Gifts in Memory

OF W.B. DIXON STROUD

Catherine Abercrombie
Doina Adam
Henrietta Alexander
Ann & Joe Armstrong
Margaret Baird
Katharine Becker
Tom Best – Watershed Sporting Club
Claire Birney
Joanie & Jamie Blaine
The Bodner Sax Group – UBS Financial Services Inc.
Douglas Bohr
Sue & Tom Bott
Diane & David Brown
Shirley Camin
Jane & H. Nichols Clark
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Cindy & Patrick Conway
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Dolly & Johnny Fisher
Mary Rose Fisher
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Sarah Jackson
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David Lindsay
Esther & Guy Lloyd
Ida K. Lofting
Wendy Lofting
Joseph Marfuggi
Patty & Fred Meserve
Phoebe Milliken
Pat & Doug Mooberry
Alice & Rod Moorhead
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Brian Norton
Jean Barlow Peelle
Jean Peirson
Sally Peirson & John Baker
M. Christina Roberts
Shirley & Tom Rosazza
Katherine & Gary Schade
Lesley & George Schoedinger
Katharine Schutt
Linny & Ed Scott
Darrel Sewell
Liz & Bill Sharp
Lucien J. Sichel
Laurel Standley
Sarah & Andrew Smith
Donna Tait – The Haverford Trust Company
Emery & Josh Taylor
Andrea & Bern Sweeney
Upland Country Day School
Mary Ann & Sam Wagner
Dean Walker
Terri & Paul Weaver
Roberta & Dick Weber
Gretchen & George Wintersteen
Diana & Bill Wister
Sally Wood

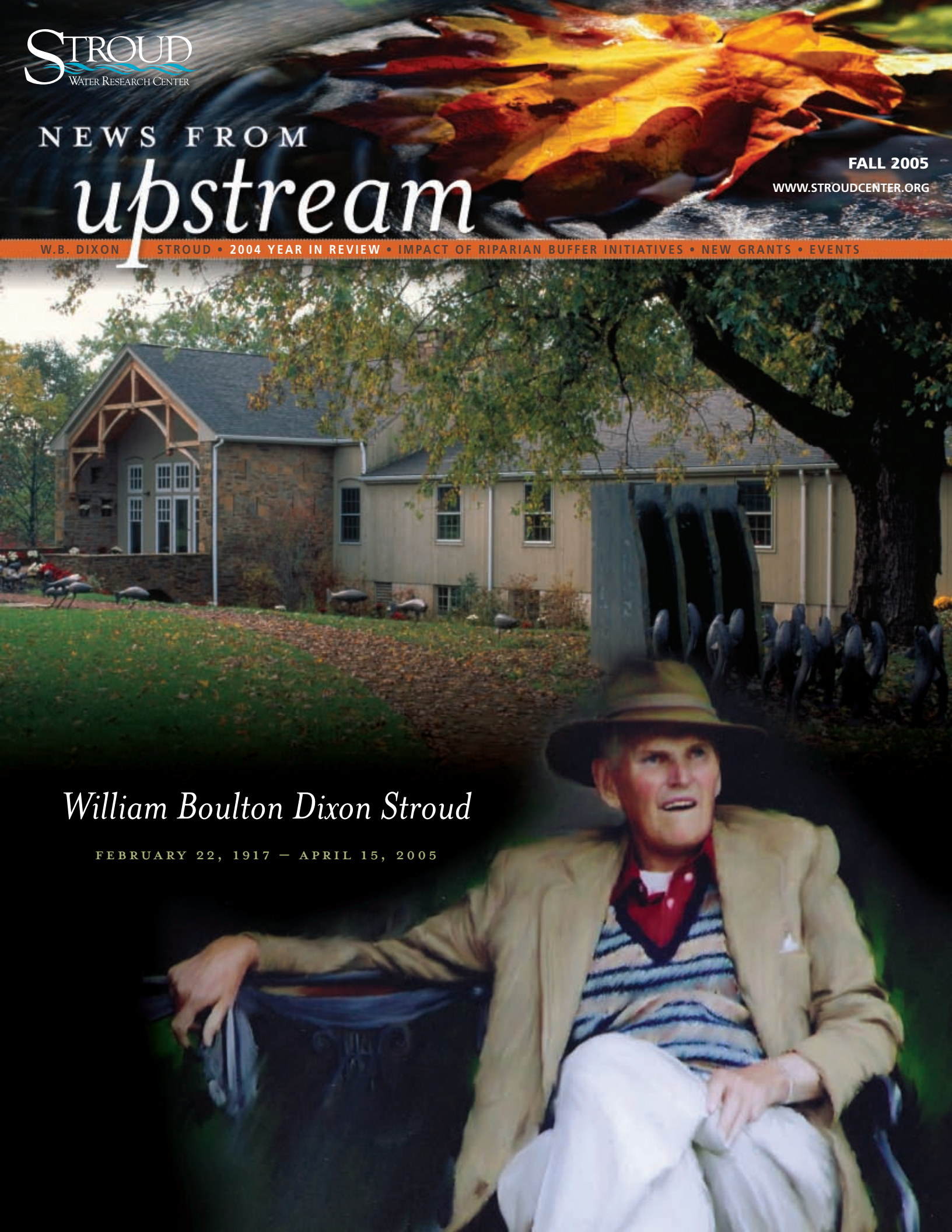
STROUD
WATER RESEARCH CENTER

NEWS FROM upstream

FALL 2005

WWW.STROUDCENTER.ORG

W.B. DIXON | STROUD • 2004 YEAR IN REVIEW • IMPACT OF RIPARIAN BUFFER INITIATIVES • NEW GRANTS • EVENTS



William Boulton Dixon Stroud

FEBRUARY 22, 1917 — APRIL 15, 2005

Dear Friends of the Stroud Center:

We hope you enjoy this new issue of Upstream. It will now be produced twice a year.

In an effort to keep in touch with you more frequently, save paper and keep a lid on production costs, we will be sending four electronic, one-page newsletters each year. This electronic newsletter allows us to keep all of you informed about our upcoming events, education programs and latest research findings.

(This printed version is always posted to the website in a PDF format as well, so back issues can be reviewed.)

If you would like to receive the electronic newsletter – please send me your email address and I will add your name to the list. Of course, you can opt out at anytime.

Thank you again for being a "Friend of the Stroud Center".

Claire Birney, CFRE
Development Director
clairebirney@stroudcenter.org
610-268-2153 x230

MISSION

The mission of the Stroud Water Research Center is to understand streams and rivers and to use the knowledge gained from its research to promote environmental stewardship and resolve freshwater challenges throughout the world.

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STROUD CENTER STUDY SHOWS VALUE OF STREAMSIDE TREES

In a study conducted on the Birch, Doe, and Buck & Doe runs, as well as 13 other streams in eastern North America, a multidisciplinary team of researchers, led by scientists from the Stroud Water Research Center, has discovered that streamside (or riparian) forests play a critical role in cleaning up our streams and rivers. The study, whose findings were recently published in the prestigious *Proceedings of the National Academy of Sciences,* demonstrated that not only do trees keep pollutants out of streams, they also help process those that are in them.

The Stroud Center team found that stream sections flowing through forested areas are wider and shallower than those in meadowlands, their beds are rougher and have more habitat, and water moves more slowly through them. These factors, along with other riparian forest benefits, such as a greater variety of organic food and more natural temperature patterns, produce a richer and more natural ecosystem than is found in deforested streams – and one that is far better able to process pollutants in their waters.

The implications of these findings are potentially enormous because they indicate that restoring riparian areas to their natural forested state is both an effective and a cost-effective way of protecting the world's fresh water. Over the course of the last century, public policies aimed at providing sufficient and clean fresh water have primarily focused on massive and expensive engineering projects, such as dams and filtration plants; and they have rarely addressed the accelerating deforestation across the country and around the world.

In doing so, such policies have overlooked – and often actually destroyed – the substantial benefits that nature provides free of charge. Perhaps nowhere is the value of such "ecosystem services" more evident than in streams and rivers, where hundreds of trillions of tiny organisms work constantly to clean the water.

The implications…are enormous, for forested streams will deliver cleaner water to downstream rivers, estuaries and, ultimately, oceans.

Because the Stroud Center's study was conducted on small streams, which comprise more than 90 percent of all streams in the United States, the implications for improving water quality by planting trees along stream banks are enormous, for forested streams will deliver cleaner water to downstream rivers, estuaries and, ultimately, oceans.

Riparian forests in our watershed

Three hundred years ago the Mid-Atlantic region of the United States was entirely forested. The streams were shaded, and all the organisms that lived in them were adapted to woodland conditions. As the land was settled, the forests were cut down and replaced with agricultural fields to provide food for the growing population. Today, urban sprawl threatens many existing riparian forests, almost all of which are secondary growth.

Riparian forests are essential to the health of our streams and rivers in a number of ways:

- They are natural filters, trapping sediments before they can enter the stream.
- They minimize erosion and the effects of flooding.
- They encourage groundwater infiltration.
- They supply the shade necessary to maintain cool water temperatures and rich oxygen levels.
- They provide essential habitat for the entire food chain, from bacteria to algae to insects to fish.
- They enhance the diversity of life in the stream.
- They are home to a variety of mammals, birds, amphibians and reptiles.
- They offer a continuous transportation corridor for the migration of plant and animal species.

Go to www.stroudcenter.org to link to full article in the *Proceedings of the National Academy of* Sciences.

Research FROM THE FIELD

AMAZON SOURCE OF 5-YEAR-OLD RIVER BREATH

Stroud Water Research Center scientist Anthony Aufdenkampe's letter in Nature

Map of Amazon river sampling site.
Credit: *University of Washington*

The rivers of South America's Amazon basin are "breathing" far harder – cycling the greenhouse gas carbon dioxide more quickly – than anyone realized.

Most of the carbon being exhaled – or outgassed – as carbon dioxide from Amazonian rivers and wetlands has spent a mere 5 years sequestered in the trees, other plants and soils of the surrounding landscape, U.S. and Brazilian researchers report in the July 28 issue of ***Nature.***

It had been hoped that regions such as the nearly 2.4 million-square-mile Amazon River basin – where tropical forests rapidly gulp carbon dioxide during photosynthesis – were holding onto that carbon for decades, even centuries, says Emilio Mayorga, University of Washington oceanographer and lead author of the ***Nature*** piece with Anthony Aufdenkampe of the Stroud Center.

As policy makers turn increasingly to carbon-credit trading as a means of grappling with the impacts of human-induced climate change, knowing how much carbon can be stored – and where and for how long – is critical, the authors say.

"Our results were surprising because those who've previously made measurements found carbon in the rivers that came from the surrounding forests to be 40 to more than 1,000 years old," Aufdenkampe says. "They assumed that the return of this forest carbon to the atmosphere must be a slow process that offered at least temporary respite from greenhouse effects.

"As part of the largest radiocarbon age survey ever for a single watershed, we show that the enormous amount of carbon dioxide silently being returned to the atmosphere is far younger than carbon being carried downstream," he said. "Previous studies failed to detect the rapid recycling of forest carbon because they never dated the invisible greenhouse gas as it is literally exhaled by the river organisms."

"River breath is much deeper and faster than anyone realized," says Jeff Richey, UW oceanographer and another co-author.

Carbon is carried by rains and groundwater into waterways from soils, decomposing woody debris, leaf litter and other organic matter. Once in waterways it is chewed up by microorganisms, insects and fish. The carbon dioxide they generate quickly returns to the atmosphere, some 500 million tons a year - an amount equal to that is absorbed annually by the Amazonian rainforest.

"Having established that the amount of carbon outgassing is much greater than anyone imagined, the issue then becomes, where does it come from," Mayorga says. "If it's young, that indicates the carbon pool is dynamic, which could make the system much more reactive to deforestation and climate change."

For example, data from a region of active deforestation in the southern Amazon already shows that the carbon leaving rivers has an identifiable isotopic signature of pasture grasses.

"You're changing the land use, changing vegetation and other conditions. In terms of what's being respired, the system is responding fairly quickly," Mayorga says. "Human and natural systems, in turn, will be impacted."

What is River Breath?

River breath is when a river cycles or exhales the greenhouse gas carbon dioxide.

Knowing how much carbon (e.g. as carbon dioxide) can be stored – and where and for how long – are critical indicators of how reactive the system is to deforestation and climate change.

No previous tropical study has used both radioactive carbon-14 and stable carbon-13 isotopes to address these questions. Funding from the Center for Accelerator Mass Spectrometry at Lawrence Livermore National Laboratory made the analysis by Mayorga and Aufdenkampe possible. The samples were collected by Richey's research group and Brazilian scientists on expeditions going back as far as 1991 that were funded by the National Science Foundation, National Aeronautics and Space Administration and the Research Support Foundation for the State of San Paulo (FAPESP), Brazil.

Other co-authors are Paul Quay and the late John Hedges, both UW oceanographers; Caroline Masiello of Rice University; Alex Krusche of the University of São Paulo, Brazil; and Thomas Brown of the Center for Accelerator Mass Spectrometry at Lawrence Livermore National Laboratory.

Go to www.stroudcenter.org to be linked to the full article that appeared in *Nature*, Volume 436-28 July 2005.

RECENT HEADLINES

Senate approves mandatory emission limits:

http://www.reuters.com/newsArticle.jhtml?type=scienceNews&storyID=8855618&src=rss/scienceNews

http://p25.news.re2.yahoo.com/s/nm/20050619/pl_nm/energy_congress_climate_dc_1

Russia backs Kyoto climate treaty:
http://news.bbc.co.uk/2/hi/europe/3702640.stm

Academies Warn of Warming
http://www.latimes.com/news/nationworld/nation/la-na-warm8jun08,0,3822148.story

Events

THE PENNSYLVANIA HUNT CUP

Sunday, November 6, 2005 • Gates open at 11:00

The 71st running of the Pennsylvania Hunt Cup. Four sanctioned races carriage parade, and for the first time a select group of vendors who feature beautiful items for your holiday shopping. Hot food will be available for purchase. Proceeds will benefit the Stroud Center, Natural Lands Trust, Cheshire Land Preservation Fund, Brandywine Valley Association and the Brandywine Conservancy.

For information call 484-888-6619

SCIENCE OF STROUD WINTER SERIES

held the second Wednesday of each month January through June

Back by popular demand! The new Summer Science series was such a success that we have honored the request of many who suggested that we run the series again. The Winter Science Series will feature Stroud Center scientists as they present the critical issues facing freshwater resources & how the science at the Center addresses these issues. Intended for a general audience - children of middle school age and above are most welcome. Although the topics are interrelated, each presentation can be understood and enjoyed separately. Come to one – come to all.

The series is FREE and open to the public; HOWEVER seating is limited so please reserve a place by going on-line, calling or emailing; Kdixon@stroudcenter.org 610-268-2153 x247

At the time of this publication – we had not yet been able to assign a speaker and topic to a specific date but the following topics will be covered and they will be assigned to any of the following dates.You will receive notification by mail and email when the schedule has been confirmed – or you can always check the website for the schedule.

WINTER SCIENCE SERIES

7:00 - 7:30 PM - Coffee and Desserts
7:30 - 8:15 PM - Lecture
8:15 - 8:30 PM - Q&A

2nd Wednesday of each month January through June 2006:

Wednesday, January 11, 2006
Wednesday, February 8, 2006
Wednesday, March 8, 2006
Wednesday, April 12, 2006
Wednesday, May 10, 2006
Wednesday, June 14, 2006

Topics to be covered, including a new lecture by Denis Newbold, David Arscott and Charlie Dow:

Algae in Ponds, Reservoirs and Rivers: Too much of a good thing – Tom Bott
Aquatic Bugs: Assessing the impact of the Clean Water Act since 1972 – John Jackson
The Freshwater Crisis: A global problem with backyard solutions – Bern Sweeney
Missing Carbon: The Amazon River and global warming – Anthony Aufdenkampe
"Watershed Tea": Why watersheds are the first stage of drinking water treatment – Lou Kaplan
NY Watershed & Ecosystem Processes: Denis Newbold, Dave Arscott, and Charlie Dow

Education

ART AND SCIENCE ON THE BRANDYWINE

On May 19, 2005, about a dozen students and their teacher from the Cab Calloway School of the Arts in Wilmington participated in a daylong program presented jointly by the Stroud Water Research Center and the Brandywine Conservancy. By introducing the students to the Stroud Center's scientific research and education and to the art of the Brandywine River school, and especially the Wyeth family, the program sought to encourage them (i) to explore connections between art and science, (ii) to discover the hidden life of streams, (iii) to think about the importance of place and the natural environment, and (iv) through their own explorations as well as through the works and stories of a remarkable artist, to look at the world around them in new ways.

The day began with a tour of the works of N. C., Andrew and Jamie Wyeth at the museum, led by Mary Cronin, coordinator of education at the Brandywine River Museum, and Victoria Wyeth, Andrew Wyeth's granddaughter. After lunch and a video on water safety, the group, several of whom had come in pirate garb, set off in canoes for Point Lookout, Jamie and Phyllis Wyeth's farm on Brandywine Creek, where the Stroud Center has ongoing research and education programs. As the group disembarked from their canoes, they were met on the banks of the creek by Vivian Williams of the Stroud education staff, who led them in a series of scientific explorations aimed at helping them understand the structure and function of streams and ways to gauge the health of their waters.

Then the group walked from the stream bank to the Wyeths' house, where Phyllis told them of her efforts to preserve the farm as a place of rural beauty, scientific research and environmental education, and Jamie gave them a tour of his art work and his community of barnyard life, which includes a couple of emus and a billy goat who periodically loses his balance and falls over. Jamie's stories about his painting, his anecdotes of quirky people and quirkier animals, and his discussion of the importance of a place to his work captivated the students and was the high point of the day. "It was really cool," wrote one student in a sentiment that was echoed by all the others, "to see and meet a great artist and his work."

The program was a pilot collaboration between two organizations that have ostensibly very different missions yet have much in common. The Stroud Center is a scientific research laboratory and the Brandywine River Museum is an art museum, yet art plays an important role at Stroud (where a number of paintings, sculptures and objects are on permanent view and changing shows line the walls), while the museum is part of the Brandywine Conservancy whose Environmental Management Center is devoted to environmental preservation and protection. Both organizations, then, embody a connection between art and the environment on a number of levels, a connection that Phyllis and Jamie Wyeth exemplify in their lives and work – and in their plans for the future of Point Lookout.

The students were enthusiastic, and so were those who provided the content. In particular, Jamie Wyeth connected with the kids in a magical way, sharing with them his stories and personal history, his thoughts about painting and artistic techniques, and his intimacy with the natural world. In addition, Victoria Wyeth captivated them with stories of her family and personal insights into three generations of its art; Mary Cronin provided important perspectives on the museum's collection; and Vivian Williams had the students looking under rocks at critters for which the first reaction of many was, "yuck!"

Both the Stroud Water Research Center and the Brandywine Conservancy embody a connection between art and the environment on a number of levels, a connection that Phyllis and Jamie Wyeth exemplify in their lives and work – and in their plans for the future of Point Lookout.

All four of these people invited the students to look at the world in new and different ways, and as the following excerpts from their reflections indicate, that is exactly what they did.

By exposing the students to research done by the area's foremost

scientific institution and the art of a legendary living artist, the program showed them two examples of excellence that they will never forget. The day was a success by any measure, and we hope to replicate it in the future. In the meantime, the students are being encouraged to create works of art reflecting their experience, and we hope to display them in a show, probably in November 2005, at the Cab Calloway School and subsequently at the Brandywine River Museum and the Stroud Center.

The program was funded by the Chichester DuPont Foundation and the Point Lookout Farmlife and Water Preserve Foundation

Student Reflections:

"I loved the fact that I was isolated from all technology, so I felt like I was the first one to venture down the river to meet any form of adventure to come my way."

"I learned that different insects that dwell on the bottom told about the river's health."

"The green banks and trees surrounding everyone, and hazel water slipping by just struck a chord with me, and I am glad we got to experience nature this way."

"The experience of finding those creatures [macroinvertebrates] left me with a clearer understanding of river life, and just how important it is to monitor what lives in the river."

"The common thread that pulled all four components of the trip together was the artistic thread."

"[The] common thread was a view of the Brandywine that I had never seen before and it helped me to realize the pure beauty of the river and its importance."

"Very often I wish there weren't any critters in the water . . . because I'm kind of a bugphobe . . . to me they're just creepy. But now after this trip, as much as I still hate bugs, I'm glad they're in the water to keep it clean."

"Nature and people's perception of it was the theme. Jamie [Wyeth] saw nature and thought it a perfect subject for paintings. Scientists see the river and see the critters in it."

Special

HATS ON FOR W. B. DIXON STROUD

Limited Edition Cap with W.B. D. S. initials

As a tribute to our founder, W. B. Dixon Stroud, Emery and Josh Taylor have donated the cost to embroider the initials, WBDS, on the back of our Stroud Center logo caps. The caps are usually only given to staff, interns and volunteers, and are not normally offered to the general public. However, to honor Dick Stroud during the year following his passing, we will offer these limited edition caps for the public to purchase until April 15, 2006. They are available on-line only. Email joshtaylor@midlanticltd.com ($9.00 plus shipping and handling.)

We have chosen the color "ocean blue" for the limited edition caps which are made of 100% cotton twill, and feature a six-panel, unstructured, low-profile design, with a fully adjustable (one size fits all) fabric back strap, and an antiqued brass closure. The Stroud Center logo is embroidered on the front and the initials WBDS are embroidered on the back.

Emery Jones Taylor's grandfather, Lewis C. Ledyard, was a long time neighbor and friend of Dick Stroud. Emery holds such fond memories of Dick from her childhood that she wanted to do something special to honor him. Her husband Josh Taylor is the President of Midlantic Ltd., a marketing company based in Kennett Square that supplies the Stroud Center with promotional merchandise including the caps. It was Emery's idea to have Dick's initials embroidered on the cap and to donate the cost of the extra embroidery to make this a very special memento. "Hats off" to Emery and Josh!

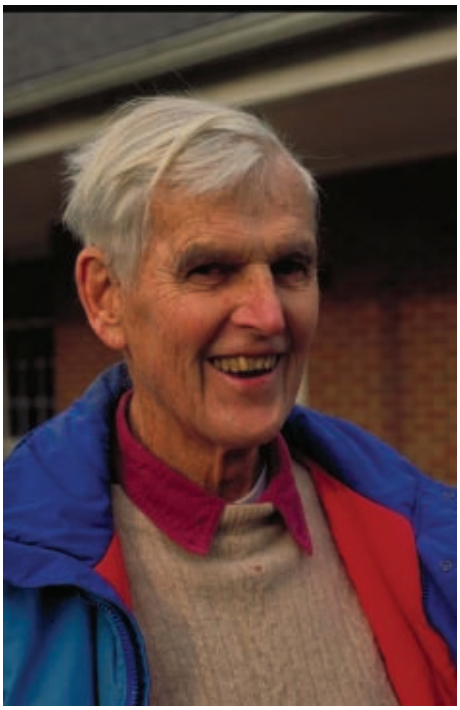
Limited Edition Cap

PRICE **$9** *plus shipping and handling*

Order by emailing: joshtaylor@midlanticltd.com

Special

W. B. DIXON STROUD: A LIFE CELEBRATED



About Dick...

"Grandad touched every single one of our lives in ways that are unparalleled, and due to this love and devotion, we are all better people today…We all share certain memories and then have our own, but the wonderful thing is that what really permeates all of our memories is his utter devotion to all of us."

— BILLY PEELLE, GRANDSON

"You have created from us and for us a marvelous story of laughter, of joy, of advocacy, of passion, of wisdom, and of love without judgment. The heavens and the earth are so lucky to have your spirit soaring free among them, and I stand before you as a promise that the journey of all of our lives will be a testament to the legacy of you."

— GAYLEY BLAINE, GRANDDAUGHTER

"Dick taught by example. I researched nature, but Dick showed me how to embrace it and conserve it. I lectured about caring for the land, but Dick did it. I dabbled in philanthropy, but Dick defined the term...and showed me the joy of giving without receiving or expecting to receive."

— BERNARD SWEENEY, DIRECTOR

William Boulton Dixon Stroud, 88, died April 15 at his West Grove home surrounded by his family. A strong and gentle man, whose unassuming manner, quiet generosity and genuine interest in the lives of all he met, has left a remarkable impact on southern Chester County, his home for the past 50 years, and beyond. Perhaps nowhere is that impact stronger or his influence clearer than here at the Stroud Water Research Center, which he, his wife Joan, and Dr. Ruth Patrick of the Academy of Natural Sciences of Philadelphia (ANS) founded in 1966 and which in the intervening years has produced some of the world's most innovative research on the ecology of streams, rivers and their watersheds.

Dick took an active interest in the Center's research and sought to incorporate the scientists' findings into his agricultural and land management practices. As a result, he became an early and committed proponent of sound environmental practices and a strong voice in the region for the conservation of open space, the reforestation of denuded landscapes, and the preservation and renovation of historic structures. And he practiced what he preached – as all those who came upon him in the woods uprooting multiflora rose, rescuing trees from invasive vines, and planting seedlings will attest.

Born in Villanova, Pennsylvania, on February 22, 1917, the third of five children of Willia Boulton Dixon and Morris W. Stroud, Mr. Stroud graduated from St. Paul's School in Concord, N.H. in 1935 and from Princeton University in 1939. As a young naval officer in World War II, he served on two ships that were sunk in battle – first in the Mediterranean and later in the Pacific, when the USS William D. Porter was hit by a kamikaze pilot during the Battle of Okinawa and went down in 90 minutes. Shortly before the war, he met Joan Milliken, whom he married in 1943 while home on leave and with whom he had seven children. Mrs. Stroud died in 1985, and in 1989 Mr. Stroud married Ann Percy, Curator of Drawings at the Philadelphia Museum of Art.

In the mid-1950s Mr. Stroud went to work for Nelson Rockefeller as president of the International Basic Economy Corporation (IBEC), a company that sought to create agricultural and other sustainable businesses in developing countries. His work took him all over the world, and in 1967 he started a cattle operation in a remote part of Colombia, where he and his wife also established a school and introduced cottage industries for the women of the region.

In the late 1960s Mr. Stroud retired from IBEC to devote time to his farm, his businesses and his environmental interests. By then his foremost interest was – and remained – the Stroud Center. Begun as a field station of the ANS, the Center's first home was a small attic above the family's garage, but within a year it had moved to its current space along White Clay Creek on land donated by Mr. and Mrs. Stroud. In 1999 the Stroud Center became an independent non-profit institution.

For his vision, his hands-on work and his principled perseverance, the Brandywine Valley Association named him Conservationist of the Year in 1975, the Chester County Conservation District gave him its Stewardship Award in 1996, and the National Society of Fundraising Executives – Brandywine Chapter gave him its 1999 Philanthropy Award. He was also a competitive tennis player, an accomplished pianist and a lover of the arts.

His life was celebrated on April 19, 2005 at the Unionville Presbyterian Church overflowing with family and friends, including his wife, Ann, his seven children, sixteen grandchildren, four great-grandchildren, and one of his two sisters. Warm and funny remembrances were given by his niece, Marion Stroud, his son, Morris Stroud, his daughter, Joan Stroud Blaine, his grandchildren, Billy Peelle and Gayley Blaine, and director of the Stroud Center, Bern Sweeney. Staff members of the Stroud Center wore their Stroud logo polo shirts to honor the commitment Dick had made to the Stroud Center and to confirm their commitment to continue the good work he began.

2004 year in review

RESEARCH AND EDUCATION REPORTS • KRESGE CHALLENGE • 2004 HIGHLIGHTS • OUTREACH • PUBLICATIONS • 2004 CONTRIBUTORS

Message FROM THE DIRECTOR

As I look at the pictures of the "Stroud babies" in this report (pages 16-17), I think of all the different histories that produced each child, and I think also of the world they will inherit from us. As I do, I am reminded that the concept of time travel has captured the imagination of everyone who ever wanted to change the course of history by revising the past or anticipating the future. That's probably just about everyone – including stream and river scientists.

Indeed, everything we study at the Stroud center takes us "back to the future." Each sample from a stream is both an expression of the past and a glimpse into the unknown. A two-inch, six-month-old brown trout from White Clay Creek, for example, reflects spawning conditions of a year ago, and sediment and food levels over the last six months. The state of the water bearing the trout reflects, among other things, decades of farming, years of deposition of atmospheric contaminants, recent septic system activities and deer feces deposited moments ago. The more we know about all these things that happened in the past, the better able we are to make adjustments in the present that will ensure the future health of the stream and its inhabitants.

While we do not have a time machine to take us directly into the past or future, we now have sophisticated instruments that enable us to do it indirectly. The Center's Isotope Ratio Mass Spectrometer, for example, can tell us the trout's diet over the past six months, where the food came from, how nitrogen got in the water, and much more. In our studies on the Amazon River, radiocarbon dating has demonstrated that far more carbon dioxide is escaping from rain forests and returned to the atmosphere than had previously been assumed – findings which have enormous implications for understanding and addressing the impact of global warming.

Although we cannot go 800,000 years into the future as H. G. Wells envisioned, we can go millions of years into the past, and we can use what we find to predict the effects of our present activities. How important is this? To answer that, we need only look at the faces of the babies highlighted in this issue.

"Each sample from a stream is both an expression of the past and a glimpse into the unknown."

SUSTAINING the FLOW of KNOWLEDGE

CAMPAIGN FOR THE STROUD CENTER UPDATE

$9,423,024
RAISED

$11,500,000
GOAL

Campaign Highlights:

- **$2,004,038** – total Kresge funds raised from 2001-2004.
- **150** donors became "Friends of the Stroud Center" with a gift to the Kresge challenge.
- **33%** gave gifts to both the Annual Fund and the Kresge Challenge.

Perhaps as important as the money is the renowned Kresge Foundation's recognition of the Stroud Center's current strength and promising future.

Thanks to the generosity of more than 345 "Friends of the Stroud Center," we met the Kresge Challenge and raised over $1.5 million to purchase and endow new instrumentation for the Center.

Under the terms of the Science Initiative Challenge Grant, Kresge agreed to contribute $250,000 for new equipment once the Stroud Center has raised $500,000 to match it.

In addition, Kresge added the final $250,000 of a $1.25 million instrument endowment fund once the Stroud Center had raised the $1 million.

Perhaps as important as the money is the renowned Kresge Foundation's recognition of the Stroud Center's current strength and promising future. In meeting the challenge, the Center demonstrated its ability to build institutional capacity by broadening and deepening its support from individuals and corporations, as well as by encouraging volunteer involvement in the fund raising effort and beyond.

As of this date, we have raised $9,423,024 of our overall Capital Campaign goal of $11.5 million, which leaves just over $2 million to raise by the end of 2005.

To give a gift, please contact Claire Birney at (610) 268-2153 or email cbirney@stroudcenter.org.

- **$255,641** in gifts received as a direct result of personal requests by Board members.
- **$78,000** netted from our second annual fall event, "The Water's Edge."
- **100%** of the staff and **100%** of the Board gave to the Kresge Challenge.
- **100%** of the board has given to the overall campaign for a total of **$3,510,556**, approximately **33%** of the goal.

TAX CREDIT: ANOTHER WAY TO GIVE TO THE FUTURE OF FRESH WATER!

Act 4 of 2001 amended the Public School Code to establish the Educational Improvement Tax Credit. Administered by the Department of Community and Economic Development, Act 4 authorizes state tax credits to businesses that make contributions to scholarship organizations or educational improvement organizations. DCED has certified the Stroud Center as an educational improvement organization. Under this program, tax credits may be applied to your Pennsylvania Corporate Net Income Tax, Capital Stock Franchise Tax, Bank and Trust Company Shares Tax, Title Insurance Company Shares Tax, Insurance Premiums Tax, or Mutual Thrift Institutions Tax.

Go to www.inventpa.com and select Education Improvement Tax Credit and then Guidelines and Application for Business Firms to Receive Credits (pdf)

Education

Staff

James G. Blaine, Ph.D.
Director

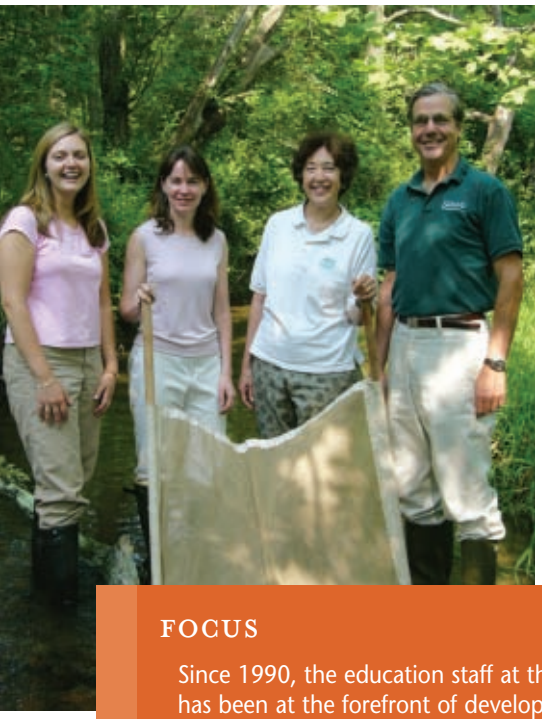
Christina Medved
Programs Assistant

Kristen Travers, M. Ed.
Programs Manager

Vivian Williams
Programs Manager

Not pictured:

James V. McGonigle, M. S.
Director
through November 2004



FOCUS

Since 1990, the education staff at the Stroud Water Research Center has been at the forefront of developing unique programs that provide students of all ages a variety of field experiences in the setting of a dynamic research facility and its 1,800 acre experimental watershed. Education programs seek to make Stroud and other watershed research accessible to a broad audience andn to give people tools to practice good stewardship.

WORKSHOPS & PROGRAMS

Using the Center's 1,800-acre experimental watershed as a living laboratory, 1750 students from PA, NJ and DE explored the physical, chemical, and biological characteristics of White Clay Creek.

- Leaf Pack Experiment Stream Ecology Kit – developed by the SWRC staff and now marketed nationally by the LaMotte Company.

  Leaf Pack Network - an international network of teachers and students sharing information on their local ecosystem.
- GLOBE (Global Learning And Observations To Benefit The Environment) – SWRC is a site for this worldwide environmental monitoring.
- Watershed Tour – developed by SWRC and the LaMotte Company.
- Macroinvertebrate ID – training for Watershed Ambassador program.
- Field Monitoring and Technology Experiences for Teachers – a weeklong investigation of the environment, incorporating Leaf Pack, GLOBE hydrology, landscape/biology and phenology protocols.
- Academy after Dark – Delaware Watershed Tour –pajama party for teachers, SWRC and the Academy of Natural Sciences of Philadelphia.
- Urban Watersheds – training for the summer institutes of the University of Pennsylvania, Partnership for the Delaware Estuary and Delaware Valley Earth Force.
- Delaware Teacher In-Service Day – SWRC is a field site for statewide professional development.

CONFERENCE PRESENTATIONS

- New Jersey Science Teacher Convention, New Brunswick, NJ
- National Science Teachers Association, Richmond, VA
- North American Youth Summit, Roots & Shoots Annual Conference, Cape Cod, MA.
- Schuylkill Watershed Congress, Philadelphia, PA

COMMUNITY OUTREACH

- Stream School – three-day workshops for citizen monitoring groups.
- CSAW (Consortium for Scientific Assistance to Watersheds) – SWRC is one of five organizations that provide technical assistance in watersheds throughout PA.

OF NOTE

- Jim McGonigle, our director of education at SWRC for 6 years, left in November to take the position of Outreach Coordinator at the University of Pennsylvania's School of Engineering, in a new program focused on nanotechnology.
- Jamie Blaine was named interim director, and the education staff is currently engaged in strategic planning to determine its direction for the next 5 years.

Entomology

FOCUS

The ecological characteristics of stream macroinvertebrates (especially aquatic insects) in tropical and temperate streams, the role they play in the food web of aquatic ecosystems and how they can be used to assess water pollution in streams and rivers

RESEARCH PROJECT HIGHLIGHTS

- NY Watersheds Phase 2: Biological monitoring and site classification at 60 sites on the Upper Delaware and Hudson river tributaries
- Schuylkill River: Research and education outreach project involving monitoring of macroinvertebrates in streams throughout the basin
- National Science Foundation Long-term Research in Environmental Biology – examining macroinvertebrate responses to long-term removal, restoration, and management of riparian forests on White Clay Creek
- *Centroptilum triangulifer* and *Centroptilum alamance*: Study of parthenogenesis (virgin reproduction) and hybridization in mayflies in White Clay Creek and other streams throughout eastern North America
- Tropical Stream Ecology: Continuing studies of rainfall, temperature, leaf fall, and stream macroinvertebrates at the Maritza Biological Station in Guanacaste, Costa Rica
- Continuing macroinvertebrate monitoring at sites in the following rivers and streams: White Clay Creek • Susquehanna River, Pa • Flint River, Ga • Mississippi River, Mo.

SERVICE AND AWARDS

- Member of the US EPA Merit Review Panel for Science to Achieve Results (STAR) Fellowships for Graduate Environmental Study programs in Aquatic Systems Ecology
- Member of Advisory Board for the The Watersheds Grants Program, William Penn Foundation
- Member of the Schuylkill Action Network

PRESENTATIONS

Jackson, J. K., and Interns, *Current conditions in White Clay Creek based on stream watch collections from March 2004*. Annual meeting of the White Clay Watershed Association.

Jackson, J. K., and Interns, *Current conditions in Maiden, Manatawny, and Hay Creeks based on stream watch collections from March 2004 and historical data from 1996-2003*. Meeting of the Upper Maiden Watershed Association, Pine Creek Watershed Association, Hay Creek Watershed Association, Berks County Conservation District, Leigh County Conservation District.

Jackson, J.K., *Stream Assessments Based on Macroinvertebrate Collections in the Schuylkill River Basin*. 2004 Schuylkill Watershed Congress, Penn State Great Valley.

Jackson, J.K., *The importance of riparian forests - a stream insect perspective*. Department of Biology, Bucknell University

Continued on page 19.

Staff

John K. Jackson, Ph.D.
Juliann M. Battle, M. S.
Andrew J. Byler
David H. Funk
Erika B. Kratzer, M. S.
Amy MacCausland
Sally Peirson
Roberta M. Weber
Patricia Zaradic, Ph.D.
Post-Doctoral Fellow

Interns

Deirdre Bowers
West Chester University
Ashley D'Antonio
Penn State University
William H. Dixon
Roanoke College
Katie Hill
Messiah College
William Hohman
Gettysburg College
Joanna Huxster
University of Richmond
Angela Jackson
University of Maryland
Buddy Kondikoff
Millersville University
Chelsea Lucas
University of Maine
Eric Lundquist
University of Pennsylvania
Mellisa McGonigle
West Chester University
Tracee Mosch
Dickinson College
Stephen Moyer
Millersville University
Kristian Varsa
University of Delaware
Arthur L. Walker
West Chester University

Graduate Students

Lynnette Sanders
Ph.D. Program, Drexel University

Organic Matter Biogeochemistry

FOCUS

Energy flow and nutrient cycling in streams with an emphasis on the interface between chemistry and biology. The study of the relationship between stream and river bacteria and their sources of food and energy.

Staff

Louis A. Kaplan, Ph.D.

Sherman L. Roberts

Michael D. Gentile

Interns

Katharine Bente
Kenyon College

Gregory Gromadzki
University of Oklahoma

Graduate Students (Ph.D. candidates)

David C. Richardson
University of Maryland

Karen M. Rowley
University of Pennsylvania

Volunteers

Jean Peirson

Outside Collaborators

Tracy N. Wiegner, Ph.D.
University of Hawaii at Hilo

David A. Stahl, Ph.D.
University of Washington

Robert H. Findlay, Ph.D.
University of Alabama

Patrick G. Hatcher, Ph.D.
The Ohio State University

Peggy H. Ostrom, Ph.D.
Michigan State Univeristy

RESEARCH PROJECT HIGHLIGHTS

- National Science Foundation Long Term Research in Environmental Biology. Renewal of funding for White Clay Creek as a LTER site for a second 5-year period. Maintenance of watershed installations, sampling stream water, groundwater and soil water for chemical signatures
- National Science Foundation ^{13}C Dissolved Organic Matter. Composting of ^{13}C-labeled tulip poplar tree tissues to generate a chemically complex tracer for dissolved organic carbon in streams. Preliminary experiments to characterize the nutritional value of the composted materials performed in biofilm reactors.
- Biostability. Assistance to the City of Philadelphia Water Department in operation and maintenance of biofilm reactors used to assess water quality in drinking water distribution systems.
- Upper East Branch, Brandywine Creek. Assist the Brandywine Conservancy in evaluating the feasibility of upgrading streams within the Upper East Branch to Exceptional Value status.
- New York Watersheds Phase 2. Sampling of 60 sites on the Upper Delaware and Hudson River tributaries for water quality measurements.

SERVICE AND AWARDS

- Technical Advisory Committee Member for U.S. EPA, U.S. DOE, and U.S. DOD Strategic Environmental Research and Development - Ecosystem Management Project
- Member North American Benthological Society Endowment Committee
- Member Ph.D. Thesis Committee for Ms. Jen Mosher, Department of Biology, University of Alabama
- Member International Scientific Committee for Symposium on Aquatic Microbial Ecology

PRESENTATIONS

Kaplan, L. A., J.D. Newbold, T. N. Wiegner, P. H. Ostrom and H. Ghandi. Contribution of dissolved organic carbon in transport to stream ecosystem metabolism: a whole-stream 13C tracer addition. North American Benthological Society Annual Meeting, June 6-14, 2004

Kaplan, L. A., R. H. Findlay, M.A. Huller, D. A.Stahl, and J. J. Mosher. Limits to functional redundancy of bacterial heterotrophs in streams from three biomes. 10th International Symposium on Microbial Ecology, August 22-27, 2004.

Microbiology

FOCUS

The ecology of bacteria, algae, protozoa and fungi living in streams and rivers.

RESEARCH PROJECT HIGHLIGHTS

- Completed manuscript on ecosystem metabolism in forested and meadow reaches of Piedmont streams. Completed two book chapters, one multi-authored on sediment quality criteria; one single authored on the measurement of ecosystem metabolism
- Continued investigation of ecosystem metabolism in streams and rivers in the New York City drinking water source watersheds.
- Continued investigation of primary productivity in reservoirs in the New York City drinking water source watersheds.
- Measured ecosystem metabolism in the stream at Pt. Lookout Preserve.

SERVICE AND AWARDS

- Member: *Editorial Boards of Applied and Environmental Microbiology* (published by the American Society for Microbiology) and of *Microbial Ecology* (published by the International Society of Microbial Ecology)
- Member: Task force to evaluate plans for determining a TMDL for coliforms for the Christiana River in Delaware.
- Ad hoc reviewer: Journal of the North American Benthological Society

PRESENTATIONS

Bott, T. L., J. D. Newbold, and C. Dow. Primary productivity in influent streams and receiving reservoirs. Annual meeting of the North American Benthological Society, Vancouver, B.C., June 2004.

TEACHING ACTIVITIES

University of Pennsylvania:
Biology 415: Introduction to Freshwater Ecology
Biology 416: Microbial Ecology seminar

Staff

Thomas L. Bott, Ph.D.
David Montgomery
Christopher Cain
Nancy Parsons

Interns

Burling Vannote
Michael Hartshorne

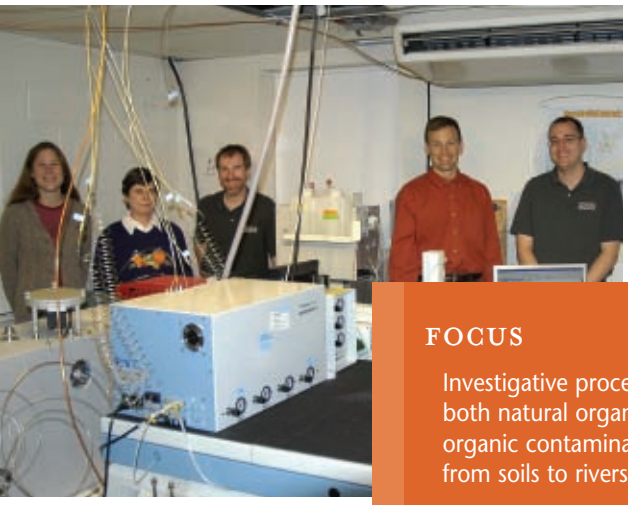
Undergraduate Student

Rajiv Shah

Outside Collaborator

Kristen Jellison, Ph.D.
Lehigh University

Organic Geochemistry



FOCUS

Investigative processes that control cycling of both natural organic matter and anthropogenic organic contaminants throughout watersheds – from soils to rivers to estuaries.

Staff

Anthony Aufdenkampe, Ph.D.

Jan Surma, M. S.

Mark Monk, M. S.

Jessica Auman

Part-Time Staff

Linda Carter, Ph.D.

Undergraduate Interns

Amy Kreuger
West Chester University

Ann Nakai
West Virginia Wesleyan College

Harleen Kaur
Youngstown State University

Outside Collaborators

Rolf Aalto, Ph.D.
Univ. of Washington

Laurence Maurice Bourgoin, Ph.D.
Institute for Research and Development, France

Peter Hernes, Ph.D.
Univ. of California at Davis

Alex Krusche, Ph.D.
CENA at the Univ. of São Paulo, Brazil

Emilio Mayorga, Ph.D.
Univ. of Washington

Carrie Massiello, Ph.D.
Rice University

Jeffery Richey, Ph.D.
Univ. of Washington

RESEARCH PROJECT HIGHLIGHTS

- Storm Driven Carbon Burial in Bolivian Amazon. This recently funded NSF project explores the role of extreme flood events during La Nina in burying – and thus removing from the atmosphere – globally significant quantities of carbon. The project got off the ground in 2004 with a 3- week expedition to Bolivia with collaborators Rolf Aalto and Laurence Maurice Bourgoin.
- Molecular Tracers of Contamination of watersheds that feed NY City's drinking water supplies. Tracers include caffeine, laundry detergent fragrances and fecal steroids – which act as indicators of sewage, lifestock and wildlife fecal contamination – and polycyclic aromatic hydrocarbons (PAHs) – which are known petroleum and combustion byproducts.
- Particulate Organic Matter in Great River Ecosystems. Analyzing the elemental and isotopic composition of suspended particles from the Mississippi, Misouri and Ohio rivers in conjuction with the Great River Ecosystems Project of EPA's Environmental Monitoring and Assessment Program (EMAP).
- River Metabolism and Carbon Dioxide Outgassing in Tropical Rivers. Using a wide array of field measurements and experiments to better constrain spatial and temporal patterns in CO2 outgassing and the source of this CO2 to river waters.
- Radiocarbon Constraints on Organic Matter Turnover in the Amazon River Basin. Surveying spatial and temporal variability in _14C signatures of dissolved, fine particulate and course particulate organic carbon and dissolved inorganic carbon between basins of differing types and sizes.
- Development of a new 'River basin Organic Matter and Biogeochemistry Synthesis' model (ROMBUS). Building on post-doctoral research results and collaborating with hydro-geo-spatial modeling efforts by the Carbon in the Amazon River Experiment (CAMREX) group at the University of Washington.

LECTURES AND PRESENTATIONS

Aufdenkampe, A. K., J. I. Hedges, P. D. Quay, A. V. Krusche, J. E. Richey. 2004. *The elemental, isotopic, and biochemical fractionation of dissolved organic matter by microbially mediated organo-mineral association.* DOM Workshop, October 3-6, 2004, Bayreuth, Germany.

Aufdenkampe, A. K., S. Remmington, E. Mayorga, J. E. Richey, A. V. Krusche, R. Benner. 2004. *Coupling DOM sorption and mineralization dynamics via molecular size: A unified approach to modeling?* DOM Workshop, October 3-6, 2004, Bayreuth, Germany.

Continued on page 19.

THE FUTURE *of* LIFE
THE FUTURE *of* WATER

RUBY

NATHAN

MATTHEW

JOHN

HENRY

GARRETT

CONNOR

BENJAMIN

ALLYSSA

THE FUTURE of WATER
THE FUTURE of LIFE

LINO

EMILY

ABIGAIL

2004 Highlights

- Stroud scientists had publications in 2 of the most prestigious scientific journals: *Proceedings of the National Academy of Sciences* and *Nature*
- **11,000** water samples were taken in 2004
- **199,935** analyses were done on the samples
- **82,045** miles were put on our vehicles
- **22** summer interns from 14 different colleges and universities
- **1750** students and **580** teachers were trained by our education staff.
- Exceeded Kresge Challenge for a total of **$2,004,038**
- **150** people became new "Friends of the Stroud Center"
- **33%** of the "Friends of the Stroud Center" gave to both the Annual Fund and the Kresge Challenge.
- **100%** of the staff and board at the Stroud Center gave to the Kresge Challenge

AND AFTER ALL THAT...

We still had time to work on producing the next generation of water lovers & users:

- Of the 62 staff and board members, **12** babies came into their families in 2004 including children & grandchildren.

Ecosystem Processes

FOCUS

The effectiveness of streamside forest buffers in protecting water quality. The role of headwater streams in generating organic particles that supply food resources to downstream ecosystems.

RESEARCH PROJECT HIGHLIGHTS

- The Stroud Preserve Riparian Forest Buffer. Continued 14-year study of the water quality benefits of streamside reforestation. The project is part of US EPA's National Non-Point Pollution Monitoring Network, designed to demonstrate and evaluate Best Management Practices. Further water quality improvements in 2004 (decline in streamwater nitrate concentrations) coincided with accelerated growth of riparian forest.
- Nutrient spiraling in streams that supply New York City's drinking water. Large-scale field experiments measure the downstream movement and in-stream processing (spiraling) of nutrients (phosphorus, nitrogen and carbohydrates). These measurements, in conjunction with studies of metabolism (Microbiology Section) and benthic macroinvertebrates (Entomology Section), indicate the condition or health of the stream ecosystems.
- Dynamics of Organic Particles. Modeling analyses of experiments conducted in Idaho showed that particles of organic matter are frequently deposited and resuspended from the stream bed and thus convey food energy from upstream to downstream ecosystems. Methods were developed for using fluorescent stains to trace particles in streams.
- NSF Long-Term Research in Environmental Biology. Monitoring of suspended organic matter and chlorophyll showed that benthic algae contribute significantly to the downstream transport of organic particles.

SERVICE AND AWARDS

- Principle Investigator:
  Stroud Preserve Riparian Reforestation National Monitoring Project. U.S. EPA and PA Department of Environmental Protection.

PRESENTATIONS

Organic particles, biofilms, and stream ecosystems. Paper presented at the Annual Meeting of the North American Benthological Society, May 9 – 51st annual meeting.

Stroud Preserve Riparian Reforestation National Monitoring Project: Nitrate Removal and Tree Growth in a 12-year-old Reforested Riparian Buffer. Paper presented to the 12th National Nonpoint Source Monitoring Workshop, September 27, 2004, Ocean City, MD.

Water Quality Functions of Riparian Buffer Systems. Invited lecture for the Mid-Atlantic Crop Management School, November 16, 2004, Ocean City, MD

Staff

J. Denis Newbold, Ph.D.
Susan Herbert, M. S.
Aaron DeLong
Phil Taylor

Volunteers

Harry West
Frank Klein, Ph.D.

Interns

Gregory Gromadzki
Catherine Bente

Outside Collarators

Colbert E. Cushing, Ph.D.
Streamside programs,Estes Park, CO.

Ted Georgian, Ph.D.
St. Bonaventure Univ.

Steven A. Thomas, Ph.D.
Idaho State Univ.

G. Wayne Minshall, Ph.D.
Idaho State Univ.

Entomology *(continued from page 12)*

LECTURES AND PRESENTATIONS *(presenter in bold)*

Jackson, J. K., *Seasonal and spatial responses of macroinvertebrate secondary production to the removal of streamside forests.* 52nd annual meeting of the North American Benthological Society.

Battle, J.M., J. K. Jackson, and B. W. Sweeney. *Macroinvertebrates in the main channel of the Mississippi River near Cape Girardeau, MO.* 2004 Annual Meeting of the Mississippi River Research Consortium, La Crosse WI.

Funk, D. H., B.W. Sweeney, and J.K. Jackson. *Genetics of parthenogenesis in two Centroptilum mayflies: is facultative parthenogenesis in mayflies a backup reproductive strategy?* 52nd annual meeting of the North American Benthological Society.

Kratzer, E.B., J.K. Jackson, D.B. Arscott, A.K. Aufdenkampe, C.L. Dow, L.A. Kaplan, and B.W. Sweeney. *Factors affecting the distribution of macroinvertebrates in the New York City drinking water watersheds.* 52nd annual meeting of the North American Benthological Society.

Sweeney, B. W., T.L. Bott, J.K. Jackson, L.A. Kaplan, J.D. Newbold, L.J. Standley, W.C. Hession, and R.J. Horwitz. *Riparian deforestation, stream narrowing, and loss of stream ecosystem services.* 52nd annual meeting of the North American Benthological Society.

Organic Geochemistry *(continued from page 15)*

LECTURES AND PRESENTATIONS *(presenter in bold)*

Aufdenkampe, A.K. *Is the characteristic elemental, isotopic and biochemical composition of mineral-associated organic matter in soils and sediments the consequence of sorption?* "Hot Topics in Organic Biogeochemistry" Session of the Gordon Research Conference in Organic Geochemistry, August 9-13, 2004, Holderness School NH.

Arscott, D.B., C. Dow, J.K. Jackson, J.D. Newbold, **A.K. Aufdenkampe**, L.A. Kaplan, and B.W. Sweeney. *Stream macroinvertebrate communities and their relationships to dominant land covers/uses and water chemistry in the NYC source water areas.* NY City Watershed Science and Technical Conference, New York, NY

Aufdenkampe, A.K., E. Mayorga, A. V. Krusche, S. Alin, J. E. Richey. *The Need for Accessible, Flexible Relational Databases for River Biogeochemistry Data.* HiBAm-LBA River Research Workshop, July 26, 2004, Brasilia, Brazil.

Richey, J. E., A. V. Krusche, M. V. Ballester, **A. K Aufdenkampe**, E. Mayorga, S. Alin, and others. *Coupling of Carbon, Biogeochemical, and Hydrological Cycles: A Fluvial Perspective.* Talk at the 3rd LBA Science Conference, July 27-29, 2004, Brasilia, Brazil.

Aufdenkampe, A.K., E. Mayorga, A. V. Krusche, C. A. Masiello, P. D. Quay, J. E. Richey. *Isotopic Constraints on Organic and Inorganic Carbon Cycling in the Amazon River System.* 3rd LBA Science Conference, July 27-29, 2004, Brasilia, Brazil.

Aalto, R. and **A. K. Aufdenkampe**.*ENSO-Orchestrated carbon supply and sequestration in Amazonian River basins by erosion-sedimentation processes.* Talk at the 3rd LBA Science Conference, July 27-19, 2004 Brasilia, Brazil.

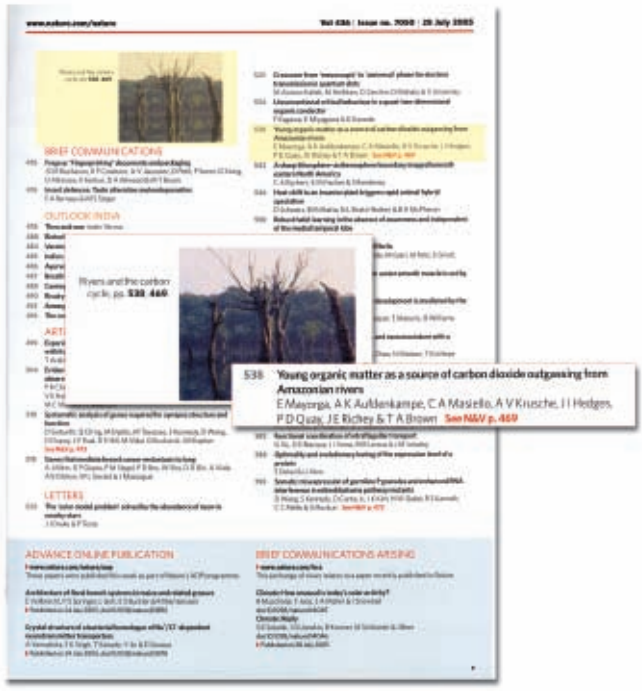
Cogo, M. C., A. V. Krusche, A. A. Montebelo, **A. K. Aufdenkampe.** *The role of suspended sediments and nutrient concentrations in the metabolism of river waters of Rondônia.* 3rd LBA Science Conference, July 27-19, 2004, Brasilia, Brazil.

Richey, J. E., **A. K Aufdenkampe**, S. Remington, A. K. Krusche, E. Mayorga. *ROMBUS: A model of DOM mobilization and reaction.* ASLO Ocean Research Conference, February 15-20, 2004, Honolulu HI.

Costa-Cabral, M., J. E. Richey, D. P. Lettenmaier, M. Logsdon, S. S. Rodda, E. Mayorga, and **A. K. Aufdenkampe**.

COMPASS: Coupled models package of surface schemes. American Meteorlogical Society (AMS) 18th Conference on Hydrology, January 2004, Seattle WA.

2004 Publications and Reports



PEER REVIEWED PUBLICATIONS

Bernardes, M. C., L. A. Martinelli, A. V. Krusche, J. Gudeman, M. Moreira, R. L. Victoria, J. P. H. B. Ometto, M. V. R. Ballester, **A. K. Aufdenkampe**, J. E. Richey, J. I. Hedges. 2004. Organic matter composition of rivers of the Ji-Paraná basin (southwest Amazon basin) as a function of land use changes. *Ecological Applications* 14(4): S263-S279.

This paper is an assessment of the effect of tropical forest-to-pasture conversion on the properties of riverine organic matter. We show that shifts of stable carbon isotopes from forest values to grass values increased with increased pasture area and decreasing stream size, and that these shifts were larger for the dissolved organic carbon versus particulate. This demonstrates that organic matter inputs to the river, which fuel ecosystem metabolism, respond rapidly (< 30 years) to changes in land use.

Sweeney, B. W., T. L. Bott, J. K. Jackson, L. A. Kaplan, J. D. Newbold, L. J. Standley, W. C. Hession, R, J. Horwitz. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. *Proceedings of the National Academy of Sciences* 101:14132-14137.

This research shows that forests play a vital role in protecting the health of the stream itself by enhancing the ability of its ecosystem to process organic matter and pollutants such as nitrogen. Conversely, the deforestation of riparian lands compromises both the quantity and the quality of a stream's ecosystem, thereby reducing its ability to deliver important services to humans.

Golladay, S.W., P. Gagnon, M. Kearns, **J.M. Battle** and D.W. Hicks. The response of freshwater mussel assemblages (Bivalvia: Unionidae) to a record drought in the Gulf Coastal Plain of southwest Georgia. *Journal of North American Benthological Society* 23(3): 494-506.

This study found that drought reduced the abundance of freshwater mussels in areas where groundwater was being withdrawn for agricultural use or where woody debris in the stream channel (which can create low flow refugia) is less common.

Kim, S., **L. A. Kaplan**, R. Benner, and P. G. Hatcher. 2004. Hydrogen-deficient molecules in natural riverine water samples - evidence for the existence of black carbon in DOM. *Marine Chemistry* 92:225-234.

Black carbon (soot) is produced by the incomplete burning of wood and fossil fuels. An understanding of the roles of black carbon in the natural environment is important because of the potential impacts on human health, global carbon cycling, and pollutant transport. There has been circumstantial evidence for the existence of black carbon in dissolved organic matter. This paper reports on the first direct evidence of black carbon based on sophisticated chemical analyses of water from McDonalds Branch in the New Jersey Pinelands and the Rio Negro, a black water tributary of the Amazon River.

Gandhi, H., T. N. Wiegner, P. H. Ostrom, **L. A. Kaplan**, and N.E. Ostrom. 2004. Isotopic (13C) analysis of dissolved organic carbon in stream water using an elemental analyzer coupled to a stable isotope ratio mass spectrometer. *Rapid Communications in Mass Spectrometry* 18:903-906.

Stable isotopes provide a powerful tool for ecosystem studies, making it possible to follow the fate of individual molecules dissolved in stream water. This paper describes a method for measuring the stable isotope of carbon in dissolved organic carbon that is simpler, faster, and more economical than previously developed methods.

TECHNICAL REPORTS

Aufdenkampe, A.K., Bott, T.L., Dow, C.L., Jackson, J.K., Kaplan, L.A., Newbold, J.D., Sweeney, B.W, and Arscott, D.B. Water Quality Monitoring in the Source Water Areas for NYC: An Integrative Watershed Approach. A Report on Year 4 of Monitoring 227 pp. Available on-line at www.stroudcenter.org.

(see page 22 for description of project report)

Jackson, J. K. and Sweeney, B. W. Quantitative Studies of Benthic Macroinvertebrates in White Clay Creek near the SECCRA Community Landfill, Chester County, PA. Contribution No. 2004006. Stroud Water Research Center.

This study found that the White Clay Creek tributary near the landfill was not in good condition, but there was no evidence that runoff from the landfill was contributing to this condition.

Jackson, J. K. and Sweeney, B. W. Studies of Macroinvertebrates on the Susquehanna River near Mehoopany, PA in 2003. Contribution No. 2004007, Stroud Water Research Center.

This report continues a 30+ year study on the Susquehanna River that has found that effluent from a large paper processing plant has no significant negative effect on aquatic insects while general conditions in the river continue to improve. The 2003 collections found more that twice the number of species found at these same locations in the early 1970s.

Jackson, J. K. and Sweeney, B. W. Aquatic Macroinvertebrate Biomonitoring of the Mississippi River near Cape Girardeau in 2003. Contribution No. 2004011, Stroud Water Research Center.

This report describes the response of macroinvertebrates in the fine sediments behind wing dikes on the Mississippi River to effluent from a paper processing facility. This project involves both method development and environmental assessment, and has identified significant differences in the macroinvertebrates over the years.

Jackson, J. K. and Kaplan, L.A. An Assessment of Upper East Branch Brandywine Creek Waters as Candidates for Exceptional Value Waters Status. Contribution No. 2004012, Stroud Water Research Center.

This report assesses stream condition for the main stem and tributaries of the East Branch of Brandywine Creek upstream of Downingtown based on the available chemical and biological evidence. Chemistry of all High Quality waters within the East Branch meet the chemistry criteria for Exceptional Value status. Macroinvertebrates at most East Branch sites are comparable or better than conditions observed at Broad Run, a nearby EV tributary on the West Branch of Brandywine Creek, but are not comparable to a site on French Creek, an EV/HQ stream just north of the East Branch. The macroinvertebrate data suggest that the main stem and tributaries of the East Branch have improved relative to the 1980s when the watershed initially received the High Quality designation. We conclude that a petition to upgrade most if not all of the East Branch of Brandywine Creek upstream of Downingtown, PA is warranted.

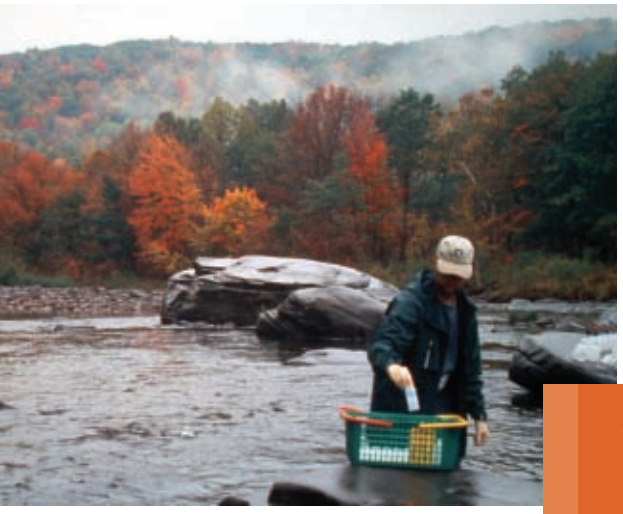
Jackson, J. K. and Sweeney, B. W. Benthic Macroinvertebrates in the Flint River (2003) and Lake Blackshear (2004) near Oglethorpe, Georgia. Contribution No. 2004013, Stroud Water Research Center.

This report continues a 20-year study of macroin vertebrates in the reservoir and river that are exposed to effluent from a large paper processing facility as well as natural disturbances such as drought, extreme floods, and drying. The study has quantified significant spatial and temporal variability, as well as the resilience of the aquatic macroinvertebrate community in response to record floods and drying.

Jackson, J. K. and Sweeney, B. W. An Assessment of the Tributaries of Upper Maiden Creek in 2004. Contribution No. 2004014, Stroud Water Research Center.

Insight into stream conditions in the Upper Maiden Creek watershed was provided to interested parties in Lehigh and Berks Counties.

New York PROJECT



RESEARCH PROJECT HIGHLIGHTS

FOCUS

Enhanced water quality monitoring in the source areas for the New York City water supply: an integrative watershed approach.

- We have completed Year 5 of the 6 year project to monitor and assess New York City's source water areas. We had a successful year for all facets of this Center-wide collaborative project. Weather cooperated with our field activities. We collected water chemistry from 4 storm events at 3 different sites and visited all 62 stream sites last spring to collect macroinvertebrates and last summer to collect water chemistry samples. Twenty-eight of the sites were re-visited in the winter to collect water chemistry during winter baseflow. Variables measured in each water sample included major ions and nutrients (such as, sodium, chloride, phosphate, and nitrate), dissolved organic carbon and organic particles, and a suite of molecular tracers (such as, fecal steroids, caffeine, fragrances, and polycyclic aromatic hydrocarbons). These activities help identify activities in the watersheds that potentially degrade stream water quality and impair biological health.
- During the summer season Ecosystem and Microbiology staff visited 10 sites to measure nutrient uptake and stream metabolism (1-week per site). This work involves injecting low concentrations of nitrogen, phosphorus and carbon into the stream and following these nutrients downstream to observe their removal rate from the water column. Concurrently, stream concentrations of dissolved oxygen are monitored for 4 days to observe the uptake (respiration) and production (photosynthesis) of dissolved oxygen over day-night cycles. These functional measures of the stream ecosystem help us better understand how streams process nutrients and organic material and, by relating differences/similarities among streams, which stressors modify these processes.
- The Microbiology staff visited seven NYC drinking water reservoirs to measure variables such as vertical light penetration, temperature and dissolved oxygen profiles, suspended chlorophyll (a proxy for algae biomass), and primary production (photosynthesis) and respiration occurring in the water column. These measures of reservoir productivity help us to understand individual reservoir conditions. By linking reservoir productivity with upstream nutrient processing, metabolism and water chemistry we can describe the processes by which watershed activities may result in degradation or improvement of reservoir water quality.
- All of these activities require a substantial amount of time of over 25 of the Center's technicians, interns and scientists.. This project could not be as successful as it has been without the dedication and devotion of its staff and interns, thank you! For more information about the project, visit the New York Project web page on the Stroud Water Research Center's web site: http://www.stroudcenter.org/research/nyproject

New York Project Manager

Charles L. Dow, Ph.D.

New York Project Coordinator

Dave B. Arscott, Ph.D.

Laboratories & Principal Investigators

Organic Geochemistry
Anthony K. Aufdenkampe, Ph.D.

Biogeochemistry
Louis A. Kaplan, Ph.D.

Entomology
John K. Jackson, Ph.D.

Ecosystems Processes
J. Denis Newbold, Ph.D.

Microbiology
Thomas L. Bott, Ph.D.

Project Director

Bernard W. Sweeney, Ph.D.

PRESENTATIONS *(Presenter in bold)*

Arscott, D.B., E.B. Kratzer, J.K. Jackson, C.L. Dow, J.D. Newbold, A.K. Aufdenkampe, L.A. Kaplan, B.W. Sweeney. *Stream macroinvertebrate communities and their relationships to dominant land cover/uses and water chemistry in the NYC source water areas.* Joint Meeting of the American Entomological Society and the Entomological Society of Pennsylvania (81st Meeting). Avondale, PA.

Arscott, D.B., E.B. Kratzer, J.K. Jackson, C.L. Dow, J.D. Newbold, A.K. Aufdenkampe, L.A. Kaplan, B.W. Sweeney. *Stream macroinvertebrate communities and their relationships to dominant land cover/uses and water chemistry in the NYC source water areas.* 2nd Annual New York City Watershed Science and Technical Conference. Fishkill, NY.

Arscott, D.B., C.L. Dow, A.K. Aufdenkampe, T.L. Bott, J.K. Jackson, L.A. Kaplan, J.D. Newbold, and B.W. Sweeney. *Enhanced Water Quality Monitoring in the New York City Drinking Water Supply Watersheds.* University of Minnesota, Crookston – Dept. of Natural Resources.

Arscott, D.B., E.B. Kratzer, J.K. Jackson. *Examining rarity in a macroinvertebrate bioassessment database.* Bulletin of the North American Benthological Society. Vancouver, Canada.

Dow, C.L., D.B. Arscott, A.K. Aufdenkampe, T.L. Bott, J.K. Jackson, L.A. Kaplan, J.D. Newbold, B.W. Sweeney. *Enhanced monitoring in drinking-water source watersheds: What have we been doing in New York for the last few years?* Olivebridge, NY sponsored by the Olive Natural Heritage Society.

WATER FOR LIFE

WATER FOR LIFE 2005–2015

The United Nations has designated 2005 – 2015 as the decade of WATER FOR LIFE. "Each year more than 1 billion of our fellow human beings have little choice but to resort to using potentially harmful sources of water. Two out of 10 people do not have a source for safe drinking water…it is a unique occasion not just to highlight the magnitude of the problem, but also to bring all stakeholders together to apply solutions that work."

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For the next 10 years, we have the opportunity to focus our attention on protecting and respecting our water resources as individuals, communities, countries, and as a global family of concerned citizens.

Visit: www.un.org/waterforlifedecade

2004 Research & Education Projects

SCHEDULE OF SPONSORED PROJECTS AWARDED IN 2004

RESEARCH

SPONSOR	TITLE	AWARD PERIOD	AWARD AMOUNT
Chesapeake Bay Foundation	Intern Program - 2004	01/01/04-12/31/04	$29,915
University of Washington	Development of the River Basin Organic Matter and Biogeochemistry Synthesis (ROMBUS) Model	01/01/04-01/01/04-08/31/0412/31/04	29,899
National Park Service/University of Delaware	2004 Assessment of Stream Conditions in White Clay Creek	03/01/04-08/31/04	7,500
The Brandywine Conservancy	Feasibilty Study of Upgrading the Status of Streams within the Upper East Branch Brandywine Basin	04/01/04-08/31/04	10,500
Weyerhauser Company	Flint River/Lake Blackshear Biomonitoring Study - 2004	04/01/04-12/31/04	79,147
National Science Foundation	Collaborative Research: Ecological Circuitry Collaboratory	05/01/04-04/30/05	28,000
United States Department of Agriculture-Natural Resources Conservation Service	Planning and Applying Riparian Buffers	05/01/04-09/30/05	80,000
The William Penn Foundation	Research and Outreach to Encourage and Facilitate Watershed Stewardship in the Schuylkill River Watershed	06/01/04-05/31/06	150,000
National Science Foundation	LTREB: Stream Ecosystem Structure and Function within a Maturing Deciduous Forest	07/01/04-06/30/09	300,000
National Science Foundation	Collaborative Research: Episodic, ENSO-Orchestrated Carbon Sequestration in Amazonian River Basins by Erosion-Sedimentation Processes	08/15/04-07/31/07	217,176
The Procter & Gamble Paper Products Company	Aquatic Insect Studies on the Mississippi River Near Cape Girardeau	09/23/04-08/31/05	52,000

EDUCATION

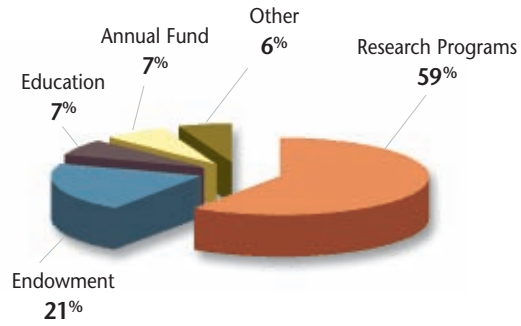
SPONSOR	TITLE	AWARD PERIOD	AWARD AMOUNT
New York State Department of Environmental Conservation	StreamKeeper Project	01/01/04-01/30/05	$53,238
Davenport Family Foundation	Leaf Pack Integration with the Roots & Shoots Youth Summit	04/07/04-05/31/04	5,500
William Penn Foundation	To support the formation of a partnership of key stake-holders to plan and design a model riparian buffer restoration program in the French-Pickering Watershed	12/15/04-06/30/05	33,000

Financial SUMMARY

OPERATING STATEMENT FOR THE YEAR ENDED DECEMBER 31, 2004

REVENUES & SUPPORT

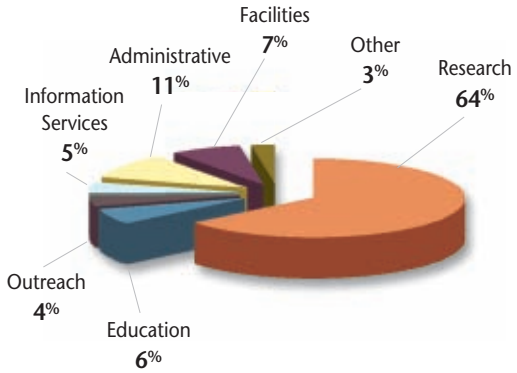
Research Programs (Grants & Contracts)	$2,388,155
Endowment Support	837,243
Education/Public Programs	272,121
Annual Fund	278,236
Other Contributions & Income	231,473



TOTAL REVENUES & SUPPORT **$4,007,228**

EXPENDITURES

Research	$2,573,668
Education	259,133
Development/Outreach	159,429
Information Services	191,633
Administration	422,048
Facilities	299,784
Other	101,533



TOTAL EXPENDITURES **$4,007,228**

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The staff of the Stroud Center recognize the tremendous support of our many generous "Friends of the Stroud Center" in 2004. Care has been taken to assure the accuracy and completeness of this listing. We regret any omission and ask that you bring any corrections to our attention by calling Claire Birney, Development Director at (610) 268-2153 x 230.

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HER DEEPNESS AND THE DEAD ZONES

The second annual Water's Edge lecture on October 8, 2004 was a celebration, a connection and a lament. Sylvia Earle, marine biologist, National Geographic Society's Explorer-in-Residence and world-record diver fondly dubbed "HerDeepness," gave the 275 in attendance a glimpse into the magical underwater world which she has done so much to explore, understand and protect

What is the connection between salt water and fresh water?

Streams and rivers owe their existence to the oceans," said Dr. Sweeney in his introduction, describing the cycle of evaporation and precipitation that recharges our fresh water. But both he and Earle emphasized that oceans also depend on the streams and rivers, and they noted that the decreasing numbers that flow regularly to the sea and the increasing amounts of pollutants they carry have caused dead zones – places where there is no oxygen – to double around the world since 1990. We cannot address the fate of the oceans without addressing the conditions of our rivers and their watersheds.

Dr. Earle celebrated the oceans both as the source of all life on Earth and as places that teem with living things we rarely see and barely understand. "Every night the greatest migration on Earth takes place . . . to the surface of the oceans," she said, while behind her sparkled filmed images of an incredible – and deadly – nocturnal oceanic ballet. "One thing consumes another, and life goes on." Oceans, she said, make our human lives possible. Not only are their waters "the great thermo-regulator of the planet," but they are "the lifeblood that sustains us."

Yet Dr. Earle's celebration was also a lament. "What once seemed an infinite realm," said a voice in another film clip, "is, in fact, a fragile resource." We have taken our oceans and their bounty for granted, said Earle, and now we must awaken to the reality that we have polluted their waters and devastated their ecosystems. In the last 50 years, the populations of big fish have declined by 90 percent, as humans have relentlessly strip-mined the oceans. "It is okay to go out and catch dinner," said Earle. "It is not okay to catch dinner with a bulldozer, which is what trawls do. We are abusing the waters of the world."

> "What once seemed an infinite realm, is, in fact, a fragile resource. We have taken our oceans and their bounty for granted," said Earle. "...and now we must awaken to the reality that we have polluted their waters and devastated their ecosystems."

As the catches get smaller, as warnings about eating fish grow louder and as the "dead zones" induced by manmade pollution expand, said Earle, "we are learning the hard way that the ocean is finite, too." Yet, she said, we are doing little to protect it – noting that, while we have preserved 12 percent of the terrestrial ecosystem, we have preserved a fraction of one percent of our oceans.

One reason for that is because we know so little about the oceans. While space exploration captured the imaginations of millions – and the budgets of their governments – beginning in the late 1950s, 95 percent of the seas remain unexplored, said Earle, who has certainly done her part to change that by spending more than 7,000 hours under water and setting the depth record for solo diving. Still, she noted, only one person has ever been to the deepest part of the ocean – seven miles below the surface – and that happened more than 40 years ago.

Knowledge, she said, leads to caring, and she urged the support of underwater exploration, "in the spirit of Lewis and Clark," as a way of learning about and protecting the oceans. "There is as big an America underwater as there is above."

The future, concluded Earle, requires us to think of the world in two ways. First, see it as an astronaut sees it: "It is all one system and all of us are dependent on its integrity." And then, think of it "from the perspective of those not yet born."

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Did you know that Plato is credited with making the first planned gift to insure further education and research at a place he held dear? Before he died, about 347B.C., the Greek philosopher made out a will leaving his farm in the care of a nephew, with instructions to use the proceeds from the sale of crops each year to support the work of the academy he had founded.

This fundamental concept holds true today. A planned gift to the Stroud Center ensures the future of our work, which we believe you hold dear. While we all find it gratifying to actually see the benefits of our generosity, it takes a certain faith in "things unseen" to set aside a portion of our assets for the future of the Stroud Center.

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