January/February 2004 • Vol. 26/No. 1 • $6.00/Year

TWINE LINE

The educational newsletter of Ohio Sea Grant, covering issues, events, and research related to Lake Erie and the Great Lakes

An Alga a Day *Keeps the Doctor Away*

Engineered Algae as a New Means to Vaccinate Fish

by Jill Jentes Banicki, Ohio Sea Grant Communications

When Ohio Sea Grant researcher Dr. Richard Sayre of Ohio State University started his research on engineered algae 10 years ago, his focus was on bioremediation methods. *Chlamydomonas reinhardtii*, a unicellular alga found abundantly all over the world, could be genetically altered to recover harmful heavy metals locked in sediments. Over the years, he has been able to enhance its binding capabilities, resulting in a significant step toward remediation of contaminated sites and waters of the Great Lakes.

But recently, his scope has broadened. "We realized that if *Chlamydomonas* could bind to heavy metals so effectively, why couldn't it be used to deliver needed vitamin supplements or a vaccine to an animal?" asks Sayre.

Sayre along with Dr. Richard Wagner expanded their research to see if the mircoalgae could be used as a way to vaccinate fish for Infectious Hematopoietic Necrosis Virus (IHNV), a viral disease that kills 30 percent of the U.S. trout population.

Controlling fish diseases has long been a problem for the aquaculture industry, adds Sayre. Antibiotics are not only useless for viral and many parasitic diseases, but they can only be partially absorbed by fish. Although fish vaccines are a more successful alternative, they can be costly, labor intensive, and stressful for the fish.

"Unfortunately, the trouble with producing many vaccines is you need to identify the pathogen and then you need time to culture it," explains Sayre. "Our system doesn't

Continued on Page 5

Inside: North Coast News & Friends of Stone Laboratory

Sea Grant Ohio Sea Grant College Program — The Ohio State University

www.sg.ohio-state.edu

TWINE LINE

January/February 2004• Vol. 26/No. 1• $6.00/YEAR

Ohio Sea Grant, The Ohio State Univ., 1314 Kinnear Rd., Columbus, OH 43212-1194 614.292.8949, Fax 614.292.4364, ***www.sg.ohio-state.edu***

Twine Line (ISSN 1064-6418) is published bi-monthly six times a year by the Ohio Sea Grant College Program at The Ohio State University, 1314 Kinnear Rd., Columbus, OH 43212-1194. Subscription price is $6.00 per year (six issues).

Ohio Sea Grant Staff

Dr. Jeffrey M. Reutter, *Director* .....reutter.1@osu.edu
Dr. Rosanne W. Fortner, *Education Coordinator* .....fortner.2@osu.edu
Jill Jentes Banicki, *Communications Coordinaator*.....jentes.1@osu.edu
Bonita Cordi, *Office Associate*.....cordi.2@osu.edu
Nancy Cruickshank, *Publications Manager*.....cruickshank.3@osu.edu
Cindy Hayter Allison, *Graphic Designer* .....hayter.2@osu.edu
John Tripp, *Fiscal Manager* .....tripp.3@osu.edu

Extension Agents **Extension Program Co-Coordinators*
Frank R. Lichtkoppler*, *Lake & Ashtabula Counties* .....lichtkoppler.1@osu.edu
Fred L. Snyder*, *Ottawa County*.....snyder.8@osu.edu
John R. Hageman, Jr., *Ottawa County*.....hageman.2@osu.edu
David O. Kelch *Erie & Lorain Counties*.....kelch.3@osu.edu
Joe Lucente, *Lucas County*.....lucente.6@osu.edu
Walter D. Williams, *Cuyahoga County* .....wwilliams@clevegrowth.com

Highlighted Publications

Living with the Lakes: Understanding and Adapting to Great Lakes Water Level Changes — This publication highlights the different factors that affect the Great Lakes. From general information about how the Lakes were formed, to how water levels, weather, and shorelines are influenced by humans, this publication is an excellent source about the natural processes of the Great Lakes. For a pdf copy of this publication, go to ***www.glc.org/living/***. To receive a hard copy, email *lhpm@lre02.usace.army.mil* with a subject line, "Order a copy of Living with the Lakes". Please include your full name and mailing address in the body of the message. (free)

Steelhead Trout: A Money Fish for Ohio — Originally appearing in the Nov/Dec 2003 issue of *Twine Line*, this excerpt discusses the benefits (angler and economic) of steelhead angling in Lake Erie's tributaries. (free)

A complete list of Sea Grant publications is available, as well as many downloadable publications, on our web site at ***www.sg.ohio-state.edu***

Publication Request 1/04

Name

Address Phone (area code)

City State ZIP

E mail Address

❑ Publications Brochure (free)
❑ *Twine Line* Subscription (1 year/6 issues for $6.00) $ _____
_____ $ _____
_____ $ _____
_____ $ _____

TOTAL ENCLOSED (U.S. Dollars) **$** _____

Make checks payable to The Ohio State University,
Mail to Ohio Sea Grant Publications, 1314 Kinnear Road, Columbus, OH 43212-1194

For Your Information

December Water Levels

Lake Erie's level rose during December. The mean level was 570.54 feet which is 0.10 foot higher than last month's mean level and 0.29 foot below normal. The 2003 level was .26 higher than the December 2002 level and 1.34 feet above the Low Water Datum elevation reference system. *TL*

Ohio Sea Grant's New Survey

From January through March, agents and volunteers working at the Ohio Sea Grant exhibits get asked a lot of questions at the various Boat, Fishing, and Sport Shows. In years past we have asked clientele at the shows to fill out surveys letting us know their opinions on various Lake Erie priorities.

This year we are asking that citizens go to the Ohio Sea Grant web site and click on "complete the Ohio Sea Grant survey" to let us know your opinions on Great Lakes and Lake Erie issues. It will take about ten minutes of your time but it will be very helpful to us as we plan our future Ohio Sea Grant efforts.

The survey is an Ohio Sea Grant effort to update and define the attitudes, opinions and priorities of Ohio citizens concerning the Great Lakes and Lake Erie in order to assist in developing the Ohio Sea Grant Strategic Plan for 2006-2010. Citizen input is very important to us. Citizen input helps us to plan better programs and improve actions that will meet citizen needs for Great Lakes and Lake Erie information.

By conducting the survey on the web we will be able to reach more people, quickly compile the data, and efficiently analyze the results. Please help us identify research, education, and outreach priorities for our 2006-10 Strategic Plan by taking the time to complete the Ohio Sea Grant Survey. The Ohio Sea Grant web site is located at ***www.sg.ohio-state.edu***.

Once you are on line, click on "complete the Ohio Sea Grant Survey" and you will go to the survey. When you have finished the survey you will go back to the Sea Grant home page. *TL*

Sea Grant Researcher Helps Guide Mars Rovers

Ohio Sea Grant researcher Ron Li leads a team of Ohio State engineering students working with NASA on the Mars Exploration Rover mission. The team is responsible for precise localization (providing exact ground location) of the Spirit rover that made planet-fall at the beginning of January. Mission data transmitted from Spirit is being sent directly to Li's Mapping and GIS Lab for processing. "We have landed safely on Mars and are working intensively to map the landing site. It was a great and smooth landing," according Li. Congrats, Dr. Li. *TL*

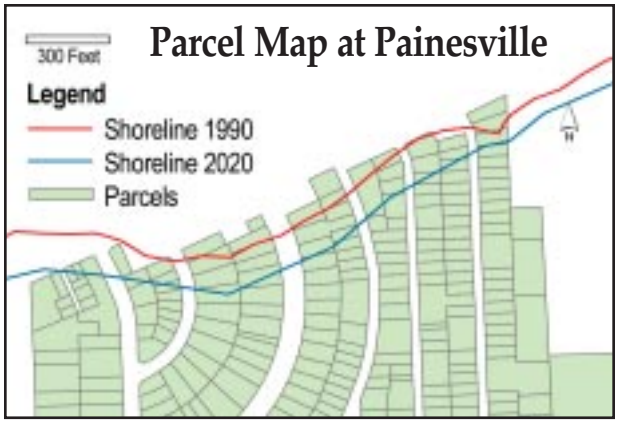
Subscription Renewals Extended

Twine Line subscriptions will increase from $6.00 to $10.00 per year starting March 1, 2004. Readers have the opportunity to renew their subscriptions at the current yearly $6.00 rate now extended through April 31, 2004. Readers may renew for multiple years. To place orders, call the Columbus office or email *cruickshank.3@osu.edu*. *TL*

Shifting Sands

Predicting the Movements of Lake Erie's Shorelines

by Jill Jentes Banicki, Ohio Sea Grant Communications



This map shows the shoreline of Painesville, Ohio, in 1990 (red line) and in model-predicted 2020 (blue line). Landowners will soon be able to access such predictions about individual parcels through a web site available later this year.

When Native Americans and early pioneers walked the Lake Erie shorelines 250 years ago, they experienced a different terrain than what exists today. Not only have many of the shoreline areas been developed, but they have also vastly shifted and eroded over time. In an effort to better determine what is here today but will be gone tomorrow, scientists are developing methods to predict the ebb and flow of shorelines.

Lakeshore landowners will soon have tools to see where their property lines could be in 20, 30, or even 50 years from now, according to new research by Ohio Sea Grant researcher, Dr. Ron Li.

Landowners of shoreline property have always had to battle the uncertainty of soil erosion. Caused by either natural processes or human activities, coastlines have never been stable and in some areas they continue to erode at alarming averages of one to two meters (3 to 7 feet) per year.

The use of new technology, however, could help landowners plan for a proactive approach. "Our research could assist land managers and owners to see the future "hot spots" (in terms of shoreline loss) so they can better prepare for preventative measures," says Xutong Niu, Dr. Li's research associate in the project.

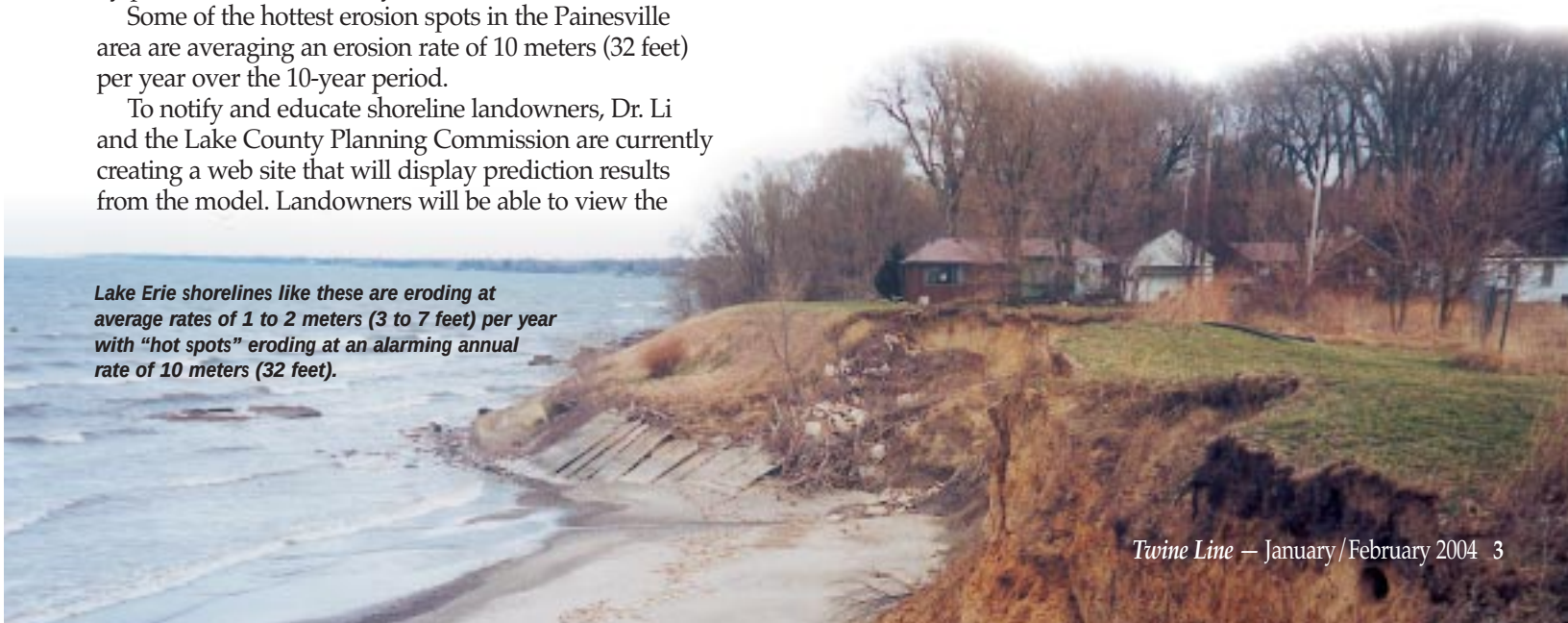
With the aid of previous Lake Erie coastline data from 1973, 1979, and 1990 provided by NOAA, ODNR and Ohio State, Li and his researchers created a shoreline prediction model that could forecast shoreline changes by parcels in annual or 10-year increments.

Some of the hottest erosion spots in the Painesville area are averaging an erosion rate of 10 meters (32 feet) per year over the 10-year period.

To notify and educate shoreline landowners, Dr. Li and the Lake County Planning Commission are currently creating a web site that will display prediction results from the model. Landowners will be able to view the shoreline changes to specific shoreline parcels and see how they will change (i.e. how much land is lost into the lake) over specific durations of time. Accessible later this year, the site will also include shore bluff erosion photos taken from 1994 to 1996 by a United States Geological Survey video camera and a three-dimensional display of the terrain along the Lake's shoreline.

Niu points out that this research is only a part of a much bigger project to document coastline changes. Through funding and support by NOAA, ODNR, and the National Science Foundation, Li's researchers are incorporating 1-meter resolution satellite images of Lake Erie shoreline into their data set. "This technology will greatly enhance the efficiency and capabilities of coastline mapping and spatial analysis in coastal management," states Li. Besides satellite images, the team will add water surface changes from radar altimetry along with daily water level from tide gauges. The hope is to document a 19.2-year history of Lake Erie's coastline changes. "By comparing data from tide gauges, altimetry, and the Great Lakes Forecasting System's model, we can determine their past accuracy and ultimately establish a 19.2 year record of Lake Erie's shoreline," states Niu.

Drs. Keith Bedford, C.K. Shum, Raul Ramirez, and A. Zhang are investigators overlooking other research areas in this project in addition to the above Sea Grant activities. For more information about this research, go to ***http://shoreline.eng.ohio-state.edu/research/diggov/DigiGov.html*** or contact Dr. Li at *li.282@osu.edu*. TL



Lake Erie shorelines like these are eroding at average rates of 1 to 2 meters (3 to 7 feet) per year with "hot spots" eroding at an alarming annual rate of 10 meters (32 feet).

Beam Me Up!

Videoconferences Extend Stone Lab Learning

by Rosanne W. Fortner, Associate Director of Stone Laboratory

Over the past year Stone Lab staff have been perfecting a new method of outreach. With a grant from the U.S. Environmental Protection Agency, Region V, and support from UNITS at Ohio State, the Lab has acquired equipment for video teleconferencing! Environmental education for larger audiences is the goal of the project, and the first year's trials have been a success with both the mainland public and school groups.

During the summer University term at the lab, students participate in a weekly seminar on current research, and the Thursday lecture series engages the public in programs about current issues and science of the lakes. Until 2003, only the people on Gibraltar had these opportunities. Now the research updates and lecture series are the "lights, camera, ACTION" for programming live from Gibraltar! Over the summer the technology was perfected so that groups of faculty and students could participate, ask questions, and enroll for credit from Ohio State University's Kottman Hall.

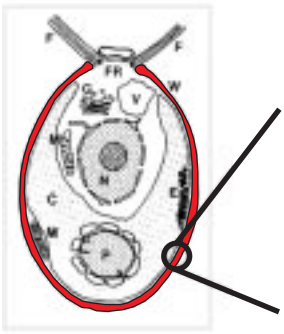
Another exciting application is in schools. For a number of good reasons, many schools find it impossible to bring their students to Gibraltar for an aquatic education workshop in spring or fall. With the video-conference capability, Stone Lab staff can conduct "virtual workshops" for schools. While the hands-on aspects can't be adequately reproduced, students can watch a fish identification and dissection laboratory and interact with the instructor. Advance materials sent to the class on the Internet or by "snail mail" prepare the class for their experience, and a follow-up activity is available on the web if the teacher wants it. The fish lab is the only one broadcast so far, but others are available for spring. The labs meet Ohio science education standards and may help classes that can't travel to experience some of the magic of aquatic science at Gibraltar.

As for research applications, scientists working at the Lab can collaborate with those in other locations to share science data, plan research or demonstrate new field research methods. Imagine holding a multi-state interactive meeting with only the costs of connectivity! For now the most exciting uses are related to education, and if you know of a middle school or high school with conferencing capabilities, the classes there may want to arrange for a spring Virtual Workshop. Contact John Hageman at the Lab for scheduling. We are also looking for downlink sites in the Cleveland area and inland for the lecture series that will be broadcast every Thursday evening in summer. Contact Rosanne Fortner at *fortner.2@osu.edu* to discuss. Maybe you can be in the audience when we beam up the next lessons from Stone Lab! *TL*

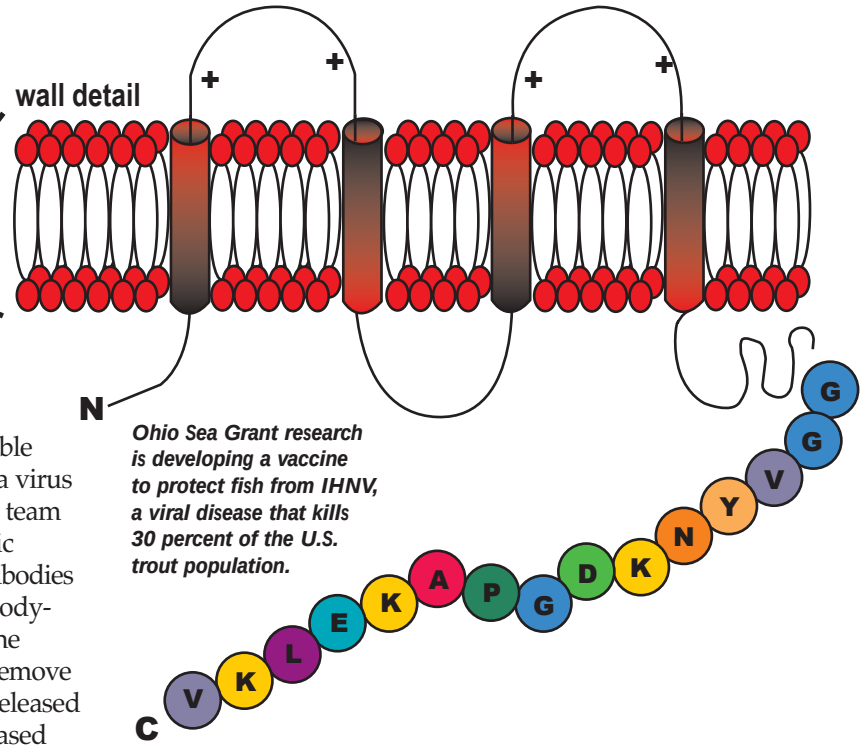
You too can be in the audience when we beam up the next lessons from Stone Lab!

ALGA *continued from Page 1*

A unicellular alga found abundantly all over the world could be an effective means to deliver vaccines to fish. By attaching the correct antigen to the outside of the Chlamydomonas cell, the algae can be fed to the fish and induce an immune response to the disease.



***chlamydomonas* cell**



require either. "Using a peptide library of all the possible amino acid combinations displayed on the surface of a virus (called a combinatorial phage display library), Sayre's team can rapidly screen for antigens using pathogen-specific antibodies. The screening process involves binding antibodies from a sick fish to polystyrene beads (*see below*). Antibody-binding peptides from the library are then bound to the beads via the antibody. After the beads are washed to remove loose phage, the tightly bound phages are specifically released and (viruses) reapplied to the beads, washed and released repeatedly for several rounds of purification. "When the antigen is isolated by the screening process, we compare it to the known IHNV genome and known antigenic determinants to see if the process produced a viable antigen," states Sayre. His research has found a tentative antigenic peptide.

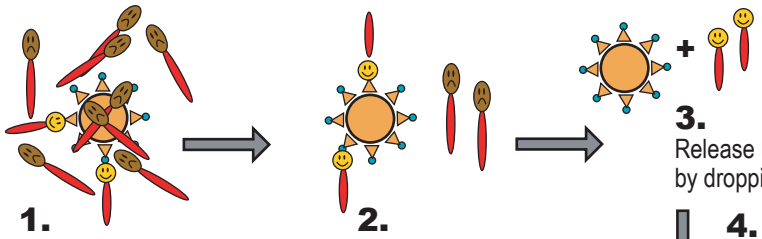
Sayre and his team plan to test those antigens by conducting vaccine trials later this year. The antigens will be attached to the outside of the *Chlamydomonas* cell, which will in turn be delivered to the fish through either food or immersion (water). "When fish (that are fed the algae) express antibodies against the antigen bound to the algae, we'll know this approach works, and we'll extend it toward other diseases," states Sayre. A patent is currently pending for this microalgal antigen delivery system.

Ohio Sea Grant research is developing a vaccine to protect fish from IHNV, a viral disease that kills 30 percent of the U.S. trout population.

Last year, Sayre broadened the alga's capabilities once again in another Sea Grant project—this time as a heavy metal biomonitor. With the addition of fluorescent proteins attached to the alga, a fluorescent color will signal if there is the presence of a heavy metal. With the help of the alga, Sayre hopes to have a simple, rapid, and non-invasive system for quantifying heavy metals in the environment. *TL*

For more information about this Ohio Sea Grant funded project, contact Dr. Sayre at *sayre.2@osu.edu* or visit ***www.biosci.ohiostate.edu/~plantbio/Faculty/sayre.htm***. For a related article about his heavy metal bioremediation research, see *Twine Line's* Sept/Oct 2001 issue at ***www.sg.ohio-state.edu***.

Antigen Screening Protocol for Phage-Displayed Peptides



1. Pre-screen library using bound pre-immune antibodies. Then apply phage-display library to antigen screening column.

2. Wash away unbound phage (virus) with wash buffer.

3. Release bound phage by dropping pH.

4. Multiply phage and reapply to antigen screening column for further screening. Repeat 3X total.

5. Isolate phage DNA for sequencing of peptide-pill fusion gene and antigen identification.

Antigen (display library) — M13 bacteriophage (virus)
Non-specific peptide — Polysepharose resin bead
Antibody of interest

Before a vaccine can be attached to the algal cell, an antigen for the virus first needs to be isolated. Sayre is using a combinatorial phage display library, to screen for peptides that bind to antibodies obtained from sick fish. The candidate antigens may be used for future vaccine trials.

Dr. Chris Stanton

Dear Friends,

Happy New Year to all of the Friends of Stone Lab! The FOSL Board of Directors is already hard at work planning another exciting calendar of events and we hope to see everyone at some point during this year.

In the last issue of *Twine Line*, Jeff Reutter asked for donations to support Lake Erie, Stone Lab, and the Ohio Sea Grant College Program. The Friends of Stone Lab also has financial challenges as we prepare to award Stone Lab summer scholarships, continue to improve lab facilities, and seek $25,000 in matching funds for the John H. Dunlap, Jr. endowment, which will provide support for education, outreach, and development activities at the Lab.

However, your assistance need not be limited to monetary donations. You can help FOSL in many other ways, such as getting the word out about us to your friends and family, advertising and promoting our programs, and by continuing to attend classes and other functions on Gibraltar and throughout the Great Lakes region. Please feel free to contact me, or any board member, with ideas on letting more people know about our exciting organization and our important work.

Our first event of the year will be the Winter Reception and Open House on February 19th in Columbus. This get-together will be an opportunity for all of our friends to reunite, socialize, and hear about what's new on the lake. Check our newly revamped web site for further information (***www.sg.ohio-state.edu/SLAB/FOSL***) and I hope to see you there.

Sincerely,
Chris Stanton
FOSL President
cstanton@bw.edu

FRIENDS OF STONE LABORATORY

Dates to Remember

April 17-18
Spring Work Weekend
Contact the Stone Lab office for further information

May 8
Ohio Academy of Science State Science Day
French Field House OSU

September 11
Stone Lab Open House/ FOSL Weekend

Summer Program 2004

Once again this year, Stone Laboratory will be offering a full curriculum of informative and intensive courses from which students may choose. Registration packets are available and can be obtained by contacting the Stone Laboratory office by telephone, or through the Ohio Sea Grant/Stone Lab web site. There are several new offerings this summer.

- **Fisheries Science for Teachers**
- **Local Flora for Teachers**
- **Alien Species Education**
- **Field Ecology**

Once again this summer, the non-credit "Lake Erie Island Photography Workshop" will be offered. Here is a chance for all photographers to work with award winning professional photographer Ian Adams. *FOSL*

News & Events

Congratulations

Stone Laboratory is proud of its tradition of excellence in both the faculty and staff that annually work there. The **Outstanding Visiting Professors** for 2003, as selected by student and staff evaluations, are Dr. R. Chris Stanton, Baldwin-Wallace College and Dr. Carmen E. Trisler, Wittenberg University. During the summer of 2003, Dr. Stanton taught Introductory Insect Biology and Dr. Trisler taught Aquatic Entomology.

Norm Haley was selected as the **Charles Morin Research Fellowship** winner for the summer of 2003. This award recognizes the outstanding research assistant for their efforts, based on recommendations of the laboratory staff and visiting research scientists. *FOSL*

Drive Home Your Support

We have all become familiar with the wide variety of specialty automobile license plates. Money raised from the sale of these plates goes to support the respective program or institution represented on the plate. Legislation creating a special license plate designating Lake Erie as the "Walleye Capital" has passed the Ohio House of Representatives. This provision was sponsored by Rep. Chris Redfern of Port Clinton. The bill has yet to be passed by the Ohio Senate. The proceeds from the sale of these license plates will go to support the Ohio Sea Grant Program and Stone Laboratory. It is estimated that as much as $250,000 could be raised through these sales. Be sure to encourage your State Senator to support the passage of this bill! *FOSL*

Sea Grant Researchers Featured

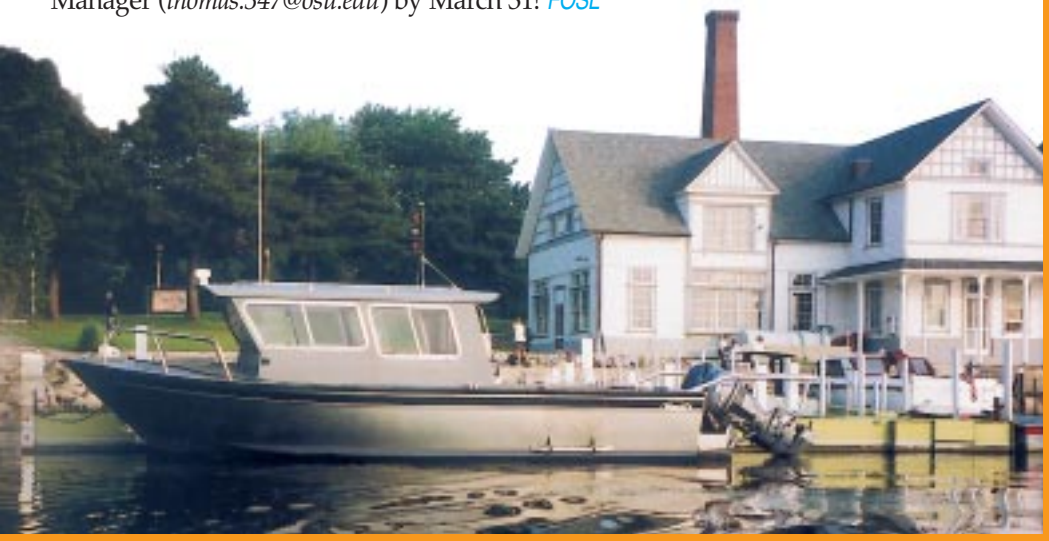
Several Ohio Sea Grant sponsored researchers were recently featured in a variety of NOAA publications and newsletters. Dr. Richard Sayre's research, summarized in an article titled "An Alga a Day Keeps the Doctor Away," was spotlighted on the NOAA Office of Atmospheric Research web site. Dr. David Johnson had his research, titled "Research Finds Reopening Wetlands to Lake Erie Largely Increases Fish Diversity," posted as a *Hot Item* in an internal publication distributed to all NOAA employees (also reported in the Nov/Dec 2003 *Twine Line*). *FOSL*

Name the Boat

Stone Laboratory added a new research boat to its fleet last summer, but the boat is without a name.

Here's where you can help: Stone Laboratory is looking for suggestions. Keep in mind that the ideal name would be one that conveys a message about the purpose of Stone Lab, the research boat itself and/or the environment. Also, every time a vessel is hailed or it broadcasts via the marine radio, it identifies itself by name.

A great vessel name can also be a great advertisement for Stone Lab. E-mail your suggestions to Matt Thomas, Assistant Lab Manager (*thomas.347@osu.edu*) by March 31! *FOSL*



F. T. Stone Laboratory
The Ohio State University, 1314 Kinnear Road,
Columbus, OH 43212-1194
614.292.8949, Fax 614.292.4364,
www.sg.ohio-state.edu

Field Station Address
F.T. Stone Laboratory, The Ohio State University
PO Box 119, Put-in-Bay, OH 43456
419.285.2341, 614.247.6502, Fax 614.247.6578

Stone Laboratory Staff

Dr. Jeffrey M. Reutter, *Director*
(reutter.1@osu.edu)
Dr. Rosanne W. Fortner, *Associate Director*
(fortner.2@osu.edu)
John Hageman, *Laboratory Manager*
(hageman.2@osu.edu)
Matt Thomas, *Assistant Laboratory Manager*
(thomas.347@osu.edu)
Arleen Pineda, *Program Coordinator*
(pineda.2@osu.edu)
Kelly Dress, *Office Associate*
(dress.3@osu.edu)

Franz Theodore Stone Laboratory, Ohio's Lake Erie laboratory, offers intensive, hands-on university field courses from June to August in biology, geology, education, and natural resources. Workshops and group field studies are offered from mid-April through October. Research in aquatic, terrestrial, and island sciences has been conducted year round since 1895.

The Friends of Stone Laboratory (FOSL) began in 1981 as a support group to "bring Stone Laboratory into the 21st century with the best possible facilities, equipment, and professors, and make this an unequaled learning experience available to all outstanding students." Members of the Friends provide a way for former students to support the facility by raising awareness and funds for scholarships, research, and equipment.

Donation Form 1/04

First Name Middle/Maiden Name Last Name

Street Address Apt. No.

City State Zip Code

E-mail Address

Home Phone Work Phone

My Gift is Designated for the Following Fund:
Please indicate on your check's memo line

_____ Stuckey Plant Course
_____ Crites' Research Fellowship *(print w/ $250 donation)*
_____ Cooke Castle Renovation
_____ Director's Discretionary
_____ Frederick Memorial Scholarship *(non-OSU)*
_____ FOSL General
_____ FOSL Scholarship
_____ FOSL Sustaining *(equipment, supplies, etc.)*
_____ FOSL Visiting Professor
_____ Langlois Research Fellowship
_____ Special Publications
_____ Franz Stone Research

Make check payable to: Ohio State University Foundation
Return this form to:
c/o Friends of Stone Laboratory, (Attention: John Tripp)
1314 Kinnear Road, Columbus, OH 43212-1194

Sea Grant
Ohio Sea Grant College Program
THE OHIO STATE UNIVERSITY
The Ohio State University
1314 Kinnear Road
Columbus, OH 43212-1194

ADDRESS SERVICE REQUESTED

Non Profit Org.
U.S. Postage
PAID
Columbus, Ohio
Permit No. 711

Don't miss your chance to experience THE ROCK! Apply by March 12th.

Stone Laboratory's Summer 2004 Courses

Introductory Courses

3 credits; classes meet daily for one week

Open to college and select high school students.*

- Aquatic Biology (offered four times)
- Field-Based Oceanography
- Insect Biology
- Local Flora
- Study of Birds

**To qualify, high school students must have completed their sophomore year, be 15 years of age or older, and have completed one course of high school biology prior to the beginning of the course.*

Special Non-Credit Course

Open to the public (18 years and older), and college students as a non-credit course. All students must register directly through the Columbus Office.

- Lake Erie Islands Photography Workshop (Digital camera required)

Courses for Educators

3 credits; classes meet daily for one week

For classroom teachers, non-formal educators, and education majors with at least junior rank by summer 2004.

- Alien Species Education
- Aquatic Environmental Science for Teachers
- Field Ecology
- Fisheries Science for Teachers
- Geologic Setting of Lake Erie
- Insect Biology for Teachers
- Local Flora for Teachers
- Marine & Aquatic Education
- Ornithology for Teachers
- Principles of Oceanography for Science Teachers
- Stream Ecology for Teachers

Upper-Level Courses

For undergraduate and graduate students in biological sciences, education, and natural resources; professional biologists, and ecologists; and biology and general science teachers.

Term 1 **Five weeks** (June 20 - July 23)
5 credits; classes meet three days a week

- Field Zoology
- Ichthyology
- Limnology

Term 2 **Three weeks** (July 25 - August 13)
5 credits; classes meet five days a week

- Aquatic Entomology
- Fish Ecology
- Aquatic Wetlands Flora

Week *3 credits; classes meet daily for one week*

- Ecology and Management of Wetland Birds
- Field Ecology
- Herpetology

1-10 Days

- Current Topics in Environment & Engineering
  1 credit; 6 evening lectures
- Diagnostic Field Plant Pathology
  3 credits; 10 days
- Ichthyoplankton Identification Workshop
  1 credit; one day

Week Courses: June 6 - August 25
Term 1 Courses: June 20 - July 23
Term 2 Courses: July 25 - August 13

For application materials go to
www.stonelab.ohio-state.edu or call 614.292.8949

Sea Grant Ohio Sea Grant College Program
THE OHIO STATE UNIVERSITY