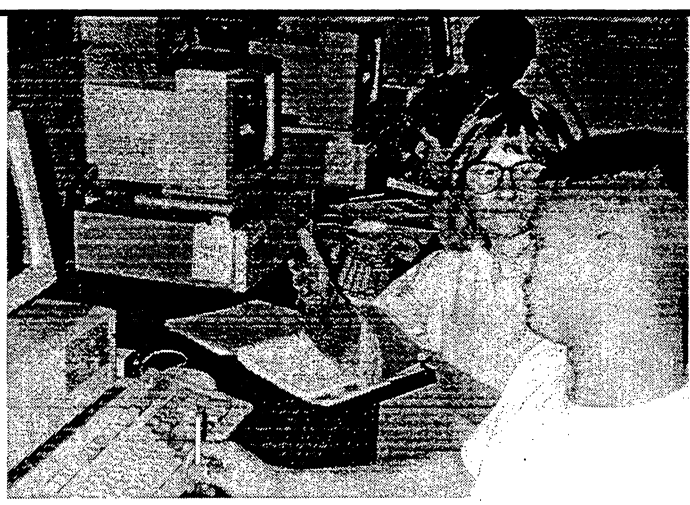
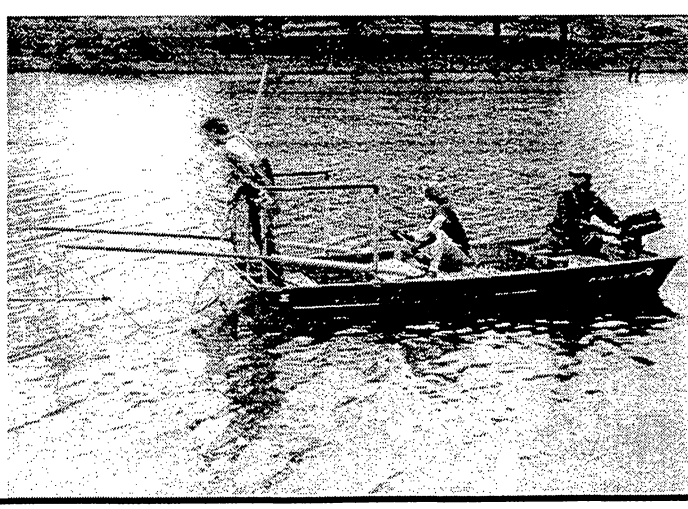
VT FISHERIES MANAGEMENT MAGAZINE

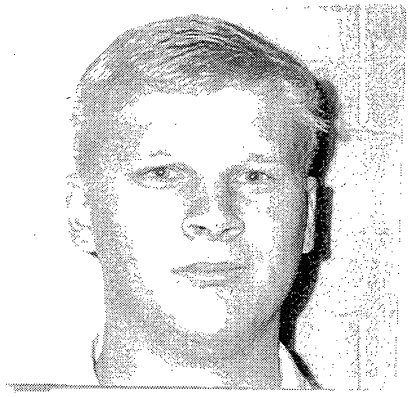
Volume Number 1, 1994



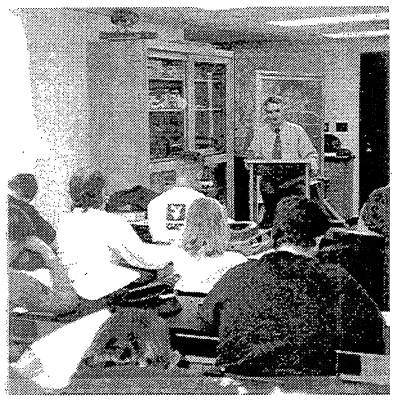


Devoted to identifying fisheries management problems, uncovering their causes, and developing creative solutions.

"Pull!"

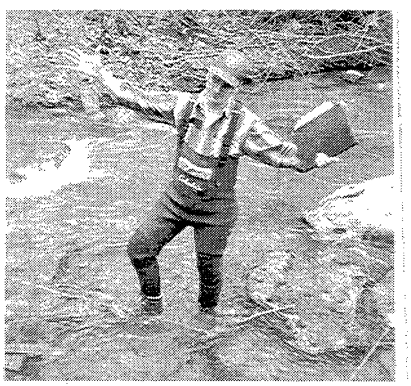


Dan Michaelson

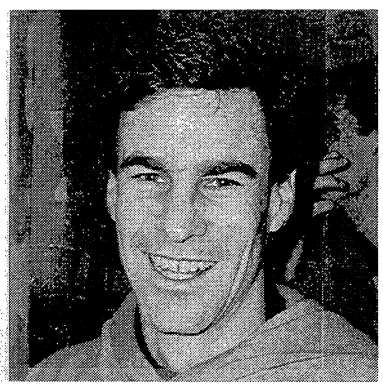


Bud LaRoche Briefs Students

Karen Hockett



"Thank you. Enough applause."



Ed Pert

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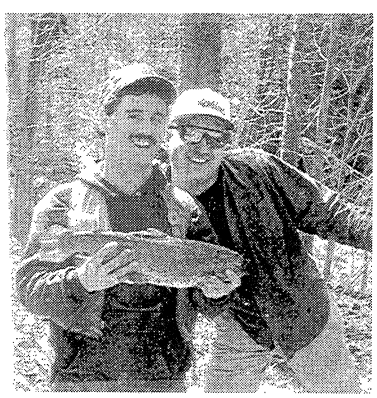
Shelley White



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VT FISHERIES MANAGEMENT

Devoted to identifying fisheries management problems, uncovering their causes, and developing creative solutions.

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Photographs by Donald J. Orth

VT FISHERIES MANAGEMENT is published annually by the Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061-0321

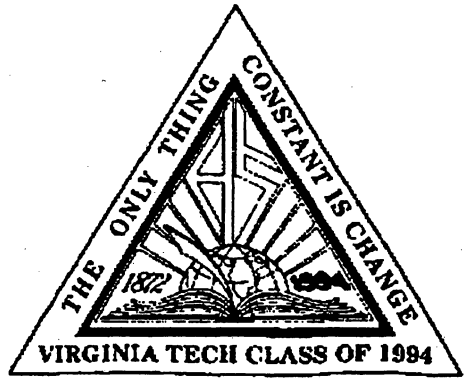
Editor's Message

A community of teachers and lifelong learners contributing to natural resource conservation as professionals and active citizens.

So reads the teaching mission of the Department of Fisheries and Wildlife Sciences. I remember the hours that we spent as a faculty debating over this simple, yet powerful, statement and I know we learned much more in that process than is reflected by the words. Writing is a powerful mode of learning, in which students get immediate feedback, make connections among their knowledge bases, and become engaged in the subject matter. I have tried a variety of written assignments in the past, but they all failed to excite some of the students and were relegated to make-work exercises that served no lasting purpose. This year I initiated *VT Fisheries Management* magazine as the focal point for writing about fisheries management after a workshop in which Sue McGann presented nearly a dozen writing-to-learn techniques. I believe the magazine assignment is superior to previous assignments for several reasons.

First, students must play a real-world role as editor of a magazine section, engage with their peers in discussion of what makes an interesting article, and provide editorial advice on what revisions are needed. Providing students with this professional writing experience is the most important learning objective. Second, it gives the student greater flexibility in selecting topics to write on, yet maintains considerable structure to guide the average student. Third, students were more motivated to write the magazine articles than the typical term paper (83% of students with opinions agreed with that statement) and all students thought the assignment should be retained in the future. Students realized why they were writing and were either excited or apprehensive about creating a quality magazine that they could show to fellow students, prospective employers, and family. Finally, the magazine is an outlet for chronicles of learning via lab and field exercises.

The magazine also serves as a tangible outcomes assessment that can be shared widely with other educators, employers, and fisheries stakeholders. It is too early for me to analyze it objectively, but when I do I am certain that I will see deficiencies that reflect on my teaching. Only then can teaching be changed and, hopefully, improved. The class of '94 taught me that "The Only Thing Constant is Change." I hope that I taught them valuable lessons that will persist through the changes they will see in their careers. This assignment was just a beginning in their lifelong learning and writing about stewardship of fish and fisheries and the land and water that sustains these values. The vitality of our valuable aquatic living resources depends on the wisdom to make decisions and the skills to communicate these decisions. As David Starr Jordan observed "The ability to make up your mind inspires self-confidence, it gives you inner power, and commands the respect of your fellow man."



I sincerely thank James W. Knight (Director, Center for Excellence in Undergraduate Teaching), Nancy Metz (Coordinator of the University Writing Program), and Susan McGann (College of Forestry and Wildlife Writing Consultant) for their support and encouragement in this project. The Center for Excellence in Undergraduate Teaching Excellence mini-grant funded part of the costs.

Donald J. Orth

Donald J. Orth
Editor

Letters to the Editor

Edited by Nancy L. Gilmore

Ed. Note: Nancy Gilmore wrote to several fisheries professionals, described the writing assignment, and requested feedback on the idea. Here are the replies.

On Early Ego Bruising

I think the fisheries magazine is a superb idea. Students cannot do too much writing, especially in a public forum. It is best to have your egos bruised and hardened at an early age by the criticisms and comments of your peers and professors so you can be more effective outside the university. Like it or not, fisheries biologists are increasingly involved in public controversy because we humans compete directly for water with fish.

I am a strong believer in having students write at every opportunity including letters to friends and relatives (instead of that last minute telephone call), field journals, letters to local newspapers, articles for newsletters, and independent studies. The more you write, the easier it becomes, and the more likely you are to develop a personal and convincing style. Best of all, word processors and e-mail now allow you to easily leave your own personal paper (or electronic) trail to the past. It is both humbling and edifying to read things I wrote over 30 years ago. We live so much in the present that such personal accounts can remind us how rapidly the world is changing and what is being lost.

Peter B. Moyle, Professor of Fisheries Biology
University of California, Davis

E-mail Outreach to Other Universities

The concept of a student fisheries magazine is an excellent approach in developing the writing and editorial skills of fisheries students, while providing exposure to the fisheries profession and the procedures used to publish in professional journals. As science editor of Fisheries, I would be interested in reviewing a submission describing this approach to teaching fisheries management. This method of restructuring fisheries management courses would be useful to other fisheries educators.

One suggestion I have is to consider the use of computer technology to exchange articles within and between universities using electronic mail. This could provide a more interactive approach to fisheries writing which can involve exchanges between fisheries management classes at VPI and other universities, as well as dialogue with fisheries professionals.

I believe that this magazine will provide a stimulating and novel vehicle which will enhance the learning and communication skills of our future fisheries professionals.

William W. Taylor, Professor and Chair, Dept of Fisheries and Wildlife, Michigan State University

Not Just Busy Work

I think the idea sounds very interesting, and I am anxious to see how the project develops. Throughout my teaching career I have sought to give students practical experience in technical writing, as I feel that development of this skill has always been a shortcoming of both our field and undergraduate education in general. The problem has always been to provide assignments that hold the students' interest by making them feel that what they are doing is more than just busy work. Your magazine may be a solution to that problem.

Brian R. Murphy, Professor and Associate Head for Research and Graduate Programs, Texas A & M University
VT Alumnus 1981

Real Life Career Activities

As senior editor of Fisheries, the monthly magazine for AFS members, I voice full support for an active letters section in any fisheries publication. One recent AFS readership survey shows that more than one-third of our members rank the section as one of the "most read" departments.

Professor Orth's magazine project idea is an excellent way to prepare fisheries students for "real life" career activities. Publishing, educating, and debating are important elements in the fisheries profession. Being an editor or contributor has many pressures, including meeting deadlines, building and maintaining a publication's reputation, and staying within budget.

Paul Brouha, Executive Director, AFS
Senior Editor, Fisheries
VT Alumnus 1974

Babba Wawwa Interviews

This activity should be an exciting exercise for students and instructors alike because it mimics procedures actually employed to produce a high-quality document. Moreover, it should be highly interesting to produce and read. An informative magazine, consisting of numerous sections of varying format and content, is clearly a major improvement over standard writing assignments.

I suggest adding some controversial topics to the magazine. The proposal to eliminate all fish stock transfers certainly has potential for some stirring commentary. Even some hypothetical controversies could serve as a means to separate facts, theories, and opinions. Columnists with opposing views could present both sides of the issues similar to newspaper editorials.

Another category that could be included would be some "Barbara Walters-type" interviews in which a prominent fisheries person is "forced" to provide viewpoints on an array of controversial topics.

Christopher C. Kohler, Associate Director and Professor of Zoology, Southern Illinois University at Carbondale, VT Alumnus 1980

Highest Form of Self-Indulgence

Your project is a good one. It will help each of you understand the purpose, the problems, and the pride of writing. I read once that publishing a bit of one's writing was the highest form of self-indulgence. I agree. This project will teach teamwork, connect you with your future, highlight your program, and show you how good it feels to finish something.

Larry A. Nielsen, Director, School of Forest Resources The Pennsylvania State University

Fisheries Humor

Fishin' for Fun
By Soren O. Kolstoe

I go fishin' for fun;
I bask in the sun.
No sense in fishin' merely for fish!
I sit in the boat
And just let it float
And I leave to the fishes to do as they wish.

I like a good bite
And relish a fight
With a lunker that battles with all its might.
But I'll take the lurch
Of a spry little perch
That skitters and flips in its game little fight.

And with hours to spend
With a good fishing friend,
With the lake and the trees and the sky and the sun,
If the fishes don't bite
It is still all right
While I'm fishing for fish, I fish mostly for fun.

Fishin' for Food
By A. U. Tilitarian

I like to go fishin', though mostly it's work.
I put out five poles and wait for a jerk.
Then hoist the poor bugger right into my bucket,
Until it's full up, if I have the luck of it.

The bass I just slice up with my electric knife.
Their guts feed the garden; it's part of life.
The shiners and hornyheads I fry up whole.
They're small but tasty; a bunch make me full.

I like to go fishin', but it's gettin' worse.
Surrounded by yuppies, the worst sort of curse.
With outfits from Orvis and wearin' pervert glasses,
And gettin' excited about rises and passes.

But yuppies ain't all bad, they got one savin' feature.
If once they do catch one, they let go of the creature,
And hold it so gently till it swims away,
To bite for me tomorrow and be my filet.

College: **A fountain of knowledge where students go to drink.**

Gunsmoke and Fire
The Other Side of Fisheries Management
By Dan Garren
with Steve Sammons

Being involved in the field of natural resources means working in environments that are sometimes unusual when compared to most peoples' work-place. This atmosphere can spawn unusual circumstances and humorous on-the-job experiences. Numerous Tech alumni, some who wish to be anonymous due to families or legal obligations, have found this to be true. Take for example, Steve Sammons, a graduate from Virginia Tech's fisheries program of 1991. He was employed on Lake Thompson in South Dakota when he related an experience of his.

He writes: *Fisheries management is not all gloriously setting nets, electrofishing and writing publications. Sometimes, you can do things that would never even occur to you...*

"If it is not one thing it is another," grumbled Rob (another VT alumnus) on more than one occasion. Little did he know how prophetic those words would turn out to be. One Friday in late October 1992, we went out to the "fish" ponds, where we would raise Canadian and South Dakota pike fry for the next spring. The word "fish" is in quotes because of what we found when we got out there. We were told there were "a few" cattails that had been allowed to grow in the ponds for some stupid duck study. When we actually started to cut down the cattails in the first pond, however, we found out that "a few" actually meant "a whole lot." In fact, it meant "about three thousand per pond" (and there were six ponds!).

Thus started the great cattail saga, a story that would go on for what seemed like forever, but which actually lasted about six days, give or take a century. These were days full of bliss and happiness, from which we would return home in a high smell and higher tempers. The general sentiment expressed by Rob and me was that we wouldn't care if we ever saw another "bleeping" cattail or duck for the rest of our lives. I will not repeat the actual quotes here, however. By the time we were done, Rob, I and a poor guy named Mark Flamming who we suckered into helping us, chopped down, raked up, and hauled out roughly 28 pickup truck loads of cattails from the six ponds. Before this episode, I regarded cattails as merely another aquatic plant, not very good for fish cover, but aesthetically pleasing. Now I consider them the carp of weeds, a bane to human existence only exceeded in malevolence by ozone, acid rain, and Domino's pizza. But hey, I'm biased!

We tried several ways to shorten the process. One was a gas powered super weed-whacker, but it didn't cut the cattails as fast as the sickles. Another was by burning-ala-Flamming. Mark poured about two gallons of gas on the cattails, then tried to light them. The cattails would burn up for a few seconds, then die back down. Finally, Rob and I went into the neighboring pond to continue to chop, while Mark continued to try and light the cattails, with no real success. Rob and I were chopping away at the other pond, when suddenly we heard a "WHOOOOOOOOSH." We looked up to see a huge fireball shoot 50 feet in the air from the neighboring pond. Apparently, the gasoline finally ignited, or so I gathered from the way Mark came out of the pond like a shot from a gun, screeching for some buckets. Rob ran to go get some, while I just watched in awe as the fireball dissipated. The buckets weren't needed. The fire burned out rather quickly, leaving about a 20 square foot section of cattails totally obliterated. A spectacular sight, but hardly practical. That ended the fire experiments.

Another story involving fire happened several years ago to some fisheries biologists who wish to remain anonymous. They were out electrofishing on a bitter cold winter day. After several hours of this, their hands were so cold they could hardly use them, so they decided to pull on to the bank and build a fire. Once they got there, they found all the wood to be fairly damp and hard to ignite. There was a brand-new can of gas in the boat, and one of the guys decided to put it on the wood to help it burn. With this added incentive, the fire started with no problem. The can was placed off to the side while everyone crowded around to get warm. After it got going, the fire started to thaw them all out. Everyone was standing with their backs to the fire warming their rear-ends, when suddenly one of the guys yelled "Surprise!" and threw a handfull of .22 rifle shells into the fire. People scattered everywhere in an effort to get out of there before the shells started going off. They say they never went back for that gas can.

And then there is the story about the two fisheries managers who were out doing some stream electroshocking one day. They were working on native trout streams, looking for presence or absense of trout in streams that were previously unshocked. They had checked several streams in this one rural area, and had an idea of another one they wanted to check. They jumped in their state vehicle, and drove up to the landowner's house to ask for permission. When they got there, the landowner was sitting on the porch, relaxing. They stepped out of their car and began walking towards the man. After they got about twenty or thirty feet away from the car, the man leaned down and grabbed a .22 rifle and laid down a steady stream of fire at the men. Needless to say, the biologists took

off running towards the car and got out of there. When they reported the incident to the local police, they found out that the state had been trying to revoke this man's welfare for a while, and them driving up in a state vehicle must have made the old man think they were with the welfare agency. So that explains the warm welcome the men received.

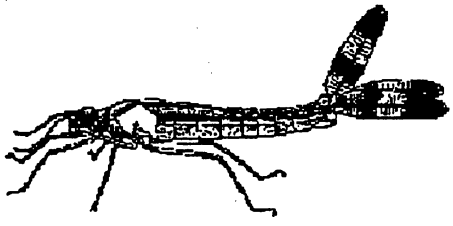
Obviously there is more to being a fishhead than just pulling gill nets and electroshocking. You have to be skilled in many aspects to be a successful manager, including arson and track and field. So the next time you are out on another electroshocking foray, keep these stories in mind. Remember, things could get exciting at any moment. Fisheries management is not just a job, it's an adventure!

Ode to Billy Jim
by Donald J. Orth

Our former colleague, Billy Jim
Would staunchly defend PHABSIM.
He tried to convince
All those who would wince
As he perched on so brittle a limb.

Oh, he was so very proud to brag
How he never once had to SWAG.
But his boss, who never knew a
Man with such faith in the WUA,
Said "Just empty your desk in a bag."

So learn a lesson from poor Billy Jim
Who tends bar where the light is dim.
If you are not made aware
Of the problems methods share,
Your employment prospects will be slim.



My Observation, by John J. Ney

In the class of the good Dr. Orth
The reporters were told to go forth.
And interview who they could
Then make it sound good.
So long as it wasn't Ollie North.

Fisheries People

An Insight Into Fisheries Education:
A Talk With Dr. Ney
by Josh Schiefer

Dr. John Ney is a professor at Virginia Tech in the Department of Fisheries and Wildlife who teaches fish ecology and fisheries techniques in the undergraduate program. Dr. Ney is well known among undergrads for his stimulating lectures. By incorporating many of his own ideas and personal experiences into these lectures, he provides his students with accessible classroom material.

In the following interview, Dr. Ney discusses his educational experiences and teaching philosophies. He also shares his feelings on today's fisheries management students and how they will impact fisheries management in the future.

Where did you receive your education?

Dr. Ney: I started college in the fall of 1963 at Michigan State University. I had always wanted to be a fish biologist, particularly a fish biologist working for the state of Wisconsin. My role model was a graduate of Michigan State, so I left Wisconsin and went there for one very unhappy year. I came back to Wisconsin and graduated from the University of Wisconsin at Madison in 1967. I then went to Minnesota to get a master's degree from the University of Minnesota, in fisheries. I was talked out of that, so I didn't get master's degree. I stayed on for six years and got a PhD and went back to Wisconsin.

What was your first job?

Dr. Ney: I went back to Wisconsin and I applied for a district biologist job and they told me I was overqualified. Unable to find real work, I wound up working for a power company in Milwaukee. This was good experience for a couple of years, on Lake Michigan, dealing with fisheries issues and power plant stuff. After a couple of years there this opportunity [Virginia Tech] came up and I thought it would be a good place for a couple of years and it *was* a good place for a couple of years. But I'm still here...so I guess it couldn't have been all that bad, or maybe I'm just completely unemployable anywhere else. So it's been about eighteen years in beautiful Blacksburg.

How did you go from an undergraduate degree to a PhD?

Dr. Ney: Because I was so incredibly *brilliant*. No, actually some institutions and even some departments at Virginia Tech encourage it. They like to say that their better students, those with the motivation, shouldn't bother with a master's degree and should do a big project for a PhD. We [Fisheries section] don't. I don't think we ever will. In retrospect I think it would have been better for me to have gotten a master's degree. I probably would have quit and become the district fish biologist.

Why do you think it's a good idea to get degrees from different univerisities?

Dr. Ney: It's the old idea of diversity, that it's a competitive field out there for jobs. Particularly jobs for PhDs, jobs like I have now, teaching and so on. If you put that all together you're more balanced than some people who stay in one school and get three degrees. I think that is really counterproductive. As a rule we don't allow any of our students to stay here for more than one degree; it's just a philosophy and other people have a different one, obviously. Maybe if I had gotten that master's degree I would have amounted to something instead of winding up in this cultural backwater.

Why do you refer to Wisconsin as "God's Country"?

Dr. Ney: People up there call it God's country and have ever since it was settled. It's just a nice place. I don't know if it's God's country. If you're up there in the winter you're pretty sure God must have gone to Florida.

What do you want your students to take away from your class?

Dr. Ney: Probably a sense of relief! No, actually, it's a very diverse class, fisheries majors, environmental science majors, and occasionally business, engineering, pre-vet majors. It's really two things I'd like the non-fisheries major to take away--an understanding of fish in their environment and that there are a lot of complicated factors that affect the success of fish.

One of the shortcomings of fisheries management has been that we focus on the one species that we're interested in. If it's striped bass, we stock striped bass but we seldom understand how those striped bass fit the system, what they're going to eat, if there's enough food, what their habitat might be and particularly how they're going to react and interrelate with other fish. Are they going to be predators on fish like bass that we want or are they going to be competitors? And what about human action, the kinds of things that can affect the fish in its environment?

I guess I want fisheries people to understand that you just can't focus narrowly on the end product, the fish you're interested in. You have to figure out how it fits in the system. For non-fisheries majors, I would like them to understand or appreciate that aquatic systems are very fragile. There are many things we can do, with the best of intentions, that can have negative effects. Many of these people are going to go out and be working in environmental consulting firms and the like. They're going to have to have some appreciation of how you might expect fish populations and aquatic communities to respond.

And for those who are just taking it for an elective, some appreciation for what it means to be a fish. What it means to live in water and to be really vulnerable to things people do--to be better environmental citizens. I guess it's not a strict fish management-type class. It's not recipes by and large; it's more or less ways of thinking.

Has this student diversity changed the way you teach the class?

Dr. Ney: The class has had an interesting history in terms of just the numbers of students. I taught ichthyology the first year I was here, so I guess the first class I had was in the Winter Quarter of '78. The year before there were 80 students. That first year I taught it there were about 50. In 1987 I had 8 and now we're back towards 50, so a large part of that reflects what happened in terms of the number of students around the country, not just here, that were interested in the environment and ecology. But during the Reagan years, it really waned. Everybody was thinking, "How much money can I make?" and "What's the best field to get into to make the most money the fastest?" And now we're seeing a return to the ecology movement.

When the class was small you could presume that it was mostly fisheries people; I could presume people had the ability to show a certain set of knowledge and we could go from there. With the class this way, I had to questionnaire the class the first day asking what courses you had in fisheries and what courses you had in ecology. A lot of people hadn't had either and most haven't had fisheries. I can't presume as much knowledge and I think the coverage is as good, but I don't cover as many topics because I have to start at a more baseline level than, say, if I have a bunch of fisheries people who have had ichthyology, principles of fish and wildlife management, fish techniques, et cetera. The only thing they may be lacking is fish

management. So I could presume that they knew a lot of stuff that I can't presume anymore. I think the topics we cover are covered as well or better than they used to be but I don't get through as many things as I'd like to get through.

What is your opinion of today's student compared to past students?

Dr. Ney: Students change, but faculty changes too. It's a good question, but it's hard for me to answer in the sense that, there I was, a 31-year old Assistant Professor, looking at my first class, and now I'm almost fifty looking at another class. I would like to be the same 31-year old looking at both classes but, lacking that, today's students are different in the sense that most of them come from urban or suburban environments. Our greatest portion of our students is, and has always been, from NOVA. Not always, but increasingly, students may not have grown up using resources in the traditional way, that is, consuming them by hunting and fishing. They may be more concerned about the environment in less tangible ways, as something that is nice to preserve for non-consumptive uses. More and more people are concerned about endangered species and sometimes I think too much so. The vast majority of species that aren't endangered still need careful protection and careful management.

We're seeing more of an interest in marine mammals. Every class has a number of students that want to go work with Flipper when they're done. But overall I would say the students, in terms of environmental issues, are probably as knowledgeable, maybe more knowledgeable, than they used to be concerning classic fish management. A lot of people in the fisheries business don't fish and I personally find it hard to believe, but they don't. They're more interested in the environment as an abstract thing -- something that, for the quality of life, would be good to preserve. Although I don't really have any factual data, I think that students today probably read less than they used to. That's one reason why the university as a whole is working harder at writing because the more you read, and I mean read for pleasure, the better writer you are. You just absorb, almost by osmosis, what a sentence that sounds good versus what a sentence that sounds clumsy is. I know there's less of that going on in the world because people are getting stuck in front of Nintendo and Sega and trying to watch all 57 channels all the time. But whether that applies to my class, I can't say. I don't see any big trends one way or the other.

Returning to the first question about today's student--how do you think today's student will impact on fisheries management?

Dr. Ney: I think today's student will be more sensitive to the human part of things. We always used to pay lip service to the idea that fisheries management consisted of three components--the fish, the habitat and the people--but then we always ignored the people thing and we paid for it. When fishermen and other groups would get upset we wouldn't know why or we didn't anticipate them getting upset or didn't know how to calm them down. The students are more sensitive by their backgrounds, and the resource agencies and universities are becoming more sensitive to the people part of fish management. I think the group of resource managers coming out of college in the next several years will have a better feel for that than I did. We never even talked about it.

Do you regard your research and teaching as two separate activities?

Dr. Ney: No. Research here at this university is almost always done with graduate students. There are two reasons we do it: we think it improves knowledge which is why you do research and it solves some problems. And the process is one of education and one of instruction. In the classroom I try to bring in examples from my experience. As long as you keep doing research, you keep your mind active. I'm not saying that everyone who doesn't research but teaches is shut down, but it's very easy to give in to that and just say "ok, I'll blow the dust off my notes." Research is important for graduate education but it's also important to keep fresh in the classroom, to keep new ideas in my head. If you get into a situation in which everybody simply teaches four or five courses a semester, which some people in the legislature here would like us to be doing, and not researching the course will inevitably become stale to some degree. It's a tradeoff. I think they're complimentary; teaching is complimentary to research because I never taught a course from which I didn't get some new ideas from students and from the material--it's symbiosis.

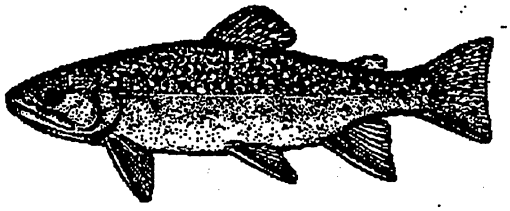
You talked about writing a book--is that likely?

Dr. Ney: I think the best book one could write is one of those Harlequin romances. You know, where some ship's captain is tearing the shirt off some comely wench on the cover. If you write the right one, you can make a ton of money and then you can go fishing as much as you want! But that's a little facetious. Writing a book is a tremendous undertaking if you're going to do it right. It takes a great deal of time and research. If I win the lottery I could do it, but then why would I? I'd go fishing!

What do think the role of today's fish manager should be?

Dr. Ney: I'm a traditionalist. I think a state fisheries biologist should be primarily concerned with his client, the person who pays his salary--the fisherman--and to maximize angler satisfaction. How do you measure satisfaction? To keep the fisherman as happy as you can within the constraints you've got to work with. Find out what the anglers, the guys paying your bill, really want. If it's to catch the most fish, have them fish in concrete swimming pools. Maybe it's to catch fish under certain circumstances, like nice scenery. Find out what they want and, to the degree that you can, within financial limits, within the limitations of the natural resources, and within the limits of conflicting demands from others, give it to them. It's a mythical, almost undefinable thing called "angler satisfaction"--try for it.

Dr. Ney continues to teach and pursue research interests at Virginia Tech. He is currently working on a project to improve the first year survival of stocked striped bass in Smith Mountain Lake.



A Closer Look at Graduate Students:
Focus on David Argent
by Shelley White

Are you getting ready to graduate with a Bachelor's degree in fisheries and have no idea where to head after that? Many students are faced with this question when graduation draws near. Some, however, beat the odds and know exactly where they want to go. If you're lucky you've run into one of these people in the early morning hours, running through the halls of the fisheries department. They're taking last minute messages and packing gear to head out into the field. There they spend their day collecting data that will hopefully prove to be useful when their projects come to an end. These are the fisheries graduate students of Virginia Tech.

David Argent is one of these students who has chosen to extend his college career to obtain his Master's degree. By the time David reached his junior year of undergraduate study he realized that he enjoyed the college atmosphere, and being there another three to four years was a deliberate decision.

David has a Bachelor's degree in Biology from the Indiana University of Pennsylvania. He began with biology-education but soon switched to a curriculum that would better prepare him for a graduate program. As would any other responsible student, he began asking professors what opportunities there were for him. Once Tech presented itself as a school with well known faculty members and programs that offered a diversity of coursework, the choice of where to apply was no longer a problem. David began inquiring with individual researchers and asking them specific questions about their projects and the availability of assistantships. He spoke with Dr. Patricia Flebbe here at Tech. After visiting the department for only a day, Dr. Flebbe made David an offer which he gratefully accepted and thus began his graduate career.

David is currently determining the survival rates of brook trout (*Salvelinus fontinalis*) from the egg stage to emergence under experimental fine sediment loads. He is also studying the relation between the levels of fine sediment and survival in natural redds and the effects that habitat variables, such as dissolved oxygen and water flow, have on them. In order to conduct this research David has been required to put his creative mind to use in the area of construction. To trap his emerging fry, David first assembled small plastic boxes that were designed to hold the eggs and sediment in the bottom of the box but also allow passage for the fry to the top. He then built a small shed-like building on the VA Tech Aquaculture grounds in order to house his artificial living streams. It was in these streams that David placed more boxes to to compare to the natural environment. It all sounds like too much for one person to handle but David wouldn't have it any other way. In his search for a position as a Master's candidate, David ran across many topics but none as intriguing to him as this. He realized that important gaps existed in the literature and that new research needed to be done. David, Dr. Flebbe, and David's advisory committee feel that David is just the person to carry out this research.

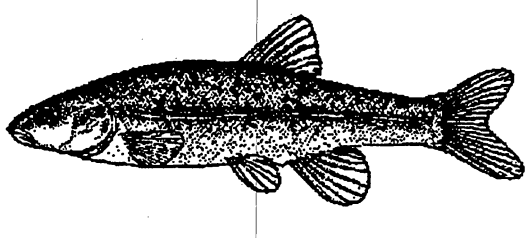
David says doing the field work to this point has been the most challenging, but in two months he's sure he'll say that writing his thesis was much more difficult. David has found that the organization of time will ultimately determine the success or failure of his project.

Not only will David have accomplished academic goals but personal ones as well. I asked him what he thought he would gain personally from this experience. His reply was that he will have proven to himself that he can conduct research in a meaningful manner that proves to be worthwhile for future management purposes. He has also gained an expanded knowledge base and a variety of useful contacts in the fisheries and other departments that will increase his self-confidence about his views on science and his ability to successfully communicate those views.

Both David and Dr. Flebbe see a Ph.D. in David's future. He wishes to head west in the pursuits of furthering his study of fisheries or zoology. She sees his qualifications as being beneficial to an academic department or professional agency as part of a research division. Dr. Flebbe says David has the dedication and the attention to detail that good researchers must consider. Critical thinking is the trait that she would value most in a fisheries major. The ability to stop and think and question those who have come before you is needed to succeed in any competitive field. Dr. Flebbe says that "fisheries is full of notions that have not been tested or tested poorly, but still embraced. We need more people in fisheries research and management who are willing to question the underlying assumptions of what we do."

David's plans include staying close to the college atmosphere. Then eventually some of the undergraduates of fisheries who read this article will decide that this is the direction for them and find themselves studying under Dr. Argent, a Virginia Tech alumnus.

Graduate school seems to be the way to get ahead these days. As fisheries majors we must always question ourselves and each other. Attention to detail and knowledge of current issues make a better student. If graduate school seems to be the calling for you, start making connections now and utilize the resources and faculty offered to you at your own college or university.



Opinions

The "Not-So-Greatest" Show
By Roy Smogor

Did you hear about the state fisheries biologist who quit to join the circus? His resume, under "Experience," read "...fortune-telling, balancing, juggling, impersonations, prestidigitation..." Such work performances seem not so far-fetched given fisheries personnel's apparent mission to give the public what the public wants. A common credo of many fisheries professionals is that their actions must accord with the public's desires. Ringmasters Dingell and Johnson and Wallop and Breaux put the belabored fish managers up on the high wire with no pole and an unforgiving public below. (I've heard some fish biologists describe public meetings in similar terms.) Because the public's wants are as varied as the colors of a rainbow darter or the ways to catch a walleye, fish managers continually must perform a balancing act, placing themselves between the resource and the public. Or is it *merely* that--an act?

If we remove the smoke and mirrors of traditional fisheries management, we view the performance in a different spotlight; it appears less a balancing act than it does a self-perpetuated illusion. Fisheries professionals' biases toward consumptive-use and sportfishing management have created their own tragedy of the commons. Until recently, the tragedy has been the common conception among many professionals--and consequently the public--that fish-resource value equals only fishing. Professional organizations such as the American Fisheries Society have addressed management of wily salmonids, bucketmouth bass, and strapping stripers far more than that of non-commercial or non-sport fishes. By long ignoring other fish-resource values (e.g., educational, religious, ethical, and non-consumptive recreational values), traditional fisheries management has nurtured the illusion that streams and lakes are merely fish farms. The public has been sleight-of-handed right along. Nowadays, when a non-fishing use conflicts with a fishing use, fish managers quickly leap to their high-wire act and bemoan the Pandora's box of issues tugging them from either side below. Fisheries professionals should blame themselves for such a situation. Like a circus barker, traditional fisheries continues to entice, "Come experience the amazing trout. Its colors will dazzle! Its leaps will astound! Your rods will bend!!" But in the traditional- fisheries hall of mirrors, everything is not what it seems and paradox takes center ring.

Witness the trout-stocking program in Virginia. Fish are reared in artificial conditions and fed artificial foods via very real dollars spent. Then they are transported to streams where they disappear by summer. But there is nothing magic about this vanishing act; many streams receiving trout are inadequate trout habitat. The grand finale comes when these non-native trout--some big-enough-of-mouth to eat fish--are stocked in areas harboring imperiled native species. Are state monies spent on recovering threatened and endangered species merely a politically correct way to increase the forage base? It seems so in Virginia, where managers have regularly stocked rainbow and brown trout in streams inhabited by Tennessee dace (*Phoxinus tennesseensis*) or candy darter (*Etheostoma osburni*), two imperiled nongame species (also see article by T. Cain *in* Fisheries vol. 18, no. 7, July 1993).

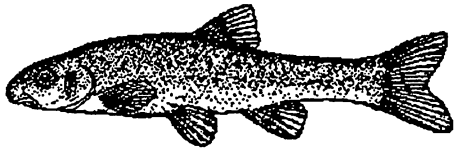
So how may one see through the smoke and mirrors? We often invoke education as the great equalizer of past imbalances. However, if our fisheries management course at Virginia Tech is any indication, upper-level fisheries education appears to be providing the props to traditional management's show. As long as fisheries-science education remains biased towards consumptive-use and sportfishing values, we (the "larval" managers) will remain developmentally constrained. This semester's material exemplifies these biases.

The process of fisheries management was introduced as a balancing of people, fish, and fish-habitat needs. The fish manager was cast as the balancer--*subject to* the weights and whims of the public's desires versus those of protecting the resource. Although the fish manager was portrayed as the potential *controller* of that balance, as well, examination of methods that a manager could use to incorporate or even manipulate public input was wanting. Fisheries managers will escape the perceived treadmill of catering to the public only if encouraged to break from the yoke of traditional fisheries attitudes. Fisheries courses should encourage *pro*active and *inter*active use of knowledge instead of rehashing the *re*active role of the belabored fish manager.

Educators who fail to present traditional-fisheries concepts in novel, more timely ways are neglecting their responsibility to equip future fish managers with an adaptable arsenal of management strategies. The fertile mental ground of a college classroom provides a constructive retreat from the real-life consequences of management techniques or decisions. Innovation in a hypothetical situation (i.e. the classroom) is a low-impact sport; it can't hurt to try new ways of presenting traditional fisheries concepts, especially given the many currently recognized non-fishing values of aquatic resources (e.g., biodiversity). But if population estimation, population dynamics, and yield models are forever presented in terms of stocks and pounds of flesh..., if stocking protocols and condition indices are continually presented in terms of angler-days and "hawg" bass..., how can fisheries educators and managers expect the public to link fish occurrence with watersheds instead of with hatchery trucks? Let's try to estimate the population size of a supposedly imperiled darter species. Let's find out how many individuals we can "harvest" for research purposes without detrimentally affecting the population. Let's learn how to stock individuals in newly restored habitats and how to monitor population growth and reproduction. Most of all, let's learn the *many* worths of doing so.

One light--slowly dawning on fisheries practitioners via educators' efforts--is the importance of habitat and watershed quality to maintaining fisheries resources. Although the "why" of watershed management was presented as a unifying concept throughout our fisheries course this semester, the "what" and "how" of watershed management was given limited attention. In fact, we spent more time addressing how to manage ponds for bluegill and largemouth bass fishing than addressing how to effect watershed-scale improvements of fisheries resources. In all fairness, our fisheries management instructor does teach another course aimed specifically at watershed and stream-habitat management; but even that course maintains a strong sport- and commercial-fisheries bias.

Until fisheries professionals start practicing and espousing broader uses and values of their science, they prolong the one-trick-pony circus of consumptive-use fisheries management. Fish managers *are* gaining some non-traditional allies given the increasing diversity of public sentiment and public-attitude shifts toward non-consumptive fisheries values. Resource managers and educators should not shy from these shifts; but rather they should be *ready and willing* to incorporate new twists on some old themes so that future resource professionals (i.e. we students) will be quite *able*.



Is Live Rock Harvest Killing Our Reefs?
By Ken Griffith

Since 1986 collecters for the marine fishkeeping hobby have been harvesting small amounts of life-encrusted rock from hard bottom areas of the Florida Keys and the Gulf Coast of Florida. As keeping reef aquariums has grown in popularity, the harvest of "live rock" has grown to 400 tons (500 cubic yards) per year in the state of Florida (Freshwater and Marine Aquarium Magazine 1991). This has drawn the attention of environmentalists who claim that the harvest of the rock is destroying the coral reefs. Florida responded to pressure from environmentalists by totally banning the collection of live rock in 1990 on the basis that this was "illegal mining on state submerged lands." Florida went further by banning the landing of rock harvested from federal waters in Florida. This was struck down in court in 1992 because Florida was illegally trying to control fishing in federal waters (Fettern 1994). The environmental lobby has been successful in influencing the federal authorities to place a 400 ton limit until 1996 after which live rock harvest will be banned in federal waters (Wheaton 1994). The question that all this brings to mind is: Should "live rock" be defined as a renewable fishery or as mining, and should there be a limited harvest allowed?

In all of the decision making resulting in the banning of live rock harvest, there have been no studies conducted on the effects of harvest on hard bottom communities or the recruitment rate for the formation and recolonization of new rock. All of the research used by the Florida Department of Natural Resources and the Bureau of State Lands and Submerged Lands was based on studies (none of which were specifically mentioned) of coral reefs rather than the hardbottom communities adjacent to them (Wheaton 1994). According to Jennifer Wheaton of the Florida Marine Research Institute, these studies found that hermatypic corals in Florida waters are at the northern limit of their range and the net accretion of calcium is zero. In other words the reefs aren't adding any new calcium, not from the corals, at least. Forrest Young, a marine life fisherman and live rock collector says that the Florida Marine Research Institute only took into account calcification from one of many possible sources. He says that pink calcareous algae is a major calcifier, and that since he doesn't collect from the actual reefs the rocks he collects are primarily formed by various species of algae and sponge (Young 1994).

Another marine life fisherman, Henry Fettern of Big Pine Key, Florida, did some studies of his own to determine if the harvest of live rock is significantly impacting hardbottom communities. He obtained Bureau of Land Management maps of the entire bottom on the south and east sides of the Florida Keys. He found that there are 163 square miles of hard bottom in that area, with 56 million tons of harvestable live rock, 95% of which is Federally owned. Live rock is harvested by hand and the average thickness is only three inches. One cubic yard of the rock weighs a ton. At 400 tons, the total annual harvest in Florida would barely fill two tractor trailers. Fettern computed that at that rate it would take 300,000 years to completely harvest one square mile of hard bottom, and that assumes that there is no recruitment of new rock (Fettern 1994).

Jennifer Wheaton of the Florida Marine Research Institute suggests that aquaculture is the long term solution to the problem. Live rock fishermen can apply for a permit to dump terrestrial rock into shallow water in hard bottom areas and let it get colonized by the surrounding marine life. This technique takes eight to twenty-four months to produce high quality rock, although it is more expensive than simply harvesting wild rock. Forrest Young agrees with this idea and is one of ten Marine Life Fishermen who has applied for an aquaculture permit since 1989. He complains that it has taken the bureaucracy three years to approve the permit. When asked what he will do when the ban on wild rock harvest takes effect in 1996, he said that he will just focus on fish and invertebrates and leave aquaculturing the rock to someone who does more business. Young said that if rock harvest is totally banned in federal waters that the supply will just shift to aquacultured rock and rock imported from the Carribean and South Pacific.

It appears that live rock harvest is going to be phased out for good in America's waters. Whether this is really necessary remains unknown. It is the opinion of the author that live rock can be maintained as a renewable fishery in Florida waters. The real damage to coral reefs is being done by dredging and mainland construction. Marine life fishermen are an easy target for bureaucrats seeking to appease environmentalists, because they aren't a huge industry with lots of money to defend themselves. Rather than taking on the real problem, it is much easier to hang the little guy who wasn't hurting anything to begin with.

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Fishing Technology

Noise vs. Poison in Biomass Assessment Shootout
By Dan Garren

The days of using rotenone as the primary tool for fish population assessment may be numbered. There is a new method for biomass assessment around now that is gaining popularity with fisheries biologists and aquatic resource agencies worldwide. It's called hydroacoustics, and is developing into an excellent way to analyze fish stocks without injuring the fish or creating smelly, day-three rotenone pickups.

Hydroacoustics have been used since Leonardo DaVinci stuck a tube down in the water to listen to the sounds produced from distant ships underwater back in 1490. During World War I, scientists developed hydroacoustics to the point where they could gauge the location of vessels by measuring sound waves echoing back from their hulls, and determine the depth of water by measuring how long it took for a sound wave to bounce off the bottom (Ransom, 1991). After a while, fishers caught on to the uses of hydroacoustics - also called sonar - and began using it to locate fish. It wasn't long afterwards that sonar was sophisticated enough to be used in fisheries assessments.

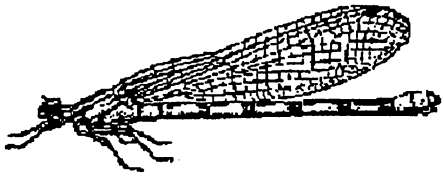
A typical hydroacoustic unit consists of a high-frequency echo sounder, a chart recorder, transducers, and a computer-based processing system. The echo sounder produces, receives, and times the signals used in monitoring. Data from the sounder is fed to the computer and chart recorder, where it provides a record of all targets within a predetermined limit. The transducer ties the sound and machinery together by receiving the signals.

Hydroacoustic systems typically collect a variety of data on individual fish, including distance from the transducer, time of entry and exit from the beam, direction of travel, trajectory angle, velocity, and acoustic size (which can then be related to actual fish size). This technology is sensitive enough to differentiate minnows from leaves and twigs, and fish from clumps of aquatic vegetation. However, these systems have a hard time collecting data near the surface or shoreline, due to water turbulence that interferes with the signals.

Hydroacoustics is used for mobile survey evaluations of fish populations in lakes, rivers, and bays. They are also used stationary in the intake of dams to study entrainment. These surveys are generally an efficient way to sample a large lake or reservoir. The main problem with a survey conducted with this technology is that fish species cannot be identified. Researchers have had some success identifying species by their acoustic signatures in the lab, but as far as field studies go, there have been no reliable results. Another problem is the need for training for users of hydroacoustic equipment. Being a technical monitoring system, it requires some instruction before an individual becomes proficient in using the system. Usually there are classes offered by makers of hydroacoustics units for those who will be using these systems.

Probably the best aspect of hydroacoustic systems is the fact that this technology does not interfere with or harm the fish being monitored, nor do they alter behavior of the fish. These systems are not size-selective, which permits users to monitor a wide variety of fish. It is also very cost-effective, compared to other methods which require more labor use. These systems can gather more data over a limited time period than any other method, providing quality, accurate and speedy collection of information. Also, these systems are capable of obtaining data on pelagic species, which are often poorly represented with cove-rotenone studies.

Scott Smith and other fisheries biologists of the Virginia Department of Game and Inland Fisheries have been involved with hydroacoustics on Smith Mountain Lake since 1991. The main problem, according to Smith, is that the resolution is not accurate enough to determine size class. Instead, it gives a range where the fish can fit into. For small clupeids, year classes could be grouped together, creating problems. These biologists found hydroacoustics to be good for counting large fish and getting a number of adults. Again, the range of sizes is too inaccurate for year class work, but it is a good method of obtaining numbers.



When asked about the problem of not being able to identify fish species, Smith said this wasn't a major obstacle in Smith Mountain Lake. He explained that there are relatively few species of clupeids, and by using reservoir stratification and type of habitat combined with gill net samples, it is possible to identify, with reasonable certainty, the fish species as well as numbers. This works especially well on larger fish.

"It's on the edge of being very useful" said Smith, referring to the falling prices and advancing technology of hydroacoustic systems. When technology advances a little further in the next few years, VDGIF will purchase a system. "We would like to replace rotenone with hydroacoustics to count clupeid biomass. At the present stage of development, it could be implemented in the Staunton River to count spawning striped bass moving upstream from Kerr Reservoir. This could be used to determine numbers of fish making this spawning run as well as mortality incurred during these trips."

While it would be nice to eliminate rotenone biomass studies completely, there will always be a use for rotenone. It's function as a management tool is not obsolete, because it could be used for backup assessments to confirm the results obtained by hydroacoustics as well as other uses.

With improvements being made every day on hydroacoustic equipment, it is not hard to see the applications and role it could occupy in management work. Hydroacoustics could routinely be used for entrainment studies in hydropower projects, as well as biomass assessments in rivers, reservoirs, and bays. As technology increases to the point where systems are capable of identifying fish species and more accurate lengths of fish (a goal of hydroacoustic engineers), as well as being more automated and requiring less attention, they will appear more and more in fisheries assessments. Their use will become more standard in the management of lakes and reservoirs, displacing rotenone as the primary tool for biomass assessment.

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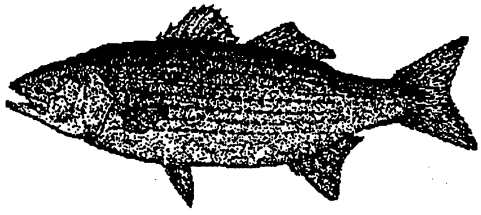

GPS vs. LORAN
By Jeff Thompson

Have you ever been out in the middle of a body of water and found out that you cannot find that one hotspot that you were fishing the other day? This is a common situation that happens to just about every fisherman a few times every season. Fortunately, there are a two types of navigation systems available for us to use. One system is LORAN, which is the tried and true method and the other is GPS (Global Positioning System), the new kid on the block. Both of these systems have unique advantages and disadvantages.

LORAN has been around for many years and has proven itself over time. LORAN is a system that uses radio signals from beacons placed throughout the country. The system uses signals from two beacons to pinpoint your position. The LORAN receiver receives these signals and converts them into LORAN TD's, more commonly referred to as "numbers". These numbers are your position. Due to the fact that the system is driven with radio signals it is susceptible to atmospheric conditions, such as storms. This is one of the major disadvantages of LORAN because some days the system will work great while others it will not. The second disadvantage of the system is that it will only work within the range of the various beacons positioned throughout the world. The third disadvantage of the system is that it does not provide second to second updates of information, it takes from a few seconds to almost a minute depending on the receiver and atmospheric conditions. The final disadvantage of the system is that it generally will not deliver pinpoint accuracy. The accuracy of the system generally ranges from 10 to 35 m. However, LORAN is the best system when it comes to repeatable accuracy, being able to continuously guide you back to the same spot over and over again with little variation. Also, since LORAN has been around for many years the cost of the system is relatively cheap. For example you can buy a quality LORAN receiver for less than $300. Another thing in favor of LORAN is that most people use it, and therefore it is easy to exchange LORAN numbers with other people.

In comparison to LORAN, GPS is the new kid on the block. GPS is a navigation system that is driven by an array of satellites in orbit. This system was originally intended for the sole use of the U.S. military as was shown in the Persian Gulf War, but the system has since been opened for civilian use. The GPS receiver works much in the same way as a LORAN receiver only that instead of reading radio signals they generally can track and read the signals from up to 8 satellites simultaneously and give your position in latitude and longitude coordinates (Lat/Lon). This

use of multiple satellites increases accuracy tremendously, approximately 3 to 5 m from the intended location. However, there is a catch. Since the system was designed for military use the signals sent to the civilian receivers have an error of up to 100 m. The military has been known to stop the civilian signal from a few minutes to few hours some days. This built in error wreaks havoc with the repeatable accuracy of GPS receivers, for example sending you 100 m north of the point one time and then 100 m south the next.

But thanks to a technology that came out a couple years ago the built-in error can be overcome. This system, dGPS (Differential Global Positioning System), employs the GPS satellites and landbased radio beacons. Basically a radio receiver is added to a GPS receiver and the two work together to provide your position, but you must be in range of the beacon. The use of dGPS can increase the repeatable accuracy of your system to approximately 3 to 5 m. A big plus of GPS is that it can be used anywhere in the world in any type of weather. This fact makes GPS very popular with anglers who travel to less developed countries, such as those in Central America. The final plus in favor of GPS is the ability of the system to provide updated information once every second. Along with repeatable accuracy problems, GPS has a couple of other problems. The first one being cost, since the average GPS receiver cost around $1000, not including a differential receiver for dGPS which averages $300. The second problem is that very few people have started using GPS and getting reliable Lat/Lon coordinates is a problem.

Both of these systems have allowed the average angler to find once obscure fishing spots with ease. Take for example, a shipwreck thirty miles out in the ocean. Not long ago, only a few captains could find the wreck using compass headings and timings. Now any captain equipped with either LORAN or GPS can locate this wreck with no problem at all. This has a consequence of increasing the fishing pressure on all of the fish found on these wrecks such as black sea bass, tautog, cod, pollock, etc. Due to the nature of these fish they are very vulnerable to overfishing. All these species live in a confined habitat and fishermen know where those areas are. If the fish are not on one wreck they will go to the next to try and locate the fish. Once the fish are located, fishermen will try and catch every fish on that wreck. Cod and pollock have declined noticeably in the past few years due to this type of fishing pressure. While not all of the blame rests with these systems, some of the blame can be attributed to them.

Due to the ease of use of both systems, GPS and LORAN, and the fact that fishing pressure has increased tremendously in the past few years many new regulations may come into effect. Because of safety considerations banning the navigation systems is out of the question; therefore other methods must be found to limit the number of fish harvested. One of the methods could be limiting the number of boats allowed to fish through a permit system. Another method would be individual transferable quotas (ITQ) in this method the number of fish taken per boat would be limited. While both of these methods would be fine for a commercial fishery other methods would have to be found for a recreational fishery. These regulations could incorporate seasons, bag limits, a recreational quota, and even permits. Length limits would be unreasonable because of the nature of the fishery, that being deep water. The fish would experience an extremely high release mortality because of the pressure differences. So in other words it would become a "you-catch-it-you-keep-it" fishery. While these regulations may not be popular with the fishermen, they may be the only way to save these fisheries.

Both systems are very similar in their operation. For example, if you found a school of fish on a wreck one day and wanted to fish the same school the next day, either one of the systems would be helpful. First of all, on the first day record the position you found the fish in your log book and put them into memory in your receiver. Second, on the next day you would then navigate to the previous day's position using your receiver. However, most of the time you will not be exactly on the same spot, so you will have to use the following procedure. First, navigate to where your receiver told you to go, turn on your fish finder, and then drop a large highly visible buoy. Second, slowly start a circular search pattern that starts at the buoy and progressively gets larger the further you are away from the buoy, all the time keeping an eye on your fish finder. Finally, when you see the wreck show up on your fish finder throw out another buoy, record your position, and start fishing. This procedure can be used for other applications, such as finding a net put out the previous night and locating the same sample spot year after year. GPS and LORAN are going to remain the primary means of navigation for many years to come. LORAN has been around for many years, and it is still very good and reliable. The Coast Guard has said that they will not close any of their LORAN stations anytime in the near future, so LORAN will continued to be used. GPS, however, is the future of navigation; once all the satellites are in orbit, the error is taken out, and the prices come down, GPS will become the primary system.

College:

A place where pebbles are polished and diamonds are dimmed.

History of Fishing Technology
By Michael Brooks

Over the past 50 years fishing and fishing technology have greatly improved. Long gone are the quiet coves, row boats, father and son trips, and bamboo rods. They have been replaced by over populated waters, roaring bass boats, tournaments and rods composed of many different materials. With these advancements many companies and corporations rapidly turned their efforts to producing and inventing products solely for fishing. Some companies actually went from producing products that had nothing to do with this sport to being the number one affiliates. The equipment has advanced from the simple, hand-carved products to computer-robotize products where the human does not touch the product until the end. These advancements have caused the overall sport of fishing to increase drastically therefore putting more pressure on the resource and the agencies managing the resource.

The history of fishing is clearly defined since the advancements in the field were so drastic and revolutionary. Before the 1940's, fishing consisted of a hand-carved bamboo pole, a heavy metal reel, a wire line covered with silk and a hand-carved lure or bait. The angler would adventure onto the water in his wooden boat or canoe, which was usually hand-carved or built, and row to his favorite spot. At the end of the 40's and start of the 50's this scene would soon change with advancements in technology and the desire to catch more and bigger fish.

In 1949, Zebco, which originally was a bomb manufacturer, introduced the Standard, the first true spincast reel. This single invention drastically changed the art of fishing and how it will be perceived in the upcoming years. It allowed anglers to cast more efficiently and further which increased their success on trips. The next innovation was with the use of electronics. In 1958 Carl Lowrance introduced the "gray box", a crude bottom finder and the "red box", a sonar unit. These innovations allowed anglers to detect bottom substrate and structure where fish were likely to be found, therefore eliminating areas that were unproductive by trial and error (pre-tech) fishing. In 1959, DuPont introduced the monofilament line which replaced the wire/silk line. This invention allowed the reel to hold more line enabling the angler to cast the lure further and more accurately. In 1969, Tom Mann invented the Humminbird depth finder which at the time was convenient to have but not essential. Today it is doubtful that any boat in the water is not equipped with one. It not only graphs and charts the substrate, but it also locates actual fish and schools of fish. This undoubtly increased angler success and efficiency.

After the introduction of casting reels in 1976, a modification was needed to control the revolutions of the spool to reduce backlash which decreased fishing success. In 1981, Diawa and Penn solved the problem by incorporating magnets into the reel. In 1984 the liquid crystal recorder was introduced. This combined the use of flashers and paper charts which also allowed the angler to detect bottom substrate and locate fish in a more efficient manner.

The lures also went through a series of changes to increase their action, range and fishing success. The first lures were hand-carved by individuals that had a great desire to fish. Some well known carvers were Tom Mann, Bill Huntley and Nick Creme. During the early 70's, Fred Young changed the appearance and action of crankbaits from a slow, lazy action to one that had more action and could be retrieved faster with the advanced reels. From his improved balsa lure, companies switched to plastic and concentrated on depth instead of wobble action to cover more preferable habitat that aquatic species dwell. The new territory which the lures offered, drastically increased both fishing pressure and success rates.

Worms changed from a natural color with two hooks and beads to a variety of colors with different tails and bouyancies with several different types of hook positions. In 1973 R. J. Bensen introduced the curve-tailed worm which was illegally copied by several manufactures since it was so successful. Several other improvements occurred in the world of lures but only as to fine tune the ones already on the market.

Finally, the drastic changes in boats and their accessories revolutionized fishing. The old boat consisted of a wooden frame with seats down in it, an anchor, and rowers or a small engine. This "skeeter" was first built by Holmes Thurmond in the town of Shreveport, La. In the early 50's fiberglass came along and started the advancement of boats. In 1975 Ranger released what is now the definition of bass boats. This boat included gas tanks, live wells, a bilge pump and other features that makes fishing more efficient. After the initial structural changes, luxury products were arising at an enormous rate to increase fishing success. In 1965 trolling motors were added to the frame of the boat which allowed more water

surface area to be covered in a shorter time. In addition, electronics were introduced and included in instruments for measuring depth, temperature, oxygen, fish and structure were added to the boats. All of which detect areas in water where fish are more likely to reside.

The past and future changes in fish technology have a direct effect on fish management. This is obvious since this technology is providing anglers a more efficient way to catch fish. Because of this increase in catch, along with more constituents, the agencies will have to manage the resources more effectively and efficiently to handle the increasing pressures.

For the agency to compensate, it will have to make several changes in its policy and management of resources. For one, the agency must be more proactive in its relationship with the public. This includes not only informing the public, but listening to their wants, desires and what they feel are important issues and ways to include them into the management plan. The staff of the agency must also increase in proportion with the constituents so that the agency employees will not become over-burdened. Finally, agencies should employ Virginia Tech graduates that have the education and dedication to accomplish these tasks.

A New Breed of Ultralight:
By Damien McMahon

There is a new breed of ultra-ultralight tackle on the market today that is much lighter that what most anglers are accustomed to. There are countless numbers of manufacturers making products in order to please a new breed of angler. The new ultra-ultralights are now having great impacts on fish, fishermen, fishing, and fisheries management.

Up until recently, if you asked the average angler what ultralight fishing consisted of, the common answer would be, "a small reel loaded with 4-6 lb test and a 4 1/2 to 5 1/2 foot rod rated from 1/32 to 1/4 ounce". To me, anything over 1/8 ounce was never considered to be ultralight; but I was the extremist exception - not the rule. Historically ultra-ultralight angling consisted of a small secretive group of fishermen. These anglers went out of their way to equip themselves with custom and modified gear, borrowing heavily from fly fishing.

When this modified gear made its way on to television fishing shows, the average fishermen got their first glance and became interested. They saw how much fun and how successful this type of fishing could be. At that point there still was not a market for this type of equipment. Today the anglers' consumer demand has forced the production of the "New Breed" of ultralight tackle. These ultra-ultralights have already become an integral part of the angling mainstream.

The following is a brief overview of some of the "new" ultralight tackle on the market today and some of the effects on fishing. I have taken the following descriptions from the Cabellas and Bass Pro Shops 1994 Spring Catalogs. These catalogs have a vast selection of ultra-ultralight tackle at some of the lowest prices anywhere. I have listed these items in alphabetical order according to the manufacturers' names.

Bass Pro Shops Pro lite jigs are tiny marabou jigs ranging from 1/100 to 1/32 ounce. They are available in nine different colors and were designed to be used with fly fishing tackle but are perfectly suited for todays' ultra-ultralight tackle. These jigs are capable of catching trout, crappie, bass, and bream; as well as many other species of fish. The extremely small size of these jigs makes them perfect for situations when fish are overly spooky because they make almost no splash when they enter the water. The small size also allows the angler to keep the bait in the strike zone longer because a 1/100 ounce jig sinks at such a slow rate that it just hangs in the fishes' face. The slow fall and compact size also makes this jig a great choice for cold water fishing. The size 14 or 16 single hooks on these baits make for easy catch and release with minimal damage to fish.

Fenwick Liteline is specifically formulated for ultralight reels. Ultra-high tensile strength, small diameter, and controlled flexibility are the main features of this low visibility line. Since this line is offered in one, two, three, and four pound test, it is the perfect component for ultra-ultralight rods, reels, and especially lures. The threadlike diameter of this monofilament makes catching fish in clear water much easier. Thin diameters also give lures unrestricted action; making them more effective. One or two pound test allows for longer casts with tiny lures or unweighted baits.

Manns Stretch 5+ is a 2 1/2", 1/10 ounce crankbait that features a unique lip design and front kicker plate. This new design enables this lure to dive almost straight down with reduced resistance. This is useful for ultra-ultralight tackle because a bait can nearly double over a light rod during a retrieve. The Stretch 5+ also gives the fisherman a bait that has a larger profile than its' weight dictates. This is good for those situations when the fish are focusing on larger forage and ignore smaller baits.

Quantum has introduced the first ultra-ultralight rods and reels to the market; their Micro Fishing System. These rods and reels are designed for super-ultralight fishing, which entails 1-4 lb line and up to 1/16 ounce lures. Micro rods come in either come in the lighter action fiberglass models or solid graphite when sensitivity is a must. Micro reels come in both spinning and underspin models with either two or five ball bearings depending on the price you want to pay. The Micro system will revolutionize ultra-ultralight fishing because these rods and reels are the first of their kind to be mass produced and offered at reasonable prices. These rods and reels make it easy to cast and control light lines and lures. The "noodle" action of Micro rods also aids in fighting fish on light lines. If a fish decides to make a sudden move, these rods are very forgiving and allow a lot of shock absorption to prevent some breakoffs.

Rapala offers a 2", 1/16 ounce version of its' famous floating minnow. Because of its' lifelike swimming action, lightness and precision construction, it is a very versatile lure. It can be fished with a steady retrieve or as a jerkbait. This lure will catch almost anything that swims.

Rebel has a whole line of plugs catering to the light line angler; its' Ultra Lights. All of these lures weigh just 1/10 ounce and come in lifelike colors. The Teeny Wee Frog is a great bass lure when fished around weeds, grass, and lily pads. The Crickethopper is a cricket/grasshopper imitation that is great for panfish and bass when it is twitched on top of the water. The Rebel Hellgrammite is the newest member in Rebels' ultra light crankbait family. It is designed to scoot along the bottoms of rivers and streams and it will also catch almost anything that swims. The Rebel Tadfry has an action that is somewhat between a tadpole and a minnow; it is great for anglers who enjoy crankbait fishing. Rebel has also produced a 1/8 ounce, downsized version of its' famous Pop-r called the Teeny Pop-r. This is a great topwater lure which attracts bass and other gamefish with its popping and gurgling sounds. Rebel also manufactures the Teeny Wee Crawfish dubbed "the most popular ultralight crawfish in the world". Its' small size allows it to attract and catch all sizes of gamefish.

Shakespeare successfully combines quality and value in their Ultralite reels. The 2500ULX holds 110 yards of 4 lb test and weighs just 5.7 ounces because of a lightweight graphite frame. The 2500ALX also holds 110 yards of 4 lb test and has two ball bearings. These reels are dependable, smooth, and long lasting for a very modest price. This is the type of deal that puts new ultra-ultralight tackle in everyones' hands.

Tectan Premium monofilament was designed to have a super-high tensile strength and a smaller diameter than other premium monofilaments of the same test. This line is manufactured in Germany and is guaranteed to have a higher knot break strength to diameter ratio than any other monofilament. It is available in 2.2 and 3.3 lb test. Tournament green color is almost invisible underwater.

Zebco has just introduced the Rhino Lite RL3 spincast reel that is perfect for the ultralight angler who prefers spincast gear. It weighs just 3.8 ounces, has 4.4:1 gear ratio, and is pre spooled with 60 yards of 4 lb test. Zebco also offers a Rhino Lite 2 triggerspin which combines under-rod balance with spincast simplicity. It has a 4.4:1 ratio and is spooled with 60 yards of 4 lb test as well.

Others - there are many other manufacturers who are now producing products that can be used with ultra-ultralight equipment. Countless numbers of spinners, spoons, and soft bodied jigs can be found in sizes 1/8 ounce and lighter. I suggest that you look in the latest Bass Pro Shops or Cabellas catalog for further selections because many stores and tackle shops do not have that great of a selection.

One reason that this new breed of ultralight has made its' way into the fishing mainstream is because of the effects of fishing pressure on angling. In many lakes and streams the fish are becoming fewer in number and much harder to fool into striking. The only way to consistently take fish under these circumstances is to downsize your tackle in order to make a more convincing presentation. In some places, it is almost necessary to use 2 lb test or less to catch a single fish.

While catching fish under tough conditions is the selling point behind this tackle, the fun of fishing with it is what keeps anglers hooked. Fishermen are now discovering what giving fish a fighting chance is all about. It is exciting to hook a 20 lb carp on 2 lb test; no, make that gut-wrenching, but the satisfaction of landing just one is immeasurable. Ultra-ultralight finesse is a acquired skill, but with a little practice and a lot of patience, anyone can learn the fundamentals with this tackle. Even catching a small fish is a memorable experience.

I believe that using this ultra-ultralight gear gives anglers a reborn sense of respect for the fish that they catch. This tackle helps them remember how valuable the fish are in a sporting sense instead of how good they taste on the table. This tackle breeds conservation and the idea of catch and release. It is amazing what giving a fish a greater chance to escape does for their value when one is finally caught.

This tackle also opens up new fishing opportunities for the innovative angler. How about catching your own bait on rod and reel? Ultra-ultralight rods, reels, and tiny hooks combined with a bit of worm or bread are the perfect way to catch a bucket full. Suckers, shiners, minnows and bream all put up an excellent fight when hooked on the right gear. Anglers might never get a chance to use this bait though, because they might be having too much fun to stop.

This new interest in catch and release needs to be accompanied by education because the chance of totally wearing a fish out on this light tackle is great. Fisheries people need to emphasize the correct way to land a fish before it reaches a state of excess physical strain and cannot survive. Pamphlets and seminars on proper fighting and handling techniques are essential for assuring survival of captured and released fish. We as fisheries mangers can ask for help from tackle manufacturers to accomplish this task.

Another possibility for fisheries is to create special "light line waters" which are similar to "fly fishing only" waters. Putting line class restrictions on a section of stream or lake could reduce the amount of angling activity in previously overfished waters. Since this type of fishing also promotes catch and release, it also gives these waters a chance to recover quickly. The concept of "Light line waters" could become an important tool in for Fisheries Managers in the know. "Light line fishing only" would also be a good choice for streams that are too tight to fish with fly gear. This way anglers can reach fish with little effort. Spinning and spincast reels do not need much room for a baitcast, so no riparian cover needs to be removed, as it does on some long rod waters.

The new breed of ultralite will bring many new opportunities to fishing and fisheries. This gear shows changing trends in angler attitudes in that there is more care for the fish. Sportsmen and mangers need to work together to assure that fishing can be enjoyed by many more generations to come. So give this "new" tackle a chance - it might be the greatest innovation since the plastic worm.

Research To Solve Tomorrow's Problems

Can Brook Trout Be Saved from Acid Precipitation?
By Mary Tokarcik

An increase in anthropogenic sulfur dioxides and nitrogen oxides during the recent decades has led to increased amounts of acid deposition and depressed pH levels in lakes and streams in the eastern United States (Cleveland et al. 1986). In conjunction with this increased acidification, the concentration of aluminum has also increased (Jordahl and Benson 1987). As a result of the toxicity of these two conditions, the biota of these streams have been severely impacted.

Brook trout (*Salvelinus fontinalis*) are the only stream-dwelling salmonid native to the eastern United States. They typically inhabit headwater streams (first to third order) due to their requirements for cooler water temperatures (Hunter 1991). While historically they were found in the lower reaches of watersheds, the introduction of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) to these areas and the subsequent competition has further isolated the brook trout to small, mountain streams (Habera and Strange 1993). However, it is this isolation that is indirectly responsible for the impact of acid deposition on the brook trout.

The impact of acid deposition is greatly determined by the geology of the watershed. In the eastern United States, brook trout streams are largely underlain by sandstones and shales which offer little buffering capacity to acidification, having acid neutralizing capacities (ANC) less than 200 ueq/L (Carline et al. 1992). This low ANC results in a decrease of stream pH, either episodically due to a storm event or snow melt, or chronically due to long-term exposure. This elevated acidity, if acute, can be toxic to adult brook trout, as well as result in reduced growth rates, reduced food availability and behavioral modifications (Kwain and Rose 1985). However, most of the decline in these eastern fisheries has been attributed to exposure during early life stages (Gunn 1986, Kwain and Rose 1985, and Cleveland et al. 1986, Jordahl and Benson 1987, Curry et al. 1991).

The susceptibility of early life stages to acidification is due to the incubation of eggs and the emergence of alevins during periods of acidic snowmelt (Gunn 1986). When eggs were subjected to various pH levels in a laboratory setting, egg mortality was found to increase in response to increased acidity

(Cleveland et al. 1986). The eggs incubate until late February to early March when they emerge (Hunter 1991). This life stage is believed to be the most susceptible because of the high probability of acidic snowmelt runoff during this time of year (Gunn 1986). It has been suggested that the exact timing of emergence is triggered by increases in discharge associated with snowmelt; however it is not known if this is due to the avoidance of reduced pH or rather the avoidance of elevated flows and the resulting siltation (Curry et al. 1991). When they do emerge, survival of yolk-sac larvae were found to be significantly lower in acid streams when compared to circumneutral streams (Jordahl and Benson 1987). Similar results were found when larvae were hatched at different pH levels in a laboratory setting (Cleveland et al. 1986 and Kwain and Rose 1985). Much of the mortality observed during emergence in these studies was the result of incomplete hatching. The shedding of the egg capsule during hatching is aided by the enzyme chorinase, which is inhibited at low pH (Jordahl and Benson 1987). This inhibition occurs at levels of 5.0 pH and lower and results in the prolonged shedding of the egg capsule which causes damage to the yolk-sack (Kwain and Rose 1985).

Once the brook trout have emerged, some larvae die immediately from the shock of leaving the alkaline ground water of the redd and entering the acidic conditions of the stream. This mortality is probably the result of the failure of blood ion regulation (Gunn 1986). Once in the acidic surface water, the larvae may not survive the physiological stress of the acid conditions. At 5.0 pH and lower, the expansion of the gill filaments during the alevin stage is retarded as is the development of the gastrointestinal tract (Kwain and Rose 1985). When daily growth was measured in larvae that were exposed to various levels of acidity, the rate of growth was found to decrease at levels less than 4.5 pH. In the same experiment, growth rates were also found to decrease when the fish were exposed to levels less than 5.0 pH and 300 µg/L aluminum (Cleveland et al. 1986).

Besides the numerous physiological stresses they must endure after emergence, the fish also suffer behavioral aberrations due to the elevated acidity. When exposed to levels below 4.5 pH, the larvae remained near the bottom of the holding chambers, often swimming on their sides or backs and were unable to maintain position against water flow (Cleveland et al. 1986). These same behaviors were also found in field observations of newly emerged brook trout larvae (Jordahl and Benson 1987). When fish that were exposed to acidity and elevated aluminum levels were presented with *Daphnia* and brine shrimp, the prey-strike frequency was much lower than that of fish which were raised in neutral conditions (Cleveland et al. 1986). This behavior is most likely a result of the reduced locomotion.

Once the brook trout become adults, the impact of decreased pH levels on their physiology continues. The regulation of blood ions is inhibited by increased acidity and may cause mortality in adults (Gunn 1986). Lowered pH has also been found to depress growth rates; however this is suspected to be due to episodic acidification, and fish which are subjected to chronic pH levels may acclimate and grow at normal rates (Kwain and Rose 1985). When subjected to elevated levels of acidity and aluminum concentration, precipitation and coagulation of aluminum hydroxides occurs on the gills of adult brook trout. This results in the accumulation of mucus on the gill filaments as well as gill damage which can cause mortality (Cleveland et al. 1986). The high concentrations of aluminum that result from acidification also inhibit the fish's ability to regulate sodium (Carline et al. 1992).

In addition to physiological difficulties, acidification causes numerous behavioral anomalies in adult brook trout. Most notable is the avoidance of areas that have been experimentally acidified to pH levels of 5.0-5.5 (Gunn 1986). Acidification also may result in inhibition of spawning, the cessation of feeding, reduced swimming abilities and the interference of olfactory senses (Gunn 1986).

The high mortality of brook trout due to acidification during hatching and emergence is largely responsible for the losses of brook trout populations in the eastern United States (Kwain and Rose 1985). This high mortality can be attributed to acid snowmelt episodes during these life stages (Curry et al. 1992). The discovery that acidification is causing these changes in population structure has led to alteration in management practices. In streams that were historically stocked with rainbow and brown trout, now only brook trout are stocked and only after early season high flows had subsided, to prevent the physiological and behavioral damage that depressed pH levels can cause (Carline et al. 1992). In Pennsylvania, the Pennsylvania Fish Commission has ceased stocking brook trout in streams with a base flow pH less than 5.7 and aluminum concentrations greater than 200 µg/L (Carline et al. 1992).

While other states have altered stocking techniques to counteract the impacts of acidification, West Virginia and Virginia have attempted to restore the water to its natural condition. In West Virginia, the streams are not only being degraded by acid deposition, but also by acid run-off from abandoned mines. To ameliorate these impacts, the West Virginia Department of Natural Resources has built

rotational drums filled with limestone at the headwater of some of their acidic streams. The stream flows through these drums and is neutralized by the limestone gravel. While this technique has been successful, the money and time required to maintain the drums make them an inefficient method for treating acidic streams (Ivahnenko et al. 1988)

In Virginia, the Virginia Department of Game and Inland Fisheries (VDGIF) is working together with the George Washington National Forest to directly apply limestone fines to the stream bed -- a technique called point source application. In 1989, Little Stoney Creek was treated with limestone fines to elevate the pH levels which had depressed to the range of 5.0-5.5. Two years later, they observed an increase to pH of 6.5, increase in brook trout abundance of 550%, and an increase in the richness of the macroinvertebrate community (Mike Odom, VDGIF, personal communication). This means that a more stable food base is available for improving the population of brook trout.

In more recent efforts, the George Washington National Forest is conducting an extensive examination of the impacts of liming upon the Fridley Gap watershed. Fridley Gap contains two first order streams, Mountain Run and Fridley Run. It lies entirely upon a sandstone formation, and therefore has little buffering capacity provided by the geology (Bent 1960). Historically, this drainage was known to support a brook trout fishery, as well as populations of blacknose dace (*Rhinichthys atratulus*), mottled sculpin (*Cottus bairdi*), longnose dace (*Rhinichthys cataractae*) and fantail darter (*Etheostoma flabellare*). However, an electroshocking survey on Forest Service property in 1993 showed that the upper reaches of the drainage contained no fish, and that the lower reaches contained only brook trout. In addition, a study of the invertebrate community showed that a considerable decrease in taxa richness had occurred. Because a small patch of limestone occurred in Mountain Run providing pH's of 6.8, a comparison of the benthic community prior to acidification was possible: acidification has caused a loss of six families of aquatic insects, a general loss of taxa richness and a food base dominated by small shredding insects (Nemouridae, Leuctridae and Chironomidae).

Because of the severity of the degradation to this community, it was decided in 1993 to conduct a point source application of limestone in an attempt to restore the fishery. During August 1993, fifty tons of limestone sand was helicoptered to the top of the watershed and deposited in the headwaters of Fridley Run. No limestone was placed in Mountain Run so that this stream can be used as a reference for studying the effectiveness of the lime treatments. The effects of the application upon the water quality were immediate: The pH increased from a mean of 4.5 to the range of 6.0-6.5. During October 1993, brook trout from another stream on the forest were transplanted to Fridley Run and the initial evidence suggests that not only are these trout surviving, but they are also growing. Currently, efforts are underway to reintroduce some of the non-game species back into this area; blacknose dace will be collected from the lower reaches of the watershed and placed in Fridley Run. If their stocking is successful, it leads the way for the reintroduction of other species, such as longnose dace, mottled sculpin and fantail darters.

While the recovery of acidified streams seems to be possible, much more research needs to be done to refine these management techniques. Perhaps the best management strategy towards the protection of brook trout fisheries from acid deposition is the initiation and continuation of monitoring programs (Carline et al. 1992). Currently, monitoring efforts are being conducted by the University of Virginia in Shenandoah National Park, the Virginia Trout Stream Sensitivity Study (VDGIF) and the National Stream Survey (USEPA) (Camuto 1991). This accumulation of data will allow an estimation of the losses incurred by the brook trout fisheries in the eastern United States upon which future management decisions can be made.

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Dumping Cold Water on Reproducing Smallmouth Bass (*Micropterus dolomieu*) in the Jackson River

By J. Wesley Neal and Cheryl L. Saben

Preface

The Jackson River is a classic example of the dilemna fisheries managers face when making a management decision. On one hand, there are the traditional users of the river, mostly locals, who swam and fished on a regular basis. On the other hand, there is the increased business from the "out of towners" who drive in to fly fish the newly ordained trout stream. From the naturalist's point of view one must ask "Who has the right to trade off the existing fishes for new and exotic species?" But the manager's view must be "Which fishery has the greatest overall value?" Decisions like these are never easy.

This following study of smallmouth bass reproductive success began as a class project. As an avid smallmouth bass angler on the Jackson River, I became concerned when I witnessed the immediate disappearance of the bass following the change in temperature regimes. It soon became apparent to me that the fish were not recovering from the initial shock of the change, and I jumped at the chance to study the problem when the opportunity arose. Being simply a class project (unfunded and under extreme time constraints) this study has obvious limitations, but my goal was to raise the idea that perhaps the release was too cold. Many systems support healthy populations of both smallmouth bass and rainbow and brown trout, and indeed the Jackson contained trout before the temperature alteration as well. Perhaps more intense studies can shed some light of the fishery and ultimately answer the question: Is there a happy medium where both fisheries can prosper, and is this type of management preferable to the current strategy?

Abstract

Smallmouth bass spawning success was examined below the discharge at Gathright Dam, Virginia, to determine the effects of coldwater release on recruitment. No young smallmouth bass were seen in each of six study sites influenced by the coldwater discharge, while 27 fish were found in the reference. This indicates that a dam effect is occurring that results in either the failure to spawn successfully or failure of fry to survive to the juvenile stage. Temperature was believed to be the factor influencing reproductive failure, for release temperatures rarely exceed 15.5°C which is at the low end of spawning requirements. Food base constraints were ruled out due to high concentrations of both Ephemeroptera nymphs (420/m^2) and Diptera larvae (580/m^2), and water quality was suitable. We hypothesize that interspecific competition with introduced trout was not limiting to smallmouth bass, given that the reference site was a heavily stocked put-and-take trout fishery.

Introduction

The Jackson River in the mountains of western Virginia has been a respectable smallmouth bass (*Micropterus dolomieu*) fishery since the introduction of the species more than a century ago. Recently however, angling success for smallmouth bass has greatly decreased. This decline in bass numbers coincides with the controlled drop of water temperature in the spring of 1990. At this time, the U.S. Army Corps of Engineers modified withdrawal of water by the multi-level intake tower at Gathright Dam (U.S.A.C.E. 1993). Previously, water was withdrawn from the warm epilimnion to be released into the tailrace below. Now the water is pulled from the cooler metalimnion with summer water releases rarely exceeding 15.5°C. In an attempt to better understand why this population crash is occurring, we initiated this study to determine the factors involved in smallmouth bass population dynamics.

Smallmouth bass begin spawning in mid-April, when water temperatures exceed 15°C (Lukas 1993), but mean temperatures at the onset of spawning range from 11.6°C (Phelan and Philip 1990) to 20°C (Gerber and Haynes 1987). Therefore, we hypothesized that maximum temperature at release from the mixing tower is not sufficient for spawning to occur. During the spring and early summer when spawning hypothetically takes place, the water is released at 15.5°C and gradually warms as it moves away from the impoundment. If our hypothesis is true, our results should show higher densities of smallmouth bass young-of-the-year with increasing distance from the dam. Unfortunately, no smallmouth bass were observed. Other factors that might impact YOY densities such as food base, DO, pH, and alkalinity were sampled as well in order to eliminate these as causes of density fluctuations.

Methods

We examined six consecutive sites beginning with site 1 less than 0.5 miles below the dam to site 6 more than 16 miles away (Table 1). Sites were determined based on similarities in velocity, depth, substrate, as well as availability of access. Velocities ranged from 0.01 m/s to 0.18 m/s, and were extremely variable within individual sites. Depth ranged from 0.5 to 1.5 m, with an average of approximately 1.0 m. Substrate size was fairly uniform, with higher levels of siltation nearer to the release and small rocks and cobble dominating with increasing distance. In addition to the six sample sites, one reference site with the same characteristics was examined above the impoundment. The only variable examined at the reference was density of young-of-the-year (YOY) smallmouth bass.

To count YOY bass, each site was divided longitudinally into quarters, each enclosing one transect. On October 24, 1993, we snorkeled each transect for fifteen minutes, resulting in one hour of observations per site.

Table 1. Sites, distance from the dam and cold-water discharge, and number of smallmouth bass observed.

Site	Name	Miles from Dam	Number
	Reference	Upstream	27
1	Dam	0.5	0
2	Johnson Spring	3.6	0
3	Smith Bridge	7.6	0
4	Indian Draft	9.8	0
5	Clearview	14.7	0
6	Intervale	16.2	0

Two Surber samples were collected per site from habitats less than 0.5 m deep near the end of each pool. The samples were placed in approximately 5% formalin to be preserved for diet analysis. Water samples were taken as well to determine pH and alkalinity. A standard pH meter was used to analyze the water samples, and titration with acid was used for alkalinity. Also tested at each site were dissolved oxygen levels and temperature, both determined using a YSI DO meter.

Results and Discussion

No fish were seen at the sample sites indicating that none or few YOY bass were present in the stretch (Table 1) The reference site was examined to rule out the possibility of an overwintering effect in which the smallmouth bass would school or hide. The presence of smallmouth bass in the reference indicates that any fish in the sample sites should have been observed. Therefore, it is a sound assumption that YOY bass did not survive from the time of spawn until the time at which the samples were taken, or spawning did not occur at all.

YOY smallmouth bass populations are affected by many variables including water quality, food base, competition with other species, and water temperature. The overall quality of water in the sample area is good, with dissolved oxygen at or near saturation and pH approximately neutral. Alkalinity is moderate (60-70 ppm), and does not appear to be a problem when compared to the pH readings.

The survival of first-feeding smallmouth bass is dependent on their foraging success. It has been shown that foraging inefficiency can result in mortality through poor growth and susceptibility to predation (Ivlev 1961: Werner 1979: Easton and Orth 1992). Inefficiencies can arise from several factors, including low food base densities, intra- and interspecific competition, and decreased metabolic rate.

Surber sample analysis from each of the six sites suggests that the aquatic invertebrate food base is not limiting in this system. Easton and Orth (1992) found that swim-up diet consists mainly of Diptera larvae (especially Chironomidae) and microcrustaceans. As total length increases, their diet shifts to Ephemeroptera nymphs. Abundance of these two orders in the samples exceed a minimum of 323 and 1135 per square meter, respectively, ignoring the silt-laden site 1. King et al. (1991) found relatively similar densities of Diptera (580/m^2) and Ephemeroptera (420/m^2) in the North Anna River, Virginia, which supports a healthy population of smallmouth bass.

The apparent abundance of aquatic insects also suggests against potential exploitative competition between smallmouth bass and rainbow (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*). In addition, Ebert and Filipek (1991) found that rainbow trout and juvenile smallmouth bass often utilize different feeding habitats. These results were taken from a put-and-take trout fishery, however, and might not be representative of an established population. Nevertheless, any competition that might occur is not represented in the insect densities of our samples.

Temperature is probably the most crucial factor in the early life history of the smallmouth bass. In particular, it affects spawning, egg and larval incubation, and growth (Armour 1993). Spawning is extremely temperature dependent and does not commence until water temperatures exceed 15°C (Lukas 1993). A study on the New River, Virginia, indicates that egg deposition occurs mainly at 16.1-18.3°C (Graham 1984). The new temperature regimes on the Jackson River approach yet rarely exceed these minimum temperatures. Summer water temperatures in 1991 ranged from a low 14.4°C at Gathright Dam to the high of 21°C at the water treatment plant in Covington. The 1993 temperatures should not vary significantly since release temperature remains constant at 15.5°C (Bugas 1991). Because temperatures are in the low range of normal spawning requirements, spawning may not even be triggered.

Due to the timing and circumstances of the study, it is not known whether or not spawning took place, only that smallmouth bass were not present in the October samples. Assuming that spawning does occur, temperature is crucial in the early life history of the bass. Rates of development are dependent on water temperature and are important because they can influence the susceptibility of a life stage to mortality from several factors, including predation. For instance, egg hatching time is 7.0 days at 15.0°C and only 2.9 days at 21.7°C (Armour 1993, Webster 1948). This increases the time in which nests are exposed to predation and weather changes (Armour 1993).

In addition, bass experience slower growth with cooler temperatures. This becomes a critical relationship if the fish have not attained sufficient size before the onset of the winter season. Pre-winter size determines winter survival, with larger fish experiencing better survival rates. Stored energy is used sooner in smaller fish and can reach levels severe enough to cause mortality. Thus, year-class strength can depend on attainment of a minimum YOY size before the starvation period (Armour 1993). Shuter et al. (1985) found an empirical relation between fall total length (cm) and mean survival over winter that shows 0% survival for fish under 5 cm. The estimated length attained by YOY smallmouth bass before the winter starvation period is 3.8 cm at a mean temperature of 16°C, the approximate mean summer temperature of the Jackson River (Armour 1993).

Conclusions

Since YOY smallmouth bass were observed in the reference site above Lake Moomaw and none below, it is apparent that a dam effect is occurring. The late-spring/early-summer temperature regimes do not appear to be warm enough to support smallmouth bass spawning success since the fish need temperatures of at least 15°C before the onset of spawning. Temperatures do reach and sometimes exceed this minimum in mid-summer, so it is possible that fish are nesting later in the season. If nesting is occurring, fry are not surviving to the pre-winter juvenile stage.

Although our data is inconclusive as to where the disruption in the early life history of smallmouth bass production occurs, it is obvious that low temperature release is having a disastrous effect on bass numbers. The few adult fish that are still being taken by anglers most likely are leftover from the 1989 spawn, or could be migrating from warmer waters downstream. It is apparent that successful spawns are no longer occurring, thus resulting in the disappearance of fish from the system.

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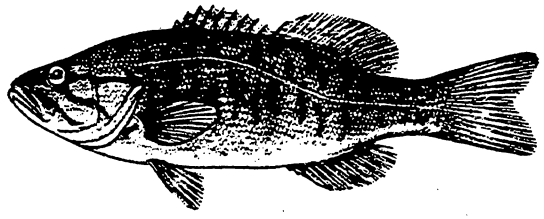

Management Through Stocking: A Case Study

By Nancy Gilmore

Fish stocking has long been a means to improve fishing. Fish culture facilities were constructed in the late 1800's and early 1900's to meet the demands of anglers for fish stocking that would improve declining sport fisheries. During this period, fish stocking and fisheries management were synonymous. In the period of the mid to late 1900's, fish stocking evolved to what it is today. Today, fish hatcheries and stocking play a crucial role in fisheries management.

The stocking of inland waters occurs in every state, and ranges from extensive operations in some states to minor ones in others. Fish are stocked to develop populations in new or reclaimed waters, in situations with inadequate recruitment, to maintain put-and-take fisheries, or to add an exotic species to a fish community (Hassler et al. 1986). The goal of both federal and state conservation agencies is to conserve and enhance the nation's fisheries resources. Stocking is often necessary as a stopgap measure until habitat recovery can be implemented.

The following study, conducted by Thomas J. Hassler, Mark E. Coleman, and Bryce R. Nielson, was done to enhance and restore the natural trout habitat in a river-lake system, Truckee River and Pyramid Lake in Nevada. Populations of cutthroat trout (*Oncorhynchus clarki*) in Pyramid Lake have been adversely affected by water development projects and exploited in the past by commercial fishing. Studies showed that a restoration program was essential to maintain the Lahontan cutthroat trout population.

The Truckee River originates as the outlet of Lake Tahoe and flows northward 119 miles before discharging into Pyramid Lake. Lake Tahoe and the upper Truckee River are on the eastern slope of the Sierra Nevada mountain range. Annual precipitation is 40 to 60 inches in the upper Truckee drainage basin, but only 6 inches in the lower basin. River-flows that originate in the Sierra Nevada are largely man-controlled. Historically, Lake Tahoe regularly overflowed into the Truckee River, but a small regulatory dam was installed in the outlet and now controls outflow from the upper 6.1 feet of Tahoe (Hassler et al. 1986).

Pyramid Lake is a terminal desert lake with a 1984 surface area of 115,000 acres. Agricultural, municipal, and industrial water-users divert much of the Truckee River from its basin, resulting in continued subsidence of Pyramid Lake. A drop of 75 feet in the lake level, between 1905 and 1981, resulted in the formation of a

massive delta at the river mouth. High runoff in 1982-1984 raised the lake level by 25 feet (Hassler et al. 1986). Erosion, channelization, overgrazing, commercial harvest of cottonwoods, and beaver damage have combined to remove most riparian vegetation. As a result, the lower river is heavily silted and summer water temperatures are usually too high for salmonids. There are more than 30 diversion dams on the Truckee River but only 5 are barriers for migrating fish. The rest of the diversion dams are mainly riprap and rock dams and are not barriers during average or above-average flows.

Lahontan cutthroat trout (LCT) once spawned in the Truckee River and its tributaries. Two distinct runs, a winter run of large fish and a spring run of smaller fish, occurred annually. The LCT provided sizable commercial and sport fisheries (Hassler et al. 1986). Fish were shipped as far as San Francisco in the late 19th and 20th centuries. The lake fishery also served as a mainstay and economic base for the Pyramid Lake Paiute Indian Tribe.

The depletion of the LCT in Pyramid Lake resulted from water diversion, introduction of exotic salmonids, and water pollution. Derby Dam, constructed in 1905, diverts water into the Truckee Canal for delivery to the Carson River basin, Nevada. During low-water years, in the past, virtually the entire flow of the lower river was diverted. The dam's fish ladder was only marginally successful and the dam soon became a barrier to upstream migration. In addition, an extensive delta that formed at the mouth of the Truckee River restricted access to the river. The presence of Derby Dam caused spawning failure of LCT as early as 1911 and LCT in Pyramid Lake had been extirpated by 1943 (Hassler et al. 1986).

Since the 1950's, cutthroat trout in Pyramid Lake have been sustained by stocking. Both the Pyramid Lake Paiute Indian Tribe and the U.S. Fish and Wildlife Service stock the lake. Several strains of relatively pure LCT were available from lakes in or near the Great Basin (Hassler et al. 1986). The Heenan Lake (California) strain was stocked almost exclusively until 1975, and the Summit Lake (Nevada) strain was stocked exclusively from 1976 to 1980. The use of Pyramid Lake LCT as brood stock began in 1980 with the first major spawning of fish from Pyramid Lake. In 1981, the Pyramid Lake Indian Tribe began collecting eggs from Pyramid Lake LCT, and has used only that brood stock for eggs since then. At the Lanontan National Fish Hatchery, production has been primarily from a brood stock, maintained at the hatchery, that came from Summit Lake. From 1982 to 1985, experimental groups of fish from Pyramid Lake brood stock and Independence Lake (California) strain have also been reared at the hatchery and stocked into Pyramid Lake.

The U.S. Fish and Wildlife Service, along with its assistance in stocking Pyramid Lake, is studying the feasibility of restoring a population of naturally reproducing LCT to the Truckee River-Pyramid Lake system (Hassler et al. 1986). The current restoration program includes continued lake and river stocking and its evaluation, improvement of river access for spawners, and assessment of spawning and nursery habitat in the Truckee River.

The LCT restoration program is currently dependent on hatchery production. Annual stocking into Pyramid Lake and the lower Truckee River averaged 1.3 million fish from 1976 to 1984. In 1982, a coded-wire tagging program was begun with the aim of comparing size at stocking and strain. Recovered tags are being collected from fishermen, at the Marble Bluff Facility, 3 miles up stream from the lake, and at the Sutcliffe trap (a rearing facility adjacent to Pyramid Lake).

The Marble Bluff dam and Pyramid Lake fishway were constructed in 1975 (Hassler et al. 1986). These facilities are used to collect adult LCT and cui-ui and to provide access to the river, thus elimination the barrier imposed by the river delta. The fishway is a canal with four fish ladders leading from the dam to the lake. The increased lake level in 1984 flooded the fishway's entrance ladder and caused erosion damage.

Salmonid spawning habitat is restricted largely to the river area that extends from Reno, Nevada, to Lake Tahoe. The lower river's high summer water temperatures and low intragravel dissolved oxygen caused total mortality of artificially planted eggs. Above Reno, on the other hand, hatching success of planted eggs was as high as 80% (Hassler et al. 1986). Before the upper river can be used by freely migrating cutthroat trout, however, a passage for adult fish must be established or a transplant system developed. Competition with resident river populations of brown trout and rainbow trout may further hamper restoration efforts. In the lower river, high summer water temperature, unscreened irrigation diversions, and resident warm-water fish populations all pose problems. In addition, few adult fish return to the river to spawn, possibly due to the lack of imprinting of hatchery-reared LCT.

Restoration of the LCT population at Pyramid Lake will remain dependent on expensive stocking of hatchery fish. Natural reproduction in the Truckee River is feasible but only at levels much lower than those that prevailed historically. Passage problems, deteriorated habitat, and resident fish populations are the primary factors limiting natural production.

Additionally, attraction of spawners to the Truckee River remains a serious problem. Hatchery-reared LCT are not imprinted to the Truckee River and, at maturity, few fish migrate into the river.

As this study shows, there was great need for a stocking program to enhance the LCT trout. But, although stocking has become a viable management tool, there have been many conflicts. Managers have argued that stocking has been relied on too heavily for the restoration and enhancement of fish stocks. Also, managers have argued that stocking has become a quick fix for the manager instead of gathering information about the system. The information gathered may lead the manager to believe that a habitat restoration program would enhance the fish population more than just stocking the fish. Managers may feel the pressure from anglers who would like immediate results. The anglers must realize that when stocking is done it is not always possible to have a sustained population. As the study of the LCT trout demonstrates, the hatchery trout lacked the imprinting that would lead them to the river in which to spawn. This argument about when to stock and when not to stock will probably continue until managers and the public are educated about the whole process. It takes a lot of cooperation from all parties involved to have a needed and successful stocking program.

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Examine each question in terms of what is ethically and aesthetically right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.

Aldo Leopold

Non-Native Introductions

Don't Dump Those Bait Buckets!
By Vanessa R. Lambert

Unauthorized or accidental, non-native introductions are the nightmare of every fish manager. There are a variety of ways that non-native fishes are introduced into watersheds without the consent of the local fisheries manager. Many times non-native species are purposely introduced by fishermen through the dumping of bait buckets or the moving of game species from one watershed to another. Some accidental methods of non-native species introduction are the discharging of ballast water, transportation on the hulls of boats, and escapement from fish farms. Non-native introductions can have a devastating effect on the systems they invade through competition, parasite-host interactions, predation, habitat modification, indirect interactions, and hybridization. The introduction of the rusty crayfish, *Orconectes rusticus* (Girard), into the lakes of Wisconsin is an excellent example of how non-native species can alter an aquatic system.

The introduction of the rusty crayfish, *Orconectes rusticus* (Girard), into northern Wisconsin lakes has caused a variety of problems leading to the degradation of these systems. Fisheries managers believe that the rusty crayfish was introduced by fisherman from Illinois and Ohio who dumped their bait buckets into the lakes at the end of their fishing trips. As an introduction the rusty crayfish is an interesting case; this successful invading species is ecologically similar to the two resident species, *O. virilis* and *O. propinquus*, instead of filling a vacant niche in a target community (Di Donato and Lodge 1993).

Orconectes rusticus is found in both hard and soft water lakes and streams; residing beneath or among rocks, logs, or other cover on the substratum, which varies from clay, silt, and sand to cobble and boulders, as well as among vegetation (Hobbs and Jass 1988). This adaptability has understandably led to the successful introduction of *O. rusticus* into Northern Wisconsin lakes. In all cases the rusty crayfish has negatively affected resident congeners, macrophytic vegetation, and macroinvertebrates.

Orconectes rusticus has been able to displace *O. virilis* and *O. propinquus* because of its life history, aggressiveness, higher growth rates, and lower mortality. One of the most important advantages the rusty crayfish has over the native crayfish is that its

eggs hatch earlier in the spring, and upon hatching its young grow faster (Lodge et al. 1985). Also its larger size confers an advantage in skirmishes and in warding off predators. The aggressiveness of the rusty crayfish leads to higher mortality rates among *O. virilis* and *O. propinquus*, by forcing these crayfish from there burrows making them more susceptible for predation by such fishes as yellow perch (*Perca flavescens*), rock bass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieu*), walleye (*Stizostedion vitreum*), and largemouth bass (*Micropterus salmoides*) [J.E. Garvey, J.E. Rettig, and R.A. Stein, Department of Zoology, Ohio State University, Columbus, OH 43210, unpublished data].

Orconectes rusticus has apparently reduced or eliminated submerged macrophytes and associated invertebrates in some northern Wisconsin lakes (Lodge et al. 1985). At a density of one crayfish per square yard aquatic plants are reduced by 40 percent (Lodge et al. 1985); however, the rusty crayfish has been found at 30 crayfish per square meter. Not only does the rusty crayfish reduce the biomass of aquatic vegetation but it also reduces species richness due to selective grazing (Lodge et al. 1985). Lodge and Lorman (1987) suggested that singularly branched species were removed faster than highly branched forms, since with one snip crayfish can remove entire single stemmed plants. Snails and other invertebrates in the littoral region are also consumed. *O. rusticus* has a much greater impact on aquatic vegetation and macroinvertebrates, relative to its congeners, because of its higher metabolic rate (Momot 1984), larger individual size, and higher population densities (Lodge et al. 1985).

The adverse effects of *O. rusticus* aren't limited to aquatic plants and macroinvertebrates; *O. rusticus* also effects fish populations. Through the consumption of macroinvertebrates and fish eggs, as well as destruction of habitat, the rusty crayfish is replacing small fish, and ultimately bass, walleye, and muskellunge as the top predator (Lodge et al. 1985). An example of this occurred in Lake Metonga, a hot spot for walleye and perch. Upon infestation aquatic vegetation dwindled, and by 1970 walleye no longer successfully reproduced (Lodge et al.). This proved costly financially as well as environmentally. By 1983 the Wisconsin Department of Natural Resources had spent $17,000 to stock the lake with walleye and lend support to a citizens' group that was trying to bring back aquatic vegetation (Lodge et al. 1985).

There are very few feasible and effective management options that can be used to control the spread of the rusty crayfish. The 20,000 kg harvest of *Orconectes* spp. for fish bait, scientific specimens, and food each summer is not intensive enough to be an effective control (Threinen 1978). Underwater fences have also been considered but would be very expensive and only temporarily effective; the use of poisons have also been considered, but these poisons would also kill other animals such as zooplankton and tiny crustaceans that are important food resources for small fish (Lodge et al. 1985). The most effective and harmless way to reduce crayfish populations would probably be to protect populations of predatory fish, especially smallmouth bass (Lodge et al. 1985). Unfortunately, the very goal of crayfish control may compromise the management of sport fishes; perhaps the best solution is to wait for other natural interactions to rein in the rusties, and in the meantime encourage commercial exploitation of crayfish (Lodge et al. 1985).

As demonstrated by Wisconsin's problem with the rusty crayfish, non-native introductions can cause tremendous degradation within aquatic systems. Wisconsin's crayfish problem also demonstrates that control measures are complex and expensive. To prevent such problems in the future, or at least problems of this magnitude, proactive management needs to be implemented by every state agency. If anglers, boaters, and shippers are made aware of the dangers of non-native introductions and the means of their dispersal, the rate of introductions would decline. This along with stiff fines for anyone caught introducing a non-native species either intentionally or accidentally would correct much of the problem. Once again education and incentive are the keys. Lastly, to better forsee future problems, we as fisheries managers need to maintain closer contact with our constituents as well as the aquatic systems for which we are responsible.

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There are two kinds of fishers, those that fish for sport and those that catch something.

The War Against Weeds In Virginia
by Gregory Coates

Introduction

Aquatic macrophytes have usually been looked upon with great approval since they provide so many beneficial qualities to a water body. Plants can provide small fish with cover from larger predators as well as offer other fish a place to spawn. Game fish of all kinds usually congregate along weed beds and offer excellent opportunities for anglers with different interests. Most aquatic systems are also dependent on plants to provide an abundant supply of oxygen, stable substrate, and storage for nutrients. Another important benefit is that aquatic plants provide a primary basis for an entire food chain in a fish community.

However, when cultural eutrophication and non-native introductions begin to increase aquatic macrophyte densities, serious problems can occur. High densities of plants can pose a threat to recreational and commercial uses of waters. They may interfere with swimming, boating, fishing. Their production and respiration dynamics may cause swings in dissolved oxygen concentrations. They can interfere with water intake valves and leave waterfront land owners with an unsightly view of weeds.

When conditions like these occur, it is obvious that reductions in aquatic weed densities, without completely eliminating the benefits that they provide, are necessary in order to prevent the negative effects from occuring in a water body.

Although eutrophication is a major cause for macrophyte densities to increase, non-native nuisance plants have been the major cause for concern in Virginia. One of the non-native introductions that has been a serious problem in the United States for more then thirty years is hydrilla (*Hydrilla* sp.). This submersed aquatic macrophyte can easily be spread accidentally through fragments left on boat propellers and trailers. From there, this plant can rapidly multiply and infest a system. Hydrilla can outcompete natural macrophtes in the area and unfortunately change the structure of an aquatic community. Already, millions of dollars have been spent in the U.S. alone, in order to control the spread of this aquatic aquatic plant.

Methods for Control

There are essentially three major methods of weed control: biological, chemical, and mechanical/physical controls. Each of these methods has proven to be effective as well as ineffective in its own way. Biological control seems to be the most effective means of weed control in use today. This type of control involves the use of living organisms to combat a problem. The most common biological control against hydrilla involves the use of the grass carp (*Ctenopharyngodon idella*). Because of the grass carp's ability to grow fast and feed at a high rate, it offers relief from high densities of weeds, especially hydrilla, in closed aquatic systems. However, because its rate of consumption is extremely high and it may consume all aquatic plants, complete macrophyte eradication may be the result of their arrival. In order to prevent this hazard from occurring, controls on stocking and the use of sterile triploid grass carp in Virginia is being regulated with the use of permits issued by the Virginia Department of Game and Inland Fisheries.

Chemical control is another effective way to thin out weed populations. Although chemicals have the potential to eliminate some desirable species of plants, this method almost always has a desirable impact on problem species. However, chemicals may have undesireable effects on non-target plants as well as the personnel that apply it. Chemical treatment is also a very costly procedure. The use of both endothal and fluridone on hydrilla in Lake Gaston has produced good results.

Mechanical/physical controls such as the use of harvesters, plastic sheeting, and water level drawdown have proven themselves to be more expensive than effective. Harvesters can cost up to $2000/acre to operate and repeated cuttings are always needed. Plastic sheeting to cover particular areas can cost up to $10,000/acre and it may interfere with benthic organisms. Drawdowns are effective for the nuisance plant *Egeria*, if the possibility exists in the system. However, due to the hydrilla's ability to survive drying, drawdowns would be an impractical solution for that

organism.

Problems in Virginia

Lake Anna and Lake Gaston are two systems in Virginia that are having a great deal of trouble with hydrilla. This weed is creating trouble for a large proportion of recreational users and waterfront property owners.

Lake Anna

Lake Anna is an impoundment that was created to provide cooling water for two nuclear reactors. The Waste Heat Treatment Facility (WHTF) is composed of up to 3,400 acres in lagoons and is separated from the lake by three earthen dikes. The main part of the lake covers over 9,600 acres and provides the public with excellent recreational resources.

In 1987, hydrilla was introduced in the lake and began to thrive in the suitable conditions there. In 1989, Virginia Power began to conduct aerial surveys during September and October, when growth densities were at their highest. The company concluded in 1990 that although hydrilla was spreading rapidly throughout the lake, it was not perceived as a problem and they would continue to monitor this introduction. At that time, the company encouraged the use of mechanical control to alleviate any problems, and discouraged the use of chemicals because of the possible side effects it has to humans and other animals.

From 1990 to 1991, the hydrilla population expanded from 95 acres to 330 acres in the main lake, and from 165 acres to 812 acres in the WHTF. In the lake, the hydrilla made up more then 4% of the total surface area, whereas the coverage in the WHTF was 24%. Since hydrilla has the ability to occupy waters of up to 10 feet deep, it has the potential to cover up to 40% of the lake and 50% of the WHTF.

Property owners who live on the lake and WHTF have issued complaints that the infestation of hydrilla has impeded recreational usage and may possibly lower their property values significantly. Town officials are extremely concerned about this problem since most of their tax base comes from real estate on Lake Anna and most of the local businesses depend on the lake recreation for their success (fishing, boating, swimming).

The issue on how to prevent this problem from developing into a potential disaster has been a controversy among many of the lake residents. Residents who have proposed the use of grass carp to control the hydrilla have been quickly countered by those who use the lake for fishing and are afraid carp may eradicate all of the macrophytes.

The state of Maryland is opposed to the use of grass carp because of its chance for escapement out of Lake Anna's waters. Maryland is also concerned with the possibility of accidental release of sexually viable diploids in the lake. However, there is little evidence to show that these outcomes are highly probable.

At this time, there is an estimated hydrilla coverage of about 900 acres in Lake Anna. Public participation with Virginia Power and the VDGIF seems to provide the best method of resolution to this dilemma. Input from the public will help to decide what management decisions are taken and to what extent.

Lake Gaston

Lake Gaston is an impoundment of the Roanoke River that covers more then 20,300 acres on the Virginia/North Carolina border. The reservoir is operated by North Carolina Power and is mainly used for hydroelectric power and flood control. This reservoir provides excellent multipurpose use for recreationalists of all sorts.

In the early 1980's, Lake Gaston experienced problems with the exotic species Brazilian elodea. However, this plant was controlled successfully through water drawdown during the winter of 1987-88. At this time the presence of hydrilla was evident, but control measures were yet to be taken.

The population of hydrilla went from 12 acres in 1985 to more then 300 acres presently. If the plant grows to its potential ten foot depth, this plant will occupy 25% of the lake's surface (>5000 acres).

As with Lake Anna, lake front property makes up a large proportion of the tax base in counties that border it. There has been great concern about the effects that hydrilla will have on the lake recreation, aesthetics, and property values. In order to prevent further expansion of this plant from occuring, the North Carolina Division of Water Resources initiated control through chemical usage. Sonar (fluridone) and Aquathol (endothal) were applied to 199 acres of hydrilla in 1992 with good success.

The funding for the aquatic weed management in the lake has mainly come from the Lake Gaston Aquatic Weed Council. This organization consists of five counties and was created for the purpose of controlling weeds in the lake. The council has funded a great deal of chemical control on the lake and will continue until Virginia and North Carolina state

agencies develop an effective management plan.

Recently a task force has been formed to develop a long-range plan for the control of hydrilla on the lake. Interested parties from both North Carolina and Virginia make up the task force in hopes of solving this problem. The management plan is looking to incorporate the best methods of weed control for optimum eradication of this nuisance. With the help of private citizens and public intervention, this problem will hopefully be solved soon.

Aquatic macrophytes can be the base of all life in a water body, as well as the cause for its downfall. Unless new and effective control methods are discovered, weeds may take over your favorite fishing spot or waterskiing area. The state of Virginia is being faced with more and more issues of aquatic weed problems yearly and effective programs are currently being developed to cope with these problems. So until complete eradication of nuisance macrophytes occurs, the war on weeds will continue.

Lessons Learned in Lab

Kerr Lake Fisheries and Public Involvement
By Donald J. Orth

One case study that was used extensively this semester was Kerr Lake. In January I requested from various stakeholders letters to define the issues from their unique perspectives. One lesson I hope students have learned is that we all hold different values or worldviews that determine how we react to fisheries policies. It is critical that future managers understand the different value systems and learn how to work effectively with diverse constituencies. Often when these groups are brought together in decision-making fora they can support similar policies, although for very different reasons.

Role-playing exercises were used to compel students to learn the issues and solution as well as to anticipate reactions and resolve conflicts. The class held a Citizens' Task Force meeting early in the semester. The charge given the Task Force was to develop mutually agreeable managment goals for Kerr Lake fisheries. In the process conflicts were readily discernable between certain stakeholders. Students also saw how the mission of an agency or organization influences the positions taken by the spokesperson. The Public Meeting Lab held later in the semester provided students with the opportunity to show off their accumulated knowledge and public speaking skills. See the accompanying article by Shelley White who played the role of the District Fisheries Manager. The class was clearly surprised to find a "real" district manager had also showed up to observe the exercise.

The exercises in public involvement could never have been carried out without the help, advice, and information from the real stakeholders who wrote extensively on their positions. Space precludes including all their perspecitves: My thanks to:

Gene Adesso, President Kerr Lake Protective Assoc.

Michael C. Duval, Fisheries Biologist, Virginia Department of Game and Inland Fisheries

John Feild, Resource Manager, John H. Kerr Dam and Reservoir, U.S. Army Corps of Engineers

Robert J. Graham, Fisheries Biologist, Virginia Power

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Wayne Jones, Fisheries Manager, North Carolina Wildlife Resources Commission

William B. Kittrell, Jr., Fisheries Biologist, Virginia Department of Game and Inland Fisheries

Bud LaRoche, Regional Fisheries Manager, Virginia Department of Game and Inland Fisheries

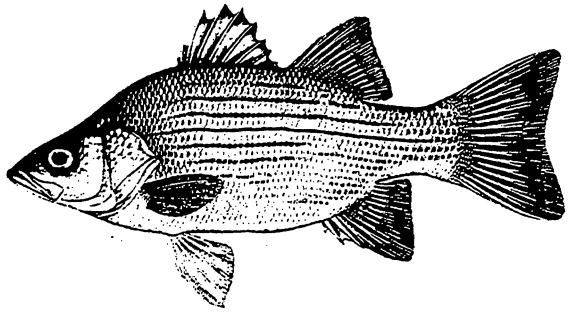
Tommy Marrow, Asst. City Manager, Oxford, North Carolina and Chair, Wildlife and Fisheries Committee, Kerr Lake Protective Association

Tim Vest, Park Superintendent, Staunton River State Park

Anthony J. Widmer, Park Superintendent, Occoneechee State Park

Quick decisions are unsafe decisions.

Sophocles



District Fisheries Biologist Perspective
William B. Kittrell, Jr.

The threefold mission statement of the Virginia Department of Game and Inland Fisheries is as follows: 1) To manage Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the commonwealth, 2) To provide opportunity for all to enjoy wildlife, inland fish, boating, and related outdoor recreation, 3) To promote safety for persons and property in connection with boating, hunting and fishing. As the District Fisheries Biologist assigned to southcentral Virginia, it is my immediate responsibility to manage all fisheries resources in John H. Kerr Reservoir. This involves working cooperatively with a host of State and Federal agencies as well as private organizations to solve a myriad of management concerns.

The multi-faceted recreational sportfishery in Kerr Reservoir is extremely valuable. For example, one nationally recognized magazine recently ranked the largemouth bass fishery as one of the 10 best in the country. The reservoir contains one of only a handful of naturally reproducing populations of landlocked striped bass in the nation. The crappie and white bass fisheries are undoubtedly, the best in Virginia. In addition, catfish, walleye, white perch and other species are commonly sought after by anglers. To maintain and enhance the quality of this sportfishery requires awareness and involvement in what is happening upstream of the reservoir, in the reservoir itself, and below the reservoir. There are many stakeholders associated with Kerr Reservoir, and each has his/her own agenda. It is ultimately my responsibility and goal, while dealing with complex management issues, to always place the aquatic resources first and strive to never compromise their integrity. Some of the management issues I am currently dealing with are listed below.

1. *Striped Bass Issues*

In recent years anglers have complained of a declining quality in the striped bass fishery. Unfortunately, funding shortages have precluded conducting scheduled creel surveys which could more accurately assess the situation. On-going sampling activities (primarily fall gill netting) indicate strong and weak year classes are being produced. This inconsistency creates problems which are compounded by ever-increasing fishing pressures.

In addition, suitable habitat shortages during the late summer are apparent from two summers worth of reservoir-wide temperature/D.O. profiles. As late June/early July water temperatures begin to warm, the lake stratifies, forcing large stripers down to the thermocline to find refuge from high temperatures above and anoxic water below. During August, we theorize that the larger stripers are thermally isolated from their forage base and not feeding well. The fish are susceptible to angling at this time because they have been forced into a relatively small area in the reservoir. Unfortunately, their poor condition and the high water temperatures causes them to also be more susceptible to catch and release mortality. We know this by the unlucky few we find floating on the surface during our profile work.

In the back of our minds we are concerned about springtime fish passage events. During the late spring and early summer of 1989, heavy rains resulted in high discharge rates at Kerr dam which apparently attracted adult stripers returning downriver from the spring spawning run. As the mature fish passed through the turbines, many were killed by excessive pressure change and/or actual impact. Over a period of several weeks, 358 striped bass were recovered downstream of Kerr dam. The only other documented fish passage event of this type occurred in 1982 when an estimated 5000 fish were killed. This only occurs periodically but we must be aware of the problem and try to prevent it.

"It is ultimately my responsibility and goal, while dealing with complex management issues, to always place the aquatic resources first and strive to never compromise their integrity."

Much of what we can do to handle these management problems is limited by funding. Also, anglers are not going to be happy with just "more studies". What should we do?

We need to continue to manage this fishery as a self sustaining population. It is a vitally important aspect of the fishery not only to Kerr but to the state and the entire country. The Brookneal Hatchery is located upstream of the reservoir and uses this spawning population as broodstock. The fish produced are stocked throughout Virginia and in many other states. However, it would be nice to know if supplemental stocking would help in those years when weak year classes are produced. Therefore, we began a three year study to determine if supplemental stocking would make a significant contribution to the year class. We stocked 46,000 fingerlings into the reservoir in 1992, 150,000 in 1993, and we plan to

stock an additional 150,000 in 1994. All fish are marked with oxytetracycline which produces a fluorescent ring on the otolith. All sampling will include otolith analysis. Through these efforts we hope to determine a percentage contribution and population estimate. A bonus is that stocking makes the anglers very happy.

We plan to continue our monitoring activities which include fall gillnetting and electrofishing. Cove rotenones will be conducted during 1994 to assess the forage base. Without trend data it is impossible to properly manage the fishery. Top priority was placed on getting a creel survey on Kerr Reservoir, and funding came through as part of the statewide striped bass project. The access point creel survey was conducted during 1993 and is awaiting analysis. Summer habitat will again be monitored in 1994 to more accurately describe what is happening.

Working cooperatively with the Corps and Virginia Power, a plan was developed to try to forecast when a passage event may be on its way. By looking at flows, discharge rates, and reservoir elevations at certain dates, and comparing this data to previous passage events, crude predictions can be made. This may give us time to change flow regime to decrease losses. The plan has not been tested yet. The Corps contracted with Virginia Tech to conduct a modeling study to better characterize the spawning population. This will allow us to more accurately estimate the significance of the losses for mitigation purposes.

2. *White Perch*

White perch began to appear in samples in the late eighties and have experienced a population explosion since that time. Now, white perch have completely invaded the system and the population is continuing to expand. Their function, which may included both the predator and prey roles, and their interaction with striped bass and white bass, in particular, are unknown. Are white perch the reason for recent declines in these two very important fisheries resources? A study incorporating striped bass, white bass and white perch should be conducted to determine 1) the degree of competition for forage, 2) the predator/prey relationships among species, 3) the predicted magnitude of expansion for white perch in Kerr Reservoir, and 4) the effect of that expansion on other fisheries resources.

3. *Habitat Loss*

As more development takes place around the 800 miles of shoreline at Kerr, more wildlife and fisheries habitat will be lost. Trying to balance economic growth and habitat protection is extremely difficult. An enormous amount of money is at stake for developers, realtors, homeowners, taxing authorities, etc. Local politicians sometimes become involved at the request of their constituents. On the other hand, hunters and fishermen recognizing the need for critical habitat assemble opposition. The District Fisheries Biologist usually gets caught in the crossfire. It is imperative to be involved with the Corps in the development of the Shoreline Management Plan. It is also imperative to remember your first loyalty, the aquatic resources. This means protecting as much habitat along the shoreline as possible. It would also be desirable to do an economic benefits analysis of the effects of hunting and fishing on the local economy and the tax base to use leverage. Severe erosion along the shoreline continues to be a major problem and steps should be taken to correct the situation.

4. *Water Withdrawals*

Water withdrawals in the form of cogeneration plants and other industrial uses continue to be a major concern. The cumulative effects on the Roanoke River should be addressed during the permitting process. Interbasin transfers of water pose even a more serious threat. The precedent that would be set if the Lake Gaston Pipeline is approved is unsettling. It must also be remembered that Lake Gaston must be operated at within one foot of mean normal pool elevation. That means that any withdrawal downstream of Kerr (in Gaston) ultimately effects Kerr. This is because Kerr's storage capacity is used to maintain Gaston's elevation.

5. *Exotic Aquatic Vegetation*

Hydrilla has recently been discovered in Kerr Reservoir. The potential for this species to spread throughout much of the reservoir is great. The Corps has already chosen to use aquatic herbicides to control the infestations and 16 acres were treated during the fall of 1993. Although many fishermen may argue for expansion of this submerged aquatic plant, it is in the best interest of the aquatic resources to control the hydrilla at a manageable level.

6. *Threadfin Shad Kill*

Extremely cold temperatures this winter have resulted in a massive threadfin shad kill on Kerr Reservoir. Threadfin shad are relative newcomers to the lake. Since being discovered in samples during 1991, we have had fairly mild winters and the shad have continued to expand throughout the Roanoke River system without a severe die-off. We will need to monitor this important part of the forage base and to

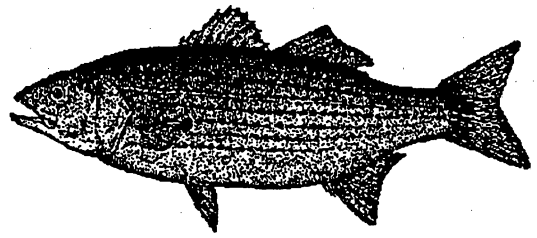
assess impacts on the sportfishery. Six cove rotenone samples are scheduled for the summer.

7. *Other Issues*

Several sandmining operations exist on the Staunton and the Dan Rivers. The cumulative effects of these on the fisheries resources are unknown. Studies should be performed to determine the effects, and existing or new permits should be calculated accordingly.

The Virginia Department of Transportation is proposing to build a new four lane bridge across the reservoir at Clarksville. This would impact Occoneechee State Park, boat navigation, bald eagle habitat, and the existing aquatic resources. Re-alignment and/or significant mitigation options are remote possibilities, but need to be pursued.

Zebra mussels are coming! Monitoring will need to be coordinated with the Corps. In five to ten years zebra mussels and exotic aquatic vegetation will probably top the list of management concerns for Kerr Reservoir.



Perspectives from Kerr Lake Protective Association
Tommy Morrow

I appreciate the opportunity to participate in your fishery exercises at Virginia Tech. I am currently Committee Chairman of "Wildlife and Fishery" for the Kerr Lake Protective Association. My real job is Assistant City Manager for the City of Oxford, N. C. To say I am an avid striper fisherman is a tremendous understatement! The mission that has been bestowed on me as Wildlife and Fishery Chairman is to focus on the preservation and quality of the lake habitat in liaison with the Virginia and N. C. Wildlife Departments.

For the purposes of this discussion, any mission statement to you will pertain only to the Fishery of Kerr Reservoir, or Buggs Island to you Northerners. The purpose of the Kerr Lake Protective Association (comprised in majority of waterfront landowners) is dedicated to representing those who use and enjoy Kerr Lake and to the preservation of this resource for future generations.

The most important issue in the fishery of Kerr Lake is the present management of the striper fishery. Landlocked stripers are a highly complex fishery which needs constant management. In addition to the complexity of the fishery, Kerr Lake is managed to some degree by two different states, Virginia and North Carolina. I am going to summarize the past, the present, and the future of the striper fishery on Kerr Reservoir. For the purpose of this report, fishery shall pertain to stripers. After I complete my observation of the fishery in Kerr Reservoir, I challenge you to find solutions to solve the maze of problems: 1) economically, 2) quickly, 3) politically, and 4) provide customer satisfaction.

What we as fisherman, your customers, cling to are the memories of how Kerr Lake striper fishing was 20 years ago. Twenty years ago the natural reproduction was more than enough to sustain a very healthy population of numerous and large stripers. Twenty years ago only a handful of fishermen even knew how to catch a striper. From the early 1980's to present, changes began to occur. Poachers began selling several hundred thousand pounds of fish commercially. This lasted 4 - 5 years before it was stopped. The worst result from the poachers was not the removal of thousands of stripers from a land locked body of water, but moreover they taught hundreds of fishermen how to catch stripers whereby the poachers could broker and sell more fish! Now you have an enormous number of fishermen who know how to catch stripers, have better boats, equipment, and knowledge than twenty years ago. Striper fishermen cling to memories twenty years ago of catching, without high tech equipment, live bait, etc., 5 - 10 stripers per day on an average day. Catching 20 - 30 stripers per day was a "good" day, and catching 50 - 100 stripers per day was worth getting your picture taken! Abuse, yes, but our Biologist back then suggested that fishermen could not really harm a healthy population. Now we all know better! Many of the "abusive" fishermen of twenty years ago have literally quit fishing because they cannot catch a fish per trip anymore. That to me says a lot!

Lets stop here and summarize what has and is happening to our striper fishery:

- Good natural reproduction is not consistent.
- Ten times more fishermen today than 10 years ago.

- Poachers devastated Kerr Lake in early 1980's, mainly Nutbush Creek.
- Technology has enabled the fishermen to be "better fishermen".
- Loss of stripers repeatedly through Kerr Dam during spring floods.
- Striper fishermen take home 90% of what they catch, unlike black bass fishermen. (Education may be the answer here)
- New competition (white bass, white perch) in Kerr Lake.
- Lack of law enforcement on Kerr Lake. (N. C. and Va.)
- Generous creel limits.
- Very low stocking rates per acre in Kerr Lake.

I try not to be a pessimist, but when you sit back and reflect at the above mentioned problems we face many challenges in the near future.

The next issue is the complexity of the striper fishery. You probably know how stripers reproduce and I will not go into that, however, Kerr Reservoir is one of a few reservoirs in the United States that has natural reproduction. According to surveys conducted by a Virginia biologist on first year fingerlings, reproduction in Kerr Reservoir over the past ten years has been extremely erratic, with the majority of years being on the low reproduction side.

White Perch

Somehow white perch have been inadvertently introduced to Kerr Reservoir and they have exploded in numbers - another competitor for the striper.

Bass Tournaments

In the spring, summer, and fall months, there is a major bass tournament on Kerr practically every weekend. Sometimes 3 - 4 per weekend - relentless fishing pressure.

Baitfish

Many years ago, pods of bait could be seen as far as the eye could see (when the striper population was excellent). Ten years ago you could go to Nutbush Bridge with your cast net, make one throw and go. Now you may spend up to an hour casting your net in order to catch a few dozen shad. Herring shad is the best, but they are almost extinct at Nutbush Bridqe!

Technology

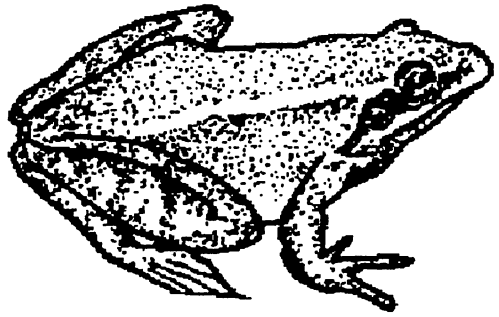
Twenty years ago only a few fishermen had fish locaters. We just went out and caught fish, plain and simple, now every bass boat has three high-tech depth finders with all the bells and whistles which would make the Russians nervous! Yet catching fish had declined tremendously.

Solution

The most obvious solution is an aggressive stocking program. Virginia has the Brookneal striper hatchery which supplies many lakes throughout the United States! North Carolina just recently refurbished an old federal hatchery just north of Wilmington which has tremendous capacity. This solution is complex and debatable, and I'm going to stop here! I have presented to you the position of my committee, and the problems as we see them. The ball is now in your court to solve the above mentioned concerns.

Before I end this mission statement, I want to drive home to you as our potential fisheries managers for the 21st Century the following: As location, location, location is to real estate, knowing who and what your customer needs are is to a successful business. Your career will be in the business of fishery management. Listen to what the fishermen (your customers) have to say. No individual, no group has more interest in the fishery than fishermen! Your biological studies should always include "the needs of fishermen".

Good luck and I look forward to speaking and/or receiving your report.



The Lake!
What To Do About The Lake!

An Eyewitness Account of the
Kerr Reservoir Public Meeting
By Shelley White

The day was about like any other. A quiet, sunny, April day in the little town of Blacksburg. However, something special was going to happen to a small group of people who have decided to pursue a life of fisheries management. On this Tuesday, April 26th, the management class, led by Dr. Don Orth, was to experience the horrors and hysterics of a public meeting about Kerr Reservoir.

The students filed into the stark classroom where we realized that there would be no windows or pictures to distract anyone's attention from what we each had to say. We all sat quietly and awaited the beginning of what could have been the worst lab experience of a lifetime. Dr. Orth took the podium first as the board member of the Department of Game and Inland Fisheries,and as he began to speak he quickly transformed from the teacher we all knew to a southerner with a drawl like we had never heard before. As I glanced around the room I watched eyes pop open and question each other as to whether we were supposed to become as dramatic as Dr. Orth had or simply state what we had to say and quickly sit down. Luckily, I was the District Fisheries Manager, whose place was only to state the facts, show no emotion and quickly sit down. After my two assistants stated the facts, the real drama began.

As each industry was represented new faces and personalities came from behind the walls. The Stripers Unlimited representative and the BASS Chapter President both voiced their opinions quietly yet truthfully. They were honest in their attempts to be heard and to make us as the biologists understand their positions.

Next, came the disgruntled angler, and boy was he disgruntled. He sat quietly through the meeting just awaiting his chance to voice his opinion. Mr. Angler is no small guy, and he wanted us to know just how he felt about the poor fishing that had been going on in the reservoir. I felt I had no choice but to agree with him, even though his attempts at coming across as truly angry were so entertaining I couldn't help but laugh.

We then sat through the trials and tribulations of the poor marina owner who just couldn't get ahead in the whole situation. The North Carolina Parks were heckling her and she can't get any support from her own Chamber of Commerce. I suppose it's true that the fishing industry supports her way of life and if for no other reason but pity we as managers must find a way to incorporate her opinions into the final plan.

The representative from Virginia Power kept a low profile throughout her speech. She more or less rode the fence on the subject of controlling water fluctuations and its effects to the riparian zone of the reservoir. In my opinion, I think we can count on her to persuade the power company in our favor of minimal fluctuation.

Mr."Rich Ness"'s opinion could be heard for miles. He was the president of MINNOW (Many Interested in Non-game Native Organisms' Welfare) who was very interested in not only the abundance and protection of game fish but more importantly of non-game fish. He seemed thoroughly disgusted with my lack of knowledge and concern for the status of these non-game species. I have made a special point to include non-game population assessment in the final plan.

The Kerr Lake Protection Agency president simply boasted about being the largest group represented and the fact that they had hundreds of members donating every year to the protection of the reservoir. The only opinion I truly recall was that he would like to see some riparian clearing in order to construct nature trails to add to the aesthetic value of the lake. This too shall be taken into consideration in the final plan, but bribery will get KLPA nowhere.

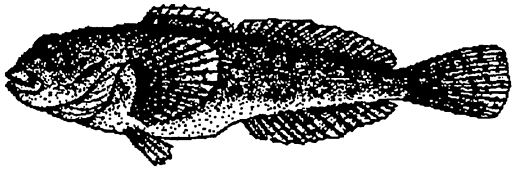
The young State Park superintendent seemed new to the whole "public" issue. Perhaps they drew straws at the office to see who would speak, and he lost. He spoke on development control, erosion problems, and what effects fish populations had on the parks success.

The ecologist from Duke spoke quickly and to the point as if he had better things to do and better people to do them with. He agreed with the fact that we needed more knowledge about the ecology of the lake and made an important reference to the control of the zebra mussel introductions and hydrilla blooms.

As I sat thinking that this whole experience wasn't so bad, Dr. Fish began to speak. He was a northerner from "God's Country" who was adamant about finding out what kind of walleye fishing Kerr Lake had to offer. I hadn't studied walleye statistics so I looked to my assistant who knew just enough to divert Dr. Fish's questioning stare from me.

Joe Public had a few questions for Va Power and the MINNOW president, who he mistakenly referred to as Dick, but was quickly corrected that the name was Rich. The discusion began to get out of my control as these three debated. It was clear the power industry biologist had dealt with these issues before.

Overall what a learning experience it was. Preparation is the key to coming out of a public meeting alive. Know what you're talking about, who it is going to effect, and where the nearest exit is in case of an emergency!



Unappreciated Species

Unexploitable Species: The Time has Come
By Anthony Showalter

According to the wise-use philosophy, a major problem with the exploitation of the fishery resource is that only a small portion of the resource is utilized. In addition, basically only two dominant attitudes toward fish are focused on by many management goals and objectives. These are the utilitarian "commercial" and the dominionistic "sport angler" attitudes toward living resources. Both are consumptive attitudes that lead to increased demands on a resource in limited supply. Simple analogies can be made between mismanaged/overexploited natural renewable resources and non-renewable resources, analogies such as a panhandler mining for gold in a Colorado stream a hundred years ago and today's sport angler mining for the wall-hanger rainbow. Perhaps a better analogy is the train of box cars full of West Virginia coal and the seines full of Chesapeake striped bass. The shortfall and detrimental effects on fishery resources are obvious when only a few desired fish are used and overexploited by sport and commercial fisherman. There is no time like the present to shift attitudes to less consumptive and more sustainable uses of the fishery resource, uses that will hopefully lessen the strangle hold put on traditional exploited fish. Yes, it's the last two minutes of the fourth quarter, and the time has come for the eager, rested, and often sidelined players that make up unexploitable fish, to even the score.

Unexploitable fish can basically be categorized into two groups: undesirables and fish too small, rare, or invulnerable for conventional uses. Both groups should be considered in future management plans, although their use and user attitudes will be different. To satisfy increases for consumptive uses, undesirables could be exploited. Fish that are too small or rare could be utilized in nonconsumptive ways. There are many methods such as bird watching and whale watching which have already been adopted by many wildlife and marine interest groups. By increasing the variety of fish used and the way they are utilized, there could be increased benefits from fishery resources that often have overexploited portions of underexploited resources as a whole.

Most undesirable fish get their reputation because they taste bad, offer little challenges on the tip of a line, or are believed to have negative impacts on more desired fish. Some undesirables on occasion develop such high densities, that managers deem it necessary to completely eradicate the system and restock with desired species. Whether its due to overharvest, unwarranted introductions, or habitat degradation, eradication and restocking projects are costly and time consuming. Although eradication is necessary at times, such projects produce no net benefits from the life lost, whether they are gamefish or undesirables.

A common management practice to help balance and stabilize fish communities is through the introduction of predatory fish. The problem with this tactic is that top piscivorous fish are sought by an even higher ordered predator...anglers. Perhaps if anglers could be influenced or manipulated to act like the predators removed from the system, imbalances in fish communities could be minimized. The predator's role is to stabilize the community by removing the weak, old, and "overpopulated". For many species which grow too large to be kept in check by piscivorous gamefish, species like carp, gar, suckers, and gizzard shad, imbalances occur due to the removal of predators that prey on their young. It is easy to see how undesirables can take over when density dependent factors no longer influence their recruitment, in addition to the lack of predation on the large adult reproductive stocks. This is when the angler, archer, or commercial fisherman should act as

the supreme predator, whether its taking carp in a "Mud Bass Tournament" sponsored by the Virginia Tech chapter of the AFS, a gar rodeo in southern Louisiana, or commercial harvest of gizzard shad in one of the Great Lakes.

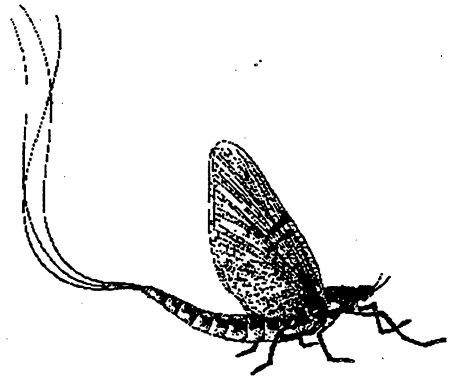
What stands in the way of using less desired fish are negative stereotypes. Improving the marketability of undesirable fish should be a part of future management plans. All that is needed is education and imagination, both on the part of the user group and the fish manager on how to promote these fish. Who knows? One day the opinion on fish like gar and bowfin may someday be equivalent to those of muskey and largemouths. If game agencies are successful at improving the desirability of undesirables, then fish like gar, carp, and suckers can be removed from a system in a way that increases opportunity for sport and commercial users, as well as help balance the fish community.

Fortunately, there are other attitudes toward fish besides the dominionist and utilitarian. Most people share a combination of attitudes ranging from naturalistic to admiring the aesthetic qualities of fish. Unfortunately, there are few ways to impart these attitudes recreationally on resources traditionally dominated by consumptive user groups. There are some good examples, but one must look at marine rather than freshwater fisheries. There are countless piers and observation towers where people other then anglers can benefit from the fishery resource. Usually, these people are admiring the days catch, trying to spot a whale, or being astonished by the spectacular display of a feeding school of bluefish. There are also examples of scuba trips in the Cayman Islands where one can feed manta rays and observe beautiful tropical fish of the coral reef community.

Personally, what lured me into the fascination of aquatic resources were the episodes of Jacques Cousteau and his adventures on the Calypso studying marine life. It wasn't until I was a bit older, that I began valuing freshwater fisheries, partly because the ocean was so far away. And although I had been taught and knew the intrinsic characteristics and importance of individual fish, whether it be a trophy brown trout or the cryptic sculpin living on the substrate, my attitudes still were primarily those shared by the utilitarian and dominionist. It wasn't until I put on a mask and viewed fish in their aquatic world, that I gained an appreciation for their uniqueness as an organism. One would be surprised at how attitudes can change, when there is a rod in hand casting at an undercut bank in the hopes of hooking a monster brown, or viewing the same frightened monster trying to be one with the rocks it's hiding under.

Just as people shouldn't be limited to traditional uses, neither should they be limited by the fish used. North America is blessed with a wide variety of temperate freshwater fish ranging from the peculiar and ancient paddlefish to the vast array of tiny but beautiful darters. There are many fish that are unexploitable by traditional methods either because they are too small, such as darters and sculpins, or too rare, such as the paddlefish and sturgeons (at least in some parts of their range). There's nothing that says the utilization of a resource has to be consumptive or destructive. Look at the example of the African safari, where endangered and threatened animals like the mountain gorilla, white rhino, and African elephant are being exploited simply through observation. This is a way of utilizing a resource that is easily sustainable and poses little harm to the organisms being exploited. Perhaps North American freshwater fisheries could adopt recreational activities like the safari, but instead of a safari leader there will be a scuba instructor. In addition to fishing guides, there can be snorkelling guides ready to lead people on an underwater journey to experience a day in the life of a brook trout, paddlefish, or be dazzled from the colorful fish represented by many minnow and darter species.

Regardless of whether the purpose is to increase recreational opportunities or decrease pressures put on traditionally exploited fish, future fish management practices should try to establish a wider range of uses for living aquatic resources. The high demand put on traditional exploited fish means there is a need to increase the variety of fish that are utilized, be it where people act as predators or simply observers. By incorporating unexploitable fish and ways they can be utilized into future management programs, a greater appreciation and benefit can result from the entire resource. Hopefully, this will result in the transformation of fish once viewed as "rough or trash" into fish viewed as "hidden treasures".



The Eel-usive Truth
By Roy Smogor

What native, finned Virginian ranges from the steamy oxbows of tropical South America to the frigid ponds of subarctic Greenland? What preponderant piscid dwells at Atlantic Ocean depths of 2000 feet, at Blue Ridge heights of the same magnitude, *and* in all wet points in between? What denizen of Virginia waters could naturally show up in *any one* of the commonwealth's 25,000 stream miles and remain there for 10 years or more? Which much-maligned member of Virginia's freshwater fishes ironically supports a one-million-dollar fishery in the state? A simple three-letter word answers all of these questions correctly: the eel. Actually, American eel and *Anguilla rostrata* are its full common and scientific names. Despite this species' wide geographic range, despite its commonness and longevity, despite its economic importance, the American eel remains less studied (more ignored?) than many North American stream fishes. Much of what is known about American eel has been inferred from research of its morphological and ecological counterpart in Europe, the European eel (*A. anguilla*).

Despite humans' worldwide and centuries-old fascination with eels, what eels do and where, how, and why they do it continue to mystify us. Perhaps it's the resemblance to snakes that prolongs the eel's reputation as considerably less than heaven-sent; a creation myth of the native Maori peoples of New Zealand casts an eel in the role of serpent in the Garden of Eden. Perhaps it's the ubiquity, abundance, and incongruous secretiveness of some eel species that have earned them the unendearing status of aquatic vermin; concerns and accusations of eels as eaters of salmonids and their eggs spawned many of the early queries into European and American eel ecology. Or perhaps it's the enigmas that eel research has assembled; the more that surfaces about anguillids, the more rippled that surface becomes.

Some of the mysteries have been unraveled, though. Studies collectively reveal that American eel and European eel spawn in the Sargasso Sea (south Atlantic Ocean), and individuals migrate to North American (American eel) or European (European eel) inland freshwaters before returning to sea as reproductive adults. Individuals of both species journey thousands of miles during a lifetime that can last up to 25 years or more. Genetic analyses show that the two are distinct (although practically morphologically identical) species, each representing *a single*, large, randomly breeding population. Although both species spawn in the Sargasso Sea, they do so in separate locations. Even given the apparent wealth of information on the oceanic comings and goings of these two species, much mystery still surrounds their roles in freshwater faunal communities. Exaggeration of results of limited-scale research and, perhaps, the blind romance of exposing such enigmatic creatures further muddy the interpretation of American eel and European eel ecological information. Just beneath some firmly held "truths" squirm a potful of "once truths" that slipped through the holes opened by subsequent findings.

One such "truth"--clutched by many, but slipping through--is that female American eels predominate in inland streams and males predominate in coastal waters. This belief stems largely from research prior to 1977. In that year, a Canadian study demonstrated the unreliability of the prevailing technique of identifying an anguillid's sex: macroscopic examination of gonadal tissue; the authors recommended histological examination as a standard to sex American eels. However, even histological assessment of an eel's sex may be fraught with uncertainty; researchers have found some individuals with *both* male and female germ cells. Because an American eel's functional femaleness or maleness is not determined genetically (no sex chromosomes have been found, as are typical in most mammals, birds, and some other fishes), varying degrees of an environmental factor may influence observed sex ratios. For example, two European studies report crowding as a possible determinant of sex in European eels; males were more abundant than females when overall eel densities were high and vice versa. Coupled with evidence that individual eels may remain sexually undifferentiated until late in life, these findings cast slippery shadows over any claims of a male-to-female "inland" gradient. Nonetheless, one such claim occurs in papers by Gene Helfman, a noted expert who studies American eel in Georgia. In a review paper in a 1987 American Fisheries Society symposium book, Helfman argues that a true male-to-female inland gradient exists, but then readily admits that "...no viable explanation exists for ... (this) distribution of sexes in American eel." However, of the studies cited by Helfman, none examined eels farther than 60 miles inland from the Atlantic Ocean. In Virginia, American eels commonly reside with brook trout in cascading streams of the Blue Ridge Mountains--over 400 miles inland! Until these landlubber individuals are investigated, the claims remain adrift.

Another common belief is that American eel are primarily night prowlers, retreating belly-full to their protective nooks and crannies by day. Indeed, some feeding studies found that large eels preferred dimly lit dining. Others report fly-by-night peaks in the seaward migration of larger adults. But these eat-and-

run undercover habits may be solely the practices of larger, older individuals. Smaller, younger eels are known to roam upstream from coastal waters by day. Also, casual snorkeling observations (courtesy of D. Orth students) in Virginia's North Anna River confirm such daytime romps, although American eel movements in such inland streams (i.e. greater than 100 miles from the ocean) remain unstudied.

A final--and perhaps most controversial--belief held by many gill-flaring anglers and some fisheries biologists as well is that anguillid eels prey on salmonids, other sportfish, and the eggs of both. Early reports of various anguillid species in Europe (pre-1965), New Zealand (1940's), and Canada (1957) attested to the continental tastes of freshwater eels for salmonid cuisine. But most of these claims have little bite. For example, the Canadian report--often cited as proof of the pudding that American eels make out of young salmon--found only 10 salmon fry in the 382 eel stomachs examined. Similarly, a European study found no salmonid eggs and only 10 salmonid individuals in over 4000 eel stomachs examined. Moreover, reports from New Zealand to Europe to the United States have shown consistently that only larger eels eat significant amounts of fish: mostly individuals of nongame benthic species and even other eels. However, true to the slippery nature of eel lore, casual observations of American eel in North Anna River (courtesy of L. Knotek, masterful snorkeler) confirm that small eels surreptitiously snatch smallmouth bass fry by hiding in the pebbly cover of the smallmouth's own nest! Biologists know little of the interactions among eels and their neighboring warmwater-stream fauna, even though American eel predominate in number and in biomass in many inland streams. Whether American eel be friend or fiend, aquatic resource management could benefit from the further study of the species' roles as predator, prey, competitor, and resource.

Given the American eel's commonness, wide geographic range, and economic importance one might expect that its ecology is well studied. But eels are cursed by the "creepy crawler" syndrome; their snake-like looks and habits evoke human biases and fears that will continue to hamper inquiry of these fascinating, though less-than-cuddly, creatures. Hopefully, the more aware we become of the life in and around us, the less we succumb to deadly ignorance. This fish of many faces and many places offers an ocean of intrigue to anyone simply willing to dive in and find out.

Fisheries Video Reviews

The Killing Tide
By Jonathon Bishock

In a CNN special report, entitled "The Killing Tide", issues concerning national and global overfishing problems are analyzed. Examples from around the USA, from Massachusetts to Louisiana to Alaska, show that the problem of overfishing is a national problem that needs to be addressed. According to the video the United Nations declared that all fish that are commercially viable are overexploited or extinct. The problems of overfishing are being publicized because fishermen are now being told that they (the fishermen) can not keep as many fish as they can haul in. Other problems that are addressed in the video are habitat destruction and by-catch, which is the non-target fish that are caught by fishermen in huge numbers and then hastily discarded as waste back into the sea. The problem is that these fish are dead or dying when they are thrown back in, and most of the time these are fish that would grow up to be of value later on in their lives. Throughout the entire program there are examples of what is presently being done to conserve and what is being done to rebuild a once thriving industry.

I believe the main reason that CNN made this video is that the fishing industry is presently in dire straits world wide and fish populations are at an all time low. This program also allowed biologists to express their concerns with the problem of by-catch, which is harming juvenile species of all kinds. For example as stated in the this special report, 10 to 20 pounds of by-catch is caught per single pound of shrimp caught off the coast of Mississippi. I believe

that the show also intended to give the general public an overall view of how some peoples lives have been totally dedicated to fishing~ knowing no other way to survive. Now their lives are threatened by new regulations that are being imposed on specific stocks that these people have fished their entire lives. In general this CNN report gives a report of what is going on in the industry without actually taking sides with either the biologist or the commercial fishermen.

The video made good use of personal testimony on all sides (biologists, government officials, and fishermen) to draw in its audience. The sincerity on the part of the fishermen fighting for their life blood would tend to win over your emotions but the logic behind the expert's testimony leads us to believe that something must be done in order to stop current problems. This means change, which in turn conflicts with the goals of fishermen who only know one way of life. This program takes us on board through their cameras and shows the viewer what actually goes into fishing on one of these trips. It also breaks up the program so that you re not just listening to people talk about boring statistics. This is good because it keeps the interest of viewers that might otherwise lose interest.

The only possible weakness that this video may have is its broadness in covering so many places so briefly. It goes from Massachusetts to Louisiana all the way back up to Alaska and on from there. It briefly discusses the present fishery problems and what is currently being done to solve these problems. Each area has a specific problem with specific solutions that can not be completely analyzed in the time allotted for the show. However, this entire program's aim was to discuss the nationwide problems in the fishery industry while maintaining the viewers interest.

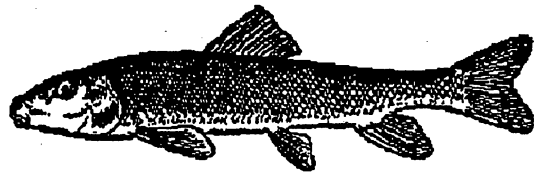
This CNN special report did a good job of covering the subject as a whole. It dealt specifically with commercial fish such as cod and flounder in Massachusetts, halibut in Alaska, and shrimp in Mississippi. CNN went into the town of Gloucester, Massachusetts and followed a family of fishermen around to show how new restrictions on fishing for cod can gravely affect the lives of these people. The main problem is that the fishermen are too smart and their equipment and practices are overly effective leading to overexploitation before regulations can be established. The video takes us next to the waters off the coast of Mississippi to show us how trawling for shrimp results in a by-catch as much as 20 times the actual amount of shrimp caught per trip. Much of the by-catch that is caught and killed are juvenile red snapper which are a major food species in this area. In another part of the video CNN takes us to the waters of Alaska aboard a vessel named the Rebecca B for a 24 hour non-stop fishing trip for halibut. Here, a crew of men bait thousands of yards of line, which they then drop only to retrieve them a few hours later. I learned that all the halibut that you may consume throughout an entire year has been caught on a single day in June. The reasoning behind this regulation is that local Alaskan fish biologists believe if there were uncontrolled fishing pressure in Alaska that this valuable resource would be expended in as few as 6 months. Alaska may follow the lead of New Zealand which gives out a fixed number of permits to its fishermen called individual transferable quotas. This in turn slows down fishing pressure because fishermen are not in a rush to catch as many fish as they can, plus they can work as a group to get the best market price for the fish they catch. This may be one of the best management practices for the future of the fishing industry.

The video was put together well and was very easy to watch without losing interest. Stephen Frazier does a good job of keeping the topic fresh by skipping around from place to place while keeping the general idea of conservation and restoration the main focus the entire time. The quality of the video itself was very good with many good photography angles on the practice of fishing. Whether the photographers were shooting from under water in Mississippi around dredge lines or aboard a frantic fishing vessel in Alaska, they did a superb job of capturing the essence of what is really going on in these locations.

A few main points that this special report covered were things such as overly effective equipment and practices that catch too many fish, target as well as non target species. Habitat destruction that leads to fish being driven from their breeding grounds, thus not allowing strong classes of fish reproduction to occur was also covered. Battles between managers, biologists, government officials, and fishermen were covered throughout the program as one of the main points. However, solutions to many of these problems were not discussed in too much detail in this program. Large numbers of layoffs and diplomatic problems were addressed in the video to show some examples of what is currently happening in the industry. I believe the intention of the program was to deliver the information to the general public and let them make decisions as to what is the right thing to do.

High school students and upper level management officials would find this program interesting and useful. This program was intended for the general public. It gives an overall view of what is happening in the fishery industry throughout this nation and the world. Fisheries managers throughout the world could use this tape as an example of what will happen to their fisheries if they are not managed properly during early

stages of use. This program would best serve its purpose as strictly an informational program rather then a tool used to solve actual problems because it lets us know the specific problem but does not cover the solutions very thoroughly.



Catfish Farming in the South
By Jonathon Bishock

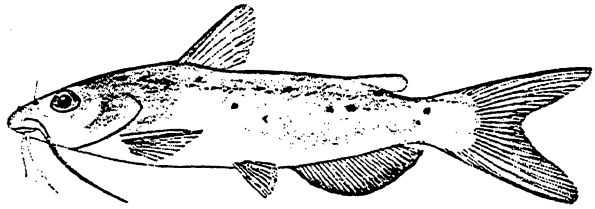
The video "Catfish Farming in the South", produced by the communications division of the Louisiana Cooperative Extension Service, describes what goes into creating a successful catfish pond. The video thoroughly describes what is needed to start, maintain, and profit from a newly constructed catfish pond. According to the video, farm raised catfish are the single most valuable aquatic commodity in the United States. The most successful farms are concentrated in southern states such as Mississippi, Alabama, Arkansas, and Louisiana. According to the video, a successful catfish farm depends on a number of factors, including favorable climate, the availability of natural resources, strong financing, feed, seed stock, supplies, services, and a good market. If all these demands are met properly then your chances of having a successful pond are improved.

Catfish farming began in the 1950's with small farms raising about 1200 lbs to 2000 lbs of fish per acre. Today, with many announcements in the industry, a small pond owner can raise anywhere from 3000 lbs to 6000 lbs of fish per acre. The use of the proper equipment and new techniques increases the chances of producing a successful harvest. Most of these catfish ponds are based on outdoor earthen areas. Some owners may choose to raise their fish in floating cages, while others may be raised in flowing raceways or large tanks. The video shows in sequential order, how to develop a catfish pond and how to market your fish effectively.

The strength of this video lies in its structure which takes you step by step through the process of developing a catfish farm. It begins by stating that new farmers should do their homework and have a good business plan before starting any kind of construction. Then it illustrates all the factors that are needed to start a catfish farm. It covers everything from selecting a pond site to where you should market your crop for the greatest profits. The only aspect of this video that could use improvement is in the entertainment department. It serves its purpose as a instructional video, but it is very cut and dried, leaving the average viewer bored.

The information in this video appears to be very complete and well organized. Throughout the entire video, there are pauses and important information written across the screen to highlight main points. This allows the viewer to get a better understanding of the material by separating the main points from other information. For example, when illustrating what goes into selecting a site for your pond, the video highlighted on the screen the cost of land, power, flood and hurricane risks, good roads, and if the land was classified as a wetland. Other aspects were then covered in detail including pond construction, wells and drainage, types of catfish, spawning cycles, management, and marketing. Through this type of sequential ordering, the viewer gets a real idea of what it takes to create a profitable catfish farm.

People who would find this video of greatest use would be potential catfish farmers. The video is very descriptive in its instructions on how to actually start a fish pond and would prove to be very useful to a new catfish farmer. The video may also prove to be very useful to people who are trying to start up any other sort of fish pond. It covers many aspects that would be required for the survival of most aquatic species in a newly constructed fish pond. Fisheries managers could use this video as an instructional tool to construct efficient fishing grounds for all types of recreational fishing. However, I don't think that this video would be very good to show to students due to its lack of entertaining quality. The short attention span of a typical student would negatively interact with the low entertainment quality of this video.



Former Students Speak Out

Where are They and What Do They Tell Us?
By Vanessa R. Lambert

Recently, Dr. Donald J. Orth, professor of fisheries management, wrote to alumni of the fisheries program and more specifically to the alumni who had taken fisheries management with him in past years. Dr. Orth wrote requesting information on where each alumnus was working, what each was doing in the field of fisheries, and what advice each would give to students currently taking fish management. The response of the alumni was excellent. Upon reading all of the alumni letters, I discovered a great deal of interesting and valuable information.

Where are they? The alumni of Dr. Orth's Fish Management class have traveled far and wide in pursuit of their careers. Approximately, fifty percent of the alumni are employed by state fish and game agencies. Fifteen percent are employed by the US Forest Service, and the rest are either pursuing graduate studies, working in cooperative education extensions, or working in other various federal agencies.

What do they have to say? The alumni have quite a lot to say. Steve Sammons in particular had a lot to say. Along with his letter, he included an abbreviated form of his manuscript entitled *The Lighter and Darker Aspects of Fish Management,* which humorously reviews the life of a fisheries professional. I highly recommend the students within the Fish Management class to read through this article that accurately portrays the everyday reality of working in the fisheries field. The most common bits of advice given by the alumni were: be computer literate, know your statistics, improve your communication skills (particularly public speaking), obtain fisheries experience while still in school, and obtain a diverse education. The alumni also stressed the importance of the public meeting within the Fish Management class, admitting that they worked as much, if not more with people than with fish. The advice given by the alumni is very sound and right on target; I wish I had come across it sooner in my academic career. In fact I would make the alumni letters required reading for incoming fisheries professionals. To close, I would like to share my favorite bit of advice given by Rick Eades: **GO FISHING!**

The following are a few of the many letters received from former students.

David Lemon
Senior Aquatic Biologist
New York Dept. of Environmental Conservation

I am writing in response to Dr. Orth's request for information regarding my current work status. I have been employed as a Senior Aquatic Biologist for the New York State Department of Environmental Conservation in Cortland for over three years. Prior to this I worked for eight months as a seasonal technician with the state. Before I go any further I want to say that I owe a big debt of gratitude to everyone I was associated with in the fisheries department at Tech especially Andy Dolloff, Larry Nielsen and Don Orth (but please don't ask for any more money). I certainly would not have experienced the things I have in the field of fisheries science without their help.

As an aquatic biologist I am responsible for the management of all the waters in three south-central counties of the state. As a regional office, we are responsible for nine central New York counties stretching from Lake Ontario in the north to the Pennsylvania border in the south. Included in these counties are hundreds of miles of quality warm and coldwater rivers and streams, thousands of acres of warm and coldwater ponds and lakes, and four of the "Finger Lakes". Additionally, we have partial management responsibility for the Lake Ontario fishery. With such an abundance of waters, our staff of four biologists, five technicians, and two "seasonal" technicians have our hands full.

Our "field season" begins in late March and runs into November. Roughly 30% of my time is actually spent in the field. Winters are spent going over data and preparing reports. The occasional ice-fishing creel survey is a welcome break from the daily routine of the office.

With the charge of managing all of the canals and warmwater rivers in the region, in addition to my county responsibilities, my duties are quite diverse. Specific field duties which I have been involved with include: trout stream surveys to evaluate stocking policies; fish community assessments of a large river and several small warmwater lakes with aid of boat electrofishing gear, trapnets, and gillnets; design and implementation of a angler census program to evaluate fishing pressure on a popular trout stream; stream protection work; and other tasks.

One other responsibility that is extremely important is meeting with our constituents, the sportsmen, either to discuss proposed management options or as a guest speaker at a club meeting. This is the part where, if you are like me, things become difficult. Public speaking has never been my strong suit

and it is a significant part of this job. I had always hoped for a position that didn't involve public speaking but I'll tell you right now that there are very few, so be prepared.

I urge every one of you who plans to get into fisheries management to take as many speech courses as possible to give yourself experience in front of an audience. It will definitely make it easier, if only a little bit, when the real day comes, and believe me it will.

What I remember most from my Fisheries Management Course at Tech is the speech we had to make in conjunction with our written report. I had taken two speech classes but, as always, I was nervous. My hands were shaking, my palms were sweating, and I could feel the blood rush to my face as I began to talk. Fortunately, I knew my material and as the talk progressed I became more comfortable. I survived the "ordeal" and took away the lesson of proper preparation. Nonetheless, even today I still am uncomfortable at the beginning of a talk, but with each one it gets a little easier.

Good luck to everyone with the course. I look forward to seeing the issue of VT Fisheries Management.

Henry G. Drewes
Fisheries Program Coordinator
Minnesota Department of Natural Resources

I was a student in Dr. Orth's very first Fisheries Management class in 1981. Officially, I was an Arts and Sciences major while attending Virginia Tech; however, all of my free electives were taken through the Department of Fisheries and Wildlife Sciences. It was during my senior year that I decided to pursue a career in Fisheries. The education and experience gained while attending Virginia Tech has proven invaluable to me in my career development.

Upon completion of my bachelor's degree, I attended South Dakota State University where I earned an M.S. in Fisheries Science. Subsequent employment opportunities found me in Oklahoma, Montana, and most recently, Minnesota where I have been for the past eight years. I am currently a Fisheries Program Coordinator for the Minnesota Department of Natural Resources, Section of Fisheries. My responsibilities include coordinating the statewide lake and stream survey program, lake and stream management planning, statewide management information systems, and warmwater experimental regulations. The job is diverse, challenging, and at times (but not always) rewarding.

I have many fond memories of my four years at Virginia Tech. I see no need to elaborate on the time spent wading and tubing on the New River, so I will focus my comments on Dr. Orth's Fish Management class. I vividly remember slogging around in the duck pond doing a mark-recapture exercise on the resident carp population. I also remember learning in subsequent years that the study area we were wallowing in, was in fact quite polluted. Despite the aesthetics of the study site, we did gain valuable experience using commonly employed fish sampling techniques. Probably the most realistic training you will get in Dr. Orth's class is via the public meeting exercise. I will never forget playing the role of fisheries chief when Larry Nielsen jumped up from the back of the room and launched several off-the-wall, unanticipated questions. We (my hypothetical staff and me) were well prepared to handle the biological questions, but not the ethical/social twist Larry provided (I've since learned that Larry wasn't really acting).

More often than not, it is the social/ethical issues that tax our ability to manage aquatic resources. Answers to the biological questions are more readily attainable than those where personal values are attached. In order to succeed as a Fisheries Manager today, one must be able to work closely with the public, constituent groups, and numerous levels of local, state and federal government. The ability to communicate with the public, negotiate, plan, assess environmental impacts, and shape public policy are important aspects of fisheries management positions.

The public meeting exercise was an opportunity to begin building these skills, which have not traditionally been part of the formal training in natural resource education.

In closing, the message that I would leave you with is this -- never miss an opportunity to further your fisheries experiences. Volunteer to help other students or professors, volunteer to work with state agencies, look for internship opportunities and finally don't hesitate to pursue opportunities when they present themselves.

John Carmichael
Graduate Student
North Carolina State University

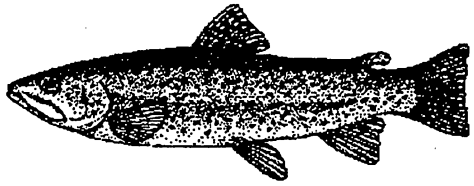
I am a 1988 graduate of the fisheries science curriculum at Virginia Tech. After working on fish surveys on the Chesapeake Bay for the Maryland DNR for three years, I decided to return to school. I am now working on an MS at North Carolina State University. My project involves investigating the effects of temperature and water flow on spawning and migration behavior of Roanoke River striped bass. We are using fixed monitoring stations and manual tracking to locate individually coded ultrasonic tagged fish. The impetus behind the project is that changes in flow and temperature caused by operation of a hydroelectric power plant have adversely affected recruitment.

I feel I received an excellent education at Tech. I realized this while employed by Maryland, and had interaction on a project with a fisheries graduate student at the University of Maryland. He was taking several classes that I had already taken as an undergrad. Additionally, the many fisheries classes allowed me to be classified as a fisheries biologist and thus receive a higher salary than others with a more general background. I remember many of the classes being tough and having to study hard, but it paid off in the real world.

Attending Virginia Tech and surviving the fisheries curriculum opened doors for graduate school. Although my grades were nothing spectacular, Tech's reputation helped overcome that deficiency. In my first few weeks at NCSU, I was once introduced as having attended "Those golden halls of fisheries in the VA mountains." It may have been somewhat tongue in cheek, but nonetheless indicates the reputation of your school. You cannot go very far in this field, especially in the Southeast, without running into Tech grads. I continue to keep in touch with most of the "fish guys" with whom I graduated. None are working at McDonalds, and all seem to be pleased with their careers.

I'm trying to recall some of the fisheries management class experiences from so long ago. I do remember the labs well, seining and electrofishing and doing population surveys. Amazingly enough, I put all those things to use once employed. I remember equations and graphs on populations from class, that often seemed to make little sense at the time, but for which I was appreciative once I needed to apply the concepts to my own data and work. Upon looking back at what was covered, I realized I recalled far more than originally thought. The class is a lot of work at the time, but once you begin putting it all to use it comes back. Additionally, developing good writing skills is incredibly important. Whether you attend graduate school or go to work, writing will always be necessary and will help your career advance.

Not just the fisheries management class, but several others seemed incredibly tough. The best advice I can think of is to remember that you are developing tools that will be used everyday. When you look back in a few years you will realize that although you may not remember all the particulars of a given class, you have developed a knowledge base upon which you unconsciously call all the time. I paid attention and learned a lot in the fisheries classes, and just wish I had done the same in statistics. Finally, don't be discouraged if your grades are not as good as you would like. I felt I could not handle graduate school upon graduation, and was nervous about how I would do once enrolled. I was very pleased to discover that with a little hard work and diligent class attendance, everything is going great. Good luck in class and your careers.



John Copeland
District Fisheries Biologist
Virginia Dept. of Game and Inland Fisheries

Since graduating from Virginia Tech with a B.S. in fisheries science in June 1984, I have worked in a number of fisheries positions in New York, North Carolina, and Virginia. In 1992, I finished an M.S. in zoology at NC State University. I was recently hired by the Virginia Department of Game and Inland Fisheries as a fisheries biologist in the Farmville district office. In this position, I share responsibility with the fisheries biologist supervisor for research and management activities in a 12 county area in south-central Virginia. Within that area, we work with a variety of fisheries resources from large reservoirs (Kerr and Gaston) to small impoundments (Briery Creek Lake) and we even work with riverine systems like the James, Appomattox, Meherrin, and Nottoway Rivers.

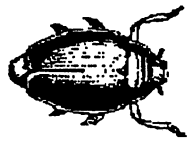
Some of our most common management activities include designing and conducting creel surveys and fish population surveys. After the field work is over, we analyze the results, report on those results, and

recommend and implement management activities, like stocking and regulation changes. Management activities we initiate on small impoundments are things such as the placement and construction of fishing piers and fish reefs.

We often function as public relations agents, serving as "front-line" information people for the anglers and hunters in our area. In that capacity, we have opportunity to promote Department programs and increase public awareness of what we do to provide better angling. My supervisor and I represent the Department at meetings on fisheries-related matters with officials from state, federal, and local organizations as well as private companies and organizations.

Sometimes, we review and comment on environmental impact statements, project designs, and permit applications for development projects. We take care of administrative details for all the aforementioned activities. Then, if we have time left, we conduct applied research projects or review research proposals from universities and private consultants. Occasionally, we have opportunity to do work that can be reported in the scientific literature.

I cannot specifically recall all the topics we covered in any fisheries management course ten years ago. However, I can offer some words of advice. First, take every opportunity to interact with the graduate students in the program. As you work on projects with them, your eyes will be opened to the world of fisheries research, and you will gain professional contacts and valuable experience. Second, as you will see in your fisheries management class, there is much information to be absorbed. Strive not to memorize, strive to know how to access the information you will need to solve problems. In other words, learn how to learn! Third, take the time to work on an undergraduate research project with one of your professors. The perspectives you gain will help you in graduate school and on the job. Finally, develop your oral and written communication skills. Without these skills, you will be poorly equipped for most jobs. A wise scientist once said to me, "It doesn't matter how much you know if you're not able to tell anyone about it." I took his advice to heart and worked on my communications skills. Those skills have helped me immeasurably in my career as a fisheries biologist.



Joe Tousignant
Missouri Dept of Conservation
Aquatic Service Biologist

I graduated in December 1989 (the 4.5 year plan), and was quickly hired by the Indiana Department of Natural Resources as a Fisheries Technician. I assisted a research biologist in this position for almost two years and was then promoted to Environmental Biologist. In that position, I mainly worked with stream and wetlands protection through a state stream protection law and section 404 of the Clean Water Act. Getting tired of the muddy ditches and streams of Indiana, I strived to escape its clutches and landed a position with the Missouri Department of Conservation working as an Aquatic Services Biologist as of December 1, 1993. (A hunter and fisherman's dream come true!) My duties here include providing lake management services and technical advice to private pond and lake-owners, and technical advice on stream management, especially streambank erosion control.

Having been through the application and interviewing process three times in four years, as well as working for two different state agencies, I feel I can provide some words of wisdom.

1) Join the AFS, and obtain a copy of the requirements to become an Associate Fisheries Scientist. This certification looks great on a resume! Even though you are going to one of the best fisheries schools in the country, your coursework may not necessarily fill the education requirements! Even more so, you must obtain a "C" or better grade for the course to count. I'm still trying to make up for poor grades in statistics and physics.

2) Bug the hell out of professors, graduate students, and staff until you can get meaningful field experience! My three summers of fieldwork is what got my foot in the door!

3) Be computer literate. This was also a big help getting my first job in Indiana. Every biologist I've ever known needs to use computers on a daily basis.

4) Learn as much as you can about stream management. It seems that streams are becoming a big priority nationwide, and if you know how to fix

stream problems, you are a step ahead of the game.

5) Don't pass up any entry-level position with a state agency because of low pay. These positions get your foot in the door and set you up for a promotion in no time! I only made $14,976 my first year in Indiana, but that soon changed for the better!

And now for some advice regarding the fisheries management class: If you are not getting these things out of it, you had better speak up!

You had better learn how to age fish scales! Picking bullheads out of a gill net is an art, not a science. Get used to working on a lake in the cold. I think the prof should schedule the pond management field trips no later than March 1. Take these labs seriously--you want to learn how to write a complete fish management report and supply recommendations. Let Smogor teach you how to identify fish. Learn about aquatic vegetation management.

Good luck in your career endeavors. I expect to see your names on a Missouri application before too long!

Thanks to all the former students who spoke out; my favorite quotes are listed. Some of your advice sounded much like mine; yet it comes from a more credible source - D.J.O.

Patrick J. Braaten. Instream Flow Biologist, Wyoming Game and Fish Department, Cheyenne, WY.

"In addition to your classroom work, flood your mind with anything and everything that is fisheries related to ensure that you have at least a working knowledge of most topics."

William Raines. BS 1990. Instructor, Army Logistic Management College, Hopewell, VA.

"Make certain your studies are broad based in the areas of forestry, wildlife, agriculture, and waste treatment."

Chad Young. BS 1992. Graduate student, Virginia Tech, Blacksburg, VA.

"Although it may not seem like it now, Dr. Orth is human and probably doesn't want to see any of you next semester either."

Bret Preston. MS 1988. Environmental Analyst, Virginia Department of Game and Inland Fisheries, Richmond, VA.

" ... have fond memories of being skewered, grilled, chewed up, and spit out during public meeting exercise ... received a pretty good lesson of what faced us in our future careers"

Derek A. Tribble. BS 1993. Fish Culturist, Virginia Department of Game and Inland Fisheries, Montebello, VA.

"Start on those tests early, read, and keep at it."

Marty Underwood. BS 1993. Research Technician, US Forest Service, Blacksburg, VA.

"Attend every class because Dr. Orth can lose you fast."

Leigh McDougal. BS 1982, MS 1990. Fisheries Biologist, US Forest Service, Alabama.

"The broader your education, the more job opportunities are available."

Joel Harrison. BS 1993. Biological Aide, US Forest Service, Blacksburg, VA.

"The thought processes and problem solving skills I developed during the class have been a valuable asset."

... rivers and all creatures that inhabit the water were put here for wise men to contemplate and fools to ignore.

Izaak Walton *The Compleat Angler*

Rick Eades, BS 1985. Fisheries Biologist, Virginia Department of Game and Inland Fisheries, Virginia Beach.

"You should enjoy Dr. Orth's course and it should all make sense by the end ... If not, maybe fisheries isn't for you."

Steve Sammons. BS 1991. Research Associate, Virginia Tech, Blacksburg, VA. Not one for being concise, Steve sent a 20 page manuscript, a portion of which appears in our Fisheries Humor section. On obtaining a Master's degree in Fisheries, Steve says

"Overcoming adversity is what makes a thing worth obtaining ... But there were times when even I was taken aback at the adversity I was called to overcome."

Patrick S. Lookabaugh. BS 1992. Research Specialist, Cooperative Fisheries and Wildlife Research Unit, Blacksburg, VA.

*"It was the worst of times, it was the worst of times. If you miss class, you probably shouldn't have. If you think the exams are too hard, you still have to fill in some of the blanks to pass. If you're hopped up on crack, you **still** shouldn't miss class."*

Thomas M. Hampton. BS 1991, MS 1993. Fisheries Biologist, Virginia Department of Game and Inland Fisheries, Staunton, VA.

"Save all your handouts and class notes ... you will consult them time and time again in years to come."

Stephanie Goudreau. MS 1988. Environmental Analyst, North Carolina Wildlife Resources Commission, Marion, NC.

"First time I went boat electrofishing, I was told musky are hard to collect by electrofishing ... Right after that a monster musky swam straight into my net."

Ian Jezorek. BS 1992. San Francisco, CA.

"Concepts and equations I struggled with are actually used in the real world."

Brian Wells. BS 1992. Graduate student, Old Dominion University.

"Trust me when I say $L_t = L_\infty[1-e^{-K(t-t0)}]$ *is going to come up again."*

John B. Smith. BS 1985. Fisheries Biologist, Federal Energy Regulatory Commission, Washington, DC.

"Eight years later I am still apprehensive about conducting public meetings."

Dave Bryson. BS 1983. Fisheries Biologist, US Fish and Wildlife Service, Cortland, NY

"I made quite a number of mistakes ... yet I did learn. This is only accomplished by keeping an open mind."

Kenneth Kopka. BS 1989. Staff Director, Lake Barcroft Watershed Improvement District, Falls Church, VA.

"Fisheries students were the most unique bunch on campus"

Brian Richardson. BS 1988. Fisheries Biologist, Maryland Department of Natural Resources.

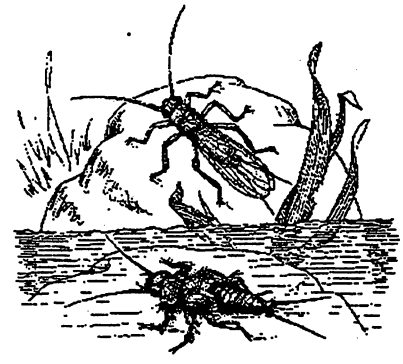
"Undergraduate coursework at VT was roughly equivalent to graduate courses at many other schools."

Stephen W. Hiner. BS 1982. Lab Specialist Sr., Department of Entomology, Virginia Tech, and Vice-Chair, Virginia Council of Trout Unlimited.

"I took Fisheries Management in 1981, before the age of soft men of the 90s"

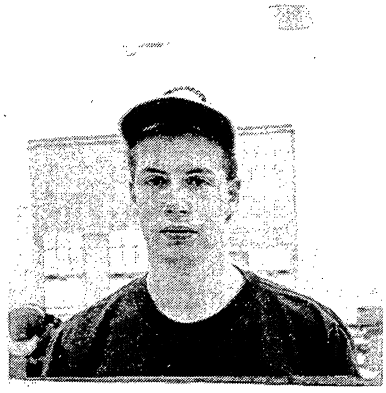
Karen Barton. BS 1993. Fisheries Biologist, US Forest Service, Monongahela National Forest, WV.

"Looking back ... I can only remember one thing. That is sitting in front of a computer manipulating huge salmon stocks. Do you all get out of that by writing the magazine? If so, you're missing out."



Damien McMahon

Josh Schiefer



Wesley Neal

Vanessa Lambert

Ken Griffith

Jon Bishock

Dan Garren

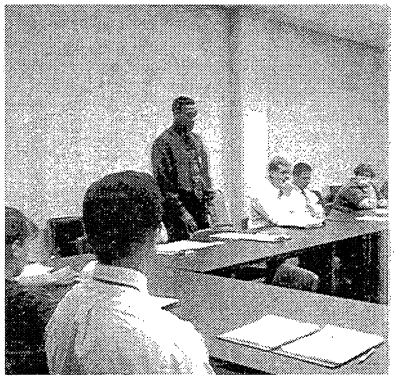
Nancy Gilmore

Mary Tokarcik

Greg Coates

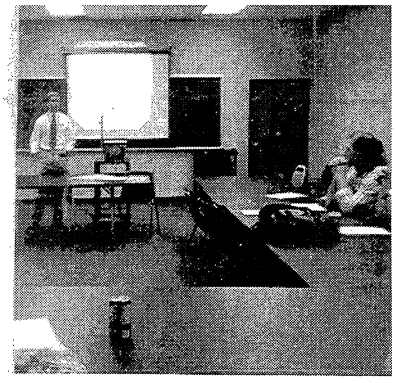
Mike Brooks

Roy Smogor



Mike's Crappie Talk

Student Editors



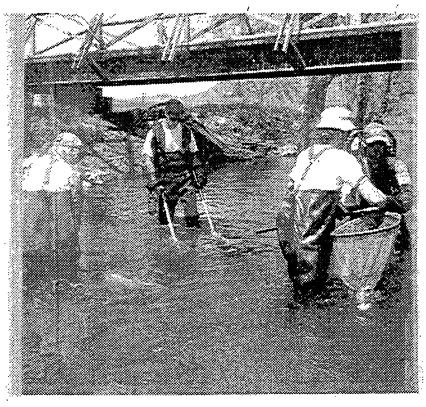
Wesley Presents the Plan

Citizen's Task Force

Bank Loafers

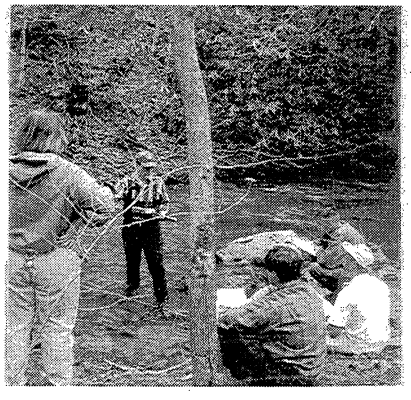
Josh and Andy Assess Pond Balance

We Guessed Its Relative Weight!



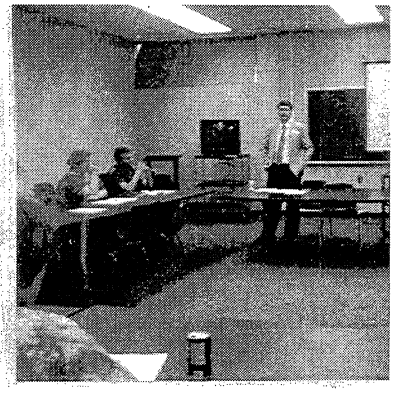
Stream Health Assessment

Jeff Weighs a Nice Bluegill



Instream Pebble Count Lecture

Ken's Pet



Orth plays Board Member