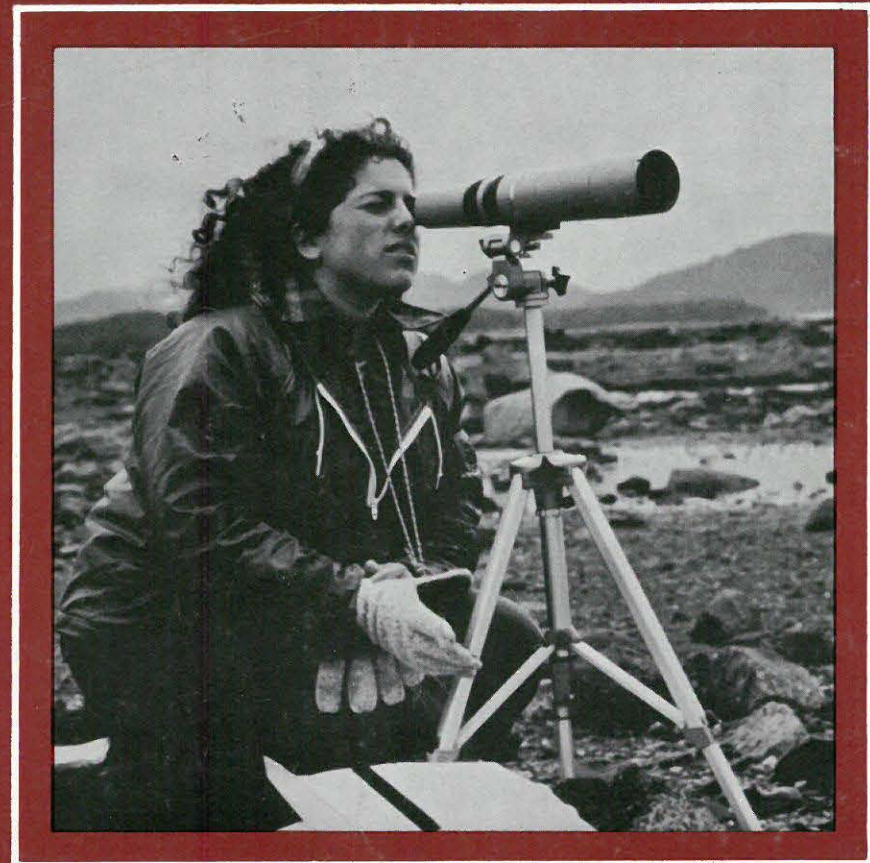


SCHOOL FOR FIELD STUDIES

Annual Report



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President and Chairman's Report

In today's world of limited resources and rapid technological growth, proper management of our environment and natural resources is emerging as a top international priority for the future well-being of all mankind. But without a broad based understanding of the relationship between economic growth and natural resource conservation, our society will not make the rational choices necessary to sustain, much less to improve, the quality of life we now enjoy.

It is critical that we find ways to develop the motivation of young people to make these problems their own. First, we must provide opportunities for young people to understand the complexities of ecosystems and their management. As the current crisis in science education illustrates, there exist few opportunities for such study particularly for high school and college age youth where the potential impact is the greatest.

The most effective method for teaching environmental science involves a hands-on, problem-solving field experience. This requires an interdisciplinary approach that complements traditional classroom work. If this educational approach is expanded to include social, emotional, and physical development, the overall impact will give the intellectual information about science a greater ethical and long-lasting value.

The School for Field Studies (SFS) was founded in 1980 to offer such an education. We provide bright, talented students from varied educational backgrounds with the opportunity to learn about the natural world, themselves and natural resource issues through substantive field training and education. Our month-long summer field courses have been our primary means of providing this opportunity. These extraordinary expeditions remove students from the traditional classroom education and immerse them in research projects focusing on a diverse range of urgent environmental issues or problems in ecosystems throughout the world.

Beyond this primary goal, SFS has set forth a number of complementary goals: to develop future decision-makers who are concerned about environmental research and policy; to provide crucial experience and training to students committed to field sciences as a career; to enable young people not yet committed to a career to test out their interest in the environmental sciences; to serve as a model for participatory and developmentally oriented education; and to further assist public and private environmental research by encouraging young people to participate personally in meaningful public issues.

The year 1984 marked our fourth consecutive year of maintaining and fulfilling these goals. With ambitious programming and admissions efforts, we effectively designed and operated eleven summer courses and one January course that took a total of nineteen teams to ecosystems ranging from the rain forests of Ecuador to the savannahs of Kenya.

These courses introduced students to the rewards and demands of conducting a serious field research project, the excitement of learning about the many different aspects of an environmental issue, the challenge of working with a small group of teammates, the thrill of exploring

a new ecosystem and the satisfaction of gaining an understanding of their strengths and weaknesses. With these components inherent in all our courses, we believe we have achieved our objective of offering a program that combines the intellectual challenge of the research problem, the physical challenge of the site, and the interpersonal challenge of group living, in a manner that accelerates both cognitive and affective learning.

In addition, through our 1984 expeditions, we have developed a unique and coherent curriculum that presents a diversity of field courses beyond the ability of a single college or high school. For example, we believe our acid rain, hazardous waste, and game ranching courses are the only courses of their kind in the country open to general undergraduate enrollment.

While we are continually in the process of designing and adding new courses to our curriculum, we have also succeeded in establishing several long-term research projects including our study of porpoises and seals in Glacier Bay and our coral reef ecology work in St. John that are producing valuable results for resource management agencies both in the U.S. and abroad. Our courses have produced nearly two dozen scientific papers, a good portion of which have been published to date, and several others which have been incorporated into area management plans. These results substantiate our goal of involving students in relevant, real-world problem-solving.

We were gratified this year to see our enrollment increase by nearly 40 percent to 210 students. To date over 650 students from more than 100 high schools, colleges and graduate programs across the country have participated in SFS courses, and over the past 2 years, approximately 10 percent of these students have enrolled in their second SFS course.

Even more satisfying is the fact that these students have come from a diverse range of academic backgrounds. Through our two levels of courses, "A" level, introductory courses and "B" level, advanced courses, we have attracted not only students geared towards scientific disciplines but also students in the humanities and social sciences. Because of the multidisciplinary nature of environmental issues, we feel the broad-based appeal of our programs is crucial to our goal to immerse students from different backgrounds in the environmental sciences.

With the development of a strong academic component of our courses, academic credit has become increasingly important at SFS. More than forty colleges and universities have granted their students credit for successful completion of an SFS course. While some SFS students have received credit directly from their home institutions, others have received credit from Northeastern University (which has accredited all our courses for the past two years) and then transferred that credit to their home institution.

We are also pleased to report that we have built the beginnings of a strong scholarship program. Nearly 50 percent of our students this past year received financial aid in the form of either scholarships and/or short-term loans from SFS.



James L. Elder, Jr.
President



Terry Herbert-Burns
Chairman

Because we wish to offer our program to as many students as possible regardless of their financial status, we hope to develop our financial assistance program even further.

The national media attention that has focused on our educational model has also been very satisfying. Articles in *The New York Times*, *Newsweek* and *The Boston Globe* and film segments produced by NBC and CBS affiliates have helped to increase our exposure. We hope our influence will extend beyond the students we serve directly to encourage other institutions to take a similar approach to education.

All this has been accomplished over the past four years with minimal accumulation of debt and capital investment and in the context of a very reputable safety record. In light of these accomplishments we feel that the School is ready to enter a second phase of growth. This three year phase will focus on solidifying these gains and strengthening the institution while reaching a larger clientele through the following objectives.

Two semester-long programs in Kenya (wildlife management) and St. John (marine studies) for the spring of 1985 have been announced in response to the popularity of our summer programs and the growing demand among college students for more detailed, extended programs. These programs have been structured so that environmental issues may be studied within a larger framework of political and socio-economic concerns. The longer timeframe will also allow students to develop more advanced field techniques. A full semester of academic credit is available for these programs.

Within three years we plan to reach a level of financial self-sufficiency at which our earned income will equal our operating expenses by reaching an enrollment of approximately 600 students per year. To accomplish this we must substantially increase our development efforts to create a working capital fund of \$150,000 to ease current cashflow problems and to provide for the

financial needs of our new students that this enrollment growth will bring. We must also continue to build on the Student Loan Fund that the Merck Family Fund so generously initiated with a grant this year.

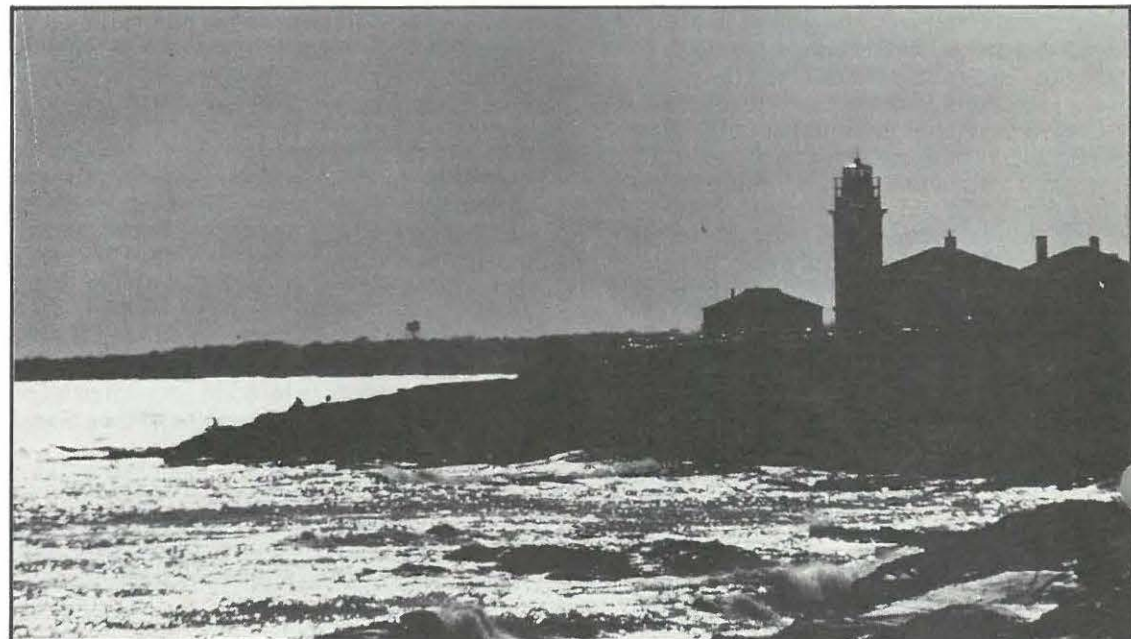
We are able to embark on these ambitious plans only because of the continued dedication and support of many different people and institutions over the past four years. Our faculty deserve high commendation for meeting the challenges and making the necessary sacrifices to produce a uniquely rewarding experience for our students. Likewise, the many donors and contributors listed at the end of this report and those foundations and corporations such as The Andreas Foundation, The Cabot Foundation, Digital Equipment Corporation, The Hunt Foundation and The Mellon Foundation, which have provided the essential funds for the growth of the School, deserve sincere appreciation.

Finally, we would like to give our special thanks to our immensely dedicated and talented staff which has devoted the time and energy needed to help the School move forward. With this continued dedication and the support and encouragement of our alumni, faculty, trustees, donors and all the others who have over the years demonstrated their belief in the concept of SFS, our goals should be well within our reach. Our sails are now set, and our course plotted. All we need are fair winds.

Sincerely,

James Elder
James L. Elder, Jr.
President

Terry Herbert-Burns
Terry Herbert-Burns
Chairman



As the site of long-term deposition of toxic wastes, Narragansett Bay with its small islands and beautiful coastline provided an ideal setting for our course on hazardous waste issues.

Photo by Eric Klos



Damp, chilly winds off Glacier Bay often penetrated even our thickest wool clothes and provided extra impetus to get us moving at the break of dawn.

Photo by Naomi Tien

Since 1982, SFS teams have conducted research on the ecology and natural history of harbor seals and harbor porpoises in Glacier Bay National Park 50 miles west of Juneau. Three teams returned this year with the objective of obtaining a complete picture of seal use throughout the Park. Harbor seals rest, give birth and moult while hauled out on land or ice. While most seals use the ice habitat in this area, the rapid retreat of one of the main glaciers is making this habitat less available. Our research goal was to take a close look at numbers and hauling patterns of seals using rocky reefs in the southern part of Glacier Bay. We also completed research on census methodology for harbor porpoise.

The first five days of the course were spent in intensive training at Park Service headquarters in Bartlett cove. Students received Park Service lectures on minimum impact camping, bear safety, the research goals of the Park and the natural history of the area while additional lectures focused on kayak safety, how to keep a field journal and bird identification. A good deal of time was spent practicing the art of kayaking in the frigid waters of the bay and assembling food which had to be specially packed for the 28 day field trip.

Our trip north to the Beardslee Islands where two concentrated weeks of research would take place was short but all signs of civilization were left behind. This peaceful island chain is covered with huge rain forests which are carpeted with a thick layer of moss and provide habitats to a diverse range of wildlife from colorful shore birds to large mammals. The small island we chose for our base of operation, Spider Island, was soon found to be inhabited by black bears. Within several days, their persistent and annoying habit of prowling through our camp forced us to move to an adjacent island. Even there, we had to bear proof all our food by stringing it high in between trees, a task which occupied a good portion of our free time.

After two days of training in the use of spotting scopes and binoculars to count and observe the hundreds of seals hauled on rocky reefs, we split into three small research groups. One group stayed on the island which had the highest number of seals on reefs around one group explored new areas for seal haul-out sites and the other group kayaked to a previously established site to census harbor porpoise. Students alternated between the groups in order to participate in all areas of the research. By nightfall, we were all usually

exhausted as we prepared our meals and hung up our food.

Students found the behavioral studies most intriguing as the hauled out seals watched their pups, slept or looked anxiously about. Their amusing behavior made the task of spending long hours recording data in the team journal extremely satisfying and served as a great impetus for enduring the often inclement weather. Toward the end of this research, we witnessed a group of orcas that cruised the waters of Glacier Bay and provided spectacular views of their six foot dorsal fins slicing through the glassy waters. One group of students was lucky enough to witness an attack of orcas on a large seal group.

The final leg of our journey took us 30 miles north into an isolated area called Adams Inlet. Here, we continued the census and behavior work on seals and porpoise while reveling in the diverse wildlife of the area including wolves, eagles, loons and thousands of Canadian geese. Students also began individual projects ranging from color attraction of humming birds to studying the distribution of animal tracks in different delta habitats.

Since this group did not work next to tidewater glaciers as did the other two summer groups, we took an adventure filled hike onto a massive glacier. Students not only got to view the glacier and its destruction but to experience first hand the elements which created it; cold, wind and plenty of precipitation.

Throughout the course a substantial amount of data was collected on the population size of harbor seals and their behavior which will be compared this fall with the behavior of ice hauling seals in other areas of the park. This comparison will indicate how seals have adapted to different environments within the park, and how they may alter their behavior to adapt to continual changes in their habitats. Other findings included the discovery of previously unknown seal hauling areas and unknown hauling patterns and an apparent decrease in the porpoise population in our study site from the previous year. This decline may have resulted from the movement of porpoises to another area within the Park or possibly from an overall population decline throughout the Park. A future census should be conducted to confirm the reason for this decline.

MARINE MAMMAL BIOLOGY AND CONSERVATION — TEAM I

Glacier Bay, Alaska June 16 — July 20

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

Faculty: Pierre Dawson, Barb Taylor

Students:

Jennifer Barrett — Maine

St. George's School

Amelia Bevacqua — New York

S. U. N. Y. Binghamton

Christine Berkman — California

John Muir High School

Eugena Carey — Ohio

Cincinnati Country Day School

Sarah Fox — Kansas

Shawnee Mission High School

Kurt Gustafson —

South Carolina

Northwestern High School

Nina McKee — Maine

Tufts University

Mary Helen Newberger —

Massachusetts

Commonwealth High School

Naomi Tien — New York

Horace Mann School

Margaret Wells — Illinois

St. George's School

Darcy Winther — Connecticut

Bloomfield High School

“My primary reason for going on this SFS trip was my interest in pursuing a career in Marine Biology. I feel the knowledge I gained while in the course will be a definite plus toward that goal. Never before had I been involved in such an intensive wildlife experience. I must say that although I sometimes wondered why I had chosen such a desolate location, I enjoyed it tremendously.”

Amelia Bevacqua

MARINE MAMMAL BIOLOGY AND CONSERVATION — TEAM II

Glacier Bay Alaska July 23 — August 27

Faculty: Sue Carter, Liam Antrim

Students:

Eleanor Acworth — *New York University of Pennsylvania*
Peter Hamman — *Pennsylvania State University*
Duncan Kuhn — *Massachusetts Brown University*
Vicky Levy — *Massachusetts Brown University*
Deirdre Platt — *Washington State University*

David Scheel — *New Mexico Rensselaer Polytechnic Institute*
Madeleine Vander Heyden — *Wisconsin University of Madison*
Charles Vite — *New York Cornell University*
Richard Walker — *Pennsylvania William and Mary College*

Photo by Eleanor Acworth



“My field research in Glacier Bay gave me a solid appreciation for the beauty of the area. In such a dynamic environment, seething with vital life forces, no doubt even the most uninformed traveler would be awed. But by learning methods of classifying and analyzing the events of the natural world, I gained a greater insight into its mysteries, a greater realization of its significance, and thus a deeper appreciation for its existence.” *Vicky Levy*

Our team to Johns Hopkins Inlet was one of two SFS teams that conducted simultaneous studies of seals in the northern end of Glacier Bay during their molting period, a period when many seals rest on icebergs and are readily visible for census. We had hoped that a comparison of the numbers and behavior of seals, ice distribution, and disturbance by vessel traffic might indicate differences between the two inlets. While the research conducted by the other August team in Muir Inlet was a continuation of SFS work in the past, this was the first year that the seals in Johns Hopkins Inlet had been closely examined.

At the National Park Service (NPS) campground in Bartlett Cove, our course began with a busy four-day orientation, similar to the orientation in which the June team had participated. In addition to the extensive lectures presented by NPS personnel, students were exposed to the specifics of the research and their trip including the design and methodology of the harbor seal study, maintaining a field journal, field identification of birds, and applied first aid. As if this were not enough to absorb, we were then immersed in a wilderness camping experience which required rapid development of such talents as staying warm and dry in a steady rain and cooking for a large group with a two burner stove.

Because travel in kayaks was to be such a major part of the journey, students were introduced to kayaking and water safety skills on the first full day of the course. All group members boldly endured an exercise in which they capsized the kayaks into the frigid water. This was perhaps a rude introduction to the kayaks, yet it was a valuable lesson for safety and survival on the long trip.

Our team was unique to the SFS groups in Glacier Bay in that the long trip to the study site allowed for research opportunities in addition to the scheduled seal research. Following a request by NPS, we spent several days in the protected waters of the Hugh Miller Inlet area completing a preliminary study of molting scoters. Our census showed that thousands of scoters (> 3000) were in the area indicating its importance as a molting ground for the birds. A novel finding was that surf scoters as well as white winged scoters were abundant in the mixed flocks of molting scoters.

In addition to variety, the pause in our travels also provided the inspiration for several independent projects by the students. Two students designed a methodology for studying the behavior of the scoters and most team members contributed to this effort. Another student studied the haul-out pattern of over 100 seals which were utilizing a previously undocumented site for climbing out of the water and resting.

We timed our study of the harbor seals in Johns Hopkins to be simultaneous with the work of the group in Muir Inlet. Group spirits and motivation were kept vibrant by the constant thundering of pieces of the glacier face falling into the water, the thousands of seals in view, and the majesty of the 6000-foot peaks which surrounded our study site.

Counts of hauled seals were as high as 5200 in the inlet. The census could be laborious and difficult when many of the seals were visible through a spotting scope only as dark spots on the icebergs a mile or more in the distance. Yet, all of us learned the patience, persistence, and meticulousness that are required of a field researcher. In addition, all students received training and experience with the theodolite, a surveying instrument used to give precise and quantitative measure of the distance at which hauled seals are disturbed by boats entering the area. Undoubtedly the most favored research activity was behavioral work because it allowed for close observations of seals for extended periods of time. The black specks counted during the census were realized to be animated and curious beings. Further results for the research require analysis of data from all three SFS sessions.

One of the most satisfying aspects of the course for the staff was arousing the students' interest in all aspects of the natural history of Glacier Bay. With an introduction to the plants, animals, and geology plus a review of the resources available in our portable library, the students blossomed as amateur naturalists. Identification of birds and plants was a daily activity enjoyed by all, and improvement in observational skills was evident in their field journals and discussions. This wilderness experience, during which minimal impact on the environment and resource management/conservation were emphasized, gave many of the students a new perspective on the human role in the global environment.



Photo by Darcy Winter

Gliding along with whales, porpoise and seals with only the thin plastic wall of our kayaks between us reinforced the fact that we were as much a part of nature as they were.

As the Hopkins team proceeded with its research on the distribution, population and haul out patterns of seals, we began comparative studies further east in Muir Inlet where the habitat of the seals is rapidly changing. In this inlet, the massive Muir Glacier is in the process of going aground, eliminating the ice habitat for seals. Our research focused on how this phenomenon is affecting the population and behavior of seals.

After several days of lectures, kayaking lessons and tip over drills and exposure to wilderness and research skills, we left the comforts of Bartlett Cove and began our 60 mile journey northward by kayak to our main study site in upper Muir Inlet. Frequent stops were made along the way where seal haul out sites could be observed and counts taken. In this early phase of the research, we worked closely with small groups of students to train them in the most accurate censusing techniques so they would be prepared for the research in Muir Inlet. As we proceeded up the Bay, a large array of wildlife accompanied us including humpback whales, harbor porpoises and many species of marine birds. Students kept detailed field journals of all sightings as well as observations on weather, vegetation and route.

By the time we arrived at the base of our main observation site in Muir Inlet after 8 days of kayaking, students had become well adapted to their surroundings and were more confident of their personal limits. The entire team climbed up a 1000 foot slope with all our equipment to establish our base next to an observation area that offered an ideal vantage point for taking a census of the seals and for watching their behavior.

From the craggy sites, awesome vistas of the raw precipitous land fresh from under the ice unfolded below. The research began in earnest with observations every three hours from 6 am to 9 pm. Two teams scanned the icebergs below with binoculars and spotting scopes counting seals hauled out on ice and swimming in the water. It took some practice to keep from getting lost as the students scanned a several square kilometer area and counted up to 1200 seals on hundreds of icebergs.

One tangent of our behavioral studies focused on the impact of vessels on the behavior of seals. When any vessel was spotted entering the study area, a practiced scramble took place to bring personnel and research equipment to bear on determining how far away vessels disturbed seals. The vessels ranged in size from cruise ships to kayaks. A sophisticated surveying instrument called a theodolite was used to plot the locations of seals and vessels while observers monitored the behavior of seals on icebergs in the path of the vessel.

During breaks from the research, lectures were presented on marine mammal conservation and management, seal adaptations, plant succession, and the natural history of Glacier Bay to give them the background to understand the significance of the research they were conducting. Students also completed individual projects ranging from plant succession to measuring daily changes in the positions of the glacier. These projects provided an opportunity for students to design and carry out a project on their own and to learn about the rewards and pitfalls that are involved in such research. Students then presented their projects to the group at the end of the session.

A satisfying result of the research was seeing an increase in the harbor seal population level in Muir Inlet despite a steadily decreasing amount of ice. Incorporating this team's data with that of the Hopkins Inlet teams showed an overall increase for these two inlets since the mid-1970's. Unfortunately, extreme time constraints prevented us from completing the analysis of all our team data at the end of the course; however, we hope the final analysis in the near future will lead us to a better understanding of how seals in Muir Inlet are adapting to changes in their habitat. In addition, with our data and future studies, we hope to determine how seal behavior is altered by encroaching vessels.

Special thanks to: Pete Donow and the staff of the Glacier Bay Lodge, Don Chase, Maggie Rivers, Michael Tollefson (Superintendent) and Gary VeQuist (Resource Management Specialist) of the National Park Service; Anjanette Perry of the University of Hawaii; and John Calambokidis.

MARINE MAMMAL BIOLOGY AND CONSERVATION — TEAM III

Glacier Bay, Alaska July 27 — August 30

Faculty: Pierre Dawson, Sara Harrison

Students:

Leslie Bonneville — *Michigan University of Michigan*
Susan Booth — *Maryland Yale University*
Jacky Cheng — *Oklahoma University of Oklahoma*
Iris Frey — *Tennessee University of Tennessee*
Alisa Hoffman — *Wisconsin University of Wisconsin*
Carol Migalski — *Illinois University of Illinois*

Chuck Nieder — *New Hampshire University of New Hampshire*
Joan Nockels — *Illinois Northwestern University*
Ada Overberg — *Oregon Oregon State University*
Lisa Van Hulsteyn — *Texas University of Texas*

“I thought I knew what the word ‘wilderness’ meant. I didn’t. It means untouched natural land and habitats. We experienced wilderness like few have. We washed in glacial streams, cooked in the rain, slept under the stars, wore the same clothes, had no electricity, no mirrors, no running water. We really got the feeling of being part of the land, being a part of nature.” *Leslie Bonneville*

ENVIRONMENTAL GEOLOGY

Mt. Vesuvius, Italy June 16 — July 17

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

Faculty: Richard Hazlett, Ron Elan

Students:

Jeanette Alexander — California
Occidental College

Virginia Bousum — Maine
Colby College

David Buesch — California
California State University at L.A.

Timothy Burch — California
Occidental College

Julie Parker — New Jersey
St. Lawrence University

Carol Pfatteicher — Pennsylvania
Mount Holyoke College

Claudia Polsky — New York
Harvard/Radcliffe

Caryl Sheehan — California
University of Southern California

Irena Van Santvoord — New York
Hofstra University

Susan Whitney — Massachusetts
Colby College

Photo by Julie Parker



Based in a lush forest reserve high on the western flank of Vesuvius, our team was involved in a program of fieldwork, mapping and formal study of deposits on a potentially active volcano. We also investigated the role of volcanism in cultural development, both past and present. Vesuvius, with its notorious history and rich association with Roman antiquity offered an ideal environment in which to conduct these studies.

In 1944 Vesuvius produced its last eruption to date greatly deepening its crater, destroying a town with lava and showering the surrounding countryside with ash. The significance of this eruption lies not just in the fact that it was the latest eruption to have occurred, but that it terminated three centuries of nearly continuous, cyclical activity. The present interval of dormancy indicates that when Vesuvius reawakens, it will probably do so with extreme violence. Why did Vesuvius suddenly undergo a change in behavior in 1944?

Although it was beyond the scope of our team research to fully address this question, a valuable contribution was made to our understanding of the character of the 1944 eruption. The primary objective of the research involved identification, stratigraphic analyses, compositional surveying, mapping, and morphologic study of a sequence of well-exposed deposits on the upper flanks of Vesuvius dating from 1944.

Our field camp was set up in an abandoned garden on the grounds of the Vesuvius Volcano Observatory, about 2.5 miles from our study area. Each day, we set out on foot with equipment, canteens, lunches, and knapsacks to "tackle the mountain." Depending on temperature, the research team worked from 8 to 10 hours in the field studying rock formations, collecting samples and constructing geological maps of surface structures. Following lunch, lectures were given on topics including mineralogy, phase petrology and plant tectonics, and a brief siesta taken before we returned to the field.

While our living conditions were primitive, we benefited from the proximity of the Observatory. We were able to use the library facilities of this institute for reading, the preparation of technical reports and for data compilation. Evening lectures were usually given in the library after dinner.

During the course, several field trips were undertaken to sites of geologic or cultural interest in the vicinity of the study area. These sites included the ruins at Pompeii and Herculaneum, a visit to the partially evacuated summer villa of Poppea, wife of Emperor Nero, a tour of the huge quarries at the western base of Vesuvius and an excursion to the National Museum of Naples. These trips enabled students to witness first hand the tremendous power of past volcanic activity at Vesuvius.

Following the research phase of the course, we departed for a week of study and field trips in the Aeolian Islands, a volcanic area a short distance north of Sicily. Here, we spent a windy night atop Stromboli, viewing a spectacular sequence of volcanic eruptions in a nearby crater. For the students, this experience gave life to the lecture section of the course and provided unforgettable memories of one of nature's most impressive processes.

On the Island of Vulcano, the team explored the crater of the Gran Fossa, another potentially active volcano which threatens a small port city at its base. On nearby Lipari several other field trips were taken to measure and statistically study stratigraphic sections of volcanic deposits in the Valle Muria and to study the world's only known occurrence of liparite, a spectacular glassy lava flow unique for its high alkali content.

Our three-week research effort paid off in demonstrating the true nature of many 1944 deposits which may help to determine future volcanic activity from Mt. Vesuvius. Our fieldwork showed that these deposits were the result of gravity-driven avalanches and not gas-driven pyroclastic discharges as had been previously thought. This modifies scientific knowledge of the 1944 eruption significantly and may provide new clues as to the reason Vesuvius ceased erupting after this event. A joint team-authored research paper on these findings is in preparation for submittal to *Bulletin Volcanologique* in the near future.

Special thanks to: Dr. Michael Sheridan (Arizona State University), Dr. Scandone, Dr. Fiuniciello, and Dr. Rosi of the Italian University system.

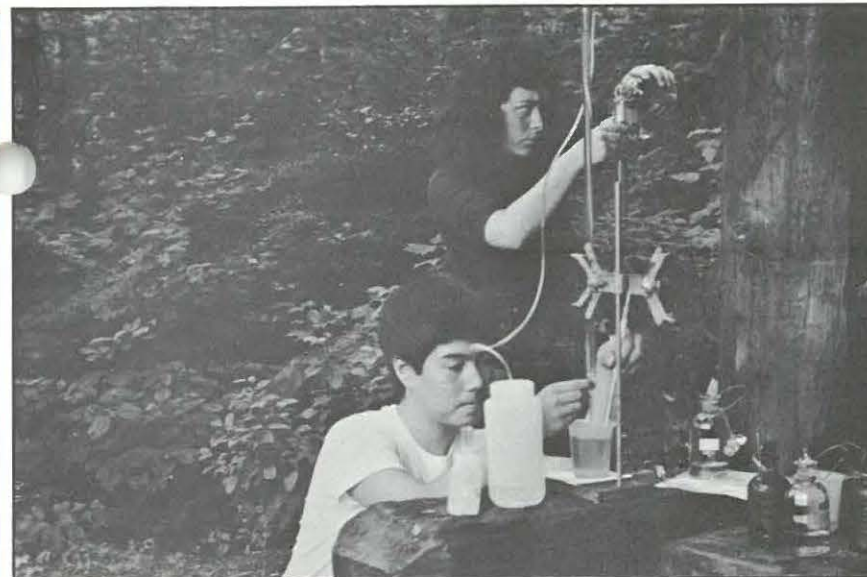


Photo by Barth Anderson

Although our field laboratory could at best be called makeshift, we still had to perform our pH titrations with utmost care and precision.

Our research was a direct outgrowth of work conducted by an SFS team in 1983 in the Adirondack Mountains. Last year, the communities of eleven lakes, along with relevant chemical characteristics were described. This year, we sought to discover why the organisms which survive in acidic lakes are there and more specifically, to distinguish direct effects of acid rain from indirect food-chain effects.

We spent our first two days in Bolton Landing, N.Y., at the Fresh Water Institute (FWI) of Rensselaer Polytechnic Institute (RPI). This research facility on the shores of Lake George served as our base camp to which we would return periodically throughout the course. After a few introductory lectures and initial exposure to the various research techniques students would be using in the field, we embarked on our first field expedition to Beaver Brook, where we would conduct our research for four days.

Beaver Brook, near Indian Lake in New York, is part of a study designed to determine what happens to the biology and chemistry of streams receiving acidic deposition as they interact with watersheds in their courses. Beaver Brook is enigmatic because there is a rise in pH (or a decrease in acidity) as the stream flows down Snowy Mountain, a rise not immediately attributable to any source.

After hiking for an hour through lush deciduous forests, we established our camp halfway up Snowy Mountain. Lectures were presented on the chemistry of water, pH, and acid neutralizing capacity, and students were instructed on the practical aspects of measuring these parameters. They then practiced these procedures until they all agreed on the results. In the afternoon, we hiked to the top of the 4,000 foot peak of Snowy Mountain for a spectacular 360 degree view of the Adirondacks.

Over the next several days, we walked the course of the entire stream, taking measurements and looking for intrusions of rock types such as limestone which could account for the variability in acidity. Stream flow was measured with a portable meter and the pH was continually monitored. Results from this study showed that one small tributary of the stream served as the principle source of acid neutralization in the entire watershed. Having completed our research, we then returned to FWI to dry out and learn more skills and background material.

After four days at FWI, we headed out on a long five-mile canoe trip in heavily-loaded canoes down the length of Stillwater Reservoir. A short but heavy rainstorm was a portent of things to come as we unpacked the boats for the mile hike to the next camp on the shore of Salmon Lake. This site, which would serve as

our base of operation for the next fourteen days, had a lean-to, an outhouse and several comfortable tent sites. It soon became home, and challenging day hikes of up to twelve miles to conduct research in various remote lakes made Salmon Lake seem like a return to civilization.

The primary group research project was designed to determine the effects of different pH conditions on the growth of the algal mat which covers mud substrates in acidic lakes. Using SCUBA gear which had been carried in by the team, students collected plastic cores full of water and the mud/algal mat community from the bottom of several lakes. The pH of the water over the algae in the cores was adjusted, and the cores were incubated for several hours. Measurements were then made to determine what effect increased pH had on the growth of the algae. These measurements indicated that oxygen production did not vary significantly under different levels of pH suggesting that acidity does not severely affect the productivity of algae.

Students had the opportunity to conduct independent projects as well, including chemical studies of acidification, effects of natural brown-water acidity, effects of predatory insects on zooplankton, vertical distribution of predatory insect larvae in several lakes, growth of bladderwort at different pH levels, and the effect of *Sphagnum* moss on water chemistry. At night back at our camp, they discussed their research and began the initial analysis of their data. On the final full day of the course, students presented final reports on their projects to a group of RPI students and faculty who had just arrived for a course on aquatic ecology.

After 14 days in the field, the team returned to FWI for four hectic but rewarding days. Most of the time was devoted to compiling and analyzing team data. From the results of this analysis, students found that the dominant plants which inhabit acidic lakes are not living under a major stress which affects productivity. In fact, plants that are surviving the acidification are not merely struggling through their life cycles, but are seemingly thriving. This finding favors hypotheses which imply that acidification causes alterations in ecosystems, but not necessarily a reduction in productivity. If these conclusions are validated with further research, the idea that acidification leads to "dead lakes" will have to be discarded.

Special thanks to: Don Long, Larry Eichler and Chuck Boylen at RPI's Freshwater Institute, Terry Perkins at the New York Department of Environmental Conservation, and Chris Cosentini at Syracuse University.

"The field skills and knowledge I acquired during my course far surpassed those of any other course I have taken. Other courses have not presented so much material while at the same time maintaining such a good balance between lectures, field work and personal time." Kirsten Turner

PRIMATE SOCIAL BEHAVIOR

Costa Rica July 24 — August 23

Purpose: To study the present population distribution of howling monkeys in an area which has been deforested.

Faculty: Margaret Clarke, Evan Zucker

Students:

Todd Broseghini — Massachusetts
Rollins College
Lieta Comfort — New York
Pine Manor College
Aaron Ferster — New York
Clark University
Adrian Forman — New Jersey
Princeton High School
Albie Nash — Massachusetts
Hebron Academy
Katharine Offutt — Ohio
Hathaway Brown

Ronald Phillips — New Jersey
Princeton High School
Romana Prokopiw — Ohio
Ohio State University
Robert Rand — Massachusetts
Boston University
Charles Rosenthal — New York
York College
Jay Sears — New York
Hackley School
Betsy Thompson — Virginia
Virginia Tech



Photo by Margaret Clarke

Counting the evasive howlers in the thick canopy required concentration and patience.

Hacienda La Pacifica, which is located in Guanacaste Province, Costa Rica, is a working cattle ranch which has been deforested by its owner in an enlightened manner. The 3300 acre ranch, with its three rivers and three forests is still one-quarter riparian and upland forest of the deciduous dry tropical life zone, and supports a population of howling monkeys as well as a variety of other wildlife. Studies of this howler population in the early 1970's suggested that they were stressed, and that their numbers would be diminishing. Our team attempted a thorough census of the farm in order to determine if this prediction was true, or if a stable or even increasing population of howlers is present today.

During the study, we stayed in small cabins adjacent to the farm. The students first had to become familiar with the farm and the forests, but most of all, they had to learn how to spot and identify animals in the trees. A sleeping howler is easily missed, and nests are mistaken for howlers which often appear as dark areas in the trees. The hardest part for most students was learning how to slow down and to concentrate on keeping their eyes looking up toward the trees.

By the fourth day of the course, the students were sufficiently acclimated to plan the census, including how much time they needed, how far they would walk each day, and how many census parties were appropriate. Having planned the census themselves, they were enthusiastic about carrying it out according to plan, and they spent six challenging days walking many miles and counting numerous howlers. Census party composition was rotated on a daily basis so students learned how to work effectively with all group members.

During the course, students were exposed to a series of lectures on evolutionary principles, population dynamics, deforestation and development, and research design and statistics, as well as a variety of topics on primate social behavior. These lectures gave students a solid basis for designing and analyzing their independent research projects.

By the time the census was complete, each student had a good idea of what they wanted to study, and they each presented their proposals to the rest of the

group for comments and criticism. Students were encouraged to undertake projects comparing howler behavior in the two habitats on the farm, but all chose instead to do projects within the realm of traditional primatology, including such topics as dominance, play, and other types of social interactions.

Independent projects began two days after the census was completed and continued for ten days. Students had to demonstrate personal responsibility to keep to their planned schedule and to tabulate their data daily. Anecdotes from the field became the major source of conversation during meals and with so many pairs of eyes in the field, very little was missed. As a part of a demonstration of the ongoing demographic and behavioral research on howlers at La Pacifica, some of the students participated in a capture and mark session. One solitary female was brought down, measured, tattooed, collared, and released. This procedure required patience, cooperation and concentration and was an experience which most of the students will probably never forget.

On the last day of the course, students gave formal presentations on their findings and gained first-hand experience with the effort, concentration and precision needed for scientific research. Their projects revealed preliminary findings on female and male dominance hierarchies, play behavior, mother-infant behavioral synchrony, interactions of juveniles and infants with other group members and adult affiliative and agonistic behavior. Preliminary results of our census indicated that the present howler population was comparable to the howler population of ten to fifteen years ago, and that this population appears to have stabilized following deforestation. The quality of the presentations allowed each student to gain an appreciation for the variety and intricacy of howling monkey social behavior and population dynamics.

Special thanks to: Lillian and Werner Hagnauer at La Pacifica, Vreni Leigh for his assistance with transportation, Ken Glander for rushing equipment to the team, Bob Jeanne for his lecture on insects and Dr. Frank Bonaccorso for his assistance throughout the course.

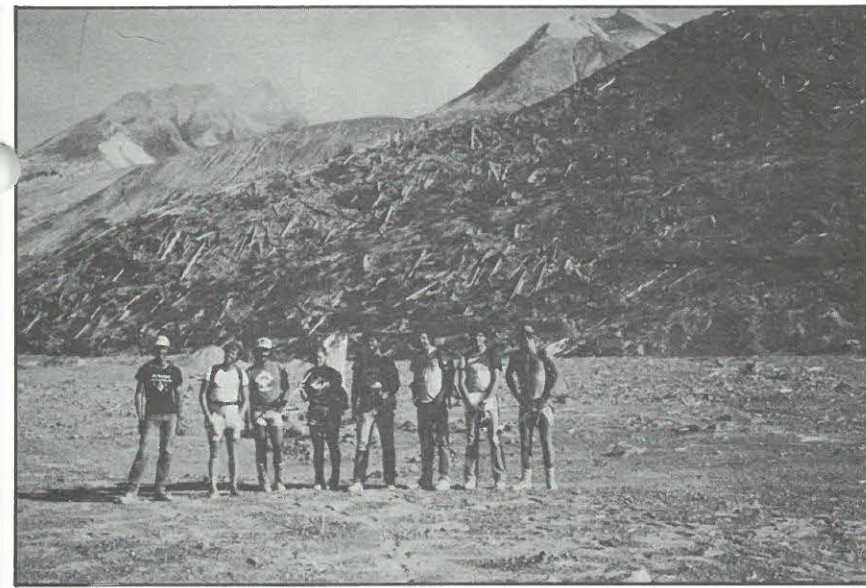


Photo by Katie Hinckley

Our team expanded on the research conducted by two previous SFS teams in the devastation zone created by the May 18, 1980 lateral blast of Mount St. Helens. For the first two years research centered on the relationship between vegetation recovery and elk recruitment in managed areas northwest of the volcano. This year our work was more diversified to include a study of small mammals and insects as well as to continue our study of vegetation recovery within the area. Once again, some time was devoted to ungulate behavior within the blast zone.

We established our campsite on Coldwater Ridge approximately 3 miles northwest of the edifice of Mount St. Helens. A brief orientation involved discussions of the objectives of the research project and addressed strict safety precautions that were to be followed throughout the research due to the remoteness of the study site. Lectures were presented on topics including the history of Mount St. Helens and plant community development after volcanic disturbances. We then began our field research which focused around the largest avalanche deposit of contemporary history. Each morning we made the arduous five mile hike to this debris slide to conduct our work.

Once on site, we began our research on the distribution of small mammals, establishment of native and exotic plant species and inventory of insects. Mammal traplines were set in areas in which 250 m² permanent plots had been established in previous expeditions. A minimum of 3 small mammal traplines were set in each of 3 habitat types created by the 1980 eruption (debris slide, blowdown timber, and areas in the blast zone that had been clearcut before the eruption). Each trapline consisted of 25 stations with small and large Sherman live traps set at each station. Every day, these traps were monitored. Tail hairs were clipped on first captures and after tail and hind foot lengths were measured and sex determined, the animals were released.

The vegetation and insect studies involved attaching seed traps to wooden frames that were placed in permanent vegetation plots. Beetle traplines, vegetation plots and in some cases seed traps were run in conjunction with the mammal traplines. Seeds and insects were removed from the traps during the expedition and identified. An insect species list was then compiled for the area representing 13 orders and over 160 species.

The course enabled students to complement the main research with individual projects that they

designed and conducted. Topics included variation of sex ratios of small mammals as a function of vegetation cover and geological habitat type, correlation of small mammal diversity and relative abundance as a function of vegetation cover and geological habitat type, and seed and seedling recruitment on the debris slide as a function of distance from seed source and soil moisture. Several days were spent in Seattle using a minicomputer to analyze plant and animal data from both these studies and the team projects.

A welcome respite from the research allowed students to spend two days studying elk and deer with Evelyn Merrill who had been associated with the two previous SFS expeditions in the area. With radio-tracking equipment, the team was able to track the magnificent elk in the blast zone. Students acquired first-hand experience with telemetry equipment and were able to observe foraging and social behavior of elk in open habitats.

The extensive research in the blast zone resulted in several interesting findings about the reestablishment of small mammals and vegetation. In the mammal studies, we discovered that deer mice were found in all habitats including the north slope of Mount St. Helens and on the debris slide. Relative abundance and diversity of small mammals was highest in habitats with blown down forests. In this type of habitat, we caught shrews and later, weasels, chipmunks and field mice. Beetles and seeds were found in significant numbers along the traplines and probably serve as food for the small mammals.

In the vegetation studies, we found that the cinna-bar moth (an insect restricted to one plant) had become established upon tansy ragwort throughout the blast zone and that this moth as well as other herbivores are having a significant impact on exotic species present within the blast zone. Most of the herbivores, however, were ascertained to be generalists rather than specialists as in the case of the cinna-bar moth. We also observed that areas of land subject to management prior to the eruption were occupied by more exotic species than unmanaged land, and land managed by burning after the eruption had still higher proportions of exotics relative to natives.

Special thanks to: the Weyerhaeuser Corporation, Department of Emergency Services in Washington state, Cowlitz County Sheriffs Office, Gifford Pinchot National Forest, the Burke Museum, Department of Natural Resources in Castle Rock and Dr. Steve West at the University of Washington.

ECOLOGY OF EXOTIC SPECIES

Mount St. Helens, Washington

July 24 — August 24

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

Faculty: A.B. Adams, Sandy Leffler

Students:

Floyd Braid — Ohio
Wright State University
Julio Dal Monte — Illinois
N.E. Illinois University
Katie Hinckley — Ohio
Denison University
Carol Hinzman — Washington
University of Puget Sound

John Kasbarian — New Jersey
Columbia University
William McElroy — New Jersey
Cook College
Kevin Reid — California
St. George's School
Tim Yarrington — Connecticut
Westfield High School

"This expedition spanned such an enormous variety of situations that occur in field research that it supplied a truly realistic view of such work. Probably the most unique and rewarding aspect of the course was the opportunity for growth on an individual level, each student having the chance to absorb the expedition in their own way." Tim Yarrington

WILDLIFE CONSERVATION — TEAM I

Kenya June 16 — July 20

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

Faculty: Dusty Becker, Brad Stelfox

Students:

Dillon Cohen — New York
Dalton School

Sarah Lampert — New York
Dalton School

Zadya Lundgren — Connecticut
Hampshire College

Lisa McLaughlin — New York
Colgate University

Janice Nicholls — Texas
University of Michigan

Lyssa Noble — California
Santa Monica High School

Mary Lou Nordell — Florida
Stanford University

Brett Oliver — Alberta
University of Alberta

Tony Optican — New York
Phillips Andover Academy

Chad Reed — Pennsylvania
Wallenpaupack High School

Eva Sgarzi — Massachusetts
Boston University

James Shields — New York
Concordia College

Valeria Young — Alberta
N. Alberta Tech



Photo by Sarah Lampert

"Not only did I learn a tremendous amount about the study of wildlife, but I also learned a lot about dealing with people with whom I had to live closely for five weeks. During these weeks in Kenya, I learned a great deal about myself while enriching my education." *Zadya Lundgren*

Kenya's national parks and David Hopcraft's ranch (Wildlife Ranching and Research, Inc.) south of Nairobi provided excellent facilities for studying tropical grassland ecology, the ungulates of East Africa, and game ranching as a method for conserving the African savannah ecosystem. Here, we studied the behavior and social structure of native hooved animals, such as wildebeest, kongoni, zebra, giraffe and gazelles. The main focus of our research was on cropping as a wildlife management technique and its effects on ungulate behavior and social structure. Specifically, we compared flight distances (distance from observers when animals fled) and the social structure of ungulates on the ranch and in Nairobi National Park and two other game reserves.

Sunrise over Chumvi Mountain and the golden Acacia-grassland was the signal for us to leave our tents to begin our research. Each morning after a campfire breakfast, two research groups were formed, with one team responsible for collecting data on the ranch, and the other for collecting data in Nairobi National Park. As one student recorded data, others called out information on species, group size, the number of adult males and females, the number of young and the distances at which the animals became accommodated to the presence of the research team. Approximately a week of preparation and academic work was required to enable students to collect dependable data.

The Hopcraft ranch facilities offered students the opportunity to study not only the behavior of ungulates and to learn about the morphology of various game animals, but also to witness first-hand the practice of game cropping. Every Tuesday evening, we headed off in Land Rovers to different sections of the ranch to participate in the weekly cropping regime. The cropped animals were then brought back to the facilities for dissection and for students to collect morphometric data and information on endo- and ecto-parasites. Advanced lectures and demonstrations were given on digestive anatomy and physiology to complement the laboratory research.

Two extended safaris outside the ranch were made to different regions of Kenya to collect additional

comparative data on ungulate behavior. We spent three days in Amboseli Park south of Nairobi and a full week further east visiting Lake Nakuru, Lake Naivasha, Masai Mara and Suswa Mountain, all sites that contained an abundance of the ungulates we were studying.

Although most of our time on these safaris involved tracking various species, collecting data or engaging in other aspects of the research, we were able to witness the incredible wildebeest migration through the lush grasslands of Masai Mara and to observe the millions of spectacular flamingos in the Rift Valley lakes. In addition, we had the opportunity to hike to the top of Suswa Mountain. Though completely exhausted upon reaching the peak, we all shared a feeling of accomplishment as we gazed out over vast expanse of the Rift Valley.

We were also exposed to some of the indigenous tribes and their cultures. On the ranch, we worked closely with members of the Masai and Kikuyus, two of the more dominant tribes. Occasional trips to Nairobi provided fascinating cross-cultural experiences, as well as fulfilled such practical pursuits as buying food and supplies. Visits to local Masai "manyattas" (dwelling places) exposed us to the primitive, subsistence living of this tribe.

Back at the Hopcraft ranch, we compiled and analyzed our data and prepared a final report which was presented to the ranch management and several guests. Our results suggested that game cropping has a significant impact on the behavior and social structure of ungulates. We found that ungulates that were cropped on the ranch were more likely to flee and stay farther from vehicles than the same species observed in national parks and reserves.

In addition, we found that the sex ratios on the ranch were heavily biased toward females. Although no disadvantages were noted during the study, the students suggested that the cropping of large, fit males may have harmful effects on the gene pool of the ungulates on the ranch. We pointed out ways of reducing certain negative aspects of game ranching which should prove beneficial to the ranch.



Photo by Annelise Allan

After a full day of studying ungulates on the ranch, we relished those relaxing moments back at camp to share ideas and to discuss the day's adventures.

Based on the Hopcraft ranch just south of Nairobi, our team continued the research conducted by the June team on the effects of cropping on the behavior and ecology of ungulates. Whereas the June team looked at both the effects of cropping on sex and age distribution and the wariness of individual species, we concentrated primarily on the latter topic and expanded on the findings of the first team.

After arriving in Nairobi, we climbed into our Land Rover and Volkswagen bus and headed south to the Hopcraft ranch. Still completely awed by the beauty of the landscape and the diverse range of animals moving gracefully through the savannahs, we rapidly set up our tents on the ranch compound. Students were introduced to the ranch personnel who quickly made them feel at home in this totally foreign but enchanting environment.

The first week was hectic. Students were exposed to a vast and exciting array of information ranging from Swahili lessons to lectures on East African ecosystems, ungulate identification, introductory ecology, hypothesis testing and research methods. They were gradually exposed to the plants and animals of the region and through field trips in the ranch vehicles, soon became proficient at field identification.

Equipped with a knowledge of their environment and an understanding of the research methods they would employ in the field, students generated a testable hypothesis designed to help answer important questions about the effects of cropping on the wariness of game animals. With this hypothesis, we then began an extensive survey of several of the animals most common to the ranch including gazelle, giraffe and wildebeest. Usually working from 8 am to 10 or 11 pm, we recorded flight distances (distance between animal and vehicle at which the animal is first startled) of these species from our vehicles. On several night ventures on the ranch, we had the rare opportunity to see some of the more unusual animals including the bat-eared fox, striped hyenas and the lesser galago or "bushbaby" that appeared fixated by the light from the vehicle.

At the end of each day, the entire team and ranch personnel engaged in general discussions on the pros and cons of game ranching, and on our role in helping to solve some of the problems facing ranch managers. Because the ranch represented a new approach to wildlife management, students enjoyed the opportu-

nity to make contributions to the refinement of the ranch cropping strategy.

For the purpose of conducting comparative studies of the behavior, particularly the wariness, of species within and outside of the ranch and of introducing students to different regions of the Kenyan ecosystem, we took two safaris during the course. The first safari was to Amboseli, a magnificent park just south of the Hopcraft ranch on the Tanzanian border. Here, we witnessed a lion stalking a wildebeest through the tall grass and saw nearly every imaginable kind of animal. Though usually enshrouded in clouds, we were treated to a full view of the snow-covered peak of Mt. Kilimanjaro one evening. Scientists who were conducting detailed studies of elephants in Amboseli presented us with an enlightening talk on their research.

The second safari involved an eight day trip to Lake Nakuru, Lake Naivasha, Masai Mara and Mt. Suswa all within a 100 mile radius of the ranch but offering an incredible array of spectacular sights. At Nakuru, the flamingoes, colobus monkeys, leopard and sunrises on the cliffs overlooking the lake were among the many memorable sights. In the Mara, we observed hyenas and lions at a kill, elephants, teeming herds of wildebeest, and a cheetah displaying its musculature atop an enormous anthill.

Throughout our research, we found substantial variations between flight distances of individuals of the same species which made it difficult to determine exactly how flight distances varied between species. Our preliminary results did suggest, however, that contrary to the results of the June research, the type of vehicle or time of day had little effect on the wariness of most species. The only species that it did seem to have a substantial impact on was the Thompson gazelle. In addition, we found that cropping did seriously affect sex and age distribution. The ranch managers were encouraged by the results of the flight distances because it meant that their cropping procedure was not seriously affecting the animals behavior.

Special thanks to: the ranch managers, Phil Tilley and Ernie Motteram who helped keep the course running; David Hopcraft for the use of his ranch; Brad Stelfox and Dusty Becker for their generous assistance with team #2; Sandra Price (African Wildlife Foundation), Elsen Karstad, Keith Lindsay, Phyllis Lee and Joyce Poole for their informative lectures; Otieno, Nygom and Malay for their patience and help on the ranch; and Sally Church for her continuing help and advice.

WILDLIFE CONSERVATION — TEAM II

Kenya July 19 — August 22

Faculty: Stan Koster, Benj Kagan

Students:

Annelise Allan — Michigan
Mount Holyoke College

Dennis Branchaud — Rhode Island
Rhode Island College

Christopher Ellis — Maryland
Marietta College

Leslie Greenslet — Connecticut
Colby College

Penninn Johnson — Utah
Berkshire School

Rosemary Knapp — New Jersey
Rutgers University

Jocelyn Little — Missouri
Skidmore College

Elizabeth Marshall — Vermont
Stanford University

Sharon Taylor — California
American River

Robin Thompson — Virginia
Virginia Tech

Emily Wharton — North Carolina
Duke University

"Not only was my stay in Kenya immensely educational, I also learned about myself and relating to others. Our group had to be self-sufficient; we had ourselves and not much else. It was amazing to see how we got along with each other and grew together. During the expedition, I made some very special friends while having experiences that will be long remembered and cherished." *Rosemary Knapp*

HUMPBACK WHALE ECOLOGY—TEAM I

Gulf of Maine June 16 — July 15

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

Faculty: Ben Baxter, Greg Silber

Students:

Gwen Barros — Texas
University of Texas
Mary Jane Bovenzi — Massachusetts
University of Connecticut
David Bravo — Pennsylvania
Ursinus College
Melanie Dana — Connecticut
Boston College
Robin Esakof — New York
Cornell University
Deborah Goldstein — New York
Cornell University
Carol Hagstrom — New Hampshire
University of New Hampshire
Suzanne La Rochelle — Massachusetts
University of Massachusetts,
Amherst

Donna Lehman — Michigan
Michigan State University
Mark Leondires — Massachusetts
Colby College
Kimberley Marlor — Connecticut
Springfield College
Holly Martel — Massachusetts
Mount Holyoke College
Ione Smith — Tennessee
Vanderbilt University
Jean Welch — Illinois
Michigan State University
Suzanne Winterbottom — Maryland
Juniata College



Photo by James Elder

This course, located off the tip of Cape Cod on Stellwagen Bank, involved a pilot study focusing on the recent controversy over the potential impact of whale-watching vessels on humpback whale behavior. A 65 foot schooner *Lelanta* served as our home for an entire month and provided us with an opportunity to observe and study the mammals up close in their natural habitat.

After first arriving in Boston, we boarded the *Lelanta* and sailed out to Peddocks Island in Boston Harbor which would serve as our base camp throughout the course. With tents set up in an old apple orchard, students were introduced by Captain Scott Miller to safety procedures aboard the schooner. Brief lectures were then presented on whale biology, physiology, behavior and natural history to prepare students for their first day of research on Stellwagen Bank.

Within this study, students concentrated on both group and individual projects focusing on the impact of vessels on the behavior of whales as well as on the environmental factors of the whales habitat. The impact studies included examinations of whale respiration, dive times and directional changes relative to the presence or absence of vessels, and dramatic changes in engine rpms. The behavioral studies involved examining surface behavior relative to fish density, available ambient light, sea state, and time of day in areas where whales were sighted. In addition, environmental data, such as sea state, weather, water and air temperatures, were taken at hourly intervals each day. Thirteen separate data responsibilities were designed by the students, and the tasks were rotated among them each day to allow them to become proficient at each.

On days when weather permitted, we departed from Peddocks Island around 3 am. The three-hour trip to and from Stellwagen Bank usually involved lectures on oceanography, ecological principles, cetacean taxonomy and evolution and diving physiology. In addition, this time was used to train students in the techniques of sailing, plotting the ship's course, and navigation. Once on the Bank, students concentrated all their energy on collecting behavioral and environmental data as the Captain carefully maneuvered the *Lelanta* around the whales and whale watching vessels. The ability of the boat to get within several hun-

dred feet of the whales amazed the students and facilitated the recording of data; however, we usually observed the whales from a distance to prevent interfering with the possible disturbance caused by other vessels.

On occasion, we remained on the bank until after sunset to obtain general behavioral data from all daylight hours, giving us the opportunity to enjoy the nighttime solitude and beauty of the ocean. In addition, we made several day trips to the local seaport of Provincetown when inclement weather prevented us from sailing to Stellwagen bank. At this port, students were able to meet with several leading cetacean specialists including Dr. Charles Mayo of the Provincetown Center for Coastal Studies and Dr. Robbins Barstow from the Connecticut Cetacean Society. These trips gave students the opportunity to learn about current whale research projects and additional concerns amongst the cetacean community about the future of whale populations.

Preliminary analysis of our data indicates that there is very little negative response by whales in the presence of vessels and vessel noise, suggesting that habituation to boats may already have occurred. This conclusion was, however, hampered by inadequate time for analysis in the field and only a cursory look at the data. More detailed analysis involving several of the students will be conducted this fall. The team also found significant results indicating that a relationship exists between fish density and whale activity at the surface. A similar relationship was found between whale activity and the ambient light levels. In addition, there appears to be a correlation between sea states and surface activity.

These findings, which will be reported to the Connecticut Cetacean Society, The National Marine Fisheries Service and the Provincetown Center for Coastal Studies, are valuable for a number of reasons. First, they improve our understanding of behavior and habitat of humpbacks. Secondly, they will assist in structuring future studies on the impact of vessels on humpback behavior and thirdly, they may contribute to the design of guidelines for operators of whale watching vessels.

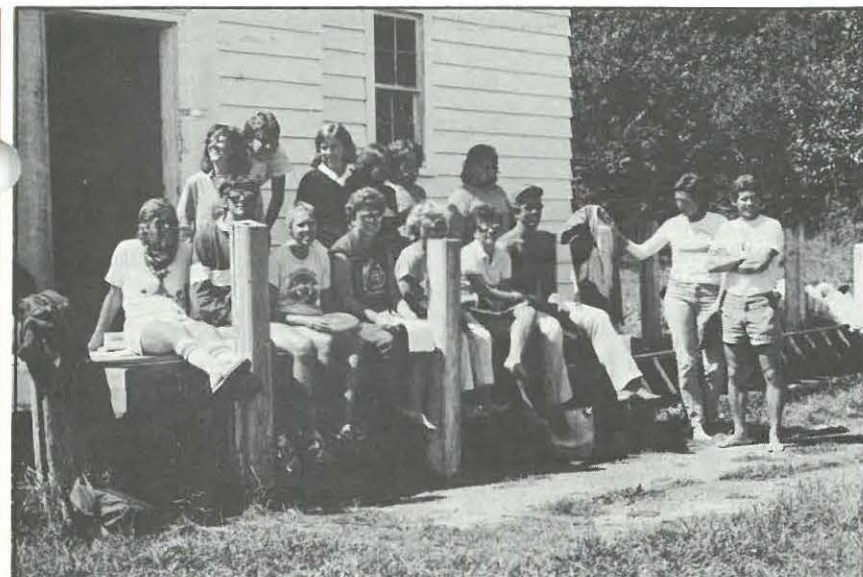


Photo by James Elder

HUMPBACK WHALE ECOLOGY—TEAM II

Gulf of Maine July 24 — August 22

Faculty: Jeffrey Goodyear, Numi Goodyear

Students:

Cynthia Bainton — New Hampshire
Bowdoin College
MaryKay Coffin — New York
Hunter College
Amy Dusza — Ohio
Denison University
Larry Iverson — North Carolina
University of North Carolina
Kristen Jackson — Virginia
Virginia Tech
William Jenkins — North Carolina
North Carolina State University
Ned Lawrence — Massachusetts
St. George's School

Kaaren Lewis — British Columbia
University of Victoria
Merryl Reichbach — New York
SUNY Albany
Tammy Schwalbe — Minnesota
University of Miami
Leslie Smith — Missouri
NW Missouri State University
Rae Wallhausser — Massachusetts
Monument Mountain High School
Todd Whitesel — Florida
Lake Brantley High School

Aboard the 65 foot schooner *Lelanta* off Stellwagen Bank, our team continued the humpback whale impact studies previously conducted by the June SFS team.

Each morning, often as early as 3 a.m., we departed the Provincetown Harbor or Peddocks Island land base in search of humpback whales and vessels. Students were assigned to one of three watches each day, which changed on a regular basis. The science watch had full responsibility for maintaining the environmental journal, which included the following recordings: all sightings of whales, their positions, and surface behaviors; water depth, fish school size, and depth as seen on the echo-sounder; sea surface and air temperature; and sea surface conditions, feed activities of birds, and weather.

Students on the sailing watch assisted the captain in plotting and steering the ship's course, setting sails and anchor, and swabbing the deck while the cooking watch was responsible for providing the team with a variety of meals from peanut butter and honey sandwiches to fresh bluefish and steamed dumplings. Once whales and vessels were sighted in close proximity to one another, all students joined the science watch and assisted in collecting data.

Students took turns with several methods of data collection and became proficient in many of them. Determination of degree headings and bearings of both whales and vessels by means of a compass was easily mastered, while distance estimates were more challenging. An optical range finder was used to help students standardize their distance estimates.

Sound levels were monitored under conditions where whales and vessels, whales only, and vessels only, were present. A sensitive hydrophone and tape recorder system allowed vessels to be categorized as to sound intensity given a certain distance away, engine and transmission status. On one occasion, a whale was radio-tagged and monitored in order to facilitate collection of respiration data. Perhaps the most fun, yet demanding type of recording, was interpretation of observable behavior of whales.

In addition to participating in the main research project, students prepared individual reports on an aspect of the study of particular interest to them. These reports gave students the opportunity to learn how to prepare a scientific paper involving the statistical analysis of data and the interpretation of results. Students then presented their reports to the team on the last full day of the course.

Throughout the course, formal and informal lectures aboard the schooner were presented on topics including general identification, ecology, evolution,

behavior, and physiology of whales, techniques of marine mammal research including radio telemetry, and oceanography. Most lectures were followed by group discussions. Additional lectures were provided by visiting scientists who spoke on topics such as the distribution of whales, preyfish and their relation to oceanographic parameters, and the exploitation and harvesting of marine mammals in the world's oceans.

Perhaps the most lasting impressions in the course were those created by the animals. Day one on the water included a one and one-half hour stop where two humpback whales swam under and around the *Lelanta*. At times, these whales peered out of the water at the boat from five feet off the port beam. On another day, we sailed within a school of Atlantic white-sided dolphins which spanned over a one mile square area. Dolphins riding the *Lelanta*'s bow wave splashed students as they leaned over to get a better look.

As with any newly designed research method, much time, both in development and in testing is required before conclusive results can be obtained. But with persistent team effort throughout the course, we designed and began using a new, effective method of data collection and analysis. The preliminary results show some interesting trends, but more data are needed before the results are statistically significant.

The indications are, however, that the speed at which vessels approach or depart from whales may significantly affect their respiration rates and dive patterns. In addition, the sound level of boat engines may alter these aspects of the whales' behavior. With more data to substantiate these findings, this information will be directly useful to the National Marine Fisheries Service which is currently calling for management recommendations from the research community. Recommendations could determine the course of management of human activities in the Stellwagen Bank area resulting in a more secure future for humpbacks and other whales in the region.

Special thanks to: Dr. Peter Tyack (Woods Hole Oceanographic Institute), Dr. Robbins Barstow (Connecticut Cetacean Society), Mike Payne (Manomet Bird Observatory/NMFS Observer Program), Jim Bird (New York Zoological Society/World Wildlife Fund), Dr. Stormy Mayo (Provincetown Center for Coastal Studies), Tracey MacKenzie (National Marine Fisheries Service), Dr. Peter Major (Ocean Research and Education Society), Doug Beach (National Marine Fisheries) and Suzanne Ayvazian (University of Rhode Island).

"What I learned out on the ocean exceeded what I could have learned in an equivalent classroom course. Often, doing research oneself and making the mistakes too is a more efficient way of absorbing material. It is definitely a more satisfying way." Cynthia Bainton

TROPICAL RAIN FOREST ECOLOGY

The Amazon, Ecuador July 20 — August 24

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

Faculty: Amos Bien, Phillip Rury

Students:

Victoria Barcus — New York
Middlebury College

Linda Bowerman —
Rhode Island
Trinity College

Alex Burgin — Indiana
Wabash College

Jennifer Leak —
New Hampshire
Mount Holyoke

Scott Lohr — Massachusetts
Wentworth Tech

Michael Meresman —
New Jersey
Brown University

Steven Michmerhuizen —
Michigan
N. Michigan University

Sarah Porter — New Jersey
University of Rhode Island

Philip Robakiewicz —
Connecticut
Brown University

Leon Rosenthal — New York
Hunter College

Jeff Spackman — Oregon
Oregon State University

Robert Van Buskirk —
California
University of California, Berkeley

Photo by Sarah Porter



Vegetation, soils and insects differ profoundly in virgin (primary) and disturbed (secondary) rain forests. Our team, in the midst of the magnificent rain forests of Ecuador, studied these differences using vegetation transects, measurements of forest cover, analyses of soil samples, collections of plants and insects and a variety of individual field projects.

The Ecuadorean Amazon region (the "Oriente") was ideal for these studies because of its extraordinary biological richness, accessibility, safety and variety of habitats. The forest ranges from almost totally undisturbed areas to clear-cut areas. The large population of indigenous people and Spanish-speaking colonists has produced almost a laboratory demonstration of types and ages of disturbances.

After arriving in Quito, the students attended lectures on the flora and history of Ecuador at the Central and Catholic Universities. Immediately thereafter, we headed east on steep, winding roads over the Andes to the Oriente. Convenient breakdowns of the bus enabled students to see the transition from tropical to high-elevation vegetation along a 4000 meter altitudinal gradient.

From Puerto Misahualli on the eastern side of the Andes, we traveled with all our team equipment one-and-a-half hours downriver in a primitive dugout canoe to the first field site, a small Quichua Indian community on the river called Campana Cocha. At this village, lectures on various topics were given in the field on ecological concepts and study methods, forest structure and gap dynamics. We then began our field research by conducting comparative studies of air temperature, relative humidity, soil structure and chemistry, plant identification and understory analysis in primary, secondary, and recently deforested areas.

Familiar with the general flora and fauna of the area, students began to design and organize individual projects in the primary and secondary forests near Campana Cocha. Projects focused on topics ranging from termite nest abundance and distribution and ferns and fern allies species diversity to the foraging patterns and behavior of leaf-cutter ants and the feeding behavior of hummingbirds on flowers.

Although most field work, team and individual, was conducted during day trips from the base camp, several overnight camping trips were made deep into the primary forest across the river from Campana Cocha. These trips permitted prolonged access to the rather remote primary forest for the projects and also exposed students to the diverse range of animal species from lizards and hummingbirds to toucans and cat-

fish. During one of these trips, a group of us were attacked by leaf-cutter ants which rapidly devoured one student's hat. A line of kerosene effectively fended them off.

During the last night in Campana Cocha, a village political leader lectured on the history, political organization and economic and agricultural problems of the area. This was followed by a two hour discussion of these issues and the relationship between the indigenous people and the government's agricultural and social policies. We then offered advice on several local agricultural and forestry problems based on our previous experience and local observations in the forests and fields.

After two weeks in Campana Cocha, we traveled west to Yusupino and stayed in a large, raised shelter on a plantation owned by William Prentice. Day hikes took us into heavily disturbed primary and mature secondary forests where atmospheric, soil and floristic studies were repeated. Mr. Prentice gave us a tour of the plantation and showed us how his plantation was rapidly being destroyed by the Rio Napo. This gave students an opportunity to learn about the agricultural problems faced by plantation owners in the lowland Amazon.

We then journeyed to the Rio Palenque field station on the Pacific coast which provided us with our only visit to undisturbed primary rain forest in a region otherwise devoid of natural vegetation due to large scale oil palm plantations and banana, citrus and coconut groves. Here, we compared soil conditions and understory diversity of primary forests to those of heavily disturbed areas.

During the last two days in Quito, students finished their written reports and presented their results. Plant samples were organized and an impressive amount of data on the differences between primary and secondary forests was compiled in a final report. All soil samples, wood samples and duplicate sets of 130 different herbarium specimens, over 30 families of flowering plants, mosses and fungi were distributed to several local universities and museums. We all felt a great sense of satisfaction having collected a substantial amount of information on environmental factors and species diversity of rain forests, information that contributes to a crucial understanding of the species composition of these rapidly dwindling ecosystems.

Special thanks to: William Prentice (Yusupino, Ecuador), Dr. Calloway Dodson (Missouri Botanical Gardens), Dr. Warren Kaplan (Harvard University), and Department of Biologia staff at the Universidad Catolica.



Photo by Jill Truex

Among the many bottom samples we dredged up in Narragansett Bay was the occasional flounder which would become a welcome addition to our dinners on Patience Island.

Narragansett Bay is an island-studded arm of the sea approximately 25 miles from mouth to head, which, like other estuaries along the Atlantic coast, offers an abundance of marine life from hard clams and mussels to bluefish and flounder. Over the years, most of the Bay has remained clean. Many coves and rivers that feed into it, however, have been locations of unmonitored large scale discharge of human waste, toxic metals and organic chemicals from local industries. Invertebrates that live in bottom sediments are severely affected by these hazardous wastes. Our team was involved in studying the presence or absence of invertebrate animals and their physical condition to determine the effect of wastes on the Bay ecosystem.

The course was based at the Bay Campus of the University of Rhode Island's Graduate School of Oceanography on the west shore of the lower Bay. When students arrived at the Bay Campus, we immediately loaded all personal belongings and team research equipment into a wide inboard launch and a quahog skiff and traveled twelve miles up the Bay to Patience Island.

Patience Island, which is part of the Narragansett Bay Estuarine Sanctuary and is unoccupied and undeveloped, served as our home for 9 days. Although living conditions were primitive and the water supply limited, students adapted quickly to this setting and enjoyed the uncanny solitude of an island situated in the middle of one of the most densely populated states in the U.S.

The Island provided a central location to study sites of possible toxic waste accumulation. During the first two days, we took bottom samples and measured water temperature and conductivity in Pawtuxet Cove where the polluted Pawtuxet River enters the upper Bay. The degraded condition of the Cove was immediately apparent as methane gas bubbled to the surface during sampling. Additional bottom samples and water measurements were taken on long day trips up the Providence and Seekonk Rivers and the Taunton River in Massachusetts, all extensions of Narragansett Bay. A chartered 40-foot fishing vessel, the *Gail Ann*, which took the team up the Providence River, enabled us to dredge large numbers of hard clams at specific stations along the river.

On our return to the Bay Campus at URI, we set up camp near the large laboratory which served as our meeting and working place for the rest of the course. In the laboratory, all team members began the time consuming task of separating bottom animals from sediments.

During respites from this work, a broad range of lectures and field trips exposed students to the numerous scientific, economic, political, and social complex-

ities of the hazardous waste issue. Field trips took students to Ciba Geigy, the chemical plant which had been a major source of pollutants in Pawtuxet Cove, to municipal sewage treatment plants which receive industrial wastes, and to the Environmental Protection Agency and Marine Ecosystems Research Laboratories which investigate the effects of the waste.

By the third week of the course students were immersed in individual projects. Four students opened several hundred hard clams from the Providence River. Two students then examined shells and tissues for gross pathological anomalies while the other two measured annual growth rings to determine the growth rate at each station on the river. Other students identified and counted benthic animals, modeled pollution dispersion and determined the growth and survival rate of soft-shelled clams from Pawtuxet Cove. In each study, the students realized that quantification and large sample sizes were necessary if they were to be able to distinguish pollution effects from natural variation.

In the final week of the course data were analyzed (in some cases with a personal computer) and oral presentations on individual projects were made. Because of time constraints, not all of the quantitative data could be analyzed; however, we were able to determine that hard clams are present in the Providence River and while growth is normal at the seaward stations, it is significantly reduced at the polluted stations. Despite reports to the contrary, these clams had a lower incidence of abnormalities than clams in clean areas open to fishing. In Pawtuxet Cove, bottom animals were limited in number and kind indicating continuing effects of waste disposal. The surprising presence of soft-shell clams in the Cove suggests some potential for recovery and provides a species for monitoring tissue pollutant levels.

These findings will provide valuable information to the various agencies and organizations concerned with improving the physical condition of Narragansett Bay. In conjunction with future studies, this contribution may, in turn, assist in the design of future management policies for the Bay.

Special thanks to: Dr. John Knauss, Robert Sexton, Richard McGannon, Ken Morse, Dr. James Quinn, Dr. Scott Nixon, Dr. Carleton Hunt and Candice Oviatt (Graduate School of Oceanography, University of Rhode Island); Dr. David Hanson and Dr. Steven Schimmel (EPA); Sue Kiernan (Save the Bay, Inc.); Dr. James Crowley (Ciba-Geigy Corp.); Richard Sisson (Rhode Island Division of Marine Fisheries); Dr. Ken Sherman and Carolyn Griswold (National Marine Fisheries Service).

HAZARDOUS WASTE ISSUES

Narragansett Bay, Rhode Island

June 16 — July 16

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

Faculty: Sheldon Pratt, Brooks Martin

Students:

Jacky Cheng — Oklahoma
University of Oklahoma

Gayle Gleichauf —
New Hampshire
University of New Hampshire

Kathrine Grimm — Michigan
Michigan State University

Sandra Hurlbut — New York
Elmira College

Carol Iancu — Pennsylvania
Cornell University

Daniel Lee — New Jersey
Oberlin College

Kathryn McDonald — Michigan
Michigan State University

Russell Stone — California
University of California

Jill Truex — California
Whitman College

Allen Van Note — Illinois
University of Illinois

"Going to Ecuador was the first trip I had ever made out of the country by myself. I was scared at first, but now that I have gone, I have realized I can do a lot more on my own than I thought I could." *Jenny Leak*

"My awareness and appreciation of the surroundings was definitely enhanced by a month of camping. Even the every day phenomenon of a sunset is reinforced when living on an island. With no electricity, the sunset becomes more than just a few minutes to notice the colorful sky: it changes your daily routine." *Carol Iancu*

POPULATION DYNAMICS OF ENDANGERED SPECIES — TEAM I

Greek Islands June 16 — July 16

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

Faculty: Stan Koster, Heidi Grether

Students:

George Bevis — New York
The Trinity School
Donald Brewster —
Massachusetts
Hamilton College
Patrice Coles — Tennessee
Mount Holyoke College
Tempe Evans — Connecticut
Greenwich High School

Lewis Farberman — New York
Horace Mann
Dana Gilbert — New Jersey
St. Andrews Presbyterian
Jennifer Loyall —
Massachusetts
North Andover High School



Photo by George Bevis

The Samaria Gorge on the southern side of Crete and several tiny islands just off the coast provide habitats for nearly the entire population of agrimi in Greece. In the setting of the dramatic and rugged White Mountains and on three uninhabited islands, Dias, Theodorou and Pandes, our team undertook the challenge of studying this endangered Cretan wild goat.

We began our expedition with a grocery shopping trip in Iraklion on the north central coast of Crete. Loaded with enough supplies for our 10 day stay on Dias Island, we boarded a small fishing boat for the 7 mile journey. Upon arriving at the island, students were at first apprehensive about their temporary study site as they gazed at the barren, rocky terrain; however, after a few trips around the island, they rapidly became accustomed to it and took on the challenge of their research.

Following a brief introduction to the island's plants, animals and history, the students familiarized themselves with the surroundings and began their work. From tiny blinds, they spent long hours quietly watching the agrimi and recording their behavior. From pellet group counts, the team determined agrimi activity on the island. They also set up vegetation plots and conducted an extensive vegetation survey of the island to determine its carrying capacity.

The studies on Dias revealed that although there were far too many agrimi for the habitat to support, reproduction was relatively good. The rabbit population was very large, and was believed to compete directly with agrimi for the scarce food supply. We determined that a hunting program aimed at reducing the agrimi and rabbit populations was necessary. After talking to some of the local officials, we were pleasantly surprised to learn that the Greek hunters viewed the agrimi with respect and admiration and not just as trophies.

With the behavioral studies and vegetation analyses completed, we traveled by bus and boat to Theodorou Island off the northwest coast of Crete where past SFS research has been conducted. Here, for one day, we observed the purebred agrimi population which served as the basis of comparison for the other populations we studied.

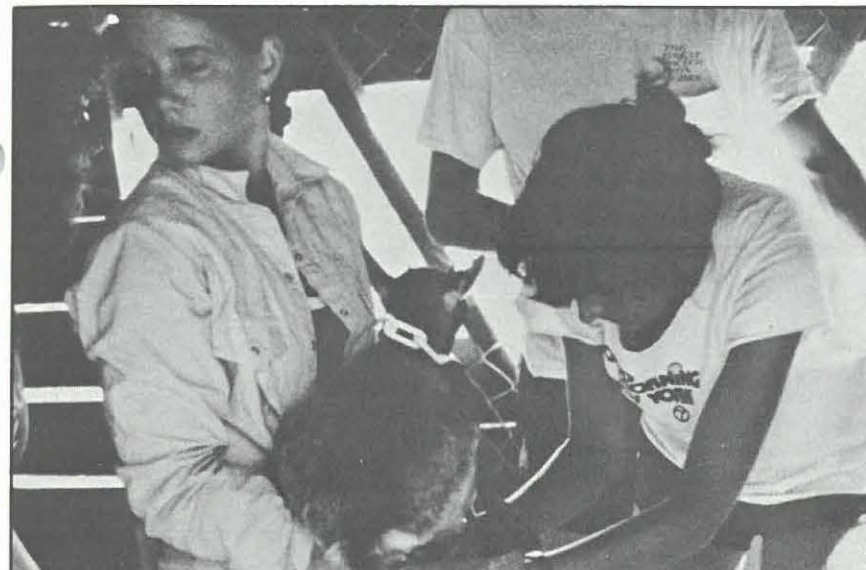
Back on Crete after the careful planning and purchasing of supplies, we donned our heavy packs and headed for a week in the Samaria Gorge National Park. The gorge trail was narrow and rugged winding its way down through massive rock walls, though the hiking was made easier by the spectacular scenery. After a three hour hike, we arrived at the abandoned village of Samaria in the heart of the gorge. This served as the base camp for our studies on the agrimi.

The work in the gorge primarily involved examining the distribution and relative abundance of agrimi because the animals were too wary to permit direct behavioral observations. The studies here revealed interesting habitat preference patterns, and showed that the population was fairly large and reproducing well. It was learned that local hunters frequently harvested agrimi for food, but that hunting had a minimal impact on the population. The main threat to the Samaria Gorge herd was inbreeding with domestic goats, an activity which is allowed to occur illegally in the park. By the time we left the gorge, we all agreed that it was an extremely difficult place to conduct studies because of the extreme heat and rugged terrain.

The next and final stop was Pandes Island in northeastern Crete. The island is classified as an archeological site and consequently the group was not permitted to camp on it. Instead, we stayed in Agios Nicolaos, a neighboring town and made the trip to Pandes daily on a small fishing craft.

We found Pandes to be seriously overstocked with agrimi and discovered that the population appeared to be declining. The animals subsisted on what little natural food there was and small amounts of hay brought by the Forest Service. To help determine the population size and age distribution, we captured several agrimi in a newly constructed corral. From our examination of these individuals, we strongly recommended that more food be brought and that several animals be translocated to another island.

By the end of the course, we had successfully assessed the current status of three different agrimi habitats and populations. We were greatly encouraged by the interest and support shown by the Greek government, and were hopeful that our studies on Dias and Pandes Islands and in the Samaria Gorge would lead toward better management of the agrimi.



By gently herding the agrimi into corrals, we had the opportunity to tag them and to study their physical condition.

Some of the last pure-bred agrimi — the rare wild goat of Crete — live on the tiny island of Theodorou just off the northwest coast of Crete. Research conducted by SFS teams in 1983 found the agrimi population on Theodorou to be destroying its limited food source by overgrazing. The 1983 SFS team recommended that some of these agrimis should be translocated to another suitable habitat. This management recommendation was implemented by Greek officials in October, 1983. Twenty agrimi (15 males and 5 females) were translocated to Sapienza Island, a 600 hectare island located 5 miles off the Peloponnesos coast of southwestern Greece.

Our research focused on two major projects. The first involved the development of a management plan for Sapienza Island including the determination of its carrying capacity (i.e. how many animals the island's flora can support). The second project involved determining the current status of the agrimi population back on Theodorou.

After a short boat ride out from Methone, Greece, we set up our camp on the southwest corner of Sapienza. We realized very quickly that as beautiful as this island was, the extraordinarily rough terrain, thick vegetation and presence of pit vipers, one of the most deadly poisonous snakes in the Mediterranean, would continually challenge our physical stamina. After a brief field trip around the island, students participated in a number of lectures on topics including vegetation analysis, island biogeography, sampling techniques and endangered species.

At 6 a.m. each morning from our basecamp, we hiked out with research equipment through the dense brush and over jagged rocks to our study sites. Transects and sample points were laid out with compass and range finder and vegetation was sampled for total forage biomass and separated by species. The team was split into four groups with one group locating and marking plots, two groups evaluating the plots, and the last group taking samples of plants and soils. As this work progressed over the course of two weeks, the entire island was inspected for signs of agrimi activity and success of the translocation.

The primary research on Sapienza usually ended around 2:30 p.m. each day to avoid the intense mid-day heat. The rest of the day was spent recuperating both physically and mentally down by the water's edge where we could take frequent swims in the cool Mediterranean between lectures and discussions. After dinner, we hiked out to different predetermined observation points near watering holes to quietly wait for a brief encounter with an agrimi. Because agrimi are most active at night in order to avoid the high daytime

temperatures, we found nighttime to be the most appropriate time to watch for the them. Unfortunately, due to the density of vegetation and size of the island, a total of only 4 agrimi were observed.

Upon completion of our research on Sapienza Island, we traveled through Athens and Crete to Theodorou Island. With our tents established at the north end of the island, we immediately began preparations to capture agrimi to assess the condition and number of animals on the island. Our method for capturing the agrimi involved herding them into a corral where students would then gently grab them by hand.

Once the corral had been repaired, students practiced the skills needed to capture and handle the agrimi. Because of the evasive nature and speed of the animals, students had to approach the task of capturing them as a group. Quick thinking and sound judgement were required on everyone's part. Excitement kept the team's adrenalin flowing. Over the course of several days, a total of eighteen individual animals were captured by hand and then weighed, marked, sexed and aged in three separate capture sessions. We were quite surprised to find that the population had declined dramatically over the last year. Unfortunately, we were unable to determine the cause of this decline, but suggested to the government that further research is needed to investigate this matter.

To break up the relative isolation of island living, we traveled to Samaria Gorge National Park in the White Mountains of Crete to investigate the wild agrimi in their native habitat. The spectacular scenery and sightings of agrimi in the exceedingly rugged terrain highlighted the wild nature of these animals.

The expedition resulted in several valuable contributions that will assist in the future management of the agrimi. Our work represented the first time a complete vegetation analysis and inventory had been conducted on Sapienza Island. The management plans for the island, based on this work and the agrimi studies, with the estimate of the island's carrying capacity will help insure the establishment of an agrimi population on that island. Since SFS is the only organization involved in studying the agrimi, the government was fully supportive of the research and expressed interest in using the course findings in future management strategies for the island.

Special thanks to: George and Jack Logan of Athens, Greece; and to Thomas Russos and Vageles Papaevagellou (Minister of Agriculture), Christos Mpaloukos, Kostas Androulakis, Michalis Marcatatos, Viglis Vagelis, John Poulouanakis and Sterios of the Greek Forest Service.

POPULATION DYNAMICS OF ENDANGERED SPECIES — TEAM II

Greek Islands July 24 — August 23

Faculty: Thomas Husband, James Brown

Students:

Philip Boag — New Jersey
Hamilton College
Caroline Culver —
Washington, D.C.
Duke University
Stephen Gruman — New York
University of California, Santa Cruz
Karol Hazard — Maryland
University of Richmond
Janice Janas — New York
Harvard University
Rose Konold — Arizona
Arkansas State University

Bruce Lamb — Massachusetts
Swarthmore College
David Narum — Minnesota
St. Olaf's College
Mary Lou Nordell — Florida
Stanford University
Diana Robbins — New Jersey
Hamilton College
Julie White — New York
Davis & Elkins

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

CORAL REEF ECOLOGY— JANUARY TEAM

St. John, Virgin Islands

December 29 — January 19, 1984

Purpose: To investigate how tropical marine systems work, and what we can do to understand and protect them as a valuable resource.

Faculty: Michael Brody, Steven Miller

Students:

Melissa T. Balbach — New York
Yale University

J. Marilee Eagles —
North Carolina
Salem College

Michael L. Finley — Michigan
Berea College

Holly C. Fowler —
North Carolina
Salem College

Richard D. Ing — Pennsylvania
University of Pennsylvania

Rex A. Madon — Tennessee
Berea College

Victor S. Maldonado —
Puerto Rico
Hamilton College

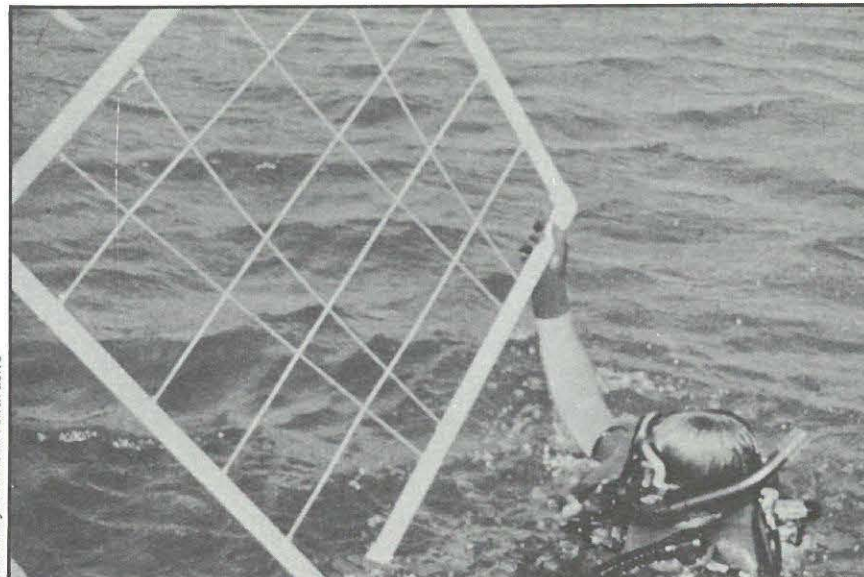
David P. Remsen —
Massachusetts
Salem State College

Naomi A. Rose — California
Mount Holyoke College

Pattisue Simpson — Alabama
Birmingham Southern College

T. Raymond White — Maryland
St. Andrews Presbyterian College

Photo by Kenneth Andrasko



After a total of more than 100 hours under water, some of us began to feel more like the aquatic species we were studying than humans.

In 1971, the United Nations Educational, Scientific and Cultural Organization (UNESCO) initiated a program called Man and the Biosphere. Through this program, over 200 Reserves throughout the world have been set aside in order to evaluate "the structure and function of ecosystems and the impacts and repercussions caused by human interactions and to provide the scientific knowledge, trained personnel, and support needed to solve practical problems of natural resource management." In 1983, the Virgin Islands National Park was designated as one of these reserves. Our team, in conjunction with the National Park Service, began the initial phase of the MAB program by conducting a detailed inventory of the fauna and flora on the reef.

After arriving at the Virgin Islands Ecological Research Station (VIERS) on Lameshur Bay, we boarded what was to become our base of operation for the entire course, the 65 foot schooner *Lelanta*. Students spent the first few days involved in introductory lectures on reef organisms and research techniques. In the afternoons, they were instructed by a professional diver on the basics of SCUBA so they could all become licensed divers. Shallow dives on the reef and in the adjacent seagrass beds introduced the students to the diverse and magnificent species composition of the area.

We began our research by acquiring aerial photographs of St. John from the Park Service. From these photographs, an appropriate site was chosen in Lameshur Bay where we would initiate the inventory. The *Lelanta* provided the mobility needed to travel to these different sites and the deck space to organize and prepare for the numerous dives that would be required for this study.

Once a site had been selected, two students dove down to complete a site survey, to determine a working list of 28 species and to test and perfect sampling techniques. We then began both the qualitative and quantitative studies. For the qualitative work, students laid down two 65 meter long transects that originated on the shore line at low tide and extended directly out to the reef. Teams of two students with underwater slates for recording data then dove and recorded the different coral species and substrate along the transect.

The quantitative study required another pair of divers to record the length, width, and height of each coral colony along the transect. This data was important in determining coral distribution and growth and zonation patterns of the site. A one-meter nylon line divided into 5cm segments attached to the slates facilitated the process of measuring this data. After each dive, students transcribed their quantitative and qualitative data into a log book from which species distribution tables, abundance histograms and depth profile distribution graphs were constructed.

A total of over 100 dives were made by the team during these studies, allowing each student to dive twice a day. This continual exposure to the abundant species of plant and animal life gave students the satisfaction of not only being able to identify many of the species but also to collect a large amount of data that was directly applicable to the MAB study. Even though personal variations in observations, species identification, and measurements undoubtedly existed, the time devoted to the research and the quantity of data collected made the differences insignificant.

Although over half of the students had had no previous diving experience, they rapidly learned to feel confident under water and to communicate in an environment where normal means of communication are impossible. The entire team was slightly apprehensive about diving at first because of a large 4 foot barracuda appropriately named "Charlie" by the students. Charlie had the unnerving habit of swimming just out of arm's reach directly behind your back. We soon learned that Charlie meant no harm, but was always looking for an easy meal.

From course results, we were able to determine that major coral formations and substrate appeared as distinct bands on the aerial photographs of the reef. We also found that of the 28 species and substrate forms studied, five species dominated the reef. Each of these species defined separate zones at distinct distances from the beach. These findings and various recommendations presented by the team for additional research on the reef will contribute to future policy and management decisions specifically for the St. John reef and generally for other reefs throughout the world.



Photo by Laura Davis

Since 1956, about 3/4 of the island of St. John has been preserved as a U.S. National Park with jurisdiction including not only lush tropical forests and pristine sandy beaches, but the surrounding waters as well. This has ensured protection of a unique and fragile habitat — the coral reef. Nestled deep within the park borders, the Virgin Islands Ecological Research Station (VIERS) served as our base of operation to continue an ongoing study initiated by SFS teams in the summer of 1983 on the long-spined sea urchin. Our team was instrumental in setting up a major section of the research that would be continued by both the July and August teams.

Our course began with several days of orientation at VIERS. Since most of our research would be conducted under water, students participated in SCUBA lessons and became fully certified divers within ten days. During this instruction, students made frequent shallow dives on seagrass beds and the coral reef to become familiar with the diversity of the plant and animal species. Back at the VIERS facilities, students attended lectures on reef ecology, natural selection, evolution, and behavioral ecology.

Armed with the necessary SCUBA skills and a basic knowledge of the reef, we began the initial preparation for our team project on the long-spined sea urchin. Once abundant throughout the reefs of St. John, the urchin population was reduced by 99% in 1983 by an unknown disease which swept through the Caribbean. Before this reduction, urchins played an important role in the reef community by grazing the bottom of benthic algae and newly settled coral larvae. The impact of the urchin reduction on the ecosystem and remaining urchins became the primary focus of our research.

The first segment of our project involved traveling by boat to different sites on the reef to observe the density of urchins as well as algae concentration. By comparing our observations to data collected by last year's teams on these same variables, we found that bare coral once almost completely devoid of algae was now covered with a filamentous and fleshy algae. Students estimated that the total algal biomass had increased by over 50 times in the last year.

The team then began a detailed study on the impact of the urchin reduction on the remaining population. Students constructed fifteen wire mesh cages which were transported by boat out to the reef. Small teams of divers then dove down and placed these cages in predetermined locations. Urchins of varying sizes and weights were collected and placed in the cages at different densities. The size and weight were then monitored weekly in order to determine how urchins adapt to changes in population.

Through our research, we hoped to find evidence supporting findings of earlier SFS research suggesting that as the urchin population increases, body size and weight decreases. Although time limits prevented the collection of large amounts of data that could be statistically tested, preliminary measurements did show that the average size and weight of urchins on the reef were slightly greater this year than the prior year. Should last year's findings be accurate, these increases could be attributed to the substantial reduction in population.

As our team research progressed, students concentrated on independent projects on topics including feeding preference of herbivorous fish, the effect of water flow on size of coral and effect of body size on damselfish or territory size. On several occasions, we made night dives on which we saw a whole new group of organisms never fully visible in daylight. We were able to see octopus out feeding, basket starfish extending their arms to feed on zooplankton, and corals with their polyps fully extended looking completely different than their "hard" appearance during the day.

In the last few days of the course, students compiled their data for both team and individual projects and made presentations to the team on the latter. Although they were unable to arrive at any solid conclusions from their urchin caging experiment, they felt a great sense of satisfaction having designed and initiated a viable project that would be pursued by the following two summer teams and would possibly lead to valuable information on how urchins deal with fluctuating intra-species competition. The unfortunate, but timely, die-off of urchins immediately after the SFS urchin research in 1983 provided our team and the following two teams with an ideal opportunity to investigate this topic in detail.

CORAL REEF ECOLOGY— TEAM I

St. John, Virgin Islands June 10 — July 1

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

Faculty: Don Levitan, Karen Koltes

Students:

Sarah Ali — New Jersey
Horace Mann

Sheryl Barnes — Illinois
St. George's School

Laura Davis — Pennsylvania
National Cathedral High School

Susan Fabry — New York
Horace Mann

Molly Kemsley — Connecticut
Duchesne University

Mary Lamar — Georgia
St. Timothy's School

Craig Onque — Pennsylvania
University of Wisconsin

Lane Savadove — Pennsylvania
George School

Jeffrey Selengut — New Jersey
Gettysburg College

Nolan Stokes — Virginia
McLean High School

Lawson Willard — New York
Trinity Pawling

CORAL REEF ECOLOGY— TEAM II

St. John, Virgin Islands July 5 — July 29

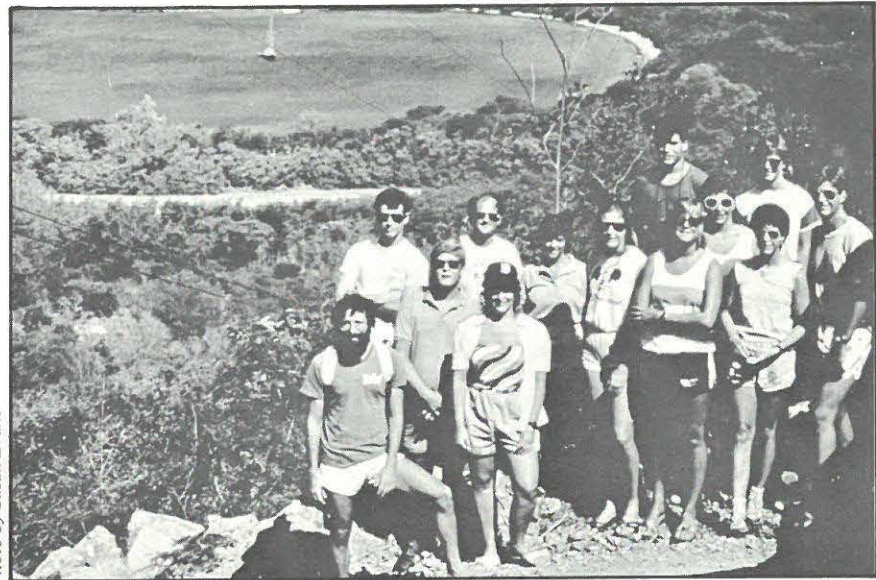
Faculty: Don Levitan, David Campbell

Students:

Frank Anderson — *Tennessee University of Tennessee Medical School*
Ignacio Cisneros — *New York Bard College*
Harold Cranmer — *Connecticut New Canaan High School*
Susan Evans — *Michigan Albion College*
Jennifer Frazee — *California University of the Pacific*
Suzanne Green — *Illinois Clark College*

Linda Gruendel — *Kansas Kansas State University*
Ruth Haas — *Georgia Connecticut College*
Susan Leavitt — *Nevada University of Nevada*
Clay Rips — *Texas Alamo Heights High School*
Catherine Scott — *Connecticut Dartmouth College*
Helga Sprunk — *Michigan Michigan State University*

Photo by Susan Evans



"From this expedition, I received more than just data. I was able to enter an underwater world that only a few are allowed to enter and even better, I was able to study this world — an even more unique opportunity." *Frank Anderson*

Our team was involved in the continuation of work initiated by the June team on the long-spined sea urchin and in an investigation of sea cucumber movement within the coral reef and seagrass bed ecosystems.

Having settled into the cabins at the Virgin Islands Ecological Research Station (VIERS) and having met the ubiquitous cockroaches with whom they would live for four weeks, students were immersed in a combination of lectures and dives for the first few days of the course. These lectures and dives exposed students to the ecology and taxonomy of the local marine flora and fauna, general oceanography, the marine communities of the tropics, the physiological adaptations of marine organisms and underwater research techniques. On the fourth day, we began the first of two urchin projects, a study of the population density of sea urchins on the coral reef.

In small boats we motored out to different locations between the reef and the shore and with SCUBA gear placed 10 meter by 10 meter quadrats at varying depths between 2 feet and 30 feet. We then collected all urchins within these areas and determined their body size and weight. With the whole team working together we were able to average ten quadrats a day. Most of us found collecting the urchins quite difficult because they tended to hide in crevices and up under the coral. Therefore, we had to be extremely careful to avoid hurting either ourselves or the urchins or getting stung by fire coral.

As this project progressed, students worked on the second urchin study. This involved measuring and weighing urchins within the cages placed on the reef by the June team to determine how their size and weight changes over time in relation to increased intraspecific competition. Groups of students performed this task on a rotating basis every three days.

The sea cucumber project focused on how this slothful creature moves about in the coral reef ecosystem and how this movement varies at different locations between the reef and the shore. Similar to the urchin study, this project required students to place 10 meter by 10 meter quadrats on the sea bottom at a depth of 20 feet. Sea cucumbers were collected and placed within the quadrat, and numbered nails were placed every meter within the quadrat to facilitate mapping the movement of the cucumbers. Diving

down every fifteen minutes for a total of six hours, students then placed small numbered sticks in the bottom to mark their movement. Careful measurements were recorded on slates at each quadrat and then compiled and analyzed back at the cabins at night. As students hovered in the water above the quadrats, much humor was generated by the combination of the remarkably slow movement and unattractive appearance of the cucumbers.

During respite from the team projects, students worked on a variety of independent projects ranging from the respiration rate of urchins, the association of wrasses and species of coral, the response of feather duster worms to high and low predation, and the distribution of snails in seagrass beds at night and during the day. In addition, the team was able to investigate the terrestrial ecology of the island. Occasional field trips were made to different regions of the Park to examine some of the 260 known species of woody plants and colorful flowering plants. A tour of the island also gave students an opportunity to learn about its history and to explore its diverse topography.

Our research produced several interesting findings that shed some new light on the ecology of both the long-spined urchin and sea cucumber. Our sea cucumber study indicated that the animals move in a relatively straight path if on the sand but tend to move randomly in a seagrass bed. Because sea cucumbers are bottom feeders and hence turnover sediments and nutrients as they feed, their movement is important to understanding what impact they have on the nutrient cycle within the coral reef ecosystem. Our results also showed that cucumbers appear to almost always move away from the seagrass beds to the shelter of the coral reef which implies that they are aware of the environment in which they are located.

In the urchin study, we discovered that the typical size distribution noted last year had changed substantially. There appeared to be a greater abundance of small and large urchins and very few of the "average" size found the year before. We were unable to determine the cause of this change, but speculated that it may have resulted from the severe reduction in the population size. Data from the caging experiment, which suggested that urchins are able to change size with increased competition, was compiled and prepared for analysis by the August team.



Photo by Tim Stout

In the process of studying sea urchins and dusky damselfish, we were always accompanied by an enormous range of exotic fish, many of which we learned to identify within the first week of the course.

The last of the three summer St. John teams, our group expanded on the various studies on long-spined sea urchins performed by the two previous teams and conducted research on one of the most common, but elusive fish on the reef, the dusky damselfish.

Following a day of exploring the facilities at the Virgin Islands Ecological Research Station (VIERS), all members of the team began short independent projects focusing on a variety of reef organisms they selected themselves. These projects enabled students to become familiar with a particular aspect of the reef ecosystem and to become comfortable with conducting research in this new environment. Students then gave brief presentations on their research to the team.

During the first several days, students also engaged in an extensive array of lectures on topics including the taxonomy of reef organisms, marine algae, mangrove and reef ecology, and natural selection and read scientific papers for additional background information. In the afternoon, students dove on the reefs and adjacent seagrass beds to witness first-hand the species, habitats and biological phenomena introduced in the morning lectures. This schedule enabled students to very quickly acquire a working knowledge of the reef ecosystem.

Using a variety of research tools including quadrats, chains, calipers and depth gauges, we then started to take an inventory of the urchin population in several areas of the reef to expand on the data collected by the July team. As one student weighed and measured each urchin, another student recorded data and kept a running tally of the urchin count. At the same time, information was collected on associated environmental variables of the urchins habitat, particularly the type and abundance of algae on which long-spined sea urchins feed. In addition, we maintained the on-going caging experiment set up by the June team to determine the ability of sea urchins to adjust their body size under conditions of fluctuating competition. Urchins within these cages were monitored on a weekly basis.

The second project involved a study of the relationship between "quality" and size of the territory maintained by the dusky damselfish. By examining the amount of protective covering provided by coral heads and various vegetation and the actual size of the territory, the team hoped to be able to determine whether territories increased in size as the amount of covering decreased.

In the morning, pairs of students snorkeled out to various sites between the lagoon and the fully developed reef to determine damselfish territories. They did this by spotting damselfish that were chasing other

fish and marking where the damselfish stopped pursuing their intruder. This stopping point was usually a reliable indicator of a territorial boundary. The boundary was then marked with small, blue stones.

In the afternoon, the team divided into three groups and using SCUBA gear began a careful examination of each previously marked territory. As one student within a group recorded the topography, another measured the size of the territory with a compass and string marked in meter sections and the third determined the amount of protective covering in the territory. Returning to VIERS physically and mentally exhausted, the students compiled and discussed their data for each territory.

Throughout the course, students designed and conducted individual research projects in addition to the brief projects performed during the first day of the course. These covered a variety of topics from the behavior of octopus, brittle stars, polychaete worms and damselfish to the diversity of coral at different depths, the effect of depth on the size of colonial sea anemones and competition between coral species. On the final day, students gave oral presentations and turned in written reports on their projects.

Our individual and team research projects resulted in several interesting findings that will provide the Park Service with important information for future management policies for the coral reef. Our study of the long-spined sea urchin showed that the species is beginning to return, but that its absence from the reef has produced some rapid changes, particularly in the dramatic increase in algal cover. It had been thought that the reduced grazing by the urchins would be compensated by an increase in grazing by reef fishes but we demonstrated that such an effect did not occur, and algae became very abundant in areas formerly grazed by urchins.

The team also found through the compilation and analysis of data collected by all three summer teams that sea urchins are able to adjust their body size in response to the amount of competition with other urchins. In other words, sea urchins can shrink as well as grow! In the study of damselfish territories, students showed that several factors must contribute to the size of the area a damselfish can defend such as the density of other fish in the area, the amount of shelter in the habitat and the number of adjoining territory holders.

Special thanks to: the staff of VIERS, particularly the manager Kirsten Canoy and the facilities manager, Vincent Power; and to Caroline Rogers, director of research at the U.S. National Park Service for permission to do research in the park.

CORAL REEF ECOLOGY— TEAM III

St. John, Virgin Islands August 2 — August 26

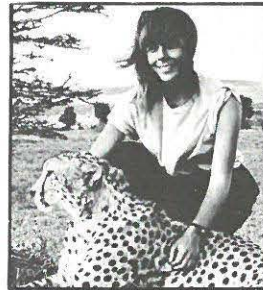
Faculty: Don Levitan, Karen Koltes

Students:

Susan Barco — *Virginia William and Mary College*
Joseph Di Pietro — *New York Vanderbilt University*
Nancy Discerni — *Ohio Millersville University*
Stefanie Fenton — *California San Francisco University High School*
Mike Fry — *Colorado Colorado School of Mines*
Chris McBride — *Colorado University of Colorado*

Merle Potchinsky — *New York Brandeis University*
Lisa Skoglund — *New Jersey Juniata College*
Doug Spady — *Washington University of Washington*
Michelle Toder — *Massachusetts Colby College*
Laurence Tucker — *Ohio Clark University*
Elizabeth Vigdorth — *Tennessee Memphis State University*

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



One of the more unique features of our site in Kenya was the presence of a pet cheetah.

Photo by Sarah Lampert

RESEARCH PAPERS RESULTING FROM SFS FIELD COURSES

1982 - present

Arctic Botany, Brooks Range 1982

Fetcher*, N., T. F. Beatty**, B. Mullinax**, D. S. Winkler**. 1984 "Changes in arctic tussock tundra thirteen years after fire."

Ecology 65: 1332-1333.

Humpback Whale Ecology, Gulf of Maine 1982

Reichley*, N. Sound production of humpback whales in Cape Cod waters. Presented at Fifth Biennial Conference on the Biology of Marine Mammals 1983. Contribution to Ph.D. dissertation. Graduate School of Oceanography, University of Rhode Island.

Wildlife Conservation, Kenya 1982, 1983

Stelfox*, B. *In preparation*. Ph.D. Dissertation, University of Alberta, Alberta, Canada.

Stelfox*, B. *In preparation*. Effects of livestock enclosures (Pomas) on East African rangeland ecology.

Stelfox*, B. *In preparation*. Effects of Fire and Topography on the Athi Plains Ecosystem, Kenya.

Community Ecology, Mount St. Helens 1982, 1983

Adams*, A. B., V. D. Adams. *In press*. Vegetative succession following glacial and volcanic disturbance. *Biological Effects on Mount St. Helens 1980 Eruption*. B. E. Bilderback editor. American Association for the Advancement of Science.

Adams*, A. B., E. H. Merrill*. 1983. Plant association in the northwest section of the blast zone of Mount St. Helens, Washington. Presented to the Northwest Scientific Association's 56th Annual Meeting, The Evergreen State College, Olympia, Washington.

Franklin, J. F., F. G. Swanson, J. E. Means, V. D. Adams, A. B. Adams*, P. Frenzen, A. McKee. 1983. Vegetative recovery in the blast zone of Mount St. Helens and its relations to geomorphic processes. 34th American Institute of Biological Sciences Meeting. University of North Carolina. G: 369.

Merrill*, E. Ph.D. Dissertation. 1984. *In preparation*. Thermal constraints on the foraging behavior and nutrition of elk in the Mount St. Helens blast zone. University of Washington, Seattle, WA.

Merrill*, E., A. Callahan, A. B. Adams*. 1984. *In preparation*. Plant succession in the northwest section of Mount St. Helens blast zone.

Wasserman, L., D. Martin, A. B. Adams*, V. Adams. 1983. The relation of fish survival to riparian vegetation on the west side of Mount St. Helens. Presented at the Mount St. Helens Symposium, Northwest Scientific Association's 56th Annual Meeting, The Evergreen State College, Olympia, Washington. Paper: 166.

Marine Mammal Biology and Conservation, Glacier Bay, Alaska 1982, 1983

Calambokidis*, J., G. Steiger**, L. Healey**. 1983. Behavior of harbor seals and their reaction to vessels in Glacier Bay, Alaska. Proceedings of the First Glacier Bay Science Symposium.

Calambokidis*, J., L. Healey**, G. Steiger**. 1982. *In preparation*. Reaction of Harbor Seals (*Phoca vitulina*) to boats in Glacier Bay, Alaska.

Calambokidis*, J., G. H. Steiger**. 1982. The behavior of harbor porpoise in Glacier Bay, Alaska with emphasis on marked individuals. Presented to Glacier Bay National Park Service.

Calambokidis*, J., G. Steiger**, R. A. Butler**. 1983. *Submitted*. Biology and behavior of molting Canada Geese in Glacier Bay, Alaska. *Journal of Wildlife Management*. Abstract in Proceedings of First Glacier Bay Science Symposium.

Calambokidis*, J., G. Steiger**. 1983. *Submitted*. Bald Eagle (*Haliaeetus leucocephalus*) consumption of Harbor Seal (*Phoca vitulina*) placenta in Glacier Bay, Alaska. *Wilson Bulletin*.

Coral Reef Ecology, St. John, U.S. Virgin Islands 1982, 1983, 1984

Brody*, M., S. J. Miller*, M. T. Balbach**, J. M. Eagles**, M. L. Finley**, H. C. Fowler**, R. D. Ing**, R. A. Madon**, W. S. Maldonado**, D. P. Remsen**, N. A. Rose**, P. Simpson**, T. R. White**. 1984. Man and the Biosphere: Ground Truthing Coral Reefs for the St. John Island Biosphere Reserve. Report to the Virgin Islands National Park Service.

Levitan*, D.. 1983. Density dependent size plasticity and negative growth in *Diadema antillarum*. Presented at the Marine Benthic Meetings.

Levitan*, D., D. Campbell*, M. B. Campbell. 1984. Descriptive study of seagrass beds of Little and Greater Lameshur Bay, St. John, Virgin Islands. A report submitted to the U.S. Park Service.

Neefus*, C. Photoadaptive responses in the Tropical Brown Seaweed, *Lobophora variegata* (lamour) *womers*. May 1982. Dissertation for Ph.D. in Botany, University of New Hampshire, Durham, New Hampshire.

Population Dynamics of Endangered Species, Greek Islands 1983

Brown*, J., T. Husband*, P. Davis*. 1984. *Submitted*. Population Measurements of Cretan Agrimi. *Journal of Mammalogy*.

Husband*, T., P. Davis*. 1984. "Ecology and behavior of the Cretan Agrimi". *Canadian Journal of Zoology* 62:411-420.

Husband*, T., P. Davis*. *Submitted*. "Detection of plant distribution through the analysis of indices of association on Theodorou Island, Crete, Greece". *Vegetatio*.

Husband*, T., J. Brown*, P. Davis*. *In preparation*. Biology and Management of Mountain Ungulates. Paper to be presented to the Theriological Congress.

Ecology and National Park Planning, Atacama Desert, Chile 1983

Raedeke*, K. J., J. A. Simonetti*, M. A. Brannon**, M. Gamble**, P. Hayward**, E. Hyde**, O. Komar**, R. Olivia**, R. Pearson**, P. Aumsey**. 1984. Sierra Las Topias, coastal northern Chile as a guanaco reserve: A preliminary biological survey. Final report to Corporacion Nacional Forestal, Santiago, Chile.

Raedeke*, K. J., J. A. Simonetti*. *In preparation*. Food habits of *Lama guanicoe* in coastal desert of northern Chile.

Raedeke*, K. J., J. A. Simonetti*. *In preparation*. Status of a guanaco (*Lama guanicoe*) population in coastal northern Chile desert.

Simonetti*, J. A., A. Poiani, K. J. Raedeke*. 1984. Food habits of the *Dusycion griseus* in northern Chile. *Journal of Mammalogy* 65:(3) 515-517.

Simonetti*, J. A., H. Nonez. 1983. *Submitted*. Sympatry and taxonomy of two Chilean *Liolaemus*. *Herpetological Review*.

Simonetti*, J. A., A. Poiani, E. Hyde**. *Submitted*. *Oryzomys longicaudatus* (Bennet 1832) en Sierra las Tapias, norte de Chile. *Neotropica*.

Simonetti*, J. A., E. Hyde**. *Submitted*. "Small mammals of coastal Chile: a case study". *Acta Theriologica*.

Limnology, Adirondacks, New York 1983

Singer*, R., D. A. Roberts*, C. W. Boylen. 1983. Biological effects of acidification on small oligotrophic Adirondack lakes. Proceedings of the Second New York State Symposium on Acid Deposition, Ithaca, New York.

Primate Social Behavior, Costa Rica 1984

Clarke*, M., E. Zucker*. 1984. Distribution of Howling Monkeys (*Alouatta palliata*) in a dry deciduous tropical forest. Abstract to be presented to the American Association of Physical Anthropology.

Environmental Geology, Mt. Vesuvius, Italy 1984

Hazlett*, R., R. Elan*. 1984. *Submitted*. Avalanche Deposits of the 1944 Eruption, Mt. Vesuvius, Italy. *Bulletin Vulcanologique*.

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SFS student with a prized catch from Narragansett Bay.

Photo by Brooks Martin

FINANCIAL HISTORY

1981 - 1984*

	FY 1981	FY 1982	FY 1983	FY 1984
Operations				
Tuition and other Income	108,894	182,971	217,518	352,931
Donations Received	63,517	106,753	146,648	234,924
Less: Operating Expenses	153,300	274,503	354,749	509,691
Less: Scholarships Granted	8,900	11,400	24,380	27,500
Net Income (Deficit)	10,211	3,821	(14,963)	50,664
Fund Balances				
Beginning Balances	—	10,211	14,032	(931)
Net Income (Deficit)	10,211	3,821	(14,963)	50,664
Ending Balances	10,211	14,032	(931)	49,733
Working Capital				
Current Assets	18,573	21,347	29,084	80,358
Less: Current Liabilities	16,658	19,509	81,125	121,750
	1,915	1,838	(52,041)	(41,392)
	1981	1982	1983	1984
Number of Student Program Days	1,868	3,302	4,486	6,218
Operating Cost/Student Day	75	83	79	77
% of Students Receiving SFS Scholarships	38%	36%	40%	48%

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

October 24, 1984

INDEPENDENT ACCOUNTANT'S REPORT

To the Board of Directors
The School for Field Studies, Inc.
Cambridge, Massachusetts

I have examined the balance sheet of The School for Field Studies, Inc. as of August 31, 1984 and 1983 and the related statements of support, revenue and expenses and changes in fund balances and changes in financial position for the years then ended. My examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the financial statements referred to above present fairly the financial position of The School for Field Studies, Inc. at August 31, 1984 and 1983 and the results of its operations and the changes in its financial position for the years then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Ernest M. Smith Jr.

ERNEST M. SMITH, JR.
Certified public accountant

EXHIBIT A

BALANCE SHEET

August 31, 1984 and 1983

ASSETS	1984	1983
Current Assets:		
Cash	\$ 45,588	(\$ 844)
Student Loans Receivable	30,905	23,497
Accounts Receivable — Other	190	1,592
Prepaid Expenses and Deposits	3,675	4,839
Total Current Assets	80,358	29,084
Fixed Assets (Note 2):		
Furniture and Fixtures	29,856	8,824
Equipment, Vessels	73,345	52,816
Total	103,201	61,640
Accumulated Depreciation	11,597	9,229
Net Book Value	91,604	52,411
	\$171,962	\$81,495
LIABILITIES AND FUND BALANCES		
Current Liabilities:		
Accounts Payable	\$ 43,371	\$23,042
Notes Payable (Note 3)	64,634	52,541
Accrued and Withheld Taxes	5,114	2,150
Accrued Interest	4,458	—
Accrued Payroll	4,173	3,392
Total Current Liabilities	121,750	81,125
Long-Term Liabilities (Note 3):		
Notes Payable (Less Current Portion Above)	479	1,301
Fund Balances (Exhibit C):		
General Fund	(31,733)	(29,640)
Student Loan Fund	17,300	—
Scholarship Fund	(26,138)	(21,580)
Equipment Fund	90,304	50,289
Total Fund Balances	49,733	(931)
	\$171,962	\$81,495

EXHIBIT B

STATEMENT OF SUPPORT, REVENUE AND EXPENSES

For The Year Ended August 31, 1984 and 1983

	1984	1983
Support and Revenue — (Note 2):		
Tuition and Fees	\$308,960	\$217,370
Scholarship Grants	25,242	2,200
Contributions	209,682	144,448
Miscellaneous	459	148
Total Support and Revenue	544,343	364,166
Expenses — (Note 2):		
Program Services:		
Field Expenses	210,102	149,174
Vessel Expenses, Commissions and Fees	28,548	273
Scholarships	27,500	24,380
Supporting Services:		
General and Administrative — Schedule B-1	271,041	205,302
Total Expenses	537,191	379,129
Excess Support and Revenue (Expenses)	7,152	(14,963)
Other Revenue:		
Excess Proceeds on Disposition of Equipment and Vessels	43,512	—
Excess Revenue (Expenses)	\$ 50,664	(\$ 14,963)

See Notes to Financial Statements.

EXHIBIT C

STATEMENT OF FUND BALANCES

For The Year Ended August 31, 1984

	General Fund	Student Loan Fund	Scholarship Fund	Equipment Fund
Fund Balances — August 31, 1983	(\$ 29,640)	\$ —	(\$21,580)	\$ 50,289
Additions:				
Tuition and Fees	308,960	—	—	—
Scholarship Grants	—	2,300	22,942	—
Contributions	106,837	15,000	—	87,845
Miscellaneous	459	—	—	—
Excess Proceeds on Disposition of Equipment and Vessels	—	—	—	43,512
Total	386,616	17,300	1,362	181,646
Deductions:				
Program Services	(238,650)	—	(27,500)	—
Supporting Services	(264,426)	—	—	(6,615)
	(503,076)	—	(27,500)	(6,615)
Transfers:				
Equipment Purchases and Debt Service Payments from Unrestricted Funds	(18,376)	—	—	18,376
Insurance Proceeds — Equipment and Vessel Dispositions	103,103	—	—	(103,103)
	84,727	—	—	(84,727)
Fund Balances — August 31, 1984	(\$ 31,733)	\$17,300	(\$26,138)	\$ 90,304

EXHIBIT D

STATEMENT OF CHANGES IN FINANCIAL POSITION

For The Years Ended August 31, 1984 and 1983

	1984	1983
Resources Provided:		
Excess Revenue (Expenses) — Exhibit B	\$ 50,664	(\$14,963)
Items Not Requiring an Outlay of Cash — Depreciation	6,615	5,436
Decrease In:		
Accounts Receivable	1,402	3,751
Prepaid Expense and Deposits	1,164	—
Increase In:		
Accounts Payable	20,329	11,182
Accrued and Withheld Taxes	2,964	436
Notes Payable	11,271	47,337
Accrued Payroll	781	1,840
Accrued Interest	4,458	—
Disposition of Equipment and Vessels	59,591	—
Total Resources Provided	159,239	55,019
Resources Applied:		
Increase In:		
Student Loans Receivable	7,408	15,837
Prepaid Expenses and Deposits	—	816
Acquisition of Equipment and Vessels	105,399	43,531
Total Resources Applied	112,807	60,184
Increase (Decrease) in Cash	46,432	(5,165)
Cash Balance — Beginning	(844)	4,321
Cash Balance — Ending	\$ 45,588	(\$ 844)

See Notes to Financial Statements.

NOTES TO FINANCIAL STATEMENTS

August 31, 1984

Note 1 — Organization:

The School for Field Studies, Inc. was incorporated under the laws of the Commonwealth of Massachusetts on October 31, 1980 and has received qualification as a tax exempt organization under Section 501(c)(3) of the Internal Revenue Code. The organization's purpose is to provide alternative educational programs to promote, improve, develop and enhance the skills and talents of its participants.

Note 2 — Summary of Significant Accounting Policies:

A. Fund Accounting:

The accounts of the school are maintained in accordance with the principles of fund accounting, wherein resources for various purposes are classified for accounting and reporting purposes into funds that reflect the activities or objectives specified.

Operating funds represent the portion of expendable funds that is available for support of school operations.

Scholarship funds represent funds available for student tuition.

Plant funds represent resources, if any, restricted for plant acquisitions and funds expended for plant.

B. Revenues and Expense:

The accounts of The School for Field Studies, Inc. are maintained on a cash basis throughout the year and adjusted to the accrual basis at year end.

C. Fixed Assets:

Fixed assets are recorded at cost, or in the case of donated equipment, at fair market value where a clearly measurable basis exists for determining the value. Equipment donated during the year ended August 31, 1984 was recorded in the amount of \$87,845. Proceeds from sale of fixed assets are transferred to operating fund balances. Depreciation is provided over the estimated useful lives of the assets on a straight line basis. For assets acquired after 1980 depreciation has been computed in accordance with the Accelerated Cost Recovery System. Accumulated depreciation at indicated dates is as follows:

	1984	1983
Furniture and Fixtures	\$ 4,404	\$2,252
Equipment, Vessels	7,193	6,977
Total	\$11,597	\$9,229

Note 3 — Notes Payable:

These debts consist of the following:

	Current	August 31, 1984 Long-Term	Total
The Andreas Foundation: Unsecured, Demand Note, 14%	\$50,000	\$ —	\$50,000
Cupac, Inc.: Payments of \$437.75 Monthly to 12/84, 14½ %	1,313	—	1,313
Xerox Corporation: Payments of \$68.44 Monthly to 2/86, 18%	821	479	1,300
Trustees	12,500	—	12,500
Total	\$64,634	\$ 479	\$65,113
	Current	August 31, 1983 Long-Term	Total
The Andreas Foundation: Unsecured, due 1/2/84, No Interest; after 1/2/84, Demand at Prime +1%	\$50,000	\$ —	\$50,000
Cupac, Inc.: Payments of \$430 Monthly to 12/83, 17%	1,720	—	1,720
Xerox Corporation: Payments of \$68.44 Monthly to 2/86, 18%	821	1,301	2,122
Total	\$52,541	\$1,301	\$53,842



Getting mired down in mud was among the many obstacles we faced every day in our field work in Kenya.

Photo by Annelise Allan

SFS ADMINISTRATIVE STAFF

James Elder, Jr., B.A.
President

Robert Singer, Ph.D.
Dean

Andrea Walgren, B.A.
Director of Marketing

Elizabeth Gibson, Ph.D.
Program Manager

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

Amy Wales, B.A.
Program Assistant

Susan Rundell, B.A.
President's Assistant

Teresa O'Neil, B.A.
Admissions Assistant

SFS FACULTY - 1984

A. B. Adams: Ph.D. candidate, Ecology, University of Washington; Seismic Data Analyst, Geophysics Program, University of Washington.

Liam Antrim: M.S. candidate, Biology, Western Washington University.

Ben Baxter: M.Ed., Secondary Science Education, University of Maine.

Dusty Becker: M.S., Forest Science, Yale School of Forestry and Environmental Science.

Amos Bien: M.A. Ecology, State University of New York, Stony Brook; President and General Manager of a proposed land use project in Costa Rica.

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

Michael Brody: Ph.D., Science and Environmental Education, Cornell University; Teaching and Research Assistant, Cornell University.

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

Sue Carter: B.A., Biology, The Evergreen State College.

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

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

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

Jeff Goodyear: M.S. candidate, Marine Science, Moss Landing Marine Labs; Research Assistant, Moss Landing Marine Labs.

Numi Goodyear: Ph.D. candidate, Zoology, University of Rhode Island; Contractor for the U.S. Fish and Wildlife Service and Nature Conservancy.

Heidi Grether: M.S., Natural Resource Economics and Policy, Michigan State University; Project Coordinator, Natural Resources and Public Policy Program, Michigan State Cooperative Extension Service.

Sara Harrison: B.S., Environmental Science, Huxley College of Environmental Studies.

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

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

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

Karen Koltes: Ph.D., Biological Oceanography, Graduate School of Oceanography, University of Rhode Island.

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

Sandy Leffler: Ph.D., Entomology, University of Washington.

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

Brooks Martin: Ph.D. candidate, Biological Oceanography, Graduate School of Oceanography, University of Rhode Island; Graduate Research Assistant, Biological Oceanography, Graduate School of Oceanography, University of Rhode Island.

Steven Miller: M.S. candidate, Yale School of Forestry and Environmental Science.

Sheldon Pratt: B.S., Biology, Tufts University; Research Associate, Graduate School of Oceanography, University of Rhode Island.

Deborah Roberts: Ph.D. candidate, Biology, Rensselaer Polytechnic Institute; Research Assistant, Freshwater Institute, Rensselaer Polytechnic Institute.

Phillip Rury: Ph.D., Botany, University of North Carolina at Chapel Hill; Atkins Research Fellow in Economic and Tropical Botany, Department of Organismic and Evolutionary Biology, Harvard University.

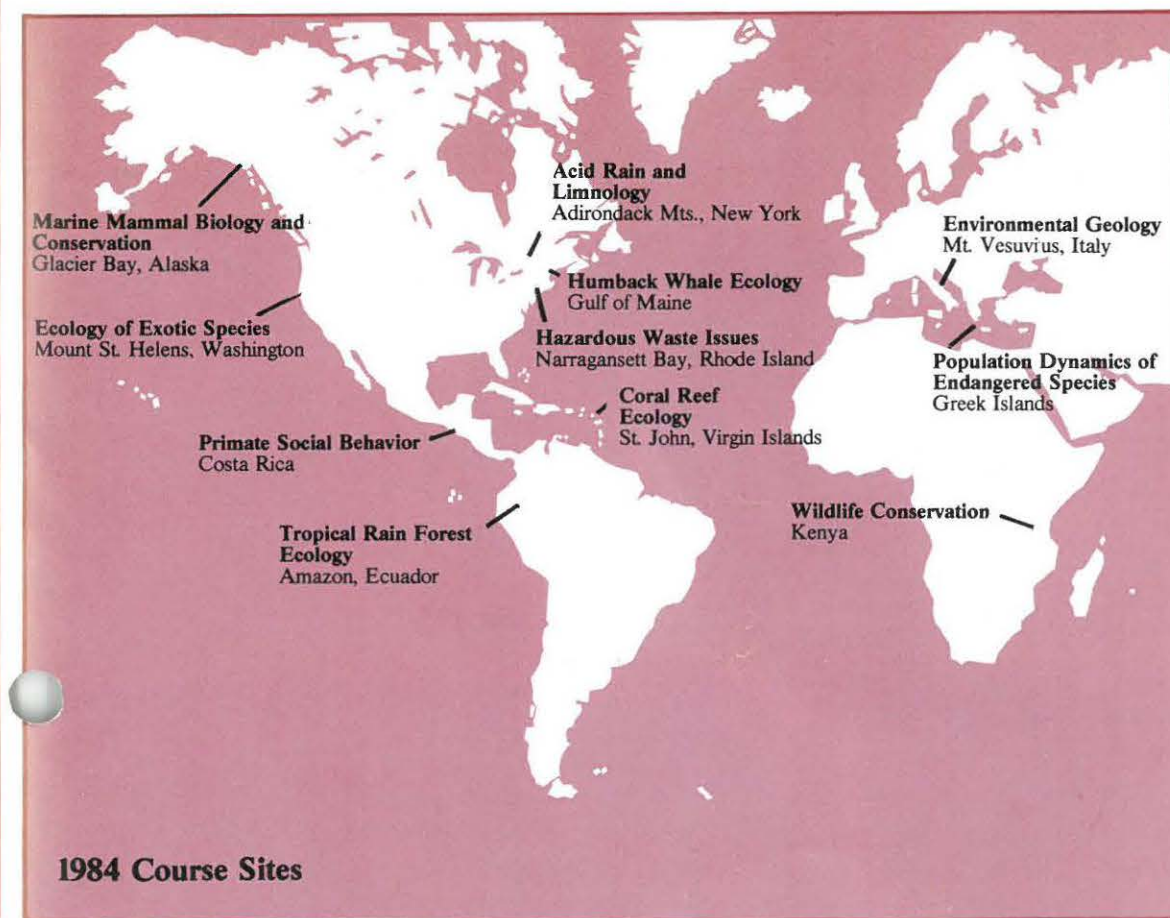
Greg Silber: Ph.D. candidate, Biology, University of California, Santa Cruz.

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

Brad Stelfox: Ph.D. candidate, Wildlife Productivity, Department of Animal Science, University of Alberta.

Barb Taylor: B.A., Biology, The Evergreen State College; Research Biologist, National Marine Fisheries.

Evan Zucker: Ph.D., Psychobiology/Psychology, Emory University; Assistant Professor, Department of Psychology, Loyola University.



1984 Course Sites