this area, counting the organisms in the water.

Another of the projects involved a study of loon nesting habits and the loons' response to the presence of canoeists. Two of the wilderness rangers in the area, Terry Perkins and Beth Coulter, were very helpful to us in providing some background data on the local loon population. Terry and Beth stopped by one afternoon and gave a delightful talk on loons, lake management and in general, wilderness area management.

When we got back to FWI we were immediately busy with final sample analyses, final exams and project reports. Several people went down to Rensselaer Polytechnic Institute to use FWI's main analytical lab for chemical analyses, while others ran tests at the Lake George labs or counted zooplankton samples under microscopes.

It was exciting to see the data come together as the course wound up. Significant correlations were found between the physical and chemical characteristics of the lakes and the structure of the biological communities. In addition the data showed that the large invertebrates were found in large numbers only in fishless lakes and these lakes had highly modified zooplankton communities. Although these relationships have been postulated in the literature, they have never been quantified before. All of us who were involved in the course took a feeling of accomplishment home with us, knowing that the hard work we had done would contribute to a greater understanding of this pressing environmental issue.

Debbie Roberts
Faculty



CARLIN FINKE

TROPICAL PARK MANAGEMENT

Big Cypress National Preserve, Florida

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

December 27, 1984 to January 17, 1985

Faculty: Tom Cervone, Ann Johnson

Students:

Elisa August
Macalester College

Michael Chase
Oberlin College

Amy Lind
Cornell University

Marna Schwartz
Williams College

Richard Thompson
Houghton College

Joanna Watson
Cornell University

Rusty Yeager
Indiana State University

THE REASONS I applied to the SFS Tropical Park Management course were several. First, I wanted to gain exposure to different types of ecosystems than those of southern Indiana and to obtain an understanding of how the many species of this region interact with their natural environment. Second, I hoped to acquire useful field study and research techniques. Finally, I hoped that through my research project I would provide the Big Cypress National Preserve with data that might help them to manage certain areas of the preserve.

Having never been to Florida before and not having done much reading prior to the course, I was unaware of the many types of ecosystems it contained. It was interesting to learn and see how the different types of vegetation which make up the ecosystems are associated with and affected by such factors as the water table, hydroperiod, soil depth and composition, fire and even wind. Through the combined efforts of Dr. Tom Cervone, our chief zoologist and Dr. Ann Johnson, our chief botanist, we received complete and accurate information on the biology and geography of south Florida through lectures, narratives of field trips or comments on sights seen while we travelled through the park.

My main interest was to be able to identify the different species of animals encountered and to observe feeding habits and styles along with intra- and inter-species behavior. I found many of my



RICHARD THOMPSON

personal observations to be most fascinating and startling: for instance, the graceful way in which the pelican glides a few inches above the surface of the water in contrast to the seemingly clumsy and often comical way in which they dive for food, or the small and harmless appearance of the cottonmouth snake in opposition to its potentially lethal bite, or the peaceful and dormant behavior of the popularly feared alligator. In spite of the fact that my main interests lay in the zoology of the area, I often found the plant life to be intriguing also, whether it be the small attractive spider lily or the tall and dominant cypress trees. We were fortunate to observe all but one of the six major ecosystems: pine woodlands, cypress strands and domes (dwarf cypress forests) and wet prairies of the Big Cypress Preserve, the mangroves around Everglades City, and the coastal prairies at Flamingo.

In addition to first-hand field study of the major ecosystems, each team member was also assigned an ecosystem on which to conduct a literature search and present a lecture to the team and instructors. This exercise provided a key opportunity to get a better understanding of how the different ecosystems evolved in conjunction with glacial and interglacial periods and limestone formations. I was made aware of the many problems which plague both the Big Cypress National Preserve and the Everglades National Park as a result of canalization, changing and obstructing the sheet flow with highways, increased water usage by Naples and Miami from the same aquifer which supplies the preserve and the park, as well as the major role, both helpful and harmful, that fire plays in the biological status of south Florida.

The chance to see any such research project through from its preliminary planning stages and strategy decisions to the final oral presentation was the type of

experience I had hoped to encounter during the course. But it is highly unlikely that I will soon forget even the most trivial aspects of my experience. Sudden rain storms in Fakahatchee Strand, mosquito invasions at Flamingo or waking up to a low- to mid-forty-degree breakfast will be remembered fondly. But the chance to work with a small yet talented group of students of varied backgrounds towards a common cause is what I feel the entire course was all about. I am happy to say that the events I encountered far surpassed any expectations or subconscious hopes I had held prior to the course.

Rusty K. Yeager
Student Report

Special thanks to: Dr. Ron Myers of the Archibald Research Station, John Waugh, Dave and Tracy Schealy, the Big Cypress National Preserve and Dr. Jim Snyder.



ANN JOHNSON

POPULATION DYNAMICS OF ENDANGERED SPECIES

Switzerland

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

Level A: June 17 to July 16, 1985

Faculty: Phil Davis, Stan Koster

Students:

Lisa Blair
Princeton University

David Bradley
Duke University

Katherine Browne
Boston University

Amy Bruckman
Harvard College

Jon Decker
Choate Rosemary Hall

Susanne Friedberg
Yale University

Elizabeth Holmes
Stanford University

Verne Mainville
Holy Cross College

Thomas Meier
Lake Forest College

Jonathan Wise
Hebron Academy

WHEN WE THINK OF Switzerland, we usually think of unparalleled mountain scenery and tidy villages nestled into peaceful valleys. Never would we think of a country where wildlife could not exist in harmony with man. Yet until recently, the alpine ibex, a magnificent mountain goat, was extinct there. Intensive land use by foresters and herders caused this species to disappear from its native Swiss habitat. Only through major restocking and protection efforts by

The future of alpine ibex depends largely on careful management, and these management efforts rely heavily on information gained from field studies such as ours.

wildlife biologists in recent years has this animal been able to regain a foothold.

Alpine ibex spend much of the year high in alpine meadows which support lush plant growth. During winter, they descend to the forested lower elevations for protection against severe weather. These remote areas should provide an ideal refuge for ibex. But Switzerland is a small country and there is ever increasing pressure on wilderness areas by hikers, skiers, herders, foresters and farmers. Throughout their range, ibex must compete with humans and livestock for diminishing resources. To help insure their survival, reserves have been established to help maintain ibex populations. But are these reserves large enough to support healthy ibex populations? Do we understand the basic ecology of this species well enough to properly manage its numbers? What habitats do these animals

prefer? What effects do humans and livestock have on these animals? These questions formed the basis for our study.

Our first camp was located above timberline on the Rothorn Mountain near Brienz. Against the backdrop of the majestic Eiger, we could observe ibex on meadows and rocky cliffs. Each morning at daybreak, we arose and prepared for a vigorous hike to our study sites. We quickly learned how to cope with the hazards of the rugged and unforgiving Alp environment, as we encountered wind, rain and cold weather during the first week. Some study sites required more than an hour of strenuous hiking to reach, but weary legs and sore feet were soon forgotten upon the sight of ibex grazing in a meadow or lying atop a cliff. We observed animals throughout the day to learn about their habitat preferences, food habits, behavior and social interactions. Sometimes it was possible to approach within 30 feet of these mountain monarchs. These encounters provided special moments that may never be

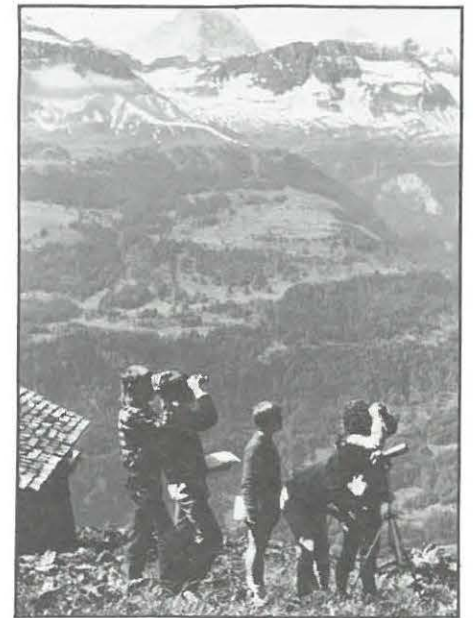


KATHERINE BROWNE

duplicated, and left lasting impressions on us.

Days were divided between field observations and lectures. Our teaching environment was unique because each lecture could be followed by examples and demonstrations on topics such as plant succession or animal behavior. We were privileged on two occasions to be visited by local game guards, biologists and the Swiss Federal Wildlife Inspector. These visits brought into focus the importance of our work and the role that research plays in assisting wildlife managers.

Through our efforts, we found that the ibex populations were presently stable, but also found a disturbingly low reproductive rate for the Rothorn ibex colony. Evidence of over-use of the habitat and competition with livestock was found on both study



KATHERINE BROWNE

sites, indicating that the reserves may be too small. It was especially exciting to learn that several of the behavioral patterns and habitat use patterns that we found had not previously been reported. These findings were welcomed by local biologists, who expressed a sincere interest in our studies.

The future of alpine ibex depends largely on careful management, and these management efforts rely heavily on information gained from field studies such as ours. While our research may not have an immediate impact on management procedures, it did provide a better base on which to form policy and management decisions by expanding our understanding of alpine ibex. And, by expanding our knowledge of alpine ibex, we may be better able to manage and preserve populations of other mountain sheep and goats.

Stan Koster, Ph.D.
Faculty

Special thanks to: Dr. Bernard Nievergelt, Reudi Fuchs, Urs Zimmerman, Quirin Zurbriggen, Dr. Hans Brullhardh, Dr. Hansjörg Blankenhorn and Dr. Tom Husband.

CORAL REEF ECOLOGY

St. John, Virgin Islands

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

January Course: December 27, 1984 to January 17, 1985

Level A: June 10 to July 2, 1985

Level B: July 6 to July 30, 1985

Level B: August 4 to August 28, 1985

Faculty: Richard Aronson (Team 1, 3), Ted DeWitt (Team 2, 3 and January), Don Levitan (January, Team 1, 2). Interns: Robin L.A. Allmon, Harvard University; Shannon Briscoe, Harvard University; Larry Tucker, Clark University

Students, January Course:

Pam Abel
Colgate University

Michael Dobbs
Colby College

Fred Dieffenbach
Keene State College

John Hoffman
Colgate University

Christopher James
Colgate University

Sarah Jennings-Clark
Castries, St. Lucia, West Indies

Deborah Mandsager
Augsburg College

Anne Metcalf
Wellesley College

Ed Metcalf
Colgate University

Tod Perkins
Colby College

Steven Roach
Colgate University

Lucy Waite
Mount Holyoke College

Students, Level A:

Christina Belton
Williston Northampton School

Nicola Brown
Minnehaha Academy

Billy Culhane
Sayre School

Ann Deichmann
Washington University

Robert Falong
Hackettstown High School

Betsy Gaines
The Seven Hills School

Salvatore Genovese
Swarthmore

Robert Lally
Thayer Academy

Elizabeth Lovejoy
St. Timothy's School

Katherine Lovejoy
Millbrook School

Lucinda Macrory
St. Timothy's School

Monica McHugh
Swarthmore College

Sam Pitmon
Minnehaha Academy

Robert Schmidt
Hawken School

Mark Sowa
Morristown-Beard School

Students, Level B, Team 1:

John Ball
West Virginia University

John Beldin
Michigan State University

Patrick Ceas
University of Illinois

Tempe Evans
Colby College

Karen Fortenberry
Agnes Scott College

Stacy Greendlinger
Packer Collegiate Institute

Scott Hines
Cornell University

Jan Koerbelin
Brown University

Douglas Lenihan
Horace Greeley High School

Monica McHugh
Colgate University

David Schill
Beach Channel High School

Kimberley Thorsfeldt
University of Iowa

Erica Wiberg
Syracuse University

John Worthly
Bowling Green State University

Students, Level B, Team 2:

Carolyn Boatman
Castries, St. Lucia West Indies

Robert Coles
Harvard University

Tracy Farmer
Smith College

Laura Glover
Middletown, Massachusetts

Mary Hoffman
Metropolitan State University

Pedro Malave
Louisiana State University

Melinda Meeks
Mount Vernon College

Rebecca Reimers
Washington University

Scott Stoutamire
Enterprise State Junior College

THIS IS PART of the journal
Ann Deichmann wrote during the
Coral Reef Ecology course in June:

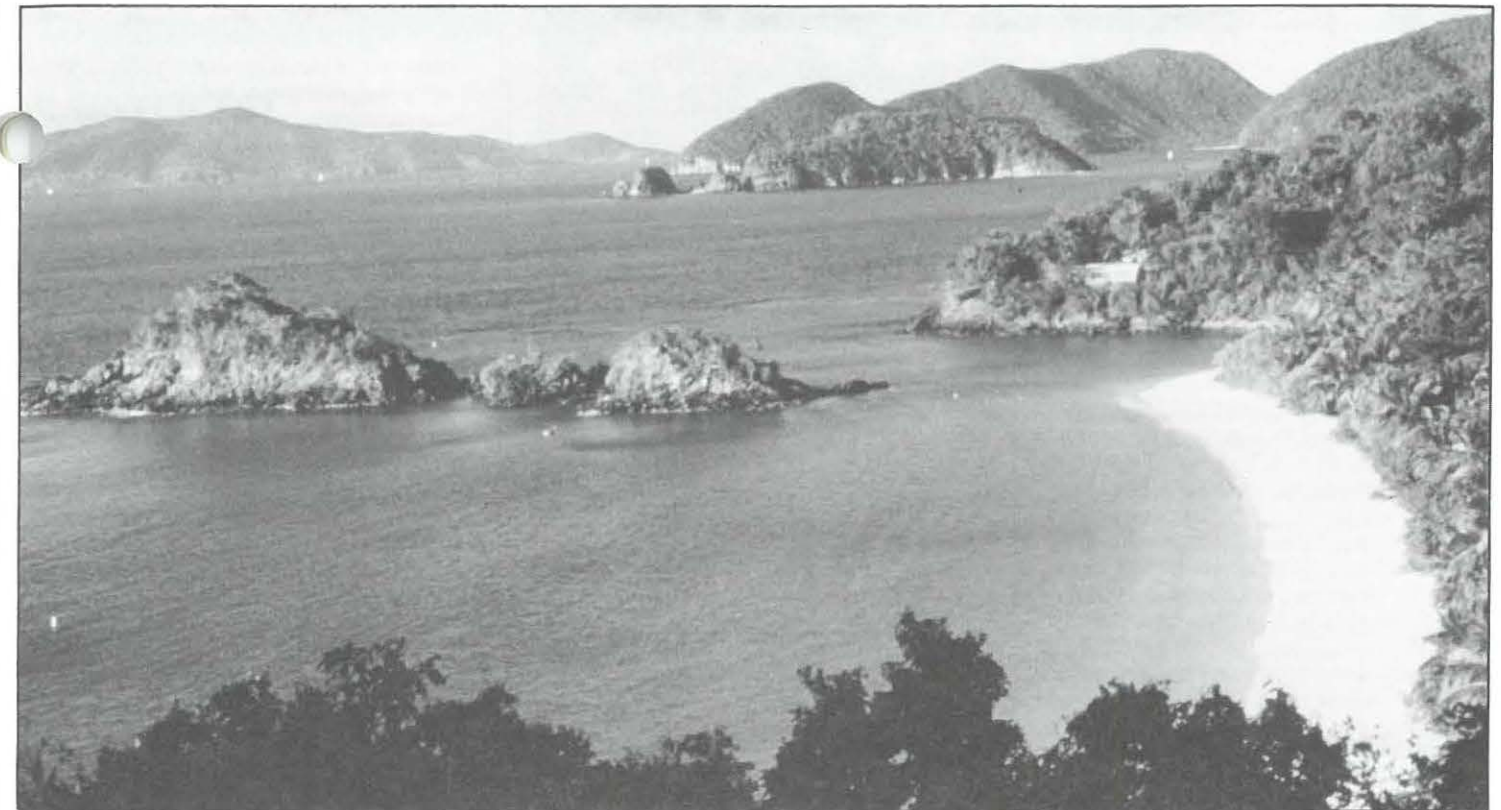
June 10, 1985: This is the beginning. This whole day smears in my memory like a fuzzy but pleasant dream. I am sitting in a small cabin that has been converted into a small lecture room. It's stickiness everywhere here. It is the kind of humidity that holds you close, almost tantalizes you into believing that a sweet breeze will be your savior... The culture here is fascinating and symbiotic. The islanders live on these islands but seem to have no awareness of their beauty. The island seems to tolerate the small hold the islanders have, but everywhere it seems the wildness of this beautiful place has a stronghold. The drive, on a beautiful wreck of a truck with open benches, was like a trip through a blurred dream. The vegetation here is extraordinary — huge, lush polypody-like plants of otherworldly shapes and colors. I have seen the most

Don Levitan is a wonderful teacher. He took us down to snorkel in a mangrove area . . . what an incredible hands-on experience in learning this is. He told me what things were, what they did and explained certain appendages and coloration. I learn so well this way.

vivid colors and imprint them in my memory to keep them forever. I can feel that beauty everywhere, sense its allure in the dusk, filled with the drone of insects. My life is abundant with new beginnings and I approach with open arms.

June 14, 1985: The camp is very primitive . . . our outdoor showers are brief but appreciated because we have such a small supply of fresh water. We snorkeled this morning, identifying all kinds of mollusca and annelids. I want to touch everything. I am not content to observe from a distance. I wonder at a crab or *Limia medusa* (a little worm with long stringy tentacles that looks like a soggy fish line blowing underwater). Don Levitan is a wonderful teacher. He took us down to snorkel in a mangrove area . . . what an incredible hands-on experience in learning this is. He told me what things were, what they did and explained certain appendages and coloration. I learn so well this way. At lecture I was drifting, but this reinforces that teaching too.

Scuba diving is still so new. I wish I was comfortable with it. There are lots of feral



CHRIS NEEFUS

donkeys here and we watched them browse near the road.

June 16, 1985: We started research today and it was hard, laying out transects, quadrants in pretty rocky surf. Fire coral was everywhere and trying to balance without smashing into it was utterly impossible, as my left cheek and leg can attest to. It did feel good to work as a team and to recognize how well we worked together.

I find myself too exhausted for lots of thought time. I am enjoying seeing my

limits and strengths and recognizing the extent, I choose to do as much as possible. Our first graded report will be Tuesday — critiquing papers. My choice is "Sex-related Foraging Behavior in Sequentially Hermaphroditic Hogfishes."

June 20, 1985: Research is in full swing. Yesterday in the lab I helped measure and weigh *Diadema antillarum* (sea urchins) and then inject them with tetracycline to measure plasticity. Don is doing a starvation/well-fed experiment to see how much and where the internal skeleton

changes. These "silly spine bears" can actually shrink when they haven't received food in a while, a remarkable finding that previous SFS courses discovered on St. John last year.

June 26, 1985: Research goes on. Injecting *Diadema* with KCL to make them spawn, doing tons of research with microscopes and chemical solutions. I love working hard and long to see my limits.

June 28, 1985: Last night we snorkeled at Donkey Bight, carrying huge oversized underwater lights that barely chipped the darkness. The water was chilly but it was fantastic. We saw the polyps out on the corals and an octopus. My fascination hasn't slowed, nor has my passion for the work or the place.

July 2, 1985: Goodbyes this morning. It is strange to think we may never see each other again. I will carry lasting memories of the work, the place, the people and the culture. This has been an immeasurable experience.

Seemingly zillions of illions of miles above the ocean, my blue chromis are invisible to me here — All I can see is blue, stretching, pulling, fading my coral reefs lie hidden, submerged. But they will always be known to me.

Special thanks to: Kirstin Canoy, Dr. Caroline Rogers, The Virgin Islands Ecological Research Station, Douglas Mathias, Enid Francis, Park Ranger Bernie Stoll, Dr. Robert Unterberger and Vincent Powell.



CHRIS NEEFUS

MAYA PALEOECOLOGY

Northern Belize

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

Level A: July 23 to August 22, 1985

Faculty: Eric Gibson, Leslie Shaw. Intern: Daniel Finamore, Boston University

Students:

Sally Anderson
Boston University
Theresa Batty
Belize City, Belize
Marcello Canuto
Trinity School
David Hatfield
Harvard College

Sophie Kevany
Trinity College, Ireland
Sonya Laurence
Harvard College
David Morgan
University of California — Berkeley
Kathryn Morgan
North Carolina State University
Donn Norton
Montclair Kimberley Academy
Mary Pye
Harvard University/Vanderbilt
Susanna Shankland
Harvard College
Sam Sussman
Montclair Kimberley Academy
Jon VandenBosch
Boston University
LAURA WHEELER
Pitzer College
Cynthia Wood
York Preparatory School

The Maya Paleoecology course was the first time that SFS had engaged in archaeological research. We contributed to previous research conducted by many Maya archaeologists throughout the last century. Our primary objective was to learn more about prehistoric relationships at a small site that has yielded tantalizing evidence of very early occupations and is located in a region where other sites have exhibited similar clues. The course offered numerous challenges and exciting opportunities to learn about past cultures by actually uncovering their material remains. By the end of the course, it was a common experience for the students to hold in their hands Maya artifacts that had not been touched by humans for well over a millenia. It was a major challenge to learn to reconstruct how these materials remain articulated with what was once a dynamic, living civilization.



KATHRYN MORGAN

We usually had three different teams excavating, one at the main pyramid to learn more about the sociopolitical status of Kichpanha within the larger Maya empire, another team working along the lagoon shore looking for evidence of early

occupations and subsistence/ecology data and a third team excavating small test units around the site looking for social and settlement information.

Though we are still in the process of analyzing our results and will continue to find insights into our research questions, some exciting results are apparent and can be discussed. The fact that we found so much evidence of an aquatic subsistence focus for Kichpanha suggests that it may have been a specialized fishing village in the area and may have engaged in relatively little agricultural production. The implications are that more communities had specialized production roles in the prehistoric economic systems than has previously been thought by most researchers. The aquatic subsistence base may have also been more important in the development of Maya civilization than most Mayanists have considered. The fact that we found the hieroglyphic bone (highlighted below) in a low mound dating from the Late Preclassic (ca. 11 B.C.), has many implications, some of which will cause critical reappraisals of past interpretations of Maya culture history. A few of these implications are as follows: The educated consensus among Mayanist researchers is that most writing was involved with the monumental art and stelae cults of the central Guatemalan area, that commemorated historic events in the life of the Maya empire. However, our find demonstrates that it is highly probable that writing was more widespread, executed in a variety of perishable media (bone is usually not well preserved), and was highly developed at a much earlier time than had previously been considered. Also, the fact that such evidence of early writing was found at such a small and rather insignificant Maya site is astonishing in the

eyes of many Maya archaeologists. The fact that the hieroglyphic bloodletter was found in the burial mound of a local "elite" family suggests many possible interpretations concerning the development of Maya sociopolitical complexity. Possibly before the nobles gained full support of the peasantry, they had to first make blood and other sacrifices to justify their claims of supremacy. These events may have preceded the actual codification of the social order that followed during the classic period of Maya civilization. Thus, it may be less surprising than it initially appears, that such an unusual artifact would be found in such a small mound at a rather small site, at a very early time in the Maya prehistoric sequence. At Kichpanha we may have actually gained a "window" into the earliest stages of how classic Maya civilization developed, how the process began.

Eric Gibson
Faculty



KATHRYN MORGAN

NEWS RELEASE: THE DISCOVERY OF EARLY MAYA WRITING

ONE OF THE EARLIEST examples of Maya hieroglyphic writing has been discovered at the small archeological site of Kichpanha in Northern Belize by a group of students from the USA, Belize, and Ireland. Fifteen students from the School for Field Studies of Cambridge, Massachusetts, have found in a burial mound dating to approximately the last century B.C., a carved bone containing six finely executed glyphs. These glyphs are among the earliest ever found in the Maya lowlands. The glyphs include a jaguar with a symbol for a Maya calendrical month in its jaws, a Maya noble with a parrot headdress and several gods of the underworld. Found associated with the carved bone were five jade beads, a marine shell pendant, four well-made elite mortuary ceramic pots, and four human skulls.

The Kichpanha Archeological Project is under the directorship of Eric C. Gibson of Harvard University, Leslie C. Shaw of the University of Massachusetts at Amherst, and Daniel R. Finamore of Boston University. The main objectives are to explore the early stages of the development of Maya civilization. The hieroglyphic bone will be taken to Harvard University for more detailed analyses before it is returned to Belize.

TROPICAL RAINFOREST ECOLOGY

Amazon Basin, Ecuador

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

Level B: June 17 to July 16, 1985

Level B: July 23 to August 22, 1985

Faculty: Amos Bien, Valerie Kapos, Eric Pallant

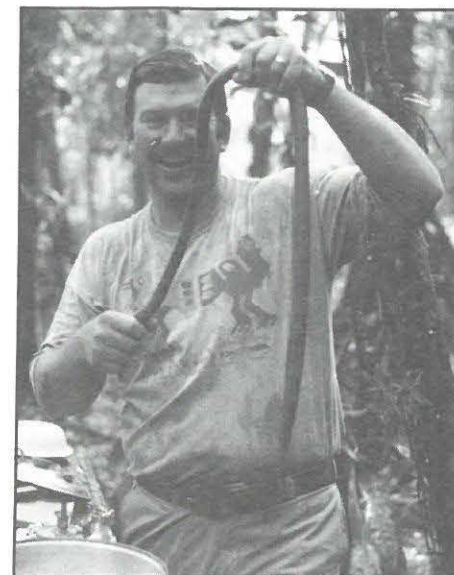
Students, Level B, Team 1:

Valerie Alliger
Skidmore College
Thomas Benander
Amherst Regional High School
Stephanie Freskos
Barnard College
Herbert Lawler
University of Nevada at Reno
David Lee
SUNY/College of Environmental Studies
Ivan Marquez
University of Puerto Rico
Laurie Sanders
Smith College

Students, Level B, Team 2:

Charles Frye
Brown University
Paul Elliott
University of Guelph
Philip Hamilton
SUNY — Binghamton
Caitlin Kennedy
Swarthmore College
Marion Klaus
Ranchester, WY
Fung Lim
Rutgers University
Linda Perry
Lewis and Clark College
Leslie Roberts
Yale University
Christopher Rodstrom
Clark University
Lynn Schwartz
Sterling College
Pablo Javier Granja
Facultad de Ciencias Agrícolas
Maria Mercedes Larrea
Universidad Católica de Quito

TROPICAL RAINFORESTS are incredibly diverse. They have more species of plants and animals than any other habitat on earth. Yet they are disappearing at an incredible rate. Entire species of plants and animals are disappearing with them. We are just beginning to understand how rainforests are put together and how they regenerate. Once we understand this, we may be able to predict what kind of disturbance (e.g. cutting on a large or small scale) a forest can sustain and still recover,



AMOS BIEN

and we may learn how long that recovery will take.

During the 1984 SFS course in the Ecuadorian Amazon, faculty member Amos Bien noticed that one of the study sites was very unusual. The site, on very poor Amazonian soils, was exceptionally uniform. It had very few treefall gaps, one of the important factors in rainforest regeneration. Nearby sites, on rich soil, looked like the Central American forests on which the regeneration models are based: they had lots of fallen trees and gaps. In all the studies of rainforest gaps, no one had suggested that the abundance of gaps, hence the rate of regeneration of the forest, was dependent on soil richness. Faculty member Valerie Kapos designed the experiments to find out if this was so.

After beginning the course at the Catholic and Central Universities in Quito where we bought supplies and had introductory lectures, we traveled to Campana Cocha, a Quichua village on the River Napo (a major tributary of the Amazon). It took two days, three buses, and a dugout canoe to get there. We explored the disturbed forest around the village and walked through the shifting cultivation fields. We left for our study site at the edge of the Huaorani (Auca) territory: a short canoe ride across the river, then six and a half gruelling hours through the mud, up and down steep hills, with a guide who spoke nothing but Quichua. We camped in the mud alongside the Rio Sumino. This was our poor soil study site.

We began our studies with a "fifty-questions" exercise. The exercise consisted of sending each student alone into the forest, out of sight, but within earshot of one or more fellow students. There he or she remained quietly, in one spot, for an hour, and wrote at least fifty questions stimulated by the environment. Several things were accomplished: fear of being alone or off the trail was diminished; the student had the opportunity to see and hear the forest for perhaps the first time

(one student saw a black panther or wild wolf-dog at close range during the exercise); and by writing down fifty questions in such a short time, inhibitions about whether a question or thought was stupid were suppressed. The site was exceedingly beautiful, even though it rained constantly, and we collected data for our research projects by laying out grids and measuring the frequency and size of gaps.

From Rio Sumino, we traveled nearly three days to our next site along the river Quilla Pacay in Primavera. We hiked six hours, were poled across the river in tiny dugouts, rode all day down the Napo in a large canoe and spent a luxurious night in real beds before our short hike to our next study site. Our campsite was isolated by a rising river and we had to trudge through a hip-deep swamp to get there. We found a better site where we made our home for ten days. Camped deep in the forest on the rich soil site, we found taller trees and many more treefall gaps than at Rio Sumino, supporting our hypothesis. One student compared earthworm abundance, and found no three-foot earthworms and fewer casts in general, confirming the Quichua belief that earthworm casts are an indicator of poor soils. Others found more superficial roots in the poor soils and also that soil temperatures varied much more in the gaps than in the deep forest. As a group we measured canopy height, tree diameter, size and shape of treefall gaps, number of shrubs, etc.

*Perhaps the Central American
regeneration models may not
apply to the majority of
Amazonian forests, and we need
to study them much more closely.*

Results were highly significant. There are dramatic differences between the poor soil forest and the rich soil forest. On the poor soils, a little rain and trampling turned the area into mud. At Primavera, water poured directly on the soil soaked right in without changing the soil texture. This suggests that the poor soil is more easily compacted and more susceptible to damage if used for agriculture. The shorter trees and less frequent gaps suggest that it is a less dynamic, less easily regenerated forest. The rich soil forest resembles the Central American forests that regenerate quickly, but rich soils are very rare in the Amazon basin. Perhaps the Central American regeneration models may not apply to the majority of Amazonian forests, and we need to study them much more closely.

Amos Bien, M.A.
Faculty

HUMPBACK WHALE ECOLOGY

Gulf of Maine

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

Level A: June 17 to July 16, 1985

Faculty: Raymond Pierotti, Amy Knowlton

Students, Level B:

Carol Baum
Oberlin College
Margaret Beuchert
Colgate University
Karen Crawley
University of Massachusetts at Amherst
Sabina Kitts
Gustavus Adolphus College

Siegfried Musser
The Latin School of Chicago
Francie Richey
New Mexico Institute of Mining and Technology
Len Robbins
Taylor University
Tom Sander
The Evergreen State College
Scott Siege
Hackley School
Brad Smith
The College of Charleston
Erie Taniuchi
Colgate University
Sheila Turpen
Pacific Union College
Gabrielle Valeri
Lehigh University
Heidi Zimmerman
Brandeis University

OUR FIELD STUDY was conducted to investigate the ways in which humpback whales (*Megaptera novaeangliae*) react to disturbances by ships, in particular, how they react to different engine sounds and boat speeds. Data was collected from a series of observations made during the research period which extended from June 18 to July 14, 1985 and took place in the Gulf of Maine. Most sightings occurred on Stellwagen Bank and Jeffreys Ledge.

Our study was based aboard the R/V Rambler which patrolled the area for whales. When a humpback whale came into range it was identified and data was recorded. The standard disturbance data form was used which recorded bearing of the whale from the vessel, direction in which the whale was moving, behaviors between respirations, and the ship's engine speed at every respiration. The observer also recorded any comments he may have

Our study of humpback whales on the Gulf of Maine brings up a serious controversy.

had regarding behavior. This data was then categorized into engine speeds and movement types of the animal.

From the data collected a listing of engine speed and movement type of the whale was made for each date of sighting. Engine speeds were broken into four groups: engine off, neutral, slow forward, and half speed. Engine sounds were louder at higher engine speeds. There were three basic ways in which an animal could have reacted: moving toward us, parallel to us,

or away from us between data points.

Results were very informative. Of 21 observations when the engine was off, the animals turned toward us on 13 instances, away in 4, and ran parallel in 4. Of 86 observations where the vessel was in neutral there were 20 cases where the humpback turned toward us, 50 cases in which they turned away, and 16 cases when they continued parallel to our vessel. In the 70 observations in slow forward, there were 11 cases where whales turned toward our vessel, 55 where they turned away, and 4 where they swam parallel to us. In the case where our vessel was at half speed there were 26 observations made. Of these only 4 showed the animals moving toward us, 20 showed them

turning away, and 2 showed them moving parallel.

When looking closely at the data obtained, several trends can be seen. Of all cases where the engine is off, the reaction of the animal was to move toward us 62% of the time. This tends to indicate that the animal was either curious about the ship or merely indifferent to it. When our engine was on but in neutral, the reaction was quite different. Under these conditions the animal turned away 58% of the time, moved toward us 22% of the time, and came parallel 20% of the time. This would indicate a mixed reaction of the animals to us since they tended to move away quite a bit but also swam toward us, or parallel to us, a fairly large (42%) proportion of time. In the cases where our vessel was at slow forward there was a much greater percentage of instances of retreat by the whale, 77% of the time. This indicates quite clearly that louder engine sounds and higher speeds tend to disturb the animals. The data taken at higher speed confirms this. Of 26 cases, 20 (77%) also retreated.

Our study of humpback whales on the Gulf of Maine brings up a serious controversy. Our data suggests that these animals were disturbed by our vessel at a fairly high degree when we were in slow forward or at half speed. Many whale-watching boats approach these animals at speeds which exceed ours to a large degree. Further research may show that this practice may negatively affect the behavior of humpback whales.

Gabrielle Valeri
Student Report

Special thanks to: Dr. Stormy Mayo (Center for Coastal Studies), Shoals Marine Lab, Dr. Steve Katona and Lisa Baroff (College of the Atlantic), Perrin Ross (School for Field Studies), Scott Kraus (New England Aquarium), Maritime Museum and Dalhousie University, Halifax, Nova Scotia.



AMY KNOWLTON

WILDLIFE MANAGEMENT

Kenya

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

Level B: June 15 to July 18, 1985

Level A: July 22 to August 23, 1985

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Claire Van Flandern
College of Mount Saint Joseph

Carey Zesiger
Collegiate School

IN JANUARY OF 1983, my family and I spent the better part of a month touring East and West Africa. Both areas of the continent have their fascinating facets: diversity of flora, fauna, and cultures. But the wildlife in East Africa was beyond compare. As it does to so many, East Africa captured our hearts, leaving us with the yearning to return. Almost two years later to the week, a friend of mine presented me with a catalog from the School for Field Studies. He spoke about the course held in Kenya, and knowing of my desire to return to East Africa persuaded me to apply.

My interest in wildlife and its conservation, along with a growing awareness of cultural diversity in the area, were two important reasons for joining the SFS course in Kenya. I have always been an animal lover, and am deeply concerned for the continued survival of wildlife. My first trip to East Africa made me aware of the inadequacy of national parks and reserves in maintaining the "integrity of ecosystems." They do little more than



SCHOOL FOR FIELD STUDIES

Financial Summary

1981 - 1986*

	FY 1981 (9 months)	FY 1982	FY 1983	FY 1984	FY 1985 (est.)	FY 1986 (projected)
Operations						
Tuition and other income	108,894	182,971	217,518	352,931	612,383	1,095,000
Donations Received	63,517	106,753	146,648	234,924	305,682	380,000
Less:						
Operating Expenses	153,300	274,503	354,749	509,691	848,150	1,230,000
Less:						
Scholarships Granted	8,900	11,400	24,380	27,500	54,030	100,000
Net Income	10,211	3,821	(14,963)	50,664	15,885	145,000

Fund Balances

Beginning Balances	—	10,211	14,032	(931)	49,733	65,618
Net Income (Deficit)	10,211	3,821	(14,963)	50,664	15,885	145,000
Ending Balances	10,211	14,032	(931)	49,733	65,618	210,618

Working Capital

Current Assets	18,573	21,347	29,084	80,358	59,092	120,000
Less:						
Current Liabilities	16,658	19,509	81,125	121,750	84,008	80,000
	1,915	1,838	(52,041)	(41,392)	(24,916)	40,000

Fixed Assets

Fixed Assets (prior year)	—	12,412	18,110	61,640	103,201	184,300
Capital Expenditures	12,412	5,698	43,530	41,561	81,099	65,000
Total Fixed Assets	12,412	18,110	61,640	103,201	184,300	249,300
Less:						
Accumulated Depreciation	1,241	3,794	9,229	11,597	18,466	28,000
	11,171	14,316	52,411	91,604	165,834	221,300

*The fiscal year of SFS runs from September 1 to August 31. SFS was founded on October 20, 1980.

The condensed financial statements shown here have been derived from the audited financial statements of the School for Field Studies, Inc. The financial statements are the unqualified opinion thereon of the auditor, Ernest M. Smith, Jr., certified public accountant. Copies of the complete audited financial statements are available from SFS upon request.

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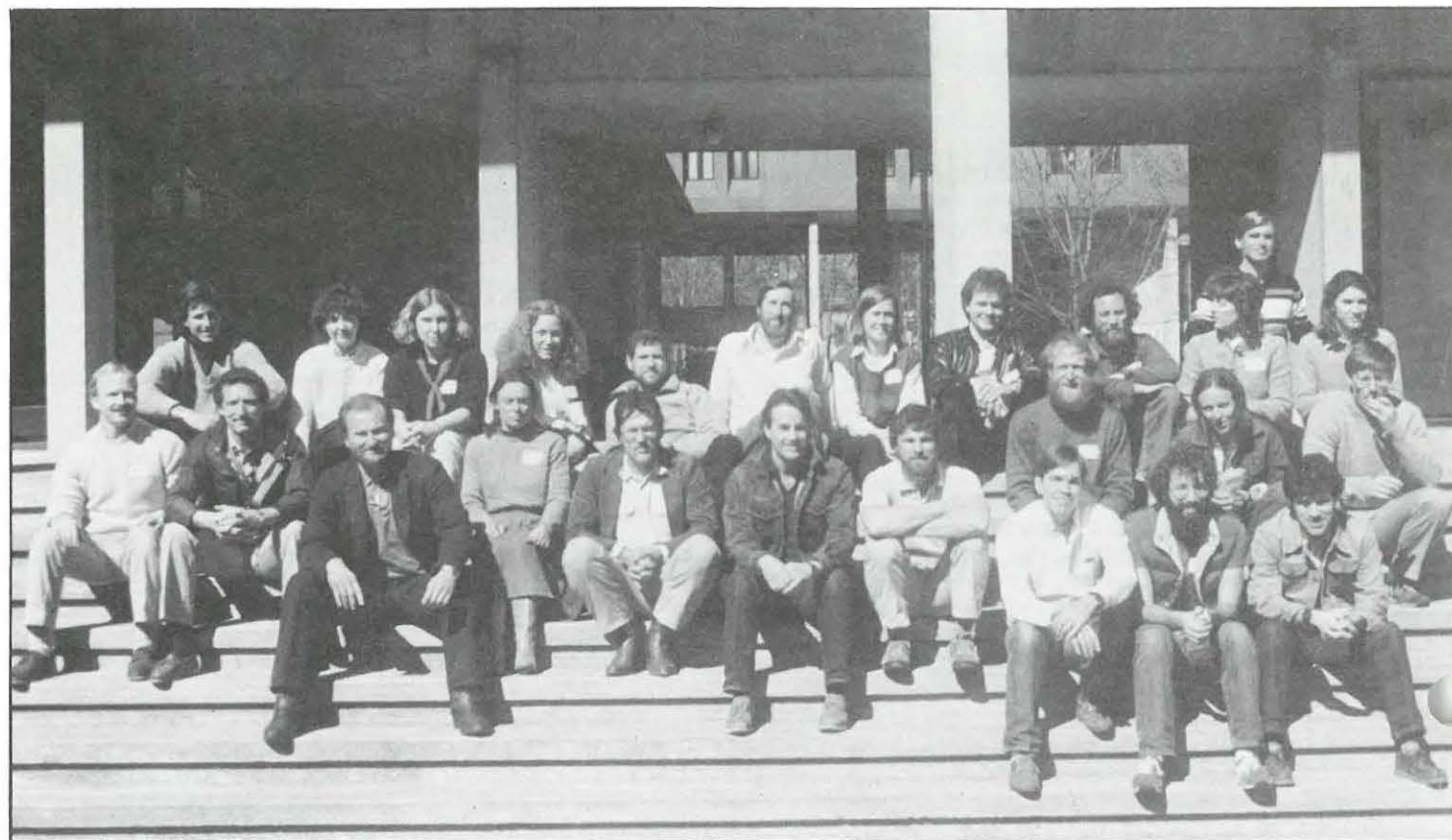
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RESEARCH PAPERS RESULTING FROM SFS FIELD COURSES

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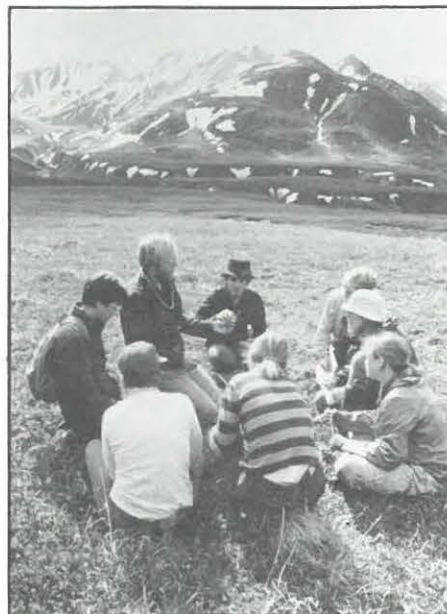
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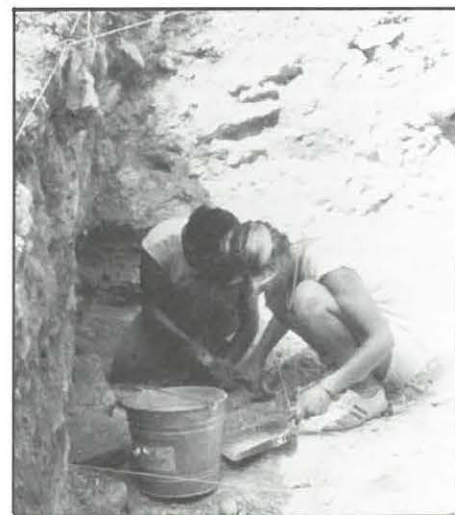
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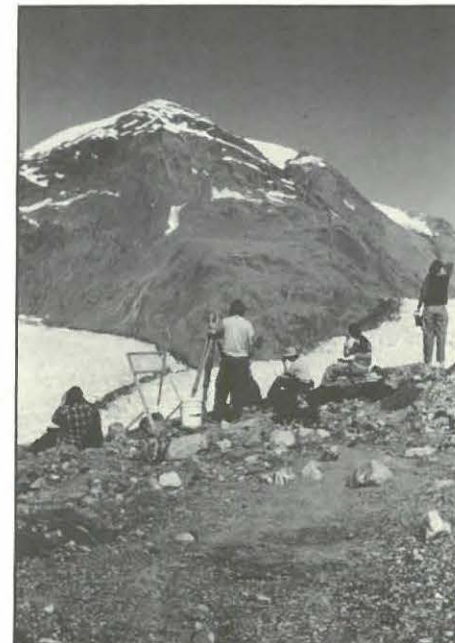
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