

# School for Field Studies

Training Expeditions to Special  
Ecosystems Around the World  
Catalogue of Expeditions 1983

"It appears to me that nothing can be more improving to a young naturalist than a journey in distant countries . . . The excitement from the novelty of objects, and the chance of success, stimulates him to increased activity . . . In a moral point of view, the effect ought to be to teach him good-humored patience, freedom from selfishness, the habit of acting for himself, and making the best of every occurrence."

*Charles Darwin  
Journal of Researches  
HMS Beagle*



# School for Field Studies



Kenneth Ambrisko

**My Personal Invitation** We live in a time of competing interests and conflicting goals. The advance of technology is so rapid, the pressures of industrial growth and world population so great that we can't fully comprehend their impact on the environment and our daily lives. Whether we want to be or not, everyone is confronted with these problems. To find constructive solutions, we must grasp the complexities of ecosystems and our global interrelationships with them. We also believe there is a pressing need to approach science education in a new way, an approach that personalizes the excitement and drama of learning. I invite you to take that step with SFS.

You may be among 250 students from across the country to invest yourself in an SFS course this year. If you make that commitment you will encounter surprises, ambiguities, and even difficulties. Adapting to them is part of your training. I think you also will find an uncommon relevance and rigor in the experience. The courses described in this catalogue bind together the academic challenge of the research problem, the physical challenge of the site itself, and the interpersonal challenge of the expedition team in a unique way for dynamic growth and learning.

*You need not have prior scientific training for many of our expeditions. You do need a strong curiosity for the subject material plus the maturity to become a functional member of the group. But before reading further, understand that SFS is not a clearinghouse for volunteers to help collect data, an independent internship, or a field survey trip. It is a carefully designed program to enhance your classroom education. Whatever your particular interest, SFS is an opportunity for academic and personal growth that you cannot find anywhere else.*

The following courses comprise a diverse but unified approach to pressing issues in the environmental sciences. They have been selected for their dramatic presentation of a problem, their special ecosystems, their ruggedness and relative isolation from the distractions of "civilization."

If you've ever wondered how your study in school relates to "the real world," this is a chance to find out. It will mean some hard work, but I think you'll find, as have hundreds of others, that SFS provides an equal measure of inspiration for every ounce of your perspiration.

So if you want an experience that carries meaning and purpose long after your return, while contributing to a worthwhile research effort, please join us. *Discover the adventure of learning.*

Sincerely,

*Jim Elder, Director*

P.S. Committing yourself to something new or unknown usually requires you to take some risks. But no matter how challenging it may seem now, we'll help you come through it. That's our job.

# Curriculum

SFS expeditions to remote sites of biotic richness combine applied academics with training in field research methods and teamwork for an unparalleled experience of learning by doing.

- 
- |                                                                                |                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>3 <b>Marine Mammal Biology and Conservation</b><br/>Glacier Bay, Alaska</p> | <p>A study of three marine mammal species (harbor seal, harbor porpoise, humpback whale) to examine the biology and effect of human activity on these species, in order to assist the Park Service in developing appropriate conservation policies. <b>Teams:</b> June; July; August</p> |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                                      |                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>5 <b>Community Ecology</b><br/>Mount St. Helens National Monument, Washington</p> | <p>An investigation of the interaction of a generalist herbivore (elk) with plant communities following large-scale ecosystem devastation, and the implications this has for forest resource management by government and private industry. <b>Teams:</b> June; July (Tentative)</p> |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                            |                                                                                                                                                             |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>7 <b>Wildlife Management</b><br/>Athi Plains, Kenya</p> | <p>A study of game ranch management techniques in East Africa to determine strategies of resource use of native ungulate populations. <b>Team:</b> June</p> |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                    |                                                                                                                                                                                       |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>7 <b>Wildlife Resource Selection</b><br/>Athi Plains, Kenya</p> | <p>An investigation of the relationships between an ungulate community and its biotic environment, in order to determine optimal stocking and harvesting rates. <b>Team:</b> July</p> |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                                |                                                                                                                                                                          |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>9 <b>Population Dynamics of Endangered Species</b><br/>Theodorou, Crete</p> | <p>An analysis of the population ecology of agrimi (the extremely rare wild goat of Crete) in order to assess possible survival strategies. <b>Teams:</b> June; July</p> |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                           |                                                                                                                                                                                              |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>11 <b>Ecosystem Management</b><br/>Canyonlands National Park, Utah</p> | <p>An analysis of human impact on mammal distribution and food sources along the canyon bed of the Green River, in order to evaluate current management policy. <b>Teams:</b> June; July</p> |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                               |                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>13 <b>Ecology and National Park Planning</b><br/>Atacama Desert, Chile</p> | <p>An analysis of a guanaco population (and its necessary ecological boundaries) in the northern coastal range of Chile for possible inclusion in the national faunal reserve system. <b>Teams:</b> June; July</p> |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                                                  |                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>15 <b>Alpine Plant Ecology and Land Use</b><br/>Obergurgl, Austria and Davos, Switzerland</p> | <p>A study of the effect of microclimate on alpine plants and forests, for use in revegetation and efforts to control the impact of commercial development at high altitudes. <b>Teams:</b> June; July</p> |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                               |                                                                                                                                                                                                             |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>17 <b>Limnology</b><br/>Adirondack Mountains, New York</p> | <p>A study of the biological effects of long-range transport of atmospheric pollutants ("acid rain") on energy-nutrient flow through food chains in pristine Adirondack lakes. <b>Teams:</b> June; July</p> |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                     |                                                                                                                                                                              |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>19 <b>Environmental Geology</b><br/>Landmannalaugar, Iceland</p> | <p>A study of environmental geology (plate tectonics, earthquakes, volcanic eruptions, and widespread erosion) on the landforms and people of Iceland. <b>Team:</b> June</p> |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                   |                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>19 <b>Explosive Volcanism</b><br/>Landmannalaugar, Iceland</p> | <p>A study of explosive volcanism in south Iceland through an examination of volcanic features and ash deposition, in order to understand the mechanisms of rhyolitic and basaltic magma mixing and contribute to efforts to predict eruptive activity. <b>Team:</b> July</p> |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                       |                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>21 <b>Coral Reef Ecology</b><br/>St. John, U.S. Virgin Islands</p> | <p>A continuing program to provide baseline data on fragile coral reef and seagrass communities, their structure and interrelationships, in order to provide for their conservation. <b>Teams:</b> May; June; July; August; (January 1984)</p> |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- 
- |                                                                |                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>23 <b>Cetacean Behavioral Ecology</b><br/>Gulf of Maine</p> | <p>An ongoing study of whale distribution, social structure, and behavior on Stellwagen Bank to further efforts toward marine mammal conservation and protection from resource extraction activities within cetacean feeding grounds. <b>Teams:</b> June; July; August</p> |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-

# Fundamentals

Kenneth Andraske



© Gary Brasch



Christopher Neefus



Jim Henderson



The School for Field Studies is a nonprofit educational organization for training in the environmental sciences. SFS provides advanced secondary school and college students with opportunities for direct involvement with special ecosystems around the world. The vehicle for this unique approach is a curriculum of month-long research expeditions. Each course involves work on a specific research problem through topical academic material, experiential training in field research techniques, and teamwork. Our students come from all over the country. While they are a diverse group (half are female), all share a sense of adventure, a high level of energy, strong personal motivation, and curiosity about the natural world. We invite you to become a participant in this adventure in learning if you:

- would like an introduction to science in the field
- need academic credit for a field project
- are considering a science major in college
- want direct experience in a scientific discipline to enhance applications to college or graduate school
- think you might like science but are intimidated by traditional courses
- want to explore a special region or unique ecosystem
- are interested in testing out a possible scientific career choice
- would like to assist in a worthwhile research effort
- need a break from the classroom
- want to use your wilderness or leadership skills, or develop these skills
- seek a memorable experience in the company of your peers.

**Academic Credit** As this catalogue goes to press, SFS is concluding affiliation agreements with Northeastern University and several others in New England to award academic credit for successful completion of SFS coursework. In terms of credit hours, we expect that our 3-4 week courses will be roughly equivalent to a full semester college course. Arrangements will be formalized well in advance of the 1983 expeditions themselves and details will be available upon request.

Many previous students received credit for SFS coursework from their parent institutions, the following among them:

Boston University  
 Colorado College  
 College of the Atlantic  
 Evergreen State College  
 Haverford College  
 Ohio State University  
 Pennsylvania State University  
 University of Cincinnati  
 University of North Carolina  
 University of Pennsylvania  
 St. Lawrence University  
 Washington University

A number of secondary schools also have awarded credit to their students for SFS coursework. A full listing is available.

If you are interested in the possibility of credit through your parent institution you must obtain the support of your academic counselor or dean for an independent project. SFS will provide your institution with a complete syllabus for the course you select plus a copy of the final expedition report. The principal faculty leader will award a grade for your participation and/or written report if so requested. (Please be aware that it is rarely possible to make credit arrangements after you complete a course.)

**Course Levels** To achieve the maximum benefit and personal reward for each student, SFS courses are taught on two levels based on the academic and outdoor living requirements:

"A": These are courses at the introductory or college freshman level. They assume little background in the academic discipline and few outdoor skills. They do require completion of junior year in high school by the time the course starts.

"B": These courses are a follow-up to level "A" courses, and generally assume completion of one of the following or their equivalent: 1. college level course in an appropriate discipline (biology, geology, ecology, etc.), preferably a laboratory course; 2. SFS level "A" course or other scientific field experience. Level "B" courses are taught at the sophomore/junior level.

Other prerequisites, such as SCUBA certification, are as noted in individual course descriptions. A student may contact the Admissions Director to petition for exemption of certain of the above requirements.

**Syllabus** A course syllabus will be sent to you upon receipt of your completed application. It will give you detailed information on your expedition and the anticipated field conditions. It should answer your questions about travel arrangements, what you need to bring, and what you should do to prepare for the expedition (reading list, physical conditioning, etc.). Final materials on the course will be sent at a later date. You may request a syllabus for different expeditions before applying to help reach your decision.

**Common Elements** Each SFS course is developed according to the following general outline. The amount of time devoted to these elements may vary based on subject matter, academic material, faculty emphasis, and group abilities, but these elements are common to each course.

#### **Orientation—days 1-3**

1. Expectations meeting with expedition team
2. Safety and first aid lectures
3. Introduction to outdoor living skills training
4. Discussion of the nature of decision-making
5. Introduction to local customs and natural history
6. Lecture on general ecosystem/environmental problems
7. Statement and explanation of the research problem
8. Explanation of group journal and naturalist's journal
9. Initial exploration of site

#### **Week One**

1. Topical lectures in appropriate scientific discipline(s)
2. Introduction to research methodology and field work
3. Overview of research problem and clarification of approach; (daily) 1½ hour research and academic lectures/discussions
4. Data collection in the field

#### **Midpoint—Week Two**

1. Return to overview within the context of data collected and knowledge gained to date; new concepts
2. Verbal evaluations of student progress; group dynamics discussion
3. Diversion from field work, 1-2 days

#### **Week Three**

Continuation of data collection in the field with accompanying lectures

#### **Week Four**

Lab work, data processing and analysis, independent projects (optional)

#### **Wrap-up**

1. Integration of research results to date
2. Written evaluations of students by faculty
3. Group debriefing

**Field Conditions** Living conditions during SFS expeditions tend toward the primitive. Meals may become repetitious, hot showers a long-awaited luxury, contact with the outside world rare, etc. Generally you will be sleeping in small tents and cooking meals as a group. There is exposure—to weather, thick and thin air, and to things that stick, sting, or bite.

Incalculable rewards can come from this investment of yourself: your awareness will grow, you will become closer to your expedition team co-workers, you will be involved in decision-making as you live with the natural processes you study. A typical day might involve waking before sunrise and cooking breakfast followed by lectures and discussion. After a lunch break you may have an afternoon of data collection in the field. Evenings may involve special collecting forays or more lectures and time to reflect or write in your journals. Occasional days off as a team may allow for excursions to a different ecosystem, or the chance to pursue an independent interest. You will experience something very different from your usual routine.



Kenneth Andraske

# Marine Mammal Biology and Conservation

## Glacier Bay, Alaska

“This expedition made me appreciate the natural world more than I could ever have imagined. To camp where a glacier was just 10 years ago, to see and feel the wilderness around me has deepened my respect for it. I can't fully express my feelings to someone else. You have to do it yourself. This has been one of the most incredible experiences of my life.”

Mary Talbot  
Northfield Mount Hermon  
School  
July 1982

A study of three marine mammal species in Glacier Bay (harbor seal, harbor porpoise, humpback whale) to examine their biology and the effect of human activity on these species in order to assist the Park Service in developing appropriate conservation policies.

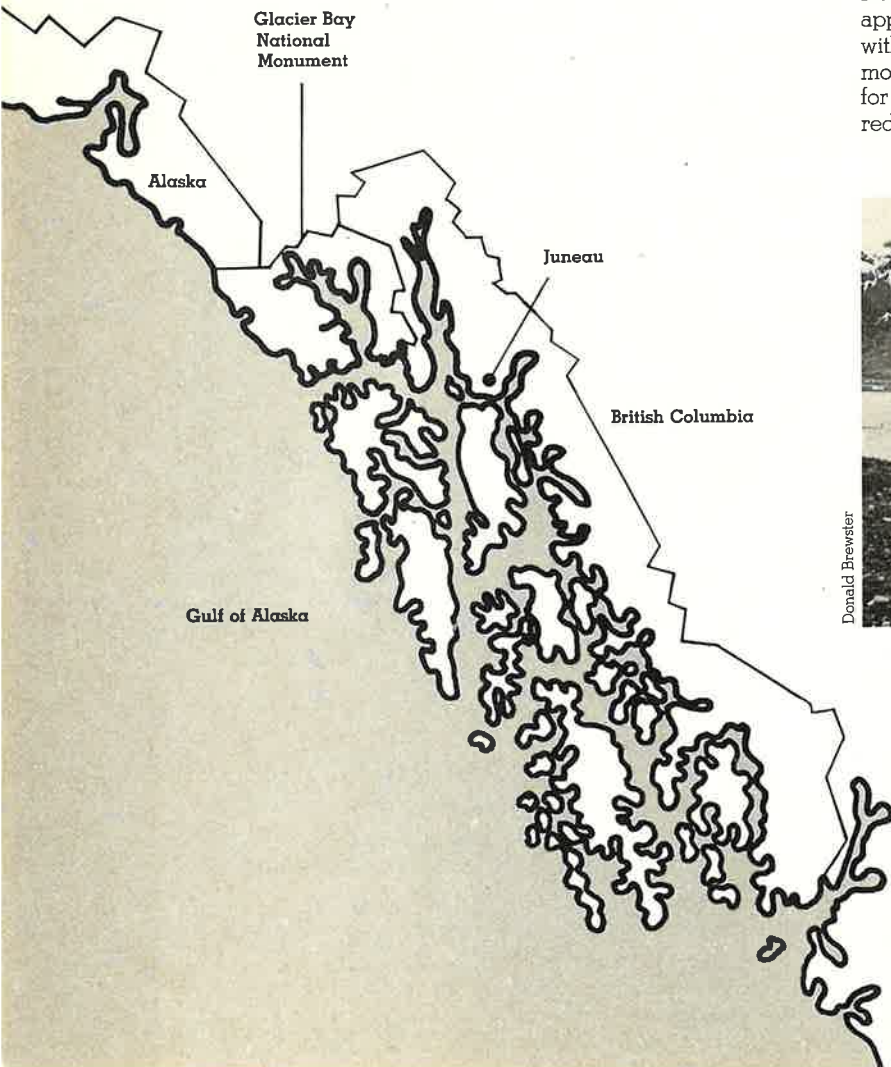
**Site** The magnificent Glacier Bay National Park is located approximately 160 kilometers northwest of Juneau, along the coast of the Alaska panhandle. Just two centuries ago, the entire area was covered by ice. Retreating glaciers have left behind a diversity of animal and plant life that dramatically represents different stages of succession and life zones. Near the mouth of the bay, where the National Park Service has its headquarters, the land is heavily forested with stately spruce and hemlock. But as one moves up the bay, vegetation becomes sparse. In the upper basin inlet, the land is raw and bare, just recovering from its glacial imprisonment.

The unusually rich variety of marine mammals that frequent the waters of Glacier Bay includes harbor seals, harbor porpoises, humpback whales, killer whales, and minke whales.

**Background and Relevance** Harbor seals, harbor porpoises, and humpback whales are the most abundant marine mammals in Glacier Bay, and are protected by the National Park Service. They also are a major attraction for park visitors. Controversies regarding factors affecting the future of these species and the basic lack of knowledge about them make continued research essential for their management and survival.

The largest concentration of harbor seals (*Phoca vitulina*) in southeast Alaska is found within Glacier Bay. During the summer months, the seals congregate at the heads of inlets with active tide-water glaciers. Hauling out on icebergs that break off into the water, the seals rest, give birth to their young, and nurse them on the drifting ice.

Harbor seals are easily disturbed from their resting sites by the approach of vessels. As was documented last summer, this occurs with some frequency. In addition, Muir Glacier, which produces most of the ice used by the seals for pupping, has been retreating for the past 200 years. If this retreat continues it will mean a major reduction in the available ice on which the seals depend.



Donald Brewster

**Most of our research will be conducted from land sites using binoculars, spotting scopes, and equipment for determining distances.**

Harbor porpoises (*Phocoena phocoena*) are one of the smallest cetaceans. Populations of harbor porpoises have declined in some areas. In 1982 we were able to identify five porpoises from the natural scar markings and notches on their dorsal fins and began to plot their movements in Muir Inlet.

The number of humpback whales (*Megaptera novaenglia*) visiting Glacier Bay declined sharply in the late 1970s. A major point of controversy in the continuing debate about park resource management is the degree to which cruise ships and other vessels influenced this decline. We will follow up the work of several other research teams which have been studying this problem.

**Course Design and Training** Lectures, reading material, and informal discussions will provide the necessary background information on the biology of marine mammals and relevant previous research. The following topics are among those that will be addressed:

- marine mammal biology and physiology
- pinniped population dynamics, social structure, and behavior
- recent marine mammal/human interaction controversies
- field identification of mammals and birds
- field methodology and research techniques
- marine mammal conservation and management

We also will attend films, lectures, and other programs presented by the Park Service on the geology, flora and fauna, and current management of Glacier Bay National Park. To help develop observational and recording skills, all team members will receive formal training in naturalist field journal writing and will regularly record their location, site conditions, and other pertinent observations of different species seen.

The major objectives of our work on harbor seals in June and August will be to examine the impact of different vessel types on them, from ocean liners to kayaks, and to monitor how environmental conditions affect them. We will utilize the data collected last summer as a base and employ more advanced techniques to measure distances and count seals to extend our profile of this population.

Our research on harbor porpoises in June and August will focus on the individuals we recognize from 1982. Our objectives will be to gather data on the behavior, location, movements, and reproduction of individual porpoises with known histories. The potential to follow individuals with known histories from year to year could provide some exciting research breakthroughs.

With humpback whales, our primary goal will be to monitor the numbers and movements of those that enter Glacier Bay. If possible, we will gather data on interactions between humpbacks and boats in the bay by means of sophisticated instruments designed to determine distance and location of vessels and whales.

Almost all of our research will be conducted from land sites using binoculars, spotting scopes, data sheets, observation journals, cameras and theolites (used to determine distance). We will try to keep at least 90 meters away from the animals we are studying to avoid influencing their behavior, but there will be ample opportunity for first-hand observation of unique and rare species. Research days usually involve extended periods at an observation site with a small group.

Team members will be carefully trained in kayaking, water safety, wilderness decision-making and low-impact camping, and will participate in navigating the capricious waters of Glacier Bay. Students will have full responsibility for camp life, from erecting tents to cooking, and other jobs essential to survival in the field.

The course design and activities will be modified for each team. The first, in upper Muir Inlet, will focus on harbor seals and porpoise since June is when the seals give birth to their young. The second team will be out for a somewhat shorter period and will do relatively less distance kayaking, with research in the middle and lower reaches of the bay on humpback whales and harbor seals. Team three will conduct more research on seals and also on porpoise in Muir Inlet when the porpoise will be giving birth to their young.

These projections are contingent upon final Park Service approval, and may be altered to meet changing circumstances.

**Living and Working Conditions** Virtually all of our time will be spent kayaking, observing, and camping in remote settings. As the weather in Glacier Bay is unpredictable, students should be prepared to endure cold weather and rain on a regular basis, although conditions can be remarkably pleasant. Transportation will be by stable, two-person kayaks, the most practical (and enjoyable) means of getting around.

The hard work, mental and physical, under sometimes adverse conditions, will require a positive attitude and willingness to work as a group, but the return in new friends and good times can be great. Continual improvement of our group dynamics skills will be an essential part of the project. This is one of our more demanding courses. It combines significant, participatory field science with a quintessential wilderness experience.

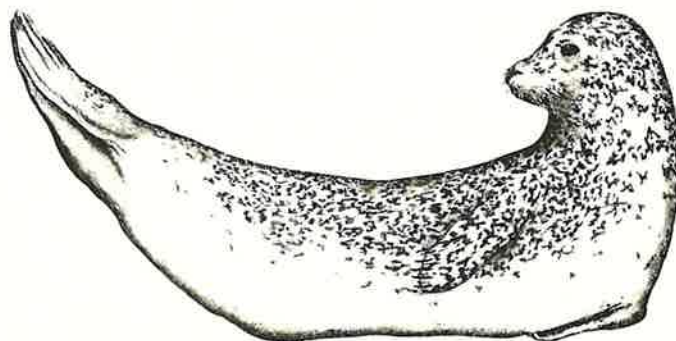
**Faculty** John Calambokidis has conducted research on seals in the Pacific Northwest and Alaska for the past six years. He is a principal in the Cascadia Research Collective and has worked under govern-

ment contract a number of times, researching seals and pollutants. John led the SFS expedition to Glacier Bay in 1982 and was co-leader of a course on seals in Puget Sound the year before.

**Team members will be carefully trained in kayaking, water safety, and wilderness decision-making.**

| Team                       | Level | Cost    |
|----------------------------|-------|---------|
| June (June 8-July 12)      | B     | \$1,410 |
| July (July 6-August 1)     | A     | 1,410   |
| August (July 26-August 30) | B     | 1,510   |

Expedition departs from Gustavus, Alaska.



**Harbor seal (*Phoca vitulina*)**

## Community Ecology

### Mount St. Helens National Monument

“The highlights of this expedition for me were seeing the scope of the devastation for the first time; observing elk from distances of 10–15 meters; the beautiful, crystal-clear night with stars and meteor showers. The memories from this experience will be around for a long time. ☺☺

*John M. Davis  
Illinois State University  
August 1982*

© Gary Braasch



© Gary Braasch



***Amid the devastation, some forms of plant life are slowly recolonizing.***

***Students from last summer work with radio telemetry equipment for tracking elk.***

***The eruption of Mount St. Helens on May 18, 1980, devastated a huge area, destroying forests and wildlife.***

An investigation of the interaction of a generalist herbivore (elk) with plant communities following large-scale ecosystem devastation, and the implications this has for forest resource management by government and private industry.

**Site** The “ring of fire” is a chain of volcanoes—active, dormant, and extinct—stretching from East Asia to the Andes. In the Pacific Northwest, the slopes of these volcanoes and surrounding mountains are distinguished by the most extensive subalpine meadows anywhere in the world, and by major timber resources that support a primary industry.

Since the Ice Age ended, not a century has gone by without at least one significant volcanic disturbance in the region. On May 18, 1980, in one of the most tremendous eruptions of recorded history, Mount St. Helens blew itself apart with a force 500 times greater than the atomic bomb that ravaged Hiroshima.

The blast killed or altered a huge proportion of the plant and animal life in the area: 1,500,000 animals and birds destroyed; 505 square kilometers of wildlife habitat, forest, and managed land devastated; 245 kilometers of trout streams and 26 lakes buried or poisoned. The slopes that had sustained a garden of botanical and zoological riches were transformed into a desolate wasteland. The economic loss, primarily to the timber industry, was in excess of \$1 billion. While another explosion of the magnitude of May 18, 1980 is unlikely, geologists believe that Mount St. Helens will be active for decades.

© Gary Braasch



**Background and Relevance** The question facing public and private managers of lands in the area is how to maximize the natural process of plant and animal recolonization and restore these lands to productivity. At the same time, Mount St. Helens National Monument was created this past summer to preserve much of the blast zone. It offers an unparalleled opportunity for studying the survival and regeneration of a complete forest ecosystem.

Following the May 18 eruption, a network of research programs was organized to fully document the phenomenon and monitor its aftermath. This course is an outgrowth of that continuing research effort and incorporates the pioneering work of last year's SFS expedition.

The study area is north and northwest of Mount St. Helens, both within and outside of the state-declared "Red Zone" (the area of maximal destruction from the eruption). We will work in both managed and unmanaged lands, publicly held as well as privately owned.

Of the higher terrestrial plant life, fireweed survived and is growing with relative speed. The giant Douglas fir, most economically important of the obliterated life forms, is beginning to grow back through the ash but in some areas common lupine is the only plant life that has reappeared. Some animal life has returned. Small rodents and the coyotes that prey on them now are spotted throughout the area. Elk and deer that survived south of the volcano once again are common in our study area through immigration. It is the interaction between the recolonizing plants and returning animals that is the focus of our course. What impact does each species have on the others, and what are the implications for the immediate future and beyond? This course offers an ideal opportunity for students interested in the fundamentals of community ecology, plant-herbivore interaction, succession theory, botany, and wildlife biology.

**I Elk Study** The principal means of studying elk behavior and habitat utilization will be direct observation using binoculars and long-range spotting scopes. Students will be involved mainly in four aspects of elk-related field work: censusing, via set routes on prescribed days; radio tracking of tagged and collared elk (about eight); documenting daily activity patterns; and studying food preference and habitat.

**II Plant Study** Vegetation sampling will focus on permanent plots constructed shortly after the eruption as part of a long-term study, and 15 new plots set up by our expedition team last summer. These plots represent large-scale disturbance types, e.g., blow-down, hummocky surface debris slide, standing scorched forest, and undisturbed forest. Vegetation communities varying by slope exposure, elevation, moisture, blast impact, and post-eruption management will be examined in detail. Habitat analysis will involve the identification of both common and uncommon species (240 species were identified last summer) and work on standardization of data to allow for efficient analysis and comparisons. Seedling collection, identification, and cultivation techniques will be used to assess how seeds arrive at a site and under what conditions they succeed.

The expedition faculty now are analyzing the data generated by last year's expedition and will incorporate the results into this year's course. Some of the questions for investigation are these:

- How do mechanisms of plant survival and establishment differ in specific types of volcanic disturbances such as mudflows, debris slide and blowdown areas?
- How does a large generalist herbivore such as the Roosevelt elk increase its foraging efficiency in a disturbed area?
- What is the relationship between successional trends in plant life and foraging strategy of the elk?
- What thermal regulatory mechanisms do elk use and how are they related to habitat type?

-Have resource management practices influenced the distribution of elk in the area? 6

Students will be carefully instructed in radio tracking and then assigned to monitor a particular elk via radio telemetry for several days. Students will be responsible for plotting the animal's location, recording behavioral data, and sampling vegetation at elk locations as well as collecting pellet groups for analyzing food habits.

As in all SFS courses, basic training in outdoor skills—camping, movement in the back country, safety, and leadership in the field—is provided. Group participation and interaction will be stressed throughout the expedition.

**Living and Work Conditions** Tangled, unstable slopes lace the study area. Movement in the field is rugged at times. During the summer it can be quite hot and dry. However, substantial rain and occasional cold temperatures also are possible in this Northwest setting. Students are advised to be prepared for either situation.

The territory in which our research will be conducted is owned and managed by either the U.S. Forest Service or the Weyerhaeuser Corporation. The safety regulations and requirements of both will be strictly observed in the study area. Should the mountain become active, alternative study sites and objectives will be attempted. The project is contingent upon safe conditions plus the necessary permits at the time of departure.

Our base camp will be in a field adjacent to woods near Kidd Valley, a small farming community outside the Red Zone. No running water or electricity are available at the camp. The site is several hundred meters above the Toutle River, safe from mudflows which periodically drain down this watershed. As water in the area is not safe for drinking, we will rely on adequate supplies from the base camp. We will drive for an hour or more into and out of the study areas each day.

Last summer's team found several opportunities for recreational hikes, including one to a ridge overlooking the crater as well as an occasional swim in local lakes, and making music around the campfire.

**Faculty** A. B. Adams is a candidate for the Ph.D. in ecology. A. B. has his B.S. in economics and M.S. in botany. Since 1980 he has been working for the University of Washington/U.S. Geological Survey seismic network telemetry project with an emphasis on the Mount St. Helens area. He is conducting long-term research on the mountain's vegetation. Evelyn Merrill received her B.A. in political science and

M.S. in wildlife resources from the University of Idaho. For several years she worked as a wildlife research biologist for the Idaho Department of Fish and Game studying elk, moose, and deer. Currently she is working on a Ph.D. program at the University of Washington, examining elk recolonization of Mt. St. Helens under a research grant. Evie was co-leader of last year's course with A. B. Adams.

| Team                      | Level | Cost    |
|---------------------------|-------|---------|
| June (June 22-July 23)    | B     | \$1,090 |
| July (July 25-August 21)* | A     | 980     |
| *(tentative)              |       |         |

Expedition departs from Castle Rock, Washington.

## Wildlife Management

### Athi Plains, Kenya

“Our project was a growing experience for everyone involved. We were exposed to a Third World country of immense beauty. We had the benefit of our leaders’ 10 years collective experience in Kenya. This was not a simple tour. Everyone of us learned a great deal about grassland game ecology and management. Many of the subtleties of my experience are still coming to me.”

H. David Dean  
Temple University  
July 1982

**Level A** (June team): An introductory course in wildlife ecology and management. No previous experience in field work or biology is required.

**Level B** (July team): An advanced course in ungulate resource use and partitioning, concentrating on the collection of data on foraging, habitat, species composition, and the effects of grazing pressures on speciation and the determination of optimal stocking and harvesting rates for a mixed ungulate community. Prerequisites include one college-level course in biology and one in ecology or animal behavior, or permission of the instructor.

**Site** A land of vast biotic diversity, Kenya hosts perhaps the greatest variety of wildlife in its natural habitat anywhere on earth. It is a country of dramatic contrasts. Within view of Nairobi’s modern skyscrapers, lions stalk gazelle. In the veldt, antelope abound, hippos and crocodiles inhabit the rivers, leopards hunt by night, and elephants roam free.

Its terrain ranges from harsh dry desert through arid plains and sunny grasslands to tropical rain forests and mountains capped with snow. Mount Kenya sits astride the equator and rises to an elevation of 5,500 meters. The Rift Valley, the most extensive geologic fault on our planet, cuts dramatically through the countryside. It contains shimmering blue lakes, smoking volcanoes and ancient lava flows, and the proud Masai with their ever-present cattle.

**Background and Relevance** Ungulates, the world’s most successful group of herbivores, are nowhere found in greater numbers and diversity than the expansive grassland ecosystems of the African continent. They exhibit amazing variations in body size, social structures, foraging strategies and patterns of resource use. They range from the large amphibious and nocturnal hippo to the diminutive, secretive dik-dik. The grace and beauty of lone impala contrast with the massive migrations of wildebeest herds.

As the human population of East Africa has grown, agriculture and domestic livestock pressures have greatly reduced wildlife populations through slaughter and the destruction of habitats. The existing livestock industry often tends to deteriorate land resources through over-stocking and daily dependence on water.

Recently, a novel land use system has been implemented by Dr. David Hopcraft to demonstrate the ecological and economic value of conserving wildlife on private land. His *Wildlife Ranching and Research* project is dedicated to the demonstration of the productive potential of wildlife in semi-arid regions, while maintaining the natural balance of the land. The sale of meat and by-products resulting from weekly cropping of selected native species of ungulates generates revenue, thereby demonstrating their importance as a renewable resource.

To achieve appropriate, effective management of wildlife on the ranch, an active research program has been initiated to monitor populations, gain insight into patterns of resource use, and collect data from cropped animals. This information has proven invaluable in determining ecologically and economically viable stocking and harvesting rates for gazelle, hartebeest and wildebeest.

**Project and Training** **Level A** (July team) is an introductory course in wildlife ecology and management, using the ungulate populations of the ranch and those in one or two game parks for study. No previous experience in field work or biology is required.

**Level B** (August team) is a more advanced course in ungulate resource use and partitioning concentrating on the collection of data on foraging, habitat, species composition, and the effects of grazing pressures on speciation and the determination of optimal stocking and harvesting rates for a mixed ungulate community. Prerequisites include one college-level course in biology and one in ecology or animal behavior, or permission of the instructor.



Students will become familiar with wildlife (specifically ungulates) ecology and management through a unified course involving lectures, training in field techniques, the first-hand experience. Topics discussed in lectures and slide talks will include ungulate social structure, taxonomy, behavior, resource patterns, anatomy, parasitology, conservation in East Africa, and harvesting strategies.

Among the numerous field techniques that will be explained and demonstrated are these:

- performing body measurements
- cropping techniques
- ground and aerial wildlife censusing
- post-mortems
- behavioral observation and recording
- habitat analysis

These skills will be employed within the 88 square kilometers of the ranch. Concurrently with our academic and field training, there will be instruction in safety in the bush, leadership, planning, group organization, and emergency care throughout the expedition.

Our primary research objective will be to determine patterns of resource use and partitioning displayed by the native ungulate communities. This ecological consideration is the basis for the high wildlife productivity which supports the ranch and which could be applicable to other areas where human populations are in apparent conflict with wildlife. To this end, our efforts will be directed toward the systematic collection of field data on habitat selection, foraging strategies, and behavioral patterns of the ungulates.

East Africa, its land, people, flora and fauna, is one of the most fascinating places on earth. We anticipate several opportunities during the course for travel to one or more game parks for additional wildlife lectures by field biologists and to absorb as much of the extraordinary setting as possible. In particular, we hope to observe again the annual migration of 100,000 head of wildebeest from the Serengeti to Masai Mara.

Breaks from data collection and field work may include activities such as bird identification, flower recognition, and visits to native markets and tribal dances. The people inhabiting this region are themselves a diverse group: pastoralists, nomads, and tribal kingdoms with influences from Arabic and European cultures. Students will be exposed to the blending of age-old customs with modern African society. We will occasionally work with people such as

**Living and Working Conditions** Our camp will be basic but comfortable. We will sleep in tents on the ranch, cook on open safari fires, and eat food from native markets. There will be ample cold showers. Often we will rise before sunrise to begin our work. Travel will be hot and dusty which will require good humor and cooperation among all participants.

Although the coming expedition will mark our third full season in Kenya, the constraints and complexities of working there make many of the logistics difficult to plan with absolute certainty. Patience and flexibility in adapting to unforeseen problems (vehicles, park permits, other inconveniences) will not only enhance your training but will undoubtedly add to the sense of adventure.

**Faculty** Brad Stelfox, a resident of Kenya, received his B.Sc. in zoology with honors from the University of Alberta. He has worked in the areas of wildlife population dynamics in British Columbia and land-use resource studies in Alberta. He was an environmental consultant during 1980, studying consumptive utilization of Kenya's wildlife and is pursuing a Ph.D. His current research is an extensive and complete study of the ecosystem in which *Wildlife Ranching and Research* is situated. Along with his boundless enthusiasm for Kenya and wildlife

research, Brad is an accomplished mountaineer and an avid birder. He was co-leader of the Kenya expedition last summer.

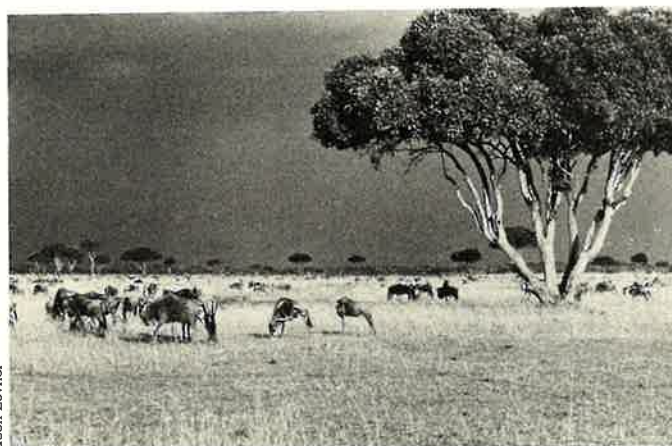
Bill Aughton has a long history of interest and participation in wildlife conservation, particularly in East Africa. To this end, he has volunteered several months of his time assisting with ongoing ecological studies at Wildlife Ranching and Research. Bill has taught outdoor education, survival skills, leadership and group dynamics and is a professional mountaineer.

| Team |                     | Level | Cost    |
|------|---------------------|-------|---------|
| June | (June 12-July 19)   | A     | \$1,980 |
| July | (July 24-August 30) | B     | 1,980   |

Expedition departs from Nairobi, Kenya.



Geoff Levner



Geoff Levner

**A recent article in The New York Times Magazine focused on wildlife management issues in Kenya, with special attention given to Hopcraft Ranch.**

**Direct experience with special ecosystems is one of the most outstanding aspects of an SFS expedition.**

# Population Dynamics of Endangered Species

## Theodorou, Crete

Thomas Husband



**There are only about 90 pure-blood agrimi living on Crete today.**

An analysis of the population ecology of agrimi (the extremely rare wild goat of Crete) in order to assess survival strategies.

**Site** Halfway between Greece and the shores of North Africa, the fabled island of Crete provides a transition of biotypes from rugged snowcapped mountains down to olive groves and sandy beaches on the Aegean sea. Just off the northwest edge of Crete lies the tiny island of Theodorou, home of the agrimi (*Capra aegagrus cretensis*), the Cretan wild goat. Theodorou is accessible only by local fishing boats.

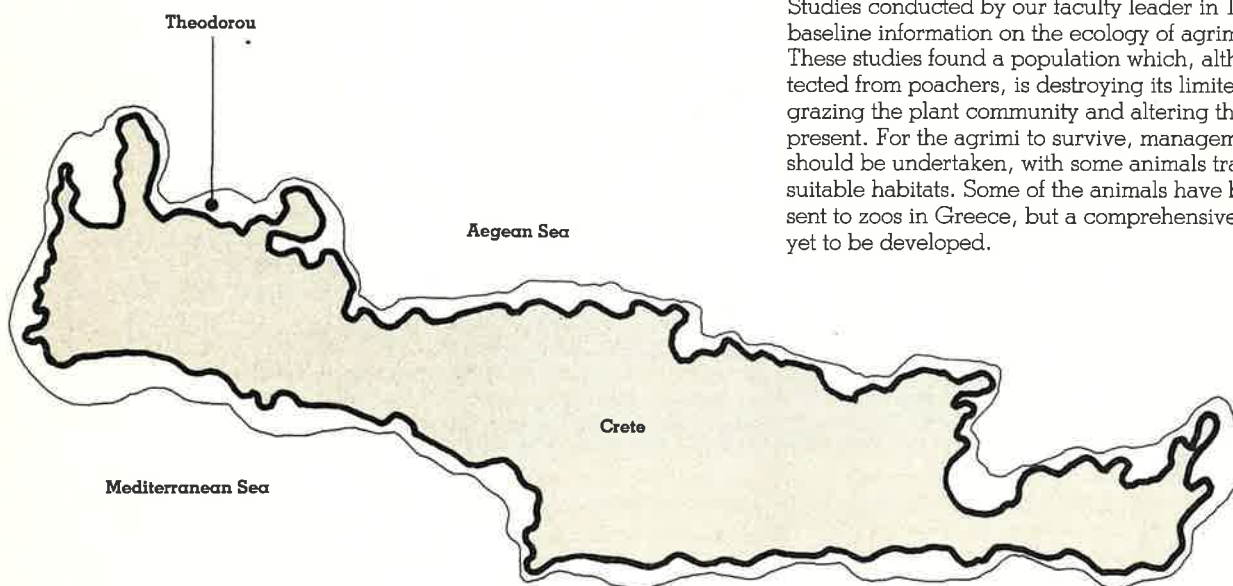
Many plant species of Europe, Africa, and Asia converge on Crete. Many of these have undergone important changes either because of climatic influences or isolation, resulting in particularly interesting endemic species and subspecies. The vegetation on Theodorou represents a complex and diverse community of unique plants as well as the more common wild olive, pistachia, and Old World cactus, many of which have water-conserving and anti-grazing adaptations that affect the agrimi.

In 1963, Theodorou was officially designated a national wildlife reserve to maintain a breeding herd of agrimi. The island had been stocked with the animals in 1928, 1937, and again in 1945 but only the last stocking was successful, as the earliest herds fell prey to hungry soldiers. Since 1945 the agrimi population has gradually degraded its habitat through heavy overgrazing.

**Background and Relevance** The agrimi permeates Mediterranean art and culture. For centuries it has been the symbol of Crete. It is thought to be the prototype of all domestic goats; its range once extended from North Africa to Afghanistan. According to folk traditions, eating the meat of agrimi guarantees strength and long life. The horns, ground to a fine powder, have been touted as an aphrodisiac. Beliefs such as these have led to poaching of the animals. Coupled with the overgrazing of their habitat, these factors have brought the agrimi to the brink of extinction.

Today only about 90 pure-bred agrimi live on Theodorou Wildlife Reserve while another handful exist in the White Mountains of mainland Crete. Though quite small (about one square kilometer), Theodorou is a perfect laboratory for measuring the effects of overgrazing in arid climates. This is a critical global problem resulting in erosion, desertification, and species diversity depletion, as exemplified by the sub-Saharan Sahel. Therefore, while our research may contribute to a solution of the important agrimi survival problem, it also addresses this larger issue.

Studies conducted by our faculty leader in 1973-75 established baseline information on the ecology of agrimi on Theodorou. These studies found a population which, although adequately protected from poachers, is destroying its limited food source by overgrazing the plant community and altering the ratio of species present. For the agrimi to survive, management of the population should be undertaken, with some animals translocated to other suitable habitats. Some of the animals have been captured and sent to zoos in Greece, but a comprehensive management plan has yet to be developed.



Only one other band of agrimi is known to exist, in the Samaria Gorge of Crete's White Mountains. the size and movements of this band have not been studied. Samaria is another relatively new national park, known for its ruggedness and coniferous forests. It presents a strikingly different and beautiful site for the study of agrimi. Little if any research has been conducted since our faculty leader's work in 1975.

**Course Design and Training** Before successful management or other formal action can be considered, accurate scientific data must be collected to ascertain the current status of the agrimi. Data on the present structure of the population (distribution of its members across age and sex, numbers of newborn and fertile females, etc.) and its island habitat must be gathered to assess trends established since 1975. Such ecological trend data is necessary to project the future of the agrimi on Theodorou and evaluate potential alternative translocation sites on the Cretan mainland.

Lectures will introduce students to demographic analysis, estimation of population parameters, factors limiting abundance, and carrying capacity of the habitat. Specific topics addressed will include density, natality, mortality and ratios of sex, age, immigration and emigration; life tables and innate capacity for increase; models of population growth, population cycles, energy flow and bioenergetics, factors limiting distributions, and current and potential management policy.

Our course will include as many of the necessary elements of a population dynamics study as are feasible at the time of our expedition:

1. capturing all of the animals in a remotely controlled corral to determine identity, weight, and population structure;
2. intensively measuring various aspects of the vegetative community on Theodorou through clipping and weighing plants to determine biomass and species distribution;
3. observing and recording agrimi behavior;
4. traveling to Samaria National Park in the White Mountains of Crete to investigate wild agrimi distribution in their native habitat there, and to compare the ecology of domestic goat grazing with the agrimi habitat and individuals on Theodorou;
5. assessing the suitability of other areas on Crete and nearby islands for the relocation of agrimi and possible park status.

If time permits, we will examine other island goat populations interbred with agrimi along the northern coast of Crete.

The scientific skills taught and utilized by students during this course will include habitat analysis techniques, behavioral observation skills, capture and handling techniques for wildlife, as well as an in-depth knowledge of population ecology. Students will learn to shoot transects with compasses and set up and harvest vegetation plots. Each student also will assist in agrimi capture ses-

sions both day and night. Every agrimi on the island must be lured into a corral and captured by hand, then weighed, sexed, tagged, and identified during several night-long sessions. (This roundup will be a matter of tough, close work with the animals.)

As time allows, other topics of potential investigation are the physiological ecology of agrimi and this animal's unique ability to desalinate sea water, a process briefly examined during the 1975 study.

**Living and Working Conditions** The climate of Theodorou is true Mediterranean, with almost no rainfall from spring through fall. Temperatures in summer often exceed 100°F near sunny coastal areas, although sea breezes help to moderate the heat. The island is rugged, lined by cliffs falling directly into the sea. Agrimi capture will be performed on a 24-hour basis with rotating shifts. The work may be tedious at times but activities such as the capture and Samaria Gorge survey will require quick thinking and sound judgement.

Emphasis will be placed on teamwork and group cooperation. Work in Samaria Gorge will require some backpacking and a good deal of stamina for movement in this terrain. Faculty will work with students individually as necessary to enhance their outdoor skills.

The team will camp in tents near the few support buildings on the island. These offer space for lectures, study, and recreation indoors. As fresh water is naturally absent from Theodorou, we will cache supplies along the craggy limestone landscape for drinking. There may be some time for such "extracurricular" activities as visits to village markets to buy supplies and a foray to archaeological ruins along the northern coast.

**Faculty** Thomas Husband, Ph.D., is an assistant professor in the Department of Forest and Wildlife Management, University of Rhode Island, and a natural resource specialist for their Cooperative Extension Service. He received his M.S. and doctorate from Michigan State Uni-

versity and wrote his thesis on population ecology of agrimi on Theodorou under a National Science Foundation grant. He has extensive experience in undergraduate teaching wildlife, forestry, and natural resource use.

| Team                     | Level | Cost    |
|--------------------------|-------|---------|
| June (June 14-July 12)   | A     | \$1,290 |
| July (July 17-August 14) | B     | 1,290   |

Expedition departs from Chania, Crete after a flight from Athens.

**Agrimi will be corralled, and weighed, sexed, and tagged. The collection of ecological trend data will help to evaluate potential translocation sites for the agrimi.**



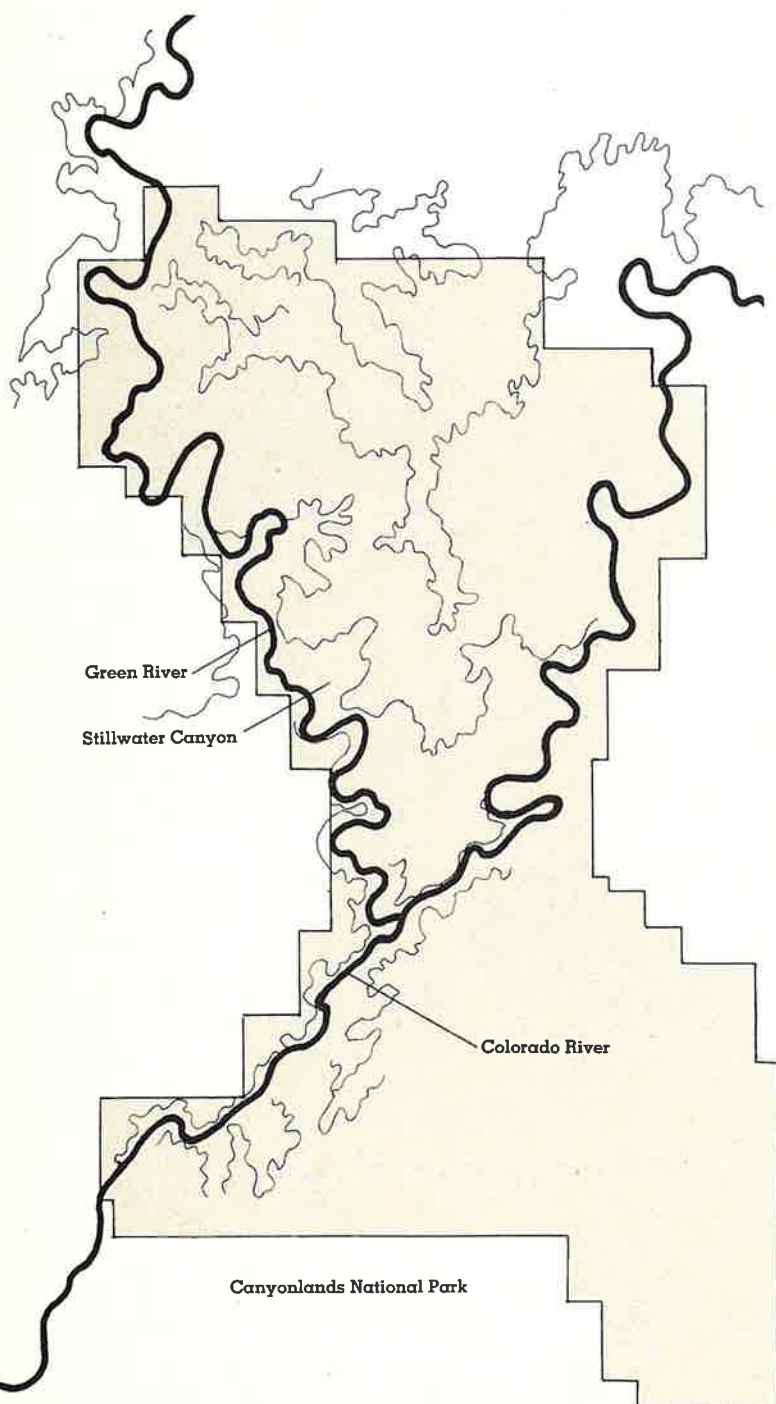
Thomas Husband

## Ecosystem Management

### Canyonlands National Park, Utah

●● The expedition expanded my understanding of the ecosystem of the canyonlands while also showing me a lot about how I act and react with other people. I think I learned not to take myself so seriously and to take nature and man's impact on it more seriously. ●●

*Bob Lord  
Hawken School  
July 1982*



An analysis of human impact on mammal distribution and food sources along the canyon bed of the Green River, in order to evaluate current management policies.

**Site** The canyonlands of the desert southwest are a living textbook of geological history, filled with fantastic configurations of layered rock in many colors. Although many of the strata are quite old, the canyons themselves are relatively recent features in geologic terms. For most of the life of the earth, the area now comprising Utah was a tropical marine coast like Florida today. The rocks at the bottom of the canyon date from late pre-Cambrian (1 billion years ago) to Mississippian (300 million years ago). About 200 million years ago, large mountains rose in the west and more than a kilometer of stream sediments was deposited along the "shore" in the eastern part of the state, where the Green River now flows. The late Cenozoic uplift of 10 million years ago rejuvenated the Colorado River and its tributaries, which carved out the spectacular canyonlands.

The overwhelming popularity of the canyon country began with Major John Wesley Powell's explorations in 1869. The waiting list for private river permits for the Grand Canyon now is several years long at any given time; the large number of recreational parties on the Colorado River make campsites there hard to find. However, the canyons of the Green River, just upstream from the Grand Canyon, are of similar geologic origin and are just as visually dramatic, but until recently were "undiscovered" by river runners.

**Background and Relevance** Pressures on the Green River and Canyonlands National Park have been increasing annually. While the human impact on the Grand Canyon has been monitored for several years, this has not been done upstream in Cataract and Desolation canyons on the Green River. A number of studies have contributed to the formulation of park management policy but budget cuts mandated by the current administration have resulted in the curtailment of ongoing Federally-funded studies.

By examining various index plant and animal species, we hope to contribute to preliminary efforts to measure the degree and direction of increasing human impacts on riparian (riverbed) ecosystems. Our data will be presented to several Federal agencies for their use in formulating future management policy.

**Course Design and Training** Because of the isolation of the canyon regions and their ruggedness, wildlife and botanical research has lagged behind that of other regions. With the advent of inflatable boats, researching the unique ecology of the canyonlands has become far easier, just as the sport and industry of white water rafting has made these canyons veritable playgrounds. The inflatable boat will be our primary support vehicle.

Any number of parameters may limit wildlife populations, but food has been targeted as the most likely factor for determining herbivore numbers. Therefore, it is necessary to identify the most important and preferred foods of a particular species in order to manage its population and thereby guarantee its survival. (The most important foods are those that comprise the greatest percentage of the diet, while a preferred food is one that is more common in the diet than in the environment.) The food habitats of canyon

wildlife must be documented before government personnel can manage and preserve the wildlife heritage in these areas.

We will investigate specific ungulate and rodent species in Desolation, Gray, and Stillwater canyons of the Green River and Cataract Canyon of the Colorado River. Background lectures will address riparian ecosystems, natural resource management strategies, small mammal and ungulate foraging and behavior, habitat and food preference analysis, adaptations to arid environments and heat stress, and field research design. Among our research objectives are the following:

1. to investigate changes in species composition around beaches and other areas subject to heavy use by recreationalists;
2. to determine the important and preferred foods of beaver (*Castor canadensis*) and desert mule deer (*Odocoileus hemionus crooki*) in those regions where domestic stock grazing is not allowed;
3. to determine plant species composition on grazed regions to compare with that found in ungrazed regions in order to quantify the effects of domestic stock grazing on competing species;
4. to discuss habitat and wildlife management options available to park resource specialists to further specific resource use goals.

We will employ four 2.5x5 meter professional inflatable boats to transport our team down portions of the Green and Colorado rivers. Using a stratified random sampling technique, we will inspect one-meter-square blocks on both sides of the rivers for plant species composition by identifying individual species and making stem and twig counts of these individuals. The sampling blocks will be further inspected for the number of beaver cuttings per plant species to indicate important and preferred foods. Sampling blocks also will be inspected for the number of twigs browsed per plant species to indicate important and preferred foods for desert mule deer.

The relationship between basic research in the field and its applications (i.e., translation into management policy and practice) is complex. Once we have addressed our research objectives, the faculty leader will compile and submit the results of our work for publication in scientific journals, as well as forward the report to

appropriate government agencies. With this and other studies in hand, resource managers can consider either increasing beaver and mule deer populations where they are scarce, or reducing them where they are in conflict with man simply by increasing or decreasing their preferred foods. If it can be shown that domestic cattle grazing in the canyons impair the range of mule deer, then perhaps managers will have a basis for reassessing grazing permits in hard-hit areas.

**Living and Working Conditions** Scouring the beaches and canyons for data will be hot and dry; running the river rapids wet and cool. Both circumstances will call for full cooperation from everyone. The possibility of an occasional cloudburst exists but the desert sun will predominate. The work itself will not be exceptionally strenuous, but negotiating the rivers and cliffs will require great care and team effort.

We will camp at isolated beaches along the river for the entire expedition and sleep in the open or in tents. Potable water is limited; all cooking will have to be planned and performed carefully to insure proper hygiene. Opportunities should be available for exploring an archaeological ruin, hiking to prominent lookout points, swimming, and quiet times around the nightly campfire.

**Faculty** Jerome Montague, originally from Kentucky, received his Ph.D. in wildlife ecology from Michigan State University. His dissertation was on morphology and growth of crocodiles in Papua, New Guinea, where he spent two

years in the backcountry as a wildlife officer for the United Nations. He also is a skilled professional river guide, working extensively on rivers in the western and southeastern United States and in New Guinea.

| Team |                     | Level | Cost    |
|------|---------------------|-------|---------|
| June | (June 16-July 12)   | A     | \$1,670 |
| July | (July 18-August 13) | A     | 1,670   |

Expedition departs from Green River, Utah.

**Although only recently "discovered" by river-runners, the vistas of the Green River canyons are just as dramatic and awe-inspiring as those of the now crowded Grand Canyon.**



**The inflatable boat will be our primary support vehicle as we travel through the spectacular Green River canyons.**



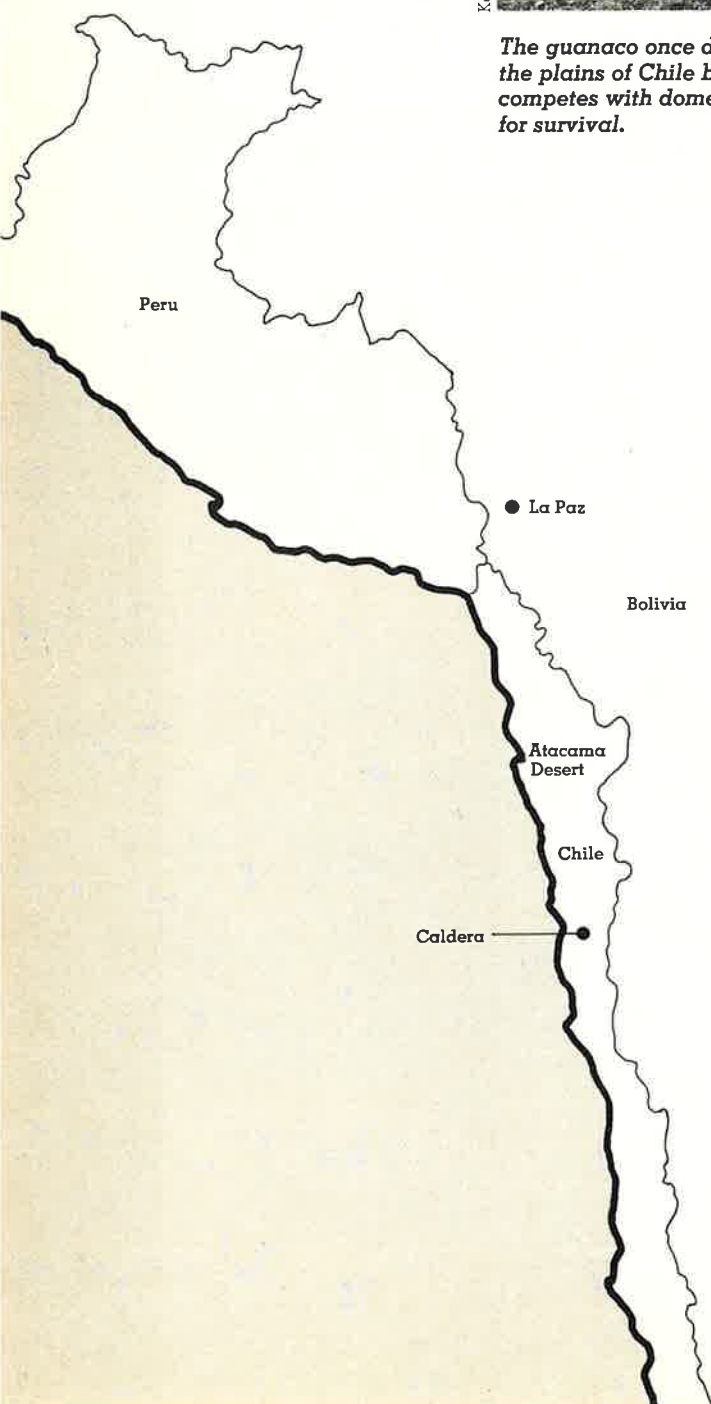
## Socio-Ecology and Park Planning

### Southern Peru and Atacama Desert, Chile



Kenneth Raedeke

**The guanaco once dominated the plains of Chile but now competes with domestic stock for survival.**



An analysis of a guanaco population and its necessary ecological boundaries) in the northern coastal range of Chile for possible inclusion in the national faunal reserve system.

**Site** Chile and Peru lie along the intersection of two continental plates. The majestic Andes, glaciated intrusive and volcanic mountains, were born of the resulting uplift and magma flow associated with this intersection. Low but gently rolling hills begin along the desert seacoast and rise to surround the valleys of rivers that flow down from the high Andes. Occasional fishing villages dot the coastline.

The altiplano (high plain) and foothills of the Andes provide the habitat for four members of the camel family: guanaco, vicuna, alpaca, and llama. Unlike the dry mountain climes, this region is characterized by warm, very dry weather. The average rainfall is about 25 centimeters, approximately the same as Arizona, for example.

The people are descendents of the original Inca and of 16th-century Spanish colonizers. The society today is predominantly one of village pastoralists, in which domestic stocks of vicuna and alpaca support cottage industries of wool and handicraft output and the llama is used as a beast of burden.

**Background and Relevance** The guanaco (*Llama guanicoe*) once was the most abundant and widespread large mammal of temperate South America. In his famous journal of researches, Charles Darwin described the guanaco as the characteristic quadruped of the continent. The guanaco probably numbered in the millions during Incan times, dominating the high plain and dry mountain biome.

With the coming of European settlers, the guanaco were decimated. Relentless hunting of the animals for meat, hides, and other by-products plus the competition from domestic stock greatly reduced the size and distribution of guanaco populations. Current estimates indicate a total of between 100,000 and 250,000 in the whole of South America. Of these, approximately a tenth exist in faunal reserves, national parks, and extremely isolated areas. The rest are subject to continual reduction.

The situation is a classic instance of competition between an indigenous species of wildlife and domesticated herds of stock maintained by and for the growing human population. The guanaco that once thoroughly dominated an ecological niche like the Chilean coastal range is faced with increased pressure from sheep, goats, cattle, alpaca, etc., that are managed and protected by villagers. The comparatively lush valleys near rivers, prime grazing land for both domestic and wild herbivores, are taken over for the expanding human population and its needs, forcing the guanaco into less productive range at higher elevations. With less food and water available, the guanaco's foraging becomes less efficient, with more energy expended per calorie of protein consumed than in richer lands with a higher carrying capacity.

Several conservation strategies for this species have been determined. They include the prohibition of guanaco hunting and commercialization of its products, the creation of reserves protected by Chilean park personnel, and land use planning to eliminate competition with domestic stock. Secure populations of guanaco now exist only in faunal reserves.

**Course Design and Training** The expedition will originate in southern Peru following a flight to Lima. We plan to work at a government-sponsored animal research station in La Raya where a variety of studies on captive animals are carried out: domestication, breeding, management. Several days of travel will take us across Lake Titicaca (elevation about 4,000 meters) to La Paz, Bolivia, circumventing the main Andean crest. We will travel down the Pan-American Highway to our research site, Caldera, in the Desierto de Atacama on the Pacific coast of Chile. We will work in the puna biome (mountain grasslands and chapparal) and deserts of Caldera.

# Application Form

## Admissions

School for Field Studies  
50 Western Avenue  
Cambridge,  
Massachusetts 02139

Before deciding to apply, read carefully the School Expedition Catalogue.

|                                                        |               |     |
|--------------------------------------------------------|---------------|-----|
| Name                                                   | Date          |     |
| Home Address                                           | Telephone ( ) |     |
| City                                                   | State         | Zip |
| School/College                                         | Grade/Year    |     |
| Address                                                | Telephone ( ) |     |
| City                                                   | State         | Zip |
| Preferred mailing address: Home (dates) School (dates) |               |     |

## I am applying to:

|                                                                                    |                                                                                |                                                                                           |       |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------|
| First choice                                                                       | team                                                                           | level                                                                                     | Dates |
| Second choice                                                                      | team                                                                           | level                                                                                     | Dates |
| Third choice                                                                       |                                                                                |                                                                                           | Dates |
| <input type="checkbox"/> Wait list me for my first choice.                         | <input type="checkbox"/> I will require financial aid. Send appropriate forms. | <input type="checkbox"/> I would like to be team journalist.                              |       |
| <input type="checkbox"/> Assign me second or third choice if first choice is full. | <input type="checkbox"/> I would like to be team photographer.                 | <input type="checkbox"/> I am seeking academic credit for my participation. Send details. |       |

## Personal Data

|                                                                                                               |                                                                                                                      |                                                                     |        |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------|
| Date of birth                                                                                                 | Sex                                                                                                                  | Height                                                              | Weight |
| Parent(s) or Guardian                                                                                         |                                                                                                                      |                                                                     |        |
| Parent(s) occupation and titles (optional)                                                                    |                                                                                                                      |                                                                     |        |
| Address                                                                                                       |                                                                                                                      | Telephone ( )                                                       |        |
| City                                                                                                          | State                                                                                                                | Zip                                                                 |        |
| <input type="checkbox"/> Do you wish to be identified as a member of a minority group? If so, which one?      | <input type="checkbox"/> Afro-American<br><input type="checkbox"/> American Indian<br><input type="checkbox"/> Asian | <input type="checkbox"/> Hispanic<br><input type="checkbox"/> Other |        |
| Previous accidents, injuries or health problems                                                               |                                                                                                                      |                                                                     |        |
| Do you have any physical handicaps, require medication, or have special dietary needs? If so, please explain: |                                                                                                                      |                                                                     |        |
| List the clubs or organizations of which you are an active member:                                            |                                                                                                                      |                                                                     |        |
| Magazines/publications you read regularly:                                                                    |                                                                                                                      |                                                                     |        |

### Academic Information

Actual or expected college  
major \_\_\_\_\_

Academic awards \_\_\_\_\_

Extracurricular activities \_\_\_\_\_

Athletic participation \_\_\_\_\_

Career plans \_\_\_\_\_

### Training and Related Experience

School-related field courses or  
research you have done \_\_\_\_\_

Previous travel experiences  
and dates \_\_\_\_\_

Briefly describe your camping  
and outdoor experience \_\_\_\_\_

Special skills, licenses,  
certificates \_\_\_\_\_

Name and address of your  
school paper: \_\_\_\_\_

Editor \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

List names and addresses of  
others who might like to receive  
information about SFS: \_\_\_\_\_

If you would like us to send  
additional catalogues,  
how many? \_\_\_\_\_

How did you first learn about SFS:

☐ SFS alumnus/ae

☐ friend

☐ poster

☐ science teacher

☐ other teacher

☐ SFS newsletter

☐ career/guidance office

☐ SFS staff member name \_\_\_\_\_

☐ newspaper/magazine name \_\_\_\_\_

☐ other \_\_\_\_\_

**Attach a three hundred word  
typed statement explaining  
your purpose in joining an  
SFS expedition, what you  
hope to gain from it, and  
what you expect to contrib-  
ute. Be specific.**

### Send your application to:

Admissions Department  
School for Field Studies  
50 Western Avenue  
Cambridge, MA 02139

I have read the SFS expedition  
catalogue thoroughly and feel  
that I would enjoy and benefit  
from the experience which it  
describes. Enclosed is my \$25  
(non-refundable) application  
fee.

\_\_\_\_\_  
Date

I approve this application  
(if applicant is under 21).

\_\_\_\_\_  
Applicant signature

\_\_\_\_\_  
Parent/guardian signature

# Application Form

## Admissions

School for Field Studies  
50 Western Avenue  
Cambridge,  
Massachusetts 02139

Before deciding to apply, read  
carefully the School Expedition  
Catalogue.

|                                                        |               |     |
|--------------------------------------------------------|---------------|-----|
| Name                                                   | Date          |     |
| Home Address                                           | Telephone ( ) |     |
| City                                                   | State         | Zip |
| School/College                                         | Grade/Year    |     |
| Address                                                | Telephone ( ) |     |
| City                                                   | State         | Zip |
| Preferred mailing address: Home (dates) School (dates) |               |     |

## I am applying to:

|                                                                                    |                                                                                |                                                                                           |       |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------|
| First choice                                                                       | team                                                                           | level                                                                                     | Dates |
| Second choice                                                                      | team                                                                           | level                                                                                     | Dates |
| Third choice                                                                       |                                                                                |                                                                                           | Dates |
| <input type="checkbox"/> Wait list me for my first choice.                         | <input type="checkbox"/> I will require financial aid. Send appropriate forms. | <input type="checkbox"/> I would like to be team journalist.                              |       |
| <input type="checkbox"/> Assign me second or third choice if first choice is full. | <input type="checkbox"/> I would like to be team photographer.                 | <input type="checkbox"/> I am seeking academic credit for my participation. Send details. |       |

## Personal Data

|                                                                                                               |                                                                                                                      |                                                                     |        |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------|
| Date of birth                                                                                                 | Sex                                                                                                                  | Height                                                              | Weight |
| Parent(s) or Guardian                                                                                         |                                                                                                                      |                                                                     |        |
| Parent(s) occupation and titles (optional)                                                                    |                                                                                                                      |                                                                     |        |
| Address                                                                                                       |                                                                                                                      | Telephone ( )                                                       |        |
| City                                                                                                          | State                                                                                                                | Zip                                                                 |        |
| <input type="checkbox"/> Do you wish to be identified as a member of a minority group? If so, which one?      | <input type="checkbox"/> Afro-American<br><input type="checkbox"/> American Indian<br><input type="checkbox"/> Asian | <input type="checkbox"/> Hispanic<br><input type="checkbox"/> Other |        |
| Previous accidents, injuries or health problems                                                               |                                                                                                                      |                                                                     |        |
| Do you have any physical handicaps, require medication, or have special dietary needs? If so, please explain: |                                                                                                                      |                                                                     |        |
| List the clubs or organizations of which you are an active member:                                            |                                                                                                                      |                                                                     |        |
| Magazines/publications you read regularly:                                                                    |                                                                                                                      |                                                                     |        |

### Academic Information

Actual or expected college  
major \_\_\_\_\_

Academic awards \_\_\_\_\_

Extracurricular activities \_\_\_\_\_

Athletic participation \_\_\_\_\_

Career plans \_\_\_\_\_

### Training and Related Experience

School-related field courses or  
research you have done \_\_\_\_\_

Previous travel experiences  
and dates \_\_\_\_\_

Briefly describe your camping  
and outdoor experience \_\_\_\_\_

Special skills, licenses,  
certificates \_\_\_\_\_

Name and address of your  
school paper: \_\_\_\_\_

Editor \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

List names and addresses of  
others who might like to receive  
information about SFS: \_\_\_\_\_

If you would like us to send  
additional catalogues,  
how many? \_\_\_\_\_

How did you first learn about SFS:

☐ SFS alumnus/ae

☐ friend

☐ poster

☐ science teacher

☐ other teacher

☐ SFS newsletter

☐ career/guidance office

☐ SFS staff member name

☐ newspaper/magazine name

☐ other \_\_\_\_\_

**Attach a three hundred word  
typed statement explaining  
your purpose in joining an  
SFS expedition, what you  
hope to gain from it, and  
what you expect to contrib-  
ute. Be specific.**

### Send your application to:

Admissions Department  
School for Field Studies  
50 Western Avenue  
Cambridge, MA 02139

I have read the SFS expedition  
catalogue thoroughly and feel  
that I would enjoy and benefit  
from the experience which it  
describes. Enclosed is my \$25  
(non-refundable) application  
fee.

\_\_\_\_\_  
Date

I approve this application  
(if applicant is under 21).  
\_\_\_\_\_  
Applicant signature

\_\_\_\_\_  
Parent/guardian signature

The guanacos of this region are found in these Andean foothills. The streams in these comparatively lush valleys are used as a source of water and for feeding. Much of the area also serves as low-intensity range land for domestic stock such as sheep and goats. The human population is sparse, with the nearest village about 25 kilometers from our site. Isolated herders live in the valleys but otherwise contact with the outside world will be rare.

Discussions with Chilean park officials and observation of their management and planning procedures will provide an overview of how species preservation goals are translated into action at the local level in the face of sociological and economic factors. Lectures and discussions in the field will address these and other topics:

- population dynamics of large mammals;
- the concept of ecosystem carrying capacity;
- community ecology;
- social organization of guanacos and other large mammals;
- territoriality in mammals (functions and costs);
- competition among herbivores and its effects on social organization;
- range relations of domestic and wild herbivores;
- summary of known guanaco population ecology;
- zoogeography (global and regional distribution to species over habitats and time).

Our principal purpose in this course is to identify a guanaco population for possible inclusion in the faunal reserve system of Chile through analysis of a number of factors including the range and population characteristics of one or two remnant herds; competition with domestic stock, poaching, low-range productivity (factors limiting the distribution of the population); the necessary ecological boundaries of a possible reserve; and the park planning process within the context of interacting ecological and sociological parameters of resource management.

A variety of wildlife research techniques will be used to accomplish these goals and objectives. Specifically, we anticipate mapping major plant/habitat communities on the study site, relying on ground-based vegetation sampling, descriptions of the plant community structure, and a thorough reconnaissance of the entire site. Daily observation of guanaco and associated wildlife on the site will be undertaken by using spotting scopes and binoculars. All sightings and census techniques will be assessed to determine distribution, territoriality, food sources, and movements.

Pellet transects will be established to determine distribution of guanaco, sheep, goats, etc., in order to plot their relative spatial relationships. Pellet distributions will help to indicate range overlap by sympatric species (those occupying the same area without interbreeding) as well. Herd composition counts can be conducted to determine the sex and age structure. This would allow the estimation of sex ratios, mother/young ratios for projecting productivity and population viability, and sex/mortality rates.

Daily observations of interactions among guanacos and with domestic stock or humans will be made and recorded to determine the relations between these species and any possible interspecific territoriality established among them. Browse plots may be established to describe the diets of guanacos and other herbivores, and to determine range productivity and trends in range conditions. Systematic searches will be made to find guanaco mortalities (carcasses) for determining mortality rates, causes, and sex-specific mortality rates. Sex and age determinations will be based on analyses of dentition (tooth growth) and skeletal characteristics.

Our field work will be accomplished with considerable hiking and backpacking throughout the area, with instruction in the basics of movement in rough terrain, map reading, camping, group leadership, and expedition logistics.

**Living and Working Conditions** The region in which we will be working is warm and dry. We will hike into the hills for several hours almost daily, carry our water with us, and backpack to several more remote sites selected as advance base camps. For most of this expedition we will camp out in these remote settings, either on the coast or along one of the rivers.

As a new project, this course is exploratory in nature, involving a higher degree than usual of day-to-day uncertainty and adventure. There will undoubtedly be events and circumstances requiring our individual and collective patience, since the nations of South America have a far less predictable atmosphere than we are used to in the comfort of our North American surroundings. Although our expedition is being undertaken with the cooperation and oversight of the Chilean National Park Service, the itinerary cannot be finalized until all necessary permissions from local officials have been obtained.

Although this is not a cultural study trip, we expect to occasionally have time for visiting Incan archaeological sites, market towns, and distant adobe villages.

**Faculty** Kenneth Raedeke is an assistant research professor at the College of Forest Resources, University of Washington. He is a widely traveled international wildlife biologist with special interests in population, ungulate ecology, and conservation issues. Ken wrote his Ph.D. thesis at the University of Washington on the socioecology

and population dynamics of guanaco in southern Chile, and worked there for three years with the Chilean National Forest Corporation as well as for the National Parks Development Program of the United Nations. He now teaches and conducts ongoing research projects throughout Washington state.

| Team         |                     | Level | Cost    |
|--------------|---------------------|-------|---------|
| June         | (June 15-July 17)   | B     | \$1,390 |
| July*        | (July 22-August 23) | A     | 1,390   |
| *(tentative) |                     |       |         |

Expedition departs from LaPaz, Bolivia.



**The altiplano and foothills of the Andes provide the habitat for the guanaco. However, secure populations now exist only in faunal reserves.**

# Alpine Plant Ecology and Land Use

Obergurgl,  
Austria and  
Davos,  
Switzerland

Kirland Barker



***Although they appear solid and forbidding, the Alps actually are in a delicate state of balance.***

A study of the effect of microclimate on alpine plants and forests for use in revegetation and planning efforts to control the environmental impact of commercial development at high altitudes.

**Site** The Alps have defined our concept of mountain life and scenery. Their spectacular beauty is celebrated in art and literature. This chain of precipitous, glaciated mountains runs east and west through south-central Europe and has been a major factor in European life since Roman times. Many ridges serve as political boundaries, and although they appear forbidding, embrace many charming mountain cultures.

**Background and Relevance** Approximately 10% of the world's population lives in mountainous regions that cover one-third of the earth's land surface. Another 20%-40% live near mountainous areas and depend on them for their livelihood. To the uninformed observer, mountain vistas seem steadfast but in fact these environments are in a state of delicate balance, susceptible to continual degradation.

Historically, development in the Alps has been carried out slowly and meticulously. The result is an altered but stable environment capable of sustaining relatively heavy use. However, in many places the traditions and techniques of farming that have resulted in high productivity are being abandoned in favor of commercial development and recreation with an emphasis on recreation. Large numbers of people and facilities are being introduced into environmentally fragile mountain valleys, both summer and winter. The environmental changes necessarily associated with this rapid shift to tourism over the last two decades are proceeding on a broad scale, due in part to minimal awareness by developers, local government, and landowners.

At this time, little is known or documented about the long-term consequences of increased pressure on alpine ecosystems. What we do know is that millions of people depend on the Alps for fresh drinking water, hydroelectric power, mineral resources, and forest products as well as recreation. The problems of flooding, avalanches, and erosion traditionally have been controlled by the application of knowledge gained by people intimately in contact with the land over many generations. Now that the rate of development has increased, often under the control of outsiders unfamiliar with local customs, there is an urgent need to gain a comprehensive understanding of ecological principles and processes of alpine environments.

Following conferences in Munich, Germany and Cambridge, England in the 1970s, a new interdisciplinary field of study has emerged: montology, the study of problems facing the world's mountain lands and peoples, including uncontrolled growth of tourism, population pressures, deforestation, and mismanagement of natural resources. As the primary research site for this course we have selected Obergurgl, Austria because of its accessibility to high alpine ecosystems that will serve as our laboratory for the investigation of these problems.

Obergurgl is located south of Innsbruck, near Austria's Italian border. It is surrounded by many peaks of over 3,000 meters, varied sedimentary and metamorphic geology and vegetation, and provides an opportunity to observe the effects of tourism on an agricultural system more than 1,000 years old. The town already has been the subject of extensive sociological and ecological research (by the University of Innsbruck faculty and the "Man in Biosphere" program of UNESCO). This provides an invaluable bank of data pertinent to our project.

Our second research will be the famed ski resort of Davos in eastern Switzerland, where the Institute for Snow and Avalanche Research and the Research Institute of the Swiss federal forestry agency are located. Much of the work being done in Davos is "state-of-the-art," with entire mountainsides being monitored by a central computer. We hope to gain access to this computer during our course.

Both Obergurgl and Davos provide exposure to European study sites, problems, and methodologies that are in the forefront of work on montology and that are models for application to the United States and elsewhere.

**Course Design and Training** A thorough understanding of the physiology of vegetation in alpine environments is a key to devising a successful land use strategy. Because of extreme growing conditions, plants and trees constantly are under stress. They have evolved many adaptive techniques for coping with this stress. This course will examine climatic variables that affect plant growth.

The exact location of a plant or tree on a hillside or ridgetop greatly influences its growth. By analyzing a plant's microclimate—temperature, solar radiation, wind, etc., within a few meters of it—we can learn about the responses of particular plant species to these factors. In this way we will know how plants revegetate best in order to regenerate disturbed areas.

Special attention will be paid to the effect of altitude on growth. By locating study plots along altitudinal gradients up mountain slopes, we can measure these phenomena.

The lecture topics for this course will include the following:

1. geology and history of development in the Alps
2. taxonomy and physiology of alpine flora and plants in stressed ecosystems
3. revegetation and reforestation at the upper limits of plant growth
4. avalanches, torrents, and landslides
5. scientific research methodology in remote settings
6. microenvironmental factors influencing plant growth
7. traditional agricultural and animal husbandry land use practices
8. summary of research and planning studies in Obergurgl to date

Our research objectives will be to investigate such questions as how the revegetation of alpine meadows and coniferous forests disturbed by development can best be accomplished, and how ecological dimensions like microclimate and altitude can be incorporated into the planning process, to help control problems associated with tourism and economic development (both localized problems such as trail building and regional ones such as deforestation and erosion). An index species such as edelweiss or *Geranium reptans* may be used to help determine the effects of altitude on plant growth and regeneration.

We will measure temperatures, wind speed and direction, and solar radiation around study plots using a variety of instruments, and students will be trained in their use. We then will statistically determine population dynamics of species in relation to these factors and to their topographical location.

A series of hikes will familiarize students with the taxonomy of alpine plants and the geography and geology of the study areas.

**Living and Working Conditions** Field work will be conducted in cool, rugged, glaciated valleys near the summits of some of Europe's highest peaks. Although no danger is anticipated, weather conditions can change rapidly. Thus, most of our data collection will occur from sunrise to early afternoon, when the weather is most stable. It is imperative that team members be able to hike for several hours at a time in rough terrain.

We will camp in areas which are extremely sensitive to the activities of man. These conditions will require minimal equipment and a great deal of responsibility for the welfare of others. The facilities of Obergurgl and Davos will be used for evening lectures and data processing.

Since our travels will take us through the Austrian and Swiss countryside, we will be able to experience some of the fine cultural aspects of the Alps, including a visit to small villages and farms, hospitality of inns, and perhaps a visit to one or more of the famous alpine club huts.

**Faculty** Kirtland Barker has a B.Sc. in botany from the University of Maine, studied botany at the Universitat Salzburg (Austria), and is completing his M.S. at the Yale School of Forestry and Environmental Studies.

Following work in electron microscopy, he studied alpine ecology and economic development issues in Obergurgl and Davos. Kirtland is an avid climber, flyer, and skier.

| Team                     | Level | Cost    |
|--------------------------|-------|---------|
| June (June 15–July 17)   | A     | \$1,360 |
| July (July 17–August 14) | A     | 1,360   |

Expedition departs from Innsbruck, Austria.



**The effects of microclimate on revegetation will be an important element of our investigations.**

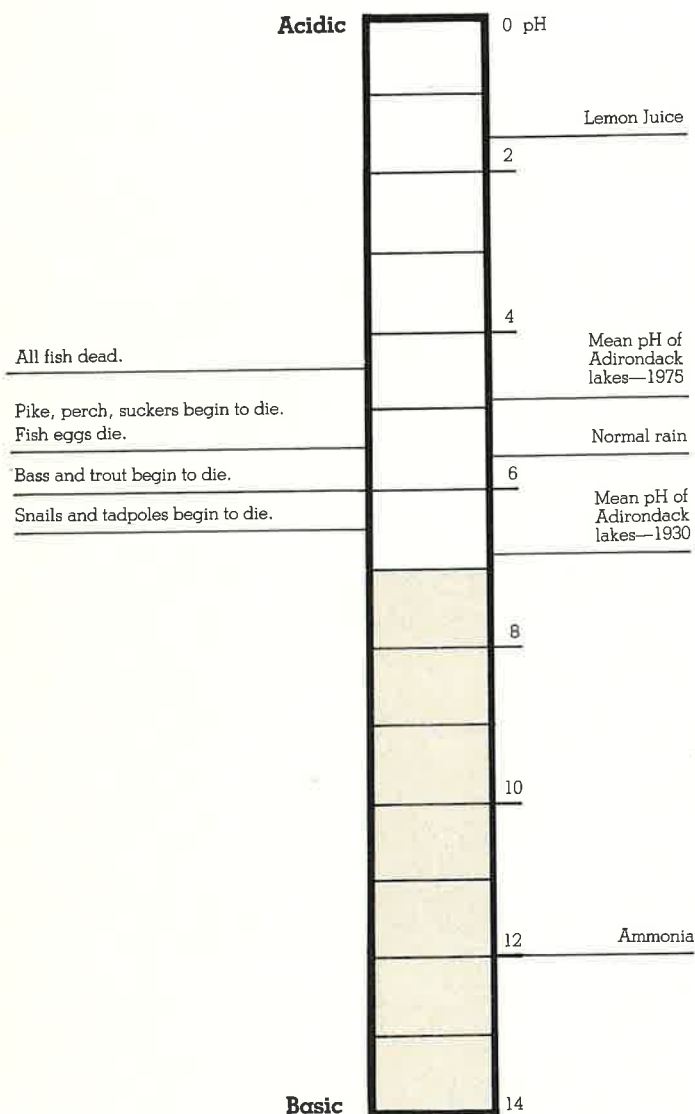
# Limnology

## Adirondack Mountains, New York

James Elder



**We will trek to remote lakes to determine the effects of "acid rain" on pristine waters.**



**The pH Scale and Acid Rain**

A study of the biological effects of long-range transport of atmospheric pollutants ("acid rain") on energy-nutrient flow through food chains in pristine Adirondack lakes.

**Site** The massif of the Appalachian mountain chain in far northern New York state has been known from Iroquois times as the Adirondacks. Unlike the flat-topped Catskills to the south, the central Appalachians of the Virginia border, and the gentle Green Mountains of Vermont, the Adirondacks are a dramatic granitic intrusion into a landscape otherwise composed of accumulated sediments. The peaks are higher (up to 1,600 meters), more rugged, and considerably wilder than other ranges in the northeast. The Adirondacks have been renowned as one of America's finest resort areas for well over a century. An amazing array of lakes teeming with sport fish attracted the wealthy and famous to build and patronize luxury hotels and private lodges at places like Saratoga, Lake Placid, and Lake George, all surrounded by rich forests and steeped in colonial history.

Along the eastern front of the range runs narrow Lake George. Sixty kilometers long, it connects with Lake Champlain, the boundary between New York and Vermont. This granite-cliffed waterway drains into the St. Lawrence River of Quebec and also joins the Hudson flowing south to New York City. As a result, the Adirondack lakes have been a principal route for travel, trade, and frequently for war. With the construction of railroads into the mountains in the mid-19th century, the Adirondacks became the center of rapidly developing timber and tourist industries. Grand hotels, weekend woodsmen, and crusty local guides coexisted with forest resource extraction until the creation of the public Adirondack Park Agency in 1892. One of the first such land-use planning and management authorities in the country, it was created by a New York Constitutional convention whose stated goal was to keep the area "forever wild." The Adirondack Park Agency now controls all development and use within its boundaries.

**Background and Relevance** The Adirondacks consist of granitic bedrock that is very non-porous, producing lakes that are naturally slightly acidic. Any additional minerals or pollutants found in these lakes are introduced by rainfall or other precipitation.

The acidity of a liquid, soil, or other substance is measured on a pH scale that ranges from 0, very acid, to 14, very alkaline. A value of 7 is neutral. Uncontaminated rain is slightly acidic (pH 5.6). Pollutants in the air make rain in most of the United States significantly more acidic than normal. This phenomenon is popularly known as "acid rain." Rain in the Adirondacks has been averaging about 4.2 (by comparison, vinegar has a pH of 3.0).

Acid rain is formed from two kinds of pollutants, sulfur dioxide ( $\text{SO}_2$ ) and nitrogen oxide ( $\text{NO}_x$ ). These are emitted primarily from utility and smelter smokestacks. As they are injected into the atmosphere, these pollutants are borne by prevailing winds and travel for days, frequently moving thousands of kilometers from their source, mainly the industrial midwest. During this transport, these pollutants are converted to acids through combination with moisture in the clouds and are released by precipitation.

In spite of the widespread use of the term "acid rain," very little work has been done on the effects of acidic deposition on lake ecosystems in the United States. Most of the research that has been done was directed toward determining the numbers of affected watersheds and their fish communities. The influence of acidification on the entire food chain—from diatoms and zooplankton up to plants and fish—has not been adequately investigated.

Acidic deposition has created ecosystems which are new to the planet: clearwater lakes low in nutrients, fishless, and acidic. In many ways in this course, we are explorers seeking an understanding of how the new chemical environment is shaping biological communities. We are interested in these environments as a scientific problem but also recognize that the interactions of the biological community must be comprehended and explained before the effects of attempts at restoration can be successfully predicted.

**Course Design and Training** Our overall plan is to develop an understanding of aquatic communities in general and the influence of acidic deposition in particular on otherwise pristine lakes and streams. Lectures and discussions throughout the course will address such topics as lake ecosystems; chemical interactions in fresh water; light, heat, water movement, and watershed interactions; the biological communities—primary producers, benthos, plankton, and fish; detritus processing, nutrient cycling, and sediment/water interaction; man-made perturbations—nutrient input, heavy metals, pesticides, and toxicants; and the chemical and biological consequences of acidic deposition to pristine waters.

We will begin with several days of field work to gain exposure to the habitats and an understanding of conditions in acidic lakes. Next we will set out enclosures and other materials for experiments that need to be in the field several weeks for subsequent analysis. We then will move to Rennselaer Polytechnic Institute's field station, the Freshwater Institute, on beautiful Lake George in Bolton Landing, New York. Here background will be furnished on normal lake ecosystems as typified by Lake George. The institute's laboratory and coves of the lake outside will be utilized to teach the basic techniques of aquatic ecology.

Once the requisite technical skills have been developed, we will backpack into remote areas of the Adirondack park to visit several lakes which are out of reach of all pollutants except those introduced by precipitation. We will utilize field instruments and collecting gear to take samples from the shoreline and bottom communities of lakes similar in size and with surrounding mountain topography. Handling small boats, snorkeling, and wading in cold water will be necessary elements of our data collection. Much of the data will be analyzed in the field but some samples will be carried out to a four-wheel-drive vehicle for transport back to the lab.

The enclosures set out at the beginning of the expedition will be removed and samples collected. After about two weeks in the field we will return to the Lake George laboratory and use microscopes and other analytical instruments to draw conclusions about the interactions of biological components of food chains with their environment.

Some of the questions for which we will seek answers are the following:

1. What is the role of the benthic mat of algae that is characteristic of Adirondack lakes in the nutrient dynamics and productivity of affected lakes?
2. Is the development of this mat a cause or a consequence of a low productivity of algae in the water column and the resulting high water clarity of these lakes?
3. How does acidic deposition affect the biota at a mechanistic level? Is it the acidity per se that is stressful, or is it the presence of elevated levels of aluminum and other metals the acids leach out that causes the damage?
4. What methods seem most likely to ameliorate pH stress and restore poisoned waters?

We anticipate that the results of our work and related studies will make a significant contribution to understanding the acidification process. During the next few years, American research on acid rain will become an even more urgent need, so this is an exciting time to be involved in what really are pioneering studies. The acid rain problem provides an ideal forum for discussing the effects of industrialization on resource conservation, a problem that involves serious economic and ethical questions with a direct bearing on many of our local, regional, and national priorities.

In addition to the benefits to be derived from learning about lake ecosystems through direct contact with them, students will gain hands-on experience with laboratory and field techniques unavailable in a classroom setting. A less tangible, but no less important benefit is the experience of working with a group in a demanding setting, applying intelligence, determination, and cooperation to accomplish difficult tasks. We expect that members of the expedition team will leave the course with an enhanced appreciation for the vast wild spaces of the Adirondacks.

Completion of a year each of high school chemistry and biology is required for this course. Some work at the college level will be helpful.

**Living and Working Conditions** As in the mountains everywhere, the weather is subject to rapid change. In the summer one usually can expect warm, shirtsleeve days with cool nights. Rain and cold are not uncommon, though, particularly at higher elevations. In the field we will camp out on the shores of small lakes surrounded by birch and coniferous forests, and possibly at an old resort on Lake George. There will be considerable day hiking and some overnight backpacking to reach remote campsites. The training necessary for a successful expedition (the mechanics of outdoor living and travel, water safety, etc.) will be provided. We will have opportunities during our travels to observe old hotels and lodges, swim in cold lakes, and sit around the campfire after doing all of our own cooking and other chores.

**Faculty** Robert Singer holds joint appointments at Colgate University, where he teaches undergraduate courses in biology, and Rennselaer Polytechnic Institute, through which he does most of his research. Bob received his Ph.D. from the University of Illinois and has been conducting research on benthic

communities in freshwater lakes and streams in the central lakes district of the Adirondacks since 1977. He is the editor of a major technical book on acid rain and lake acidification, and teaches alternative energy and field biology courses in the outdoors several times a year.

| Team                     | Level | Cost  |
|--------------------------|-------|-------|
| June (June 16–July 14)   | A     | \$880 |
| July (July 19–August 16) | A     | 880   |

Expedition departs from Glens Falls, New York.



James Elder

## Volcanology

### Landmanna- laugar, Iceland

“There were two major goals I had in choosing this expedition: learning about geology and about Iceland itself. Both have been fulfilled very much to my satisfaction. I have learned a tremendous amount about geology in general and Iceland in particular that will be a great help in choosing a college major. I also have seen this country literally from top to bottom, learning about its history and culture. Awesome.”

*Richard Williams  
St. George's School  
July 1982*



Andrew Hyman

*One of last summer's teams poses for a "class photo."*

*Iceland, popularly known as the land of fire and ice, presents a startling array of geological wonders.*

**Level A** (July team): A study of the effects of environmental geology (plate tectonics, earthquakes, volcanic eruptions, and widespread erosion) on the landforms and people of Iceland.

**Level B** (August team): A study of explosive volcanism in south Iceland, through an examination of volcanic features and ash deposition in order to understand the mechanisms of rhyolitic and basaltic magma mixing and contribute to efforts to predict eruptive activity.

**Site** Legend has it that the Vikings named the prime farmland they wanted for themselves "Iceland" while calling its northern, barren, and much colder neighbor "Greenland." Despite its name, this island nation midway between Europe and North America, just south of the Arctic Circle, has a relatively temperate climate due to the warm Gulf Stream waters that caress its southern shores. It is a land of extraordinary contrasts and eerily beautiful landscapes. Popularly known as "the land of ice and fire," its panorama is the result of frequent volcanic activity and the ravages of climatic extremes.

Geologically, Iceland is the only place where the junction of two major tectonic plates, the Reykjanes Ridge, surfaces above the ocean. Nearly all types of volcanoes are found in Iceland, from classic cones to broad shields and dramatic explosive craters. Most numerous are the fissure eruptions several kilometers long that pour out enormous basalt lava floods and form rows of craters. A third of all the lava flow thrown up on earth since the year 1500 is found in Iceland.

Alkaline hot springs are found at about 300 localities throughout the country; many are favored spots for bathing and health treatments. Iceland's 700 geysers go off continuously, spurring out some 1300 liters of superheated water per second. Glaciers cover 16% of the land area and range from small cirques to extensive icecaps. Roaring meltwater streams carry heavy loads of volcanic ash down to vast outwash plain deltas along the southern coast. The interior consists largely of a barren volcanic plateau, covered with ice caps, lava flows, and ash. This area is accessible only with great difficulty.



© Kenneth M. Alden

Human habitation is confined to the warmer coastal areas. Almost half of the total population of 230,000 lives in Reykjavik, the capital, where the warming effect of the Gulf Stream is strongest. With its northern arctic tundra devoid of trees, Iceland is perhaps the best field laboratory on earth for investigating the complex processes of volcanism.

**Background and Relevance** Volcanism threatens the lives and livelihood of millions of people worldwide. In Iceland, major eruptions over hundreds of years have caused crop failure several times, bringing on famine, and forced the relocation of entire villages and fishing fleets. Now a gigantic power plant tapping geothermal energy near the famous Krafla volcano is being threatened. Improving our understanding of eruptive volcanism will help to predict volcanic activity and aid in the complex process of land-use planning in Iceland and elsewhere.

In structural terms, the earth is basically a rather rigid and solid rock mantle floating on a liquid core. The mantle is composed of a series of continent-sized plates that have been drifting apart throughout the life of the earth. This is dramatically illustrated in Iceland. The rift and fissure system running through the North Atlantic, the Reykjanes Ridge, is a manifestation of this drift. Where the earth's crust is thin, magma (molten material) can flow to the top. In most places, the spreading of plates is gradual and continuous, about 2 centimeters per year, but in Iceland the average annual spread is about 20 centimeters and it tends to occur in sudden episodes of earthquake and volcanic activity.

Magma reaching the surface normally is of two types: basaltic and rhyolitic. Basaltic magma, which accounts for the greatest proportion of volcanic output, is derived from the earth's upper mantle. During eruptions, basaltic lava flows easily and covers broad areas, solidifying into vast lava fields. Rhyolites have a much higher percentage of silicon, are output in far greater volume as ash, and because of this are more susceptible to erosion. Rhyolites account for approximately 10%–15% of the total volcanic output in Iceland, a much higher proportion than is generally found elsewhere. This abundance of rhyolites is one of the major unsolved mysteries of Iceland's geology.

These rhyolites are not randomly distributed but occur in central volcanoes that exhibit high-temperature geothermal activity, explosive eruptions, shallow-level earthquakes, and high eruption rates. Most of the famous volcanoes of Iceland are in this category—Askja, Hekla, Krafla, and Torfajökull. Beneath them are magma reservoirs at shallow depths (2–4 kilometers) where the magmas evolve and mix. Compositional gradients may exist between these magmas, or they may be separated by a relatively sharp contact. Agitation of the reservoirs occurs when the crust is rifted and when hot, fresh batches of basaltic magma are injected into the system. Such injection and rifting can lead to eruptions.

**Course Design and Training** **Level A:** This introductory level course is designed for students with an elementary understanding of geologic processes and geomorphology (origin of landscapes). The academic material and lectures will introduce students to geologic hazards such as earthquakes, volcanic activity, and erosion; the basics of plate tectonics (continental drift), ocean basin development, and structure of the earth. All of these will be presented at sites that are prime examples of volcanic landforms and features. Other topics of interest are the interpretation of geologic maps, field mapping techniques, basaltic and rhyolitic lava composition, and magma mixing.

**Level B:** This course is designed for geology majors or those with a solid interest and background in the subject material. The prerequisite is at least one (preferably more) college-level course in geology. The topics address will include plate tectonics at the global and local levels; Icelandic volcanic sequences, tephra layer analysis and chronology; magma chamber formation and geochemistry; subglacial and subsurface eruptions; and eruptive volcanism in south Iceland.

The first week and a half will involve studying the full range of volcanic features in Iceland, learning to identify major types and approximate magma composition. Much of our time will be spent hiking in the field among various formations. We will work with detailed geologic and topographic maps, drawing in the results of careful tephra layer analysis from ash profile pits that we dig. We also will map fissure and vent systems. Training in these skills and in the use of appropriate instruments will be given to all team members.

This is our third season in Iceland. Last year's expedition to Torfajökull and Landmannalaugar began mapping the relationship of eruptive events in that region, to the east of Hekla. Working with maps, ash layers, and shovels, we discovered that the range of scale of the features under investigation was much greater than anticipated and that additional field work would be necessary. We plan to move our operations slightly to the west of last summer's location and expand sampling and tephrochronology profiling (analyzing layers of ash deposition from eruptions) to a larger area. This is pioneering work in the area and should yield published papers on the results from these several summers of SFS expeditions.

**Living and Working Conditions** For the entire period of the course we will camp out in sturdy tents in national parks, isolated settings, and some private campgrounds. Except for occasional baths in hot springs, we will experience cool, moist, often rainy weather. We will work outside very day in very rough terrain marked by jagged lava fields. There will be a great deal of hiking, possibly some backpacking, and travel over barren trails in four-wheel-drive vehicles. We will take our food with us and prepare meals at our camps in the field.

Work in Iceland always is contingent upon permission from the federal government; final camping and study site approval is necessary. Weather conditions at the time of the expedition also could affect the project.

Iceland is a modern Scandinavian society, with picturesque fishing villages and sprawling green farmlands along the southern coast. It is a land of seemingly incredible contrasts: between the lush emerald coasts and the black/tan interior devoid of life; between the total darkness and snow of winter and the 24-hour light of early summer.

**Faculty** Haraldur Sigurdsson, a native Icelandic volcanologist, now holds an appointment as professor of oceanography at the University of Rhode Island Graduate School of Oceanography. He has held other teaching and research positions in Iceland, Trinidad, and the United States. Haraldur has been the recipient

of more than a dozen research grants for his work and has some fifty published papers to his credit. Two summers ago he served as principal consultant for a National Geographic Society film on Iceland and last summer led the SFS expedition. In addition to his skill as a teacher, he is an enthralling guide to his native land.

| Team                     | Level | Cost    |
|--------------------------|-------|---------|
| June (June 14–July 12)   | A     | \$1,480 |
| July (July 19–August 30) | B     | 1,780   |

Expedition departs from Reykjavik, Iceland.

# Coral Reef Ecology

## St. John, U.S. Virgin Islands

Personal growth was not the reason I chose this expedition but it certainly was one of the results.

Ossama Elshazley  
White Mountain School  
July 1982



Christopher Neefus

**Team members will probably participate in at least one dive per day.**

A continuing study to provide baseline data on fragile coral reef and seagrass communities, their structure and interrelationships, to aid in conservation efforts.

**Site** St. John, the most beautiful and least populated of the U.S. Virgin Islands, lies east of Puerto Rico. Steep mountains, deep valleys, and gleaming white beaches are ringed by extensive coral reefs. The island has a remarkable diversity of natural habitats: mangrove ecosystems, rocky intertidal communities, sandy bottom and beach communities, lagoonal systems, cactus-dominated scrubland, and a remnant rainforest.

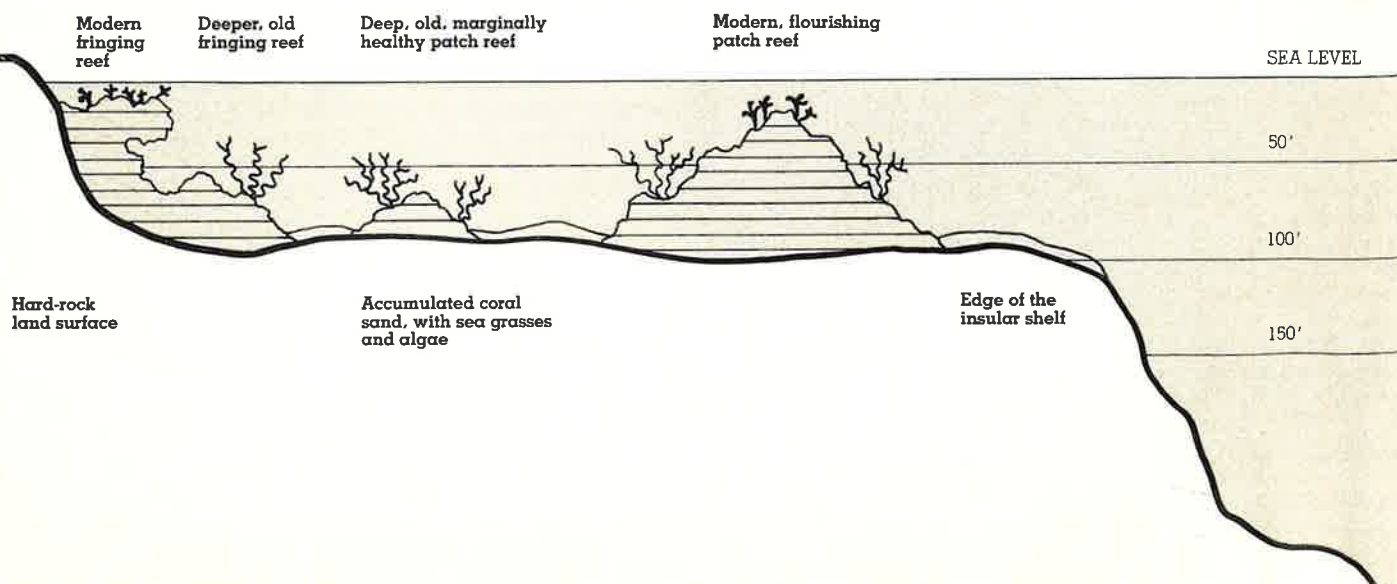
The interior highlands and ravines are dominated by green hardwoods while the drier slopes are covered by broad-leaved forest. Hibiscus, frangipani, flamboyant, and bougainvillea are among the flowering plants providing brilliant displays of color.

**Background and Relevance** This course is a continuation of a series of Caribbean expeditions over the past several years. Although research of various kinds has been conducted at St. John for many years, not a great deal of attention has been given to inventorying reef systems in order to manage and protect them. Our base of operations will be VIERS, the Virgin Islands Ecological Research Station on Lameshur Bay at the isolated southeast corner of the island. VIERS has been the site of research work on coral reefs, seaweeds, hydrology, and a variety of terrestrial biological topics. As VIERS abuts Virgin Islands National Park, we expect our work to complement the research and management program of the National Park Service.

The coral reef ecosystem and adjacent seagrass bed ecosystem are among the most productive in the world, rivaling the carefully managed agricultural crops above water. Although they are two of the most complex, diverse ecosystems on earth, they also are among the least well-known, perhaps because of their aquatic nature and degree of complexity.

The term "coral reef" does not refer to any single species of plant or animal but to an integrated community, a functioning aggregation of a large variety of organisms. The fundamental construction unit of the reef is the coral animal itself, a tiny hollow cylinder of tissue topped with contractile tentacles that secrete a hard, skeletal cup of calcium carbonate outside its soft body. Soft-bodied sponges, sea urchins, burrowing worms, and certain fish species act to break down, rearrange, and cement this material into a solid layer on which coral growth continues.

The seagrass ecosystem lies directly shoreward of the reef and is intimately linked to it. Seagrasses are vascular plants which have been studied by a handful of scientists in the last decade. Any investigation of tropical seagrass ecosystems is applicable to all others, however. From a global point of view, they are more impor-



tant than reefs. Seagrass ecosystems protect coastlines from storm damage, provide nursery areas for other life forms, and habitat and food for an incredible number of animals including ten endangered species. They are important agents of nutrient cycling, exporting organic matter to the surrounding waters.

**Course Design and Training** Daily lectures and informal discussions will cover all major aspects of tropical reef and seagrass ecology as well as fundamentals of algal and coral identification and classification. Topics will include:

1. introduction of St. John and the tropical marine environment;
2. introduction to marine algae and coral reefs;
3. coral reef geology, formation, and morphology of coral species;
4. interspecific relationships, e.g., competition, grazing, symbiosis;
5. adaptation "strategies" for survival;
6. photosynthesis, respiration, and photorespiration;
7. nutrition and nutrient uptake.

A general objective of our work will be to study the functional processes producing the structure (abundance and distribution) of coral reef/seagrass ecosystem food chains, i.e., the primary producers of algal and vascular plants. A paradox in coral reef ecology has puzzled scientists for a long time: what accounts for the high primary productivity of reef systems when typically the plants growing on a reef are very inconspicuous and grow as a turf? Why are a few species able to grow profusely while most are very small? Specifically, we will investigate the primary productivity of the reef and seagrass beds, what factors control the rate of production, and the distribution and fate of the organic matter produced. By choosing to emphasize functional aspects (energy flow, interactions between organisms) rather than structural aspects (kinds and abundances of organisms), our results will help explain how these ecosystems exist, not merely what they are.

We will continue work on a general survey of the subtidal marine environment on St. John. In order to maximize our efficiency and provide reference points in this qualitative survey, we may establish 25x2 meter transect lines in selected areas covering the major zones of reef systems—lagoon, back reef, crest, wall, and patch reef. Collection, identification, and rough charting using underwater slates may be performed. Fishes will be identified and visually censused. Notes on topography, clarity, biological interactions, and other physical and biological parameters will be recorded.

The program undertaken for each team may vary somewhat depending on the stage of the work during the summer, Park Service goals and needs, and individual student interests and expertise. All teams will spend several days a week using the lab at VIERs for work with their permanent collection of specimens, discussions of taxonomy and physiology, and preliminary analysis of specimens and data gathered from research plots.

Ecology is still a very new, practical branch of field science. Experimental approaches and innovative modifications to equipment and data gathering occur regularly as a result of trial and error in the field, particularly when the field is marine. While this aspect of field study can be frustrating, it challenges our ingenuity. This is an area where even novices can make valuable contributions to new methodology.

**Living and Working Conditions** The mean annual temperature is 79°F. Most of the rainfall occurs in the summer but the sun usually is intense. A common danger on St. John is sunburn so we will carefully monitor outdoor exposure. There are few special hazards.

**Note:** Diving is an integral part of the course. Previous experience with SCUBA is not necessary, though, as students can be given the full PADI or NAUI training by certified instructors if necessary at a cost of about \$100 (the SCUBA course takes about three days; this offering is dependent on adequate enrollment by uncertified divers). For the July and August teams, divers must be certified prior to the beginning of the course.

**Faculty** Christopher Neefus, who recently received his Ph.D. in marine biology from the University of New Hampshire, has done extensive

research on marine ecosystems. 22 He has led several SFS expeditions to the Caribbean. Chris also is a member of the SFS Board of Advisors.

| Team                 | Level | Cost    |
|----------------------|-------|---------|
| May (May 4–25)       | A     | \$1,390 |
| June (June 9–30)     | A     | 1,390   |
| July (July 4–30)     | B     | 1,580   |
| August (August 3–29) | B     | 1,580   |

Expedition departs from St. John, U.S. Virgin Islands.

**January 1984:** To meet the needs of students who want academic credit or valuable experience during the January intersession, SFS announces a course on marine science in the Caribbean, following the above outline. Details are available upon request.



**St. John is considered the most beautiful of the U.S. Virgin Islands.**

**Team members examine specimens placed under domes for photosynthetic activity.**

## Cetacean Behavioral Ecology

### Gulf of Maine

“I am not scientifically oriented, so it was really a new experience for me to be part of a program like this. I have a better feeling for science now, and although it's not my major, I really do enjoy it. The faculty and other students were great to work with and I'll never forget that feeling of exhilaration when our first humpback breached right off our boat. ”

Tani Denham  
Doane College  
July 1982



Kenneth Andrasko

**In spite of the demands of the course, there are times for relaxation, reflection, and journal writing.**

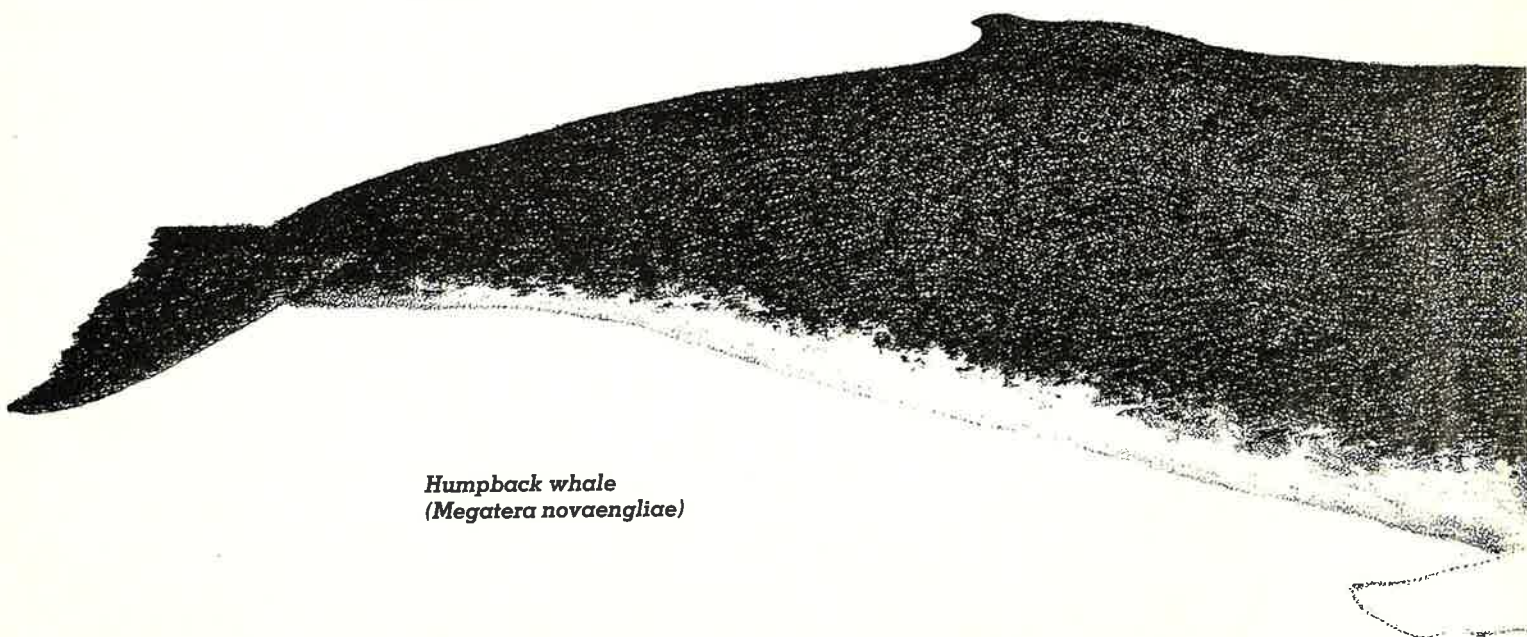
An ongoing study of whale distribution, social structure and behavior on Stellwagen Bank, to further efforts toward marine mammal conservation and protection.

**Site** The Gulf of Maine, on the western reaches of the North Atlantic, abounds in different forms of marine life. It is bordered on the south by Georges Bank, one of the richest fishing grounds in the world. Within the Gulf of Maine are smaller groups of underwater hills such as Jeffreys Ledges and Stellwagen Bank, near Gloucester, Massachusetts, on the north shore of Boston and Provincetown on the tip of Cape Cod. During the 1600s and early 1700s, American whalers hunted whales out of ports such as these that retain much of their early charm.

The relatively shallow banks such as Stellwagen increase seawater mixing and concentrate nutrient-rich water carrying plankton and fish via upwelling. Because of this richness, several species of whales are abundant in the Gulf of Maine during the summer. The upper portion of the ocean where light penetrates is called the euphotic zone. It is here that photosynthesis occurs in small plant organisms called phytoplankton. Feeding on the phytoplankton are numerous varieties of tiny zooplankton which in turn serve as food for larger organisms.

**Background and Relevance** By the year 1750, right whales had been hunted almost to extinction. It is estimated that less than 200 of the animals remain today. More numerous are the humpbacks, of which there are several thousand. Humpback and right whales are on both the United States and the international endangered species lists. Because of their global migration routes, whales are still subject to hunting pressures from other nations. Complicating the situation is the fact that extensive oil exploration is now being conducted in Georges Bank, part of the whales' summer feeding ground.

The humpback (*Megaptera novaeangliae*) and finback (*Balaenoptera physalus*) whales are the two most common large whale species in the Gulf of Maine between May and October. During the winter months the humpbacks migrate to the Caribbean to mate and calve. Around May they appear off Cape Cod to feed. The finback is found in the area throughout the year, but in the winter most of the population moves south and/or east of New England to mate and calve. Their specific breeding areas remains unknown. Finbacks feed by gulping large quantities of water thick with fish. The water is expelled and the fish are caught by sieve-like baleen plates (long, hairlike structures the animals have instead of teeth). When finbacks feed at the surface they may lunge vigorously, making great splashes that can be seen from some distance. Hump-



**Humpback whale**  
(*Megaptera novaeangliae*)

backs use several feeding methods. They may swim through schools of fish like the finbacks but often create "bubble nets" to corral their prey. The whale blows a circle of bubbles from below that traps a school of fish and then comes up with its mouth open. Different species of birds and occasionally dolphins have been observed in the vicinity of feeding whales. Right whales filter plankton from the seawater for their food.

Relatively little is known about the social systems of these animals. More information and basic data are needed to insure the proper management of the waters they inhabit in order to protect the whales.

**Course Design and Training** The overall objective of this project is to provide students with a working knowledge of cetacean behavior and activity in the Gulf of Maine. The humpback whale will be the primary target of this research.

Associating a behavior with a specific animal is problematical for a variety of reasons. The whale is visible to observers only when it is on or near the surface and then it is difficult to approach. Moreover, little is known about the origin or stimulus for sound production in whales. Their vocalizations often are audible only with hydrophone equipment. When correlations can be made between sounds and behavior, we can begin to describe the communication system used by whales.

Using a sailboat as our base of operations, we will collect quantitative and qualitative data on intraspecific interactions (associations between members of the same species). Social interactions between adult whales, especially while feeding, will be studied. The behavior between cows and their calves, and between cows, calves, and other whales also will be noted. By studying interspecific associations we hope to gain a better understanding of the social organization and structure of the humpback and other whale species.

We also will study interspecific associations (those among members of different species). Communication occurs not only within a species but also between members of other species. No organism is an isolated entity; rather, all live and function in an interrelated system. For example, white-sided dolphins often are seen in the vicinity of feeding right whales. Studying interspecific interactions will enable us to learn about the ecology of the system in which the whales live.

In addition, we will photograph and sketch specific features on whales to identify individuals since recognition of individuals is necessary for deciphering any social system. Humpbacks bear a black and white pattern on the ventral side of their flukes that varies from individual to individual. When diving, humpbacks often throw their flukes, presenting an opportunity for photographing and sketching the pattern. A previously compiled catalogue of

flukes has made it possible to trace the yearly movement of individual humpbacks between feeding and calving areas, as well as their movements over different years. Our photographs will become part of this catalogue.

If any right whales are sighted, we will photograph and sketch their callosity patterns. These consist of a series of bumps on the head which are infested with lice, giving them a characteristic yellowish-white coloration. It is believed that callosity patterns can be used to identify individual animals.

We hope to obtain sound recordings of humpback vocalizations that will be analyzed for several kinds of information. We may attempt to correlate sounds with behaviors observed at the time of vocalization.

Several days may be spent in field study of local marshes and dune systems, particularly if bad weather prevents sailing out. Students will be trained in fluke photography and sketching, and data collection and observation techniques. Lectures and discussions will address topics such as the evolution, zoogeography, and ecology of cetaceans; marine mammal migration; biology and feeding patterns of baleen whales; population dynamics of marine mammals; introduction to acoustic research; sources and meaning of humpback whale sounds.

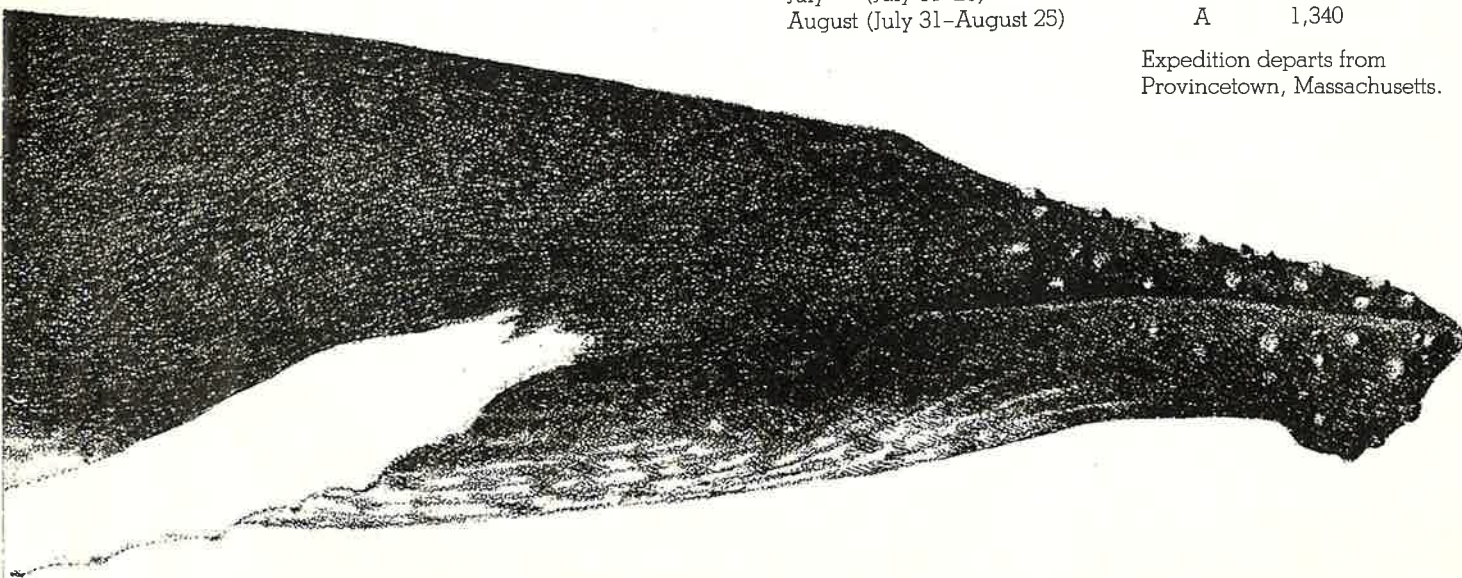
**Living and Working Conditions** We will spend most of our days at sea. While there may be a few evenings spent on board, we will usually camp out at local public or private campgrounds near our mooring site. Summer in New England generally is quite pleasant with much sun but it is always cool and windy at sea. Gales can whip up unexpectedly and bad weather can prevent sailing out. Moreover, the presence and exact location of the whales cannot be predicted perfectly. The research site may be changed to adapt to such circumstances. The pleasures of sailing in New England waters, seeing the active harbors of ports still active today, and walks through dunes and marshes should more than compensate for any inconveniences.

**Faculty** Dr. Charles Mayo, Associate Scientist of the Provincetown Center for Coastal Studies and the center's cetacean research program is the scientific advisor for the course. He has been deeply involved in research on the biology and behavioral ecology of whales,

especially humpbacks, for the past seven years. He and his staff have photographed and identified some 140 individual animals within the Stellwagen Bank population and have assembled a computer data base on their sightings and behavior.

| Team                       | Level | Cost    |
|----------------------------|-------|---------|
| June (June 17-July 15)     | A     | \$1,340 |
| July (July 11-26)          | B     | 1,340   |
| August (July 31-August 25) | A     | 1,340   |

Expedition departs from Provincetown, Massachusetts.



# Processes and Requirements

☞ You get out of an SFS experience what you put into it. ☞

Martha Gallagher  
Kenya  
July 1982



Julie Bradley



Geoff Lerner



Linda Cregg

## Applications

1. Complete the Student Application Form in this catalogue. Please type.
2. Attach a 300-word Personal Statement which sets forth your reasons for wanting to join the expedition of your choice.
3. Enclose a check for \$25 (non-refundable) to the School for Field Studies to cover your application fees. All applicants will be given a year's membership in SFS.
4. Mail all of the above in one envelope to:

Admissions Department  
School for Field Studies  
50 Western Avenue  
Cambridge, MA 02139

Applications cannot be processed until all of the above elements are received.

**Acceptance** The Admissions Committee will review applications on February 1, March 1, and April 1. All acceptances after April 1 will be on a "first come, first served" rolling admission basis for any remaining team positions. Teams fill quickly. We strongly urge you to apply early in order to join the expedition of your choice. We will maintain waiting lists for expeditions which have filled early. Accepted students will be notified by mail within 10 days of the above dates and you will be contacted by the expedition leader to discuss your participation. At that time, additional information regarding logistics (travel, equipment, documentation needs, etc.) will be sent.

A non-refundable deposit of \$350 (\$200 for financial aid candidates) is due no later than 10 days following final acceptance to reserve your place. Full tuition (remaining balance) is due as follows:

|              |          |
|--------------|----------|
| May teams    | April 1  |
| June teams   | April 15 |
| July teams   | May 1    |
| August teams | May 15   |

**Tuition** SFS is a nonprofit organization. Tuition is kept as low as possible so that as many students as possible can participate. Tuition pays for room and board, instruction, and ground transportation during the expedition. It also includes group equipment, medical supplies, scientific instruments and material. It does *not* include transportation to and from the departure point. Personal gear such as packs and sleeping bags and personal equipment such as SCUBA gear are the responsibility of each student, as are medical insurance, inoculations, passports and visas. The tuition fees listed in this catalogue are based on estimates that are nearly a year in advance of expedition departures and involve many variables—currency rates, outside project support, enrollment projections, etc.—all of which may change. Thus, *the tuition for each expedition is tentative until confirmed in writing by SFS.*

**Scholarships and Financial Aid** Financial aid in the form of partial scholarships are available to qualified students who require such assistance in order to participate. Students between the ages of 16 and 21 who need assistance should request a Financial Aid Form with their applications. Students 21 years old or above who demonstrate financial need are eligible for assistance in the form of an interest-free loan.

Financial aid applicants are advised to complete the application process as early as possible since decisions are made on an ongoing basis. All funds usually are allocated by late spring.

**Refunds** Most of the costs of an expedition are incurred well in advance of its departure. Students who withdraw or otherwise fail to carry through jeopardize the success of an expedition. As the costs of replacing participants are high, *refunds are made only in the event of cancellation of the expedition.*

**Tax Deductions** For some expeditions, student fees and directly related out-of-the-pocket expenses such as airfare may be treated as a tax-deductible contribution to a scientific research effort. Since tax circumstances vary with the individual, each expedition contributor should consult his/her own tax advisor.

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

|                                   |         |
|-----------------------------------|---------|
| New York City/Nairobi, Kenya      | \$1,052 |
| New York City/St. Thomas, VI      | \$ 290  |
| New York City/Innsbruck, Austria  | \$ 806  |
| New York City/Athens, Greece      | \$ 650  |
| New York City/Iceland             | \$ 589  |
| New York City/Lima/LaPaz, Bolivia | \$ 868  |

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

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

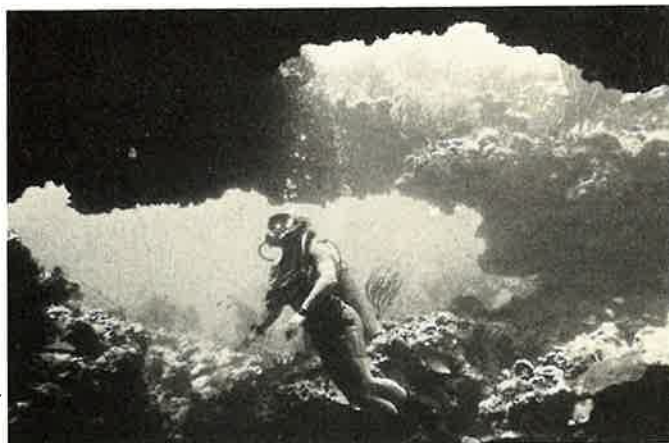
SFS reserves the right to refuse any applicant to any expedition if he/she is deemed unsuited for the project for any reason.

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

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

- over half of our projects take place in highly regulated and sensitive environments, usually requiring special permits, as in the Canyonlands, Iceland, Kenya, and Mount St. Helens;
- some projects depend on the goodwill and generosity of individuals and institutions which lend support;
- tenuous weather situations such as hurricanes in the Caribbean, or natural disasters such as another eruption of Mount St. Helens, or changes in political conditions in another country may require last-minute changes in sites or plans.

All applicants should understand that these or other variables may necessitate changes before or during an expedition. Indeed, part of the challenge is in adapting to changing conditions and overcoming the obstacles they may present. In other words, the whales are not always where we want them.



Christopher Neefus

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

### School for Field Studies

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

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

### 1983 Course Sites

Glacier Bay, Alaska  
Mount St. Helens National  
Monument, Washington  
Athi Plains, Kenya  
Theodorou, Crete  
Canyonlands National Park, Utah  
Atacama Desert, Chile  
Obergurgl, Austria and  
Davos, Switzerland  
Adirondack Mountains, New York  
Landmannalaugar, Iceland  
St. John, U.S. Virgin Islands  
Gulf of Maine

Get on our mailing list and receive  
updated news about these  
opportunities for academic and  
personal growth. See back page.



●● My participation in SFS has  
proven to be one of the best  
experiences of my life thus far. I  
not only had the opportunity to  
grow academically but person-  
ally as well . . . I wanted to  
participate in the Mount St.  
Helens expedition for three  
main reasons. First, to under-  
stand and appreciate the tech-  
niques of field research. Sec-  
ond, to challenge my interest in  
environmental studies, i.e., do I  
see a future for myself in this  
area? Finally, to experience the  
excitement of studying the  
effects of a unique natural dis-  
turbance—a volcanic eruption.  
I completed the expedition  
finding that I had learned much  
more than I ever imagined or  
expected. ●●

*Dolores Maghrak  
College of St. Thomas  
Mount St. Helens  
August 1982*

John R. Haldeman  
 B.S., Northern Arizona University, Biology  
 M.S., Northern Arizona University, Vertebrate Zoology  
 Ph.D., University of Arkansas, Ecology  
 Associate Professor of Biology  
 Florida Southern College

Thomas P. Husband  
 B.A., University of Michigan, General Biology  
 M.S., Michigan State University, Wildlife Biology  
 Ph.D., Michigan State University, Wildlife Ecology  
 Assistant Professor  
 Department of Forest and Wildlife Management,  
 University of Rhode Island

Evelyn Merrill  
 B.A., University of Idaho, Political Science  
 M.S., University of Idaho, Wildlife Resources  
 Ph.D. (in process), University of Washington

J. Jerome Montague  
 B.S., University of Idaho, Wildlife Resources  
 M.S., Michigan State University, Wildlife Ecology  
 Ph.D., Michigan State University, Wildlife Ecology  
 Graduate Teaching Assistant,  
 Michigan State University

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

Haraldur Sigurdsson  
 B.Sc. (honors), University of Belfast, Geology  
 Ph.D., Durham University, Petrology and Geology  
 Associate Professor of Oceanography, University of Rhode Island

Robert Singer  
 A.B., University of Illinois  
 Ph.D., University of Illinois  
 Assistant Professor of Biology, Colgate University

J. Brad Stelfox  
 B.Sc. (honors), University of Alberta, Zoology  
 Ph.D. (in process)

Thomas K. Wessels  
 B.S., University of New Hampshire, Wildlife Management  
 M.A., University of Colorado, Environmental Biology  
 Adjunct Professor of Ecology, Antioch College

Christopher Neefus  
 B.A., Boston University, Biology  
 Ph.D., University of New Hampshire



*The SFS staff charting the course: Andrea Walgren (seated), Mike Calmes, Ken*

*Andrasko, Jim Elder, Ann Shuhler, and Jane Flaherty (seated).*

I am interested in knowing more about the \_\_\_\_\_ expedition. Please send me additional information.

|                             |                                  |
|-----------------------------|----------------------------------|
| Name _____                  | School/College _____             |
| Address _____               | Major (actual or expected) _____ |
| City, State, Zip Code _____ | Year of Graduation _____         |
| Telephone _____             | Career Goal _____                |

Please send me \_\_\_\_\_ additional catalogues for my friends. Please send catalogues directly to:

\_\_\_\_\_

\_\_\_\_\_



**School for Field Studies**  
 50 Western Avenue  
 Cambridge, Massachusetts 02139  
 (617) 497-9000

# Organization

## Board of Trustees

Terry A. Herbert-Burns,  
Chairman  
New York, New York

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

James L. Elder, Jr. (ex officio)  
Director  
School for Field Studies  
Cambridge, Massachusetts

Francis W. Hatch, III, Treasurer  
Yale School of Organization  
and Management  
New Haven, Connecticut

Roy A. Hunt, III, Ed.D.,  
Secretary  
President  
Aqua Retreat Center, Inc.  
Boston, Massachusetts

Sandrea Andreas McMurtrie  
Washington, D.C.

Richard B. Wilson  
President  
Wilson Laboratories  
Boston, Massachusetts

The following are considered  
founding institutions in view of  
their substantial contributions  
toward the School's development  
and/or special projects:

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

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

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

We acknowledge with thanks  
technical assistance and encour-  
agement from the following  
organizations:

Atlantic Center for the  
Environment  
Boy Scouts of America  
National Geographic Society  
Outward Bound  
Sea Education Association  
Student Conservation Association

## Board of Advisors

David Ayer  
Trustee, Ayer Office  
Boston, Massachusetts

Travers Evans  
New York, New York

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

Harrison Mosher  
Director of Personnel  
Warner Communications  
New York, New York

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

Sarah Jenkins  
New York, New York

Arthur Page, Esq.  
Palmer and Dodge  
Boston, Massachusetts

Ala Reid  
Director  
Theodore Edson Parker  
Foundation  
Boston, Massachusetts

Dr. Richard St. Onge  
Pentucket Orthopaedics  
Bradford, Massachusetts

Walter A. Wood  
Southampton, New York

## Administrative Staff

James L. Elder,  
*Director*

Kenneth Andrasko,  
*Program Management*

Andrea C. Walgren,  
*Admissions*

Michael Calmes,  
*Public Information*

Jane Flaherty,  
*Administrative Assistant*

Anne M. Shuhler,  
*Administrative Assistant*

## Faculty

A. B. Adams  
B.S., Vanderbilt University, Economics  
M.S., University of Tennessee, Botany  
Ph.D. (in process), University of Washington, Botany

William Aughton  
B.A.  
Wilderness Skills and Emergency Medicine Instructor  
White Mountains, New Hampshire

Kirtland M. Barker  
B.Sc., University of Maine  
Universitat Salsburg  
M.S., Yale University  
Micrographics Consultant,  
Yale University

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

Susanne Carter  
B.Sc., Evergreen State University  
Field Biologist  
Cascadia Research Collective

Ned Fetcher  
A.B., Harvard College  
M.A., University of Wyoming, Botany  
Ph.D., Colorado State University, Range Science  
Research Associate,  
Botany Department, Duke University