

# SEI NOW

Spring, 1998

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## The European Green Crab


### ...A New Invader

For thousands of years humans have carried species from one ecosystem or country to another, often with devastating biological and economic effects. Once again a tale of invasion is unfolding in Oregon and the West Coast USA, as the European Green Crab, *Carcinus maenas*, invades coastal areas. A native of Europe, the green crab has been widely introduced to Australia, South Africa and much of the Atlantic seaboard of the US. Arriving in San Francisco Bay in 1989, it rapidly expanded northwards. In 1996, the first specimen was found in Coos Bay, Oregon, and since then more individuals have been discovered. At this stage the Oregon population size is small, but we can expect a dramatic increase. The original method of introduction is unknown and remains controversial. Ballast water carrying larvae in ships from the Atlantic or Japan is one possibility. Packaging materials have also been suggested. The crab's subsequent spread northward is probably the result of larvae riding on ocean currents or additional ballast water introductions.

The green crab is the ideal invader species. It can tolerate a wide range of temperatures and salinities. Green crabs grow quickly and produce large numbers of offspring. They are voracious predators and feed on mussels, oysters, other crabs, small fish, insects, and anything else they can catch. The only restriction appears to be their inability to tolerate the strong wave action of the open coast and they will probably be confined to bays and estuaries. This, unfortunately, is bad news for many commercial shellfishing concerns. A curious feature of these west coast invaders is that they are much larger than their European ancestors, thus making them even more ferocious predators.



*The Green Crab, photo courtesy of Dr. Sylvia Yamada; photographer, Dr. Jim Carlton.*

Evidence suggests that the green crab may have major impacts on local commercial and recreational fisheries through predation and competition. Oysters and other shellfish are particularly at risk. However, young Dungeness crab may also be vulnerable. SEI's Zasha Bassett working with OSU's Drs. Sylvia Yamada and Gary Allison, recently conducted extensive surveys of bays on the central Oregon coast to gather general baseline information. Zasha focused her efforts on potential effects on three existing local crabs, and other species in Siletz Bay (contact SEI for results). She plans to continue her efforts, with experimental studies, predictive models, and by developing mitigation methods to help protect shellfish industries. She recently started a bulletin board that you can visit on the SEI web site at <http://www.sei.org/crablist.html>. You can also contact her at [bassett@sei.org](mailto:bassett@sei.org). 

# President's Column

by



**“Extinctions are natural. Aren't you interfering with nature when you try to preserve a species?”** We're asked this question many times. On a global scale, it's the question that all conservation ecologists deal with daily. What is a natural extinction and how does it differ from an “unnatural” extinction? Species are born and die on an evolutionary landscape. During the Paleozoic era (circa 500-290 million years ago), the platycerids, a family of snails, became extinct. The platycerids had an unusual and specialized life style; they attached themselves to the anuses of crinoids (sea lillies). For millions of years they and their crinoid hosts flourished. When crinoids went extinct, the platycerids disappeared too. This extinction, which took place over millions of years, is typical of many species. The mass extinctions at the end of the Permian (c. 245 mya) and the Cretaceous-Tertiary boundary (c. 65 mya) also occurred over millions of years. Each was followed by periods of speciation and radiation when many new forms and species emerged. These extinctions are associated with natural and major environmental shifts or global disturbances. However, today we are witnessing a higher and more rapid rate of extinction than previously recorded. Many losses or population reductions are the result of human activities that alter conditions faster than a species can respond, or that destroy vital habitat.

In the last newsletter we highlighted

## Q & A: SEI What?

*How do you decide which projects to work on?, asks Dr. Jack Corbett, Professor of Public Administration at Portland State University.*

First, all SEI's work must meet the following criteria: 1) Be scientifically sound, 2) Directly benefit communities that are affected by the ecological issue, and 3) Be carried out in a way that is non-partisan and that fosters co-operative problem solving.

There are two different routes through which projects may begin through SEI. Sometimes, SEI receives requests from individuals, organizations, corporations and governments for assistance with natural resource issues. We evaluate these requests through the framework of our guidelines. If we decide to take on the issues proposed, the participants must adhere to three policies described above. Participants must also agree to our process of finding a solution that is science based and approached cooperatively.

Alternatively, SEI scientists identify issues in need of attention, or issues that we anticipate developing in the future. The Institute carries out the research, or studies needed to adequately address these topics. Our goal is to actively prevent such issues from becoming problematic. We also inform interested groups of such upcoming issues, so they may become involved in the process through education and awareness of their role in the balance of natural resources.

*I've recently seen a Pileated Woodpecker. Are they rare?, asks Jasmin Weber, avid birdwatcher.*

The Pileated Woodpecker (*Dryocopus pileatus*, aka Woody Woodpecker) is probably the most famous of all the woodpeckers. With its distinctive bright red crest at the rear of its head, white throat, and black body, it cannot be mistaken. These cavity nesters are permanent residents in their woodland habitat and do not migrate seasonally. Their diet consists of insects and occasional fruits. You can find the Pileated Woodpecker in the Southeastern, Northeastern, and Northwestern forests of the US.

To see a Pileated Woodpecker is considered a rare occurrence for most birders, although they are not listed as threatened or endangered. As permanent residents of the woodlands, these birds usually only move out of their home range if it is destroyed. Therefore, you will not see one pass through your neighborhood unless it lives there, or is passing through on its way to a new home. If you are trying to find a Pileated Woodpecker, look in older forest stands with good woodpecker habitat (dead trees and

### Presidents Column, continued...

the Montserrat Oriole. In this issue we bring you the results of a formal Population Viability Analysis, commissioned and carried out through SEI, for the Oriole (see page 4 and our web site). This analysis indicates a high extinction probability for the species. Unlike the platycerids, if this bird goes extinct, it will not be a “natural extinction”. The proximal cause of extinction may be the volcano; the ultimate cause is human activity. These types of scenarios are common today, and they make the scientist's job more challenging. Distinguishing between natural events and their consequences, and human-induced changes is part of an ecologist's work. This issue forms the basis of many conflicts and controversies in the application of environmental

laws and regulations, including the Endangered Species Act. Interpreting data in the larger ecological framework when the information is incomplete is an ongoing challenge. It's one that SEI scientists are familiar with from many aspects of the Institute's work. But hard data, solid analysis and interpretation of those data are the best tools available to scientists to detect and interpret ecological changes. SEI scientists are committed to helping distinguish between natural and human-induced events and to using the best data to provide information to a wider audience. In other articles in this issue you can read about using coral reef data to monitor for changes in Caribbean waters (page 5), as well as updates on SEI activities, and symposia.

## Report on The Wildlife Society Conference Symposium organized by SEI-Idaho

From September 21-27, 1997, The Wildlife Society (TWS) held its 4<sup>th</sup> Annual Conference in Snowmass Village, near Aspen, Colorado. The Conference attracted over 2000 wildlife biologists, natural resource managers, students, academics, and agency administrators. The Conference included 14 high-quality Symposia that provided an in-depth look at a wide variety of topics. The first Symposium of the Conference, "Contemporary Research on the Effects of Forest Management on Bird Populations", was organized by Drs. Rex Sallabanks and John M. Marzluff of SEI-Idaho. The Symposium included twelve 20-minute papers from researchers throughout North America, each of whom was individually invited to participate by the organizers.

Most research on how forest management, such as timber harvest, influences bird populations has been short-term, correlative, and has not directly examined demographic parameters such as nest success or rates of nest predation. Therefore, the mechanisms ultimately responsible for changes in bird populations following forest disturbances cannot be accurately assessed; any recommendations for forest managers are consequently weak and of limited utility. The TWS Symposium organized by SEI was intended to increase our awareness of the limitations with past work, showcase recent studies that have overcome some of these limitations, and ultimately set new standards for avifaunal research in the 21<sup>st</sup> Century. Each of the studies reported on during the Symposium was significant in that it addressed mechanistic relationships between birds and forestry, included experimental manipulations of silvicultural treatments, and/or provided data on avian fitness components rather than simple abundance or density estimates.

The Symposium began with two introductory papers by Sallabanks and Marzluff, respectively. These papers provided a review and critique of past research, identified information gaps, emphasized the importance of mechanistic approaches, and offered numerous suggestions for future research directions. The 10 papers that followed then provided examples of how new and improved research approaches might be implemented by spotlighting independent case studies on a variety of bird species from different regions of North America. Some of the highlights were papers by Dr. Frank R. Thompson, III (USDA Forest Service) on research in the Midwest, Dr. Richard H. Yahner (Penn. State University) on long-term research in northeastern forests, and Dr. Kathy Martin (Canadian Wildlife Service) on experimental studies in British Columbia. The entire session was well attended and the papers that were presented were of high quality. Feedback received by the organizers after the Symposium was positive, complimentary, and indicative that the session was a huge success.



*Symposium organizers, Dr. Rex Sallabanks (left) and Dr. John Marzluff (right) of Sustainable Ecosystems Institute.*

Eight of the 12 papers from the Symposium were selected for publication in the Wildlife Society Bulletin as part of a special feature on bird populations and forest management. Lead authors on the 8 papers are Rex Sallabanks, John M. Marzluff, Jeffrey P. Duguay, Carol R. Foss, David I. King, Frank R. Thompson, James C. Manolis, and Richard H. Yahner. Manuscripts are currently being peer reviewed and are scheduled to appear in the Bulletin early in 1998.

## SEI SNIPPETS

In this issue, some examples of our educational outreach work ...

**Rick Merizon** escaped the pressures of graduate academia, and rediscovered his love of teaching recently at Grant High School. Rick used the opportunity to talk about the rewards and challenges of studying Marbled Murrelets, and to give the students some hands on experience of research. Rick brought SEI's radio telemetry gear, and the students learned first-hand the joys of radio-telemetry by tracking down small transmitters on the baseball field. Students were keen on learning about research, making it a rewarding day for Rick and the students.

**Mariann Koop** spent 15 hours with Oregon Episcopal School first graders over four weeks leading a hands-on exploration of mammal habitats. Each student researched a chosen mammal and its habitat and used his/her findings to build a model habitat, using only recycled or found objects. Students also sculpted their mammals out of salt-dough clay for their displays and made posters illustrating their research findings. The project culminated with oral presentations by each student and a public display of their projects.

**Dr. Deborah Brosnan** gave a series of presentations at the Career Day at Central Catholic High School. To standing-room-only classrooms, she talked about becoming a marine biologist, college choices and requirements, graduate schools, and provided answers and practical advice to these future scientists. Afterwards she visited with some of the students and their projects.

**Zasha Bassett** recently combined the natural history of marine organisms with a creative arts activity for fifth grade students attending the Children's Clean Water Festival, at Portland Community College, Rock Creek Campus. Students enjoyed creating their own replica of an ocean critter while Zasha explained the differences of living in a pelagic, versus a benthic environment.

# Population Viability Analysis for the Montserrat Oriole

**The Montserrat Oriole (*Icterus oberi*)** is an endemic bird, restricted to the island of Montserrat, British West Indies. It was previously regarded as threatened by the loss of habitat (montane forest) to agriculture. Hurricane Hugo, in 1989, and the ongoing eruption of the Soufriere volcano further indemnified its population. Volcanic eruptions have increased in frequency since 1995, and the best quality habitat has now been destroyed. The purpose of the Population Viability Analysis (PVA) is to present an impartial analysis of both, the current situation, and of conservation options.

A Population Viability Analysis (PVA) is a method of predicting the future trends in a population. The output of the analysis is usually a set of probabilities of alternative outcomes ('the risk of extinction', 'the risk of major decline' etc.) and should be used by managers as a guide to risk. The technique has been widely applied in conservation biology to many different animal and plant species. Formal PVA has been applied in management situations by the US government (e.g. President Clinton's Northwest Forest Plan; Thomas et al 1995).

There are many possible factors that put populations at risk of extinction. PVA is a technique which allows us to examine the magnitudes of these risks, and to develop a more formal understanding of how factors interact to determine the probability of population persistence. While most PVAs have a more or less explicit mathematical formulation (model), there is no set format, nor a single 'best' approach. The structure of any given PVA is usually dictated by data availability, and the goals of management.

The Montserrat Oriole PVA was carried out by SEI's Dr. Brosnan and Dr. Courtney in conjunction with Dr. Resit Akcakaya, of Applied Biomathematics, NY, who developed the RAMAS software used in the analysis. Additional biological information from Wayne Arendt, Irby Lovette, Jon Selz, and C.J. Ralph greatly helped in setting the parameters.

The basic structure of the model is a stage-based Leslie matrix projection. Age-specific fecundities and survival are used to predict the abundance of birds in different populations. The model is sophisticated in that it allows the experimenter to select among numerous types of population dynamics. Density dependence of several forms can be incorporated, as can changes in the carrying capacity of the environment.

We analyzed five different possible outcomes, ranging from the best case scenario of a full recovery, to the pessimistic scenario of continued damage from major eruptions. We also included a scenario involving management via a rescue program. We carried out 400 simulations for each scenario, and projected populations over the next 50 years. Results were presented as an average of these 400 simulations for each scenario.


A variety of parameter values in the model were estimated from the known biology and status of the Montserrat Oriole. Parameters included estimation of habitat loss, volcanic activity, hurricane frequency, Oriole life history, demography, migration and dispersal, survival and breeding, and direct and indirect effects of volcanic activity on individual birds.

The PVA revealed an unequivocal result: the Montserrat Oriole is a species at great risk. Under realistic assumptions about current conditions there is a substantial risk of extinction. For example based on estimates calculated after the large explosive eruption on December 26, 1997, the Montserrat Oriole has a 72% probability of extinction. There is little chance that the species can persist in the wild with a viable population.

Conservation biologists have developed guidelines for determining the degree of risk faced by a species. Mace and Lande (1991) proposed an evaluation of a species status on the basis of extinction risks.

Their categories have been adopted by IUCN and other conservation organizations and are as follows: CRITICAL = 50% probability of extinction within 2 generations; ENDANGERED = 20% probability of extinction within 10 generations; VULNERABLE = 10% probability of extinction within 100 years.

Based on the above criteria, the Montserrat Oriole would be classified as either endangered or critically endangered.

Current status: The PVA Model has been favorably peer reviewed by a team of top scientists. The model and report has been forwarded to the ministry of Montserrat with our offer of assistance. We are awaiting their reply. 

## Evolutionary Facts

The Montserrat Oriole was first recognized as a new species in 1880 by Fred Oberi of the Smithsonian Institute US.

The Oriole is a member of the Troupial family (which includes 91 species distributed in North, Central and South America, and the West Indies).

Recent mitochondrial DNA (mtDNA) genetic analysis confirmed that this Oriole is a distinct species. It is more divergent in mtDNA from the other Antillian Orioles than many North American congeneric species are from one another.

Lovette (1997) concluded that the Montserrat Oriole represents an Evolutionary Significant Unit.

# Monitoring Coral Reefs

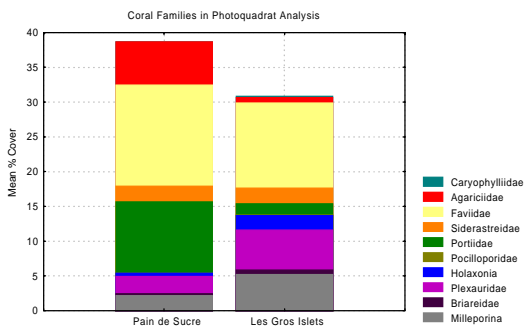
## The Marine Reserve Program in St. Barthelemy

In late 1996, the Caribbean island of St. Barthelemy designated its new Marine Reserve with the goal of protecting coral reef and coastal ecosystems, and fostering science and education. That same year, the New England Biolabs Foundation (instrumental in the development of the reserve) requested that Sustainable Ecosystems Institute assist in establishing a monitoring and scientific research program for the reserve. Working with St. Barths, and with support from the Foundation and locally, SEI developed a monitoring program and initiated the first phase.



Many reserves are established to protect reef ecosystems, but without scientific monitoring it is impossible to evaluate success in meeting that goal. Sound scientific information is essential for making good policy decisions. But all too often, reserves are designated without a clear management or monitoring program, and the subsequent cost and effort needed to establish one can be too high for many reserves. But St. Barth's is different, and enters a new phase in marine protection with an established baseline of scientific information and a monitoring program.

The initial monitoring work was extensive, and consisted of island-wide manta tows, setting up permanent



photoquadrats, fish analysis, and water clarity measurements. Manta Tow surveys are effective in monitoring large scale patterns and processes. As the name suggests they involve towing a diver (armed with data collection gear) behind a boat at fixed speeds and intervals. (Many SEI divers will tell you that manta towing is like chumming, and SEI divers have been followed by sharks and schools of barracuda during the tows!) Creating permanent quadrats allows scientists to monitor organisms at a finer scale, and photographs create permanent records of coral communities. Photographs can be digitized and analyzed at a later time, thus relieving some of the time-pressures on divers.

Reflecting the volcanic origins of St. Barthelemy, most marine life grows on rocky outcrops and benches. Rocky headlands and offshore islands provide substrate for a rich marine community. Seagrass bays (e.g. Cul de Sac) are vital nursery areas for fish and shellfish. Coral life is rich and diverse (see figure), but the elkhorn reefs are mostly dead, victim primarily to disease that struck the wider Caribbean. Yet, signs of recovery are visible. Small reef fish are abundant but there are few large fish (e.g. groupers) on any reef.


*Remember, 1998 is the International Year of the Ocean! Find out how you can help by contacting SEI.*

*The graph at the left depicts abundance of coral families at two locations. Agariciidae are common at both sites. Finger and Mound corals are more common at Pain de Sucre while Seafans (Plexauridae) are more common at Les Gros Islets.*

We hope that, as the reserve establishes, we will begin to see increases in the abundance of corals and fish species (particularly those that have been over-exploited).

These data reflect the status of the reef at a single point in time. Future changes in the system can be detected by comparing new data to original baseline information. These results can provide a framework for management. Local dive operators concerned for marine life became involved with SEI's activities. Owners and divers with West Indies Dive, and local fisherman, Patrick Laplace participated and learned monitoring methods.

The Marine Reserve of St. Barthelemy is an exciting venture in conservation. We appreciate the opportunity to assist the Marine Reserve, and are grateful for support and help from St. Barthelemy during this study. We look forward to working again with our friends and colleagues on St. Barthelemy, including Nicole Aussedat (of the Marine Reserve) and Jean Aubin.

More information and data are on the website and a full report is available from SEI. Check the website and future issues of SEI Now for updates on this monitoring program. SEI scientists will be returning to St. Barthelemy in April and June 1998 for continued research and preliminary development of an exciting diver program. 

# Songbirds and Their Forest Habitat in Southern Idaho

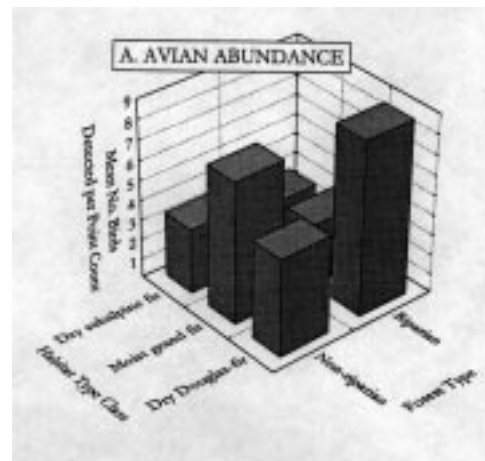
Forested landscapes of the Northern Rocky Mountains provide critical habitat for many species of birds, including Neotropical migratory songbirds. Reports of declines in several of these species have sparked attention from both researchers and land managers as we attempt to understand why these declines (if indeed they are real) might be occurring. However, before we can even begin to manage for and conserve bird species, we must know two things: (1) Where do they occur on the landscape; and (2) What are the proximal and ultimate factors that drive their distribution, abundance, and demographics. SEI researchers are conducting a study designed to address these needs for forests of west-central Idaho. The results will also offer general applicability to other forests throughout the inland Pacific Northwest.

Using a recently developed forest management tool, called an ecosystem diversity matrix for the Idaho Southern Batholith landscape as a framework, we mapped the distribution of bird species across the landscape, assessed relative abundance, and developed bird habitat models. The matrix is currently being used to describe historical disturbance regimes, existing landscape conditions, required conditions to support biodiversity, and desired future landscape conditions. The integration of data on bird species' distribution, abundance, and habitat relationships into the matrix therefore provides forest managers with the information necessary to prescribe future management with these species in mind. Such an approach is critical for the maintenance and conservation of bird populations in these forests.

Breeding bird communities were sampled in 46 forested stands in west-central Idaho in 1996. Each stand was classified into one of four habitat classes (dry Douglas-fir, dry grand fir; Breeding bird communities were sampled in 46 forested stands in west-

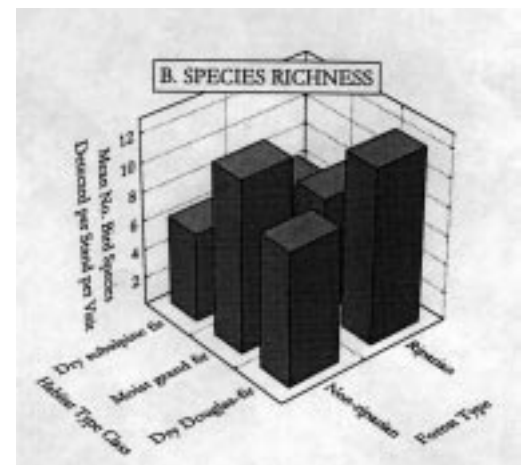
central Idaho in 1996. Each stand was classified into one of four habitat classes (dry Douglas-fir, dry grand fir; cool, moist grand fir; or warm, dry subalpine fir) and one of three growth stages (shrub/seedling/sapling; small tree; or old growth). Each combination of habitat class and growth stage represented an "ecological land unit" within a recently developed forest planning and management tool for the Idaho Southern Batholith landscape called an "ecosystem diversity matrix." Bird species were not distributed evenly across the landscape and many were found to have significant relationships with either habitat type, growth stage, or even specific ecological land units within the matrix. Bird-habitat relationships were further examined by developing bird habitat regression models

using habitat data collected in the same locations. These models further improved our understanding of habitat selection for a number of species, although less than 25% of the variation in relative abundance, on average, was accounted for by the stand-level parameters considered. Our results, which appeared to be robust when tested using data collected over the three-year period, 1994-1996, have high utility for forest managers, especially when interpreted using the ecosystem diversity matrix. The influence of different management scenarios on the composition of bird communities in forests of the Idaho Southern Batholith can be assessed, as can the potential for current landscape conditions to maintain avian biodiversity and support viable populations of breeding birds.



*A. Avian Abundance depicts the distribution of birds between riparian and non-riparian forest stands in three different habitat types*

*B. Species Richness depicts the distribution of species between riparian and non-riparian forests in three different habitat types.*



For more information on this work, contact Dr. Rex Sallabanks in the SEI Idaho office (rsallaba@sei.org).

# SEI WHO?

**Zasha Bassett**, is a graduate of Lewis and Clark College with a BA in biology and plans to do graduate work in marine biology. Zasha has worked in a variety of educational capacities at the Metro Washington Park Zoo. She has also worked at Oregon Trout, a local fish conservation organization. She is currently working on a project at SEI regarding the European Green Crab, a species that was recently introduced on the Oregon coast. In her spare time, Zasha enjoys hiking, camping, reading and jazz dance.

**Gail L. Achterman**, an attorney with Stoel Rives LLP in Portland, Oregon, is a member of the professional board of directors for SEI. Ms. Achterman has a wide range of interests and responsibilities in environmental and natural resources law and policy, including endangered species issues, solid waste and recycling regulation, forest management, and water quality and quantity. She was the Governor's representative for natural resources in a previous administration. In addition to her commitments to SEI, Ms. Achterman also chairs the Oregon Department of Environmental Quality 401 Certification Rules Advisory Committee, and the Oregon Landslides Task Force. She is the President of the Board of Directors of 1,000 Friends of Oregon. Gail enjoys cross country skiing, hiking, and choral singing when she isn't working.

**Dr. Barry Noon**, is a member of the SEI Science Advisory Board. He received his BA from Princeton University and Ph.D. from State University of New York in Albany. An expert in mathematical ecology and modeling, Dr. Noon has published extensively on population biology and viability analysis. He is actively involved in the use of science and scientific analysis in decision making. For 10 years, Dr. Noon was a scientist and project leader at the USFS California Redwoods Lab, where he carried out extensive work in population biology, including work on the spotted owl. He recently accepted an appointment at the Colorado State University. This marks a return to academic life for Barry who previously held academic positions in New York, and California. Dr. Noon was recently appointed a federal committee to provide technical advice on National Forest Management Act.

**Dr. Deborah Brosnan**, SEI President, was recently appointed to the Oregon State University, Forest Advisory Board. This Board assists the college with forestry issues and research directions. She attended her first meeting in October, which included stimulating presentations by faculty, and a lively discussion among board members on the importance of research and world trends in forestry.

**Chris Becker Alert!** SEI biologist Chris Becker is now the top woman saber fencer in USA after winning first place at the North American Cup in South Bend, Indiana in January, 1998. Congratulation Chris!

**NEW PUBLICATION:** *SEI announces the publication of "A Practical Guide to Coral Reef Monitoring: Answers to Frequently Asked Questions" by Timothy L. J. Grubba. This publication is number 4 in the Ecology in Action Series. Based on SEI's experience in reef monitoring in the Caribbean and on Tim's training programs for local people and groups, this publication is a practical and down to earth guide to monitoring. It covers issues such as what to monitor, when and where to monitor, and provides an extensive species list for the Caribbean. The program can be adapted to a wider geographic area. For copies contact SEI.*

## SEI Thanks....

### WADNR grant received by SEI-Idaho

Dr. Rex Sallabanks, Director of SEI-Idaho, has recently been awarded a two-year grant from Washington Department of Natural Resources to address the question of whether we can infer habitat quality from the use of wildlife surveys. Dr. Sallabanks will use the \$150,000 grant to evaluate the effectiveness of avian point count surveys to assess habitat quality for forest-nesting songbirds in the western Washington Cascades. Intensive nest monitoring will be combined with results from avian point count surveys and spot-mapping techniques to determine whether measures of songbird abundance and density correlate with reproductive success. The study begins in 1998 and promises to have significant implications for past and future research on the relationships between bird populations and forest management in the Pacific Northwest.

### \*\*\*NEWS FLASH\*\*\*

SEI was recently awarded a Corporate Award by the New England Biolabs Company. "In celebrating the year of the ocean, New England Biolabs recognizes those individuals and organizations committed to maintaining the beauty and integrity of marine environments". SEI was selected to receive a corporate award from NEB to help with SEI's efforts in marine conservation. Look for a unique and informative feature on marine parks in the new NEB catalogue, that also provides some information about SEI. Our thanks to all the people at NEB for their support, and for their commitment to ocean life.

Volunteer opportunities are available at SEI. If you are interested please call SEI headquarters.



**SEI Moment** : Dr. Deborah Brosnan finds shelter under a Swiss Cheese Plant on Montserrat. Deborah was visiting Montserrat in December, 1997, investigating the status of the remaining endemic Montserrat Oriole population. At the time this photograph was taken she was patiently waiting for the Soufriere Volcano to finish erupting.

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