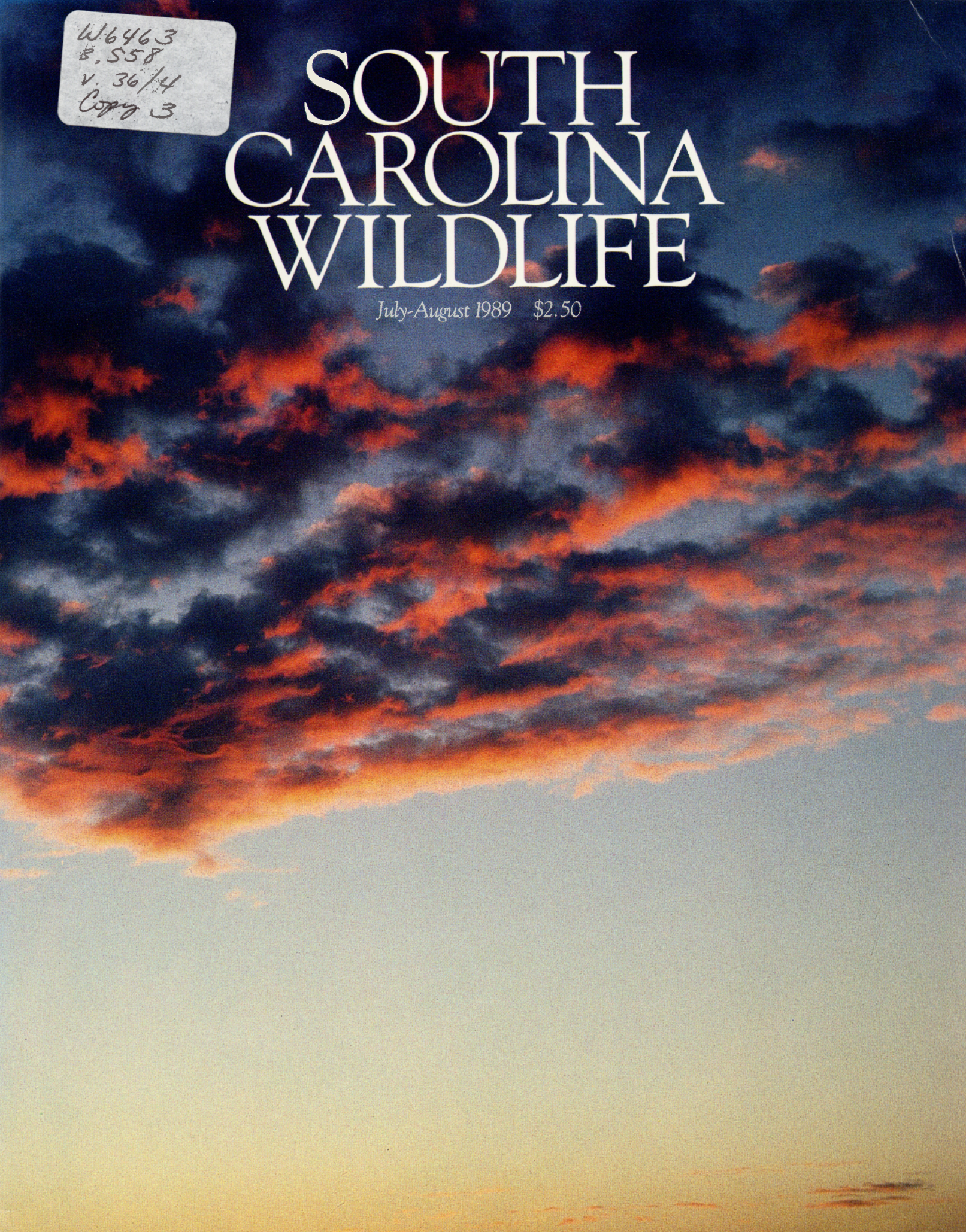


W6463  
B. 558  
v. 36/4  
Copy 3

# SOUTH CAROLINA WILDLIFE

July-August 1989 \$2.50



# Create a collection!

If you're like many subscribers who treasure each copy of our magazine, you'll appreciate our binders.

Constructed of simulated leather and screened with logo and wildlife art, these binders not only provide safe storage and easy reference for a year of SOUTH CAROLINA WILDLIFE, but also are a tasteful addition to any bookshelf or coffee table. **Only \$8 each—use the convenient order form on the last page.**



# SOUTH CAROLINA WILDLIFE

JULY-AUGUST 1989, VOL. 36, NO. 4

*Dedicated to the Conservation, Protection, and Restoration of Our Wildlife, And to the Education of Our People to the Value of Our Resources.*

DIRECTOR, CONSERVATION  
EDUCATION AND COMMUNICATIONS  
Prescott S. Baines

EDITOR  
John E. Davis

MANAGING EDITOR  
Linda Renshaw  
ASSOCIATE EDITOR  
Glenn Oeland  
EDITORIAL ASSISTANT  
Patricia Garrett Way

STAFF WRITERS  
Bob Campbell  
Mike Creel  
Pete Laurie

ART DIRECTOR  
Linda Laffitte  
ART ASSOCIATE  
Ellen Fishburne Seats

CHIEF PHOTOGRAPHER  
Ted Borg  
PHOTOGRAPHERS  
Michael Foster  
Phillip Jones

CIRCULATION DIRECTOR  
Jim Goller  
CIRCULATION  
Rose McManus  
PROMOTIONS  
Ginger DeHaven  
FINANCE  
Carole Collins

South Carolina Wildlife (ISSN 0038-3198) is published bimonthly by the Conservation Education and Communications Division of the South Carolina Wildlife and Marine Resources Department, 1000 Assembly St., Dennis Building, Columbia, S.C. 29201. Copyright ©1989 by the South Carolina Wildlife and Marine Resources Department. No part of the contents of this magazine may be reproduced by any means without the consent of South Carolina Wildlife.

Manuscripts or photographs submitted to South Carolina Wildlife should be addressed to: The Editor, P.O. Box 167, Columbia, SC 29202-0167, accompanied by self-addressed envelopes and return postage. The publisher assumes no responsibility for unsolicited material. Subscription rate is \$10 per year. Second-class postage is paid at Columbia, S.C., and additional mailing offices. Circulation/Special Products: (803) 734-3944; Editorial: (803) 734-3972.

POSTMASTER: Send address changes and inquiries to South Carolina Wildlife, Circulation Department, P.O. Box 167, Columbia, SC 29202-0167.

# CONTENTS

## S. C. STATE LIBRARY

JUL 13 1989

2 Biosphere 3 Books 4 Readers' Forum STATE DOCUMENTS

6 Natural History: Chimney Swift 11 Events

12 **Magnuson Act** by *Pete Laurie*  
In its twelve-year history, this act has had a tremendous impact on offshore fisheries, an impact finally being felt by South Carolina anglers.

16 **Daughters Of Earth And Water** by *Linda Renshaw*  
Shelley's poem "The Cloud" lauded these wondrous heaps of water vapor and ice crystals.

24 **The Sea Devil** by *Rick Leonardi*  
Up and down ... swell after swell ... hell ad infinitum, ad nauseum. The day becomes a battle fought inch-by-inch, and only the sea can win.

26 **Greenhouse** by *Mike Livingston*  
Orange groves in Clemson, the Charleston peninsula under water, a monsoonal South Carolina where cotton and magnolias no longer grow—these may not be too far-fetched.

32 **Jellies** by *Dixie L. Anderson and Linda Renshaw*  
Exquisite and unique, jellyfish pulse through all the world's seas. While those that visit our waters are generally fragile and harmless, they should be treated with respect.

38 **Carolina's Own** by *Henry Herndon*  
Our roots go deep into her soil; our allegiance is pledged to all about her that is natural and good.

40 **Summertime Strippers** by *Jim Goller*  
While most of us retreat to air-conditioned homes to escape summer temperatures and humidity, persistent anglers seek hot action below the surfaces of South Carolina's big lakes.

46 **Springs Eternal** by *Jim Fenwood*  
Magical powers are attributed to them; families travel miles and stand in line to partake of their offerings.

50 **Field Trip: Raven Cliff Falls** 54 **Roundtable**

**The Cover** by *Michael Foster*  
Alto cumulus clouds, the dappled formations of a "mackerel sky," give meteorologists few clues to the weather that lies ahead. (See page 16.)

26



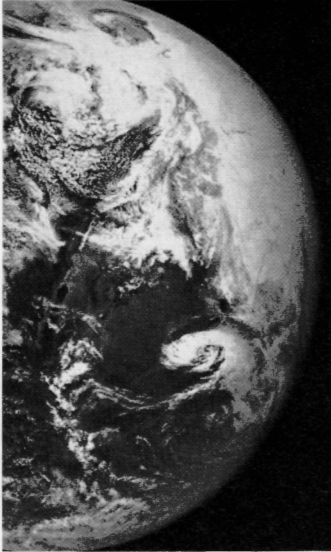
32



40



# BIOSPHERE



COURTESY OF NASA

*Simply put, man's numbers, coupled with the capabilities and demands of his technology, are threatening Earth's ability to support societies such as our own.*

IF ANNUAL REPORTS WERE ISSUED FOR PLANETS AS THEY ARE FOR CORPORATIONS, Earth's analysis of gains versus losses would do little to inspire confidence among stockholders.

Unless the calculations of our best scientists are incorrect, the Greenhouse Effect is already upon us, exacerbated by our pollution of the atmosphere. Rising global temperatures and associated climatic change threaten to substantially alter the planet over the next several decades.

Worldwide, the extinction rate for plant and animal species is increasing at an alarming rate. Earth's forests are being toppled at more than one acre per second. Vital areas such as coastal marshes and freshwater wetlands are on a critical downswing. Reports of flooding, desertification and dwindling groundwater supplies come from around the globe.

Disposal problems already exist in handling the increasing chemical, nuclear and solid waste byproducts of our prosperous society. Severe shortages of fossil fuels, predicted decades ago, are certain to occur within the coming century.

Simply put, man's numbers, coupled with the capabilities and demands of his technology, are threatening Earth's ability to support societies such as our own. How ironic if man's opposable thumbs and superior brain, key assets in his ascent to mastery of the planet, ultimately prove the limiting factors directing his and Earth's demise.

However, let's not write off this Earth Corporation just yet; you and I and its billions of other living stockholders can't afford the consequences of filing Chapter 13. In fact, a good argument can be made that our instinct for survival, spurred by the effects of technology and expanding population, may actually rally our defense of this beleaguered planet.

Astronauts' views of Earth have given us a holistic perception of our world as a dynamic blue and white life form isolated in the black void of space. Instant worldwide communications bring us firsthand news of ecological disasters: cutting in the rain forests, holes in the ozone layer, the effects of acid rain, etc. News reports would desensitize us were it not for the increasing number of related incidents, occurring daily, on a regional and local scale.

We can understand the international problem of acid rain through the sight of mountain peaks trimmed with tree snags at the highest elevations of the Great Smokies. We can appreciate the nation's waste disposal dilemma through headlines about sister states using South Carolina landfills.

We can associate the worldwide loss of forests to cutover hardwood drains where we once hunted or hiked among great oaks. We can relate to water pollution and vanishing species through bulletins flashing news of a fish kill on waters where we boat. We can sense global atmospheric problems while stalled in the rush hour smog. We can weigh the pressure of our own kind on Earth's natural resources by the shopping centers, industrial developments and housing projects replacing lands and waters where we once sought the solitude of nature.

Many South Carolinians are exhibiting a growing intolerance for abuse of their environment. Economic progress at any price is no longer welcome. Our actions at home could make this coming decade the most critical ten-year period in the history of man and planet Earth.

Carroll A. Campbell Jr.  
Governor of South Carolina

## WILDLIFE AND MARINE RESOURCES COMMISSION

Marion Burnside  
7071 Bluff Road, Hopkins  
Chairman

Rep. L. Edward Bennett  
Box 156, Springfield

Charles L. Compton  
106 Leftbank, Laurens

Sen. John Drummond  
Suite 313, Gressette Building, Columbia

Thomas W. Miller  
P.O. Box 1853, Anderson

Larry C. Owen  
Rt. 8, Box 97-A, Easley

J.M. Pendarvis  
Rt. 1, Box 2, Estill

G.B. "Bo" Stokes  
P.O. Box 905, Florence

James O. Thomason  
P.O. Box 306, Spartanburg

Sen. Rembert C. Dennis  
Box 1174, Moncks Corner  
Commissioner Emeritus

## CONSERVATION EDUCATION AND COMMUNICATIONS ADVISORY BOARD

James O. Thomason, Spartanburg  
Chairman

William Y. Edens, Columbia

Dr. Robert L. Lumpkin, Georgetown

Helen Maybank, Charleston

Duncan Newkirk, Charleston

James H. Quackenbush Sr., Columbia

A. Pinckney Skinner III, Florence

Dr. James C. Todd III, Laurens

John B. White Jr., Spartanburg

## WILDLIFE AND MARINE RESOURCES DEPARTMENT

Dr. James A. Timmerman Jr.  
Executive Director

Larry D. Cartee  
Assistant Executive Director

John B. Reeves, Director, Administrative Services; Albert G. Courie, Personnel; Fred Ramage, Accounting.

Prescott S. Baines, Director, Conservation Education and Communications; John W. Evans, Public Information; John E. Davis, Magazine; Jim Goller, Circulation; Don Winslow, Education; James L. Haynsworth, Special Publications.

W.K. Chastain, Director, Law Enforcement and Boating; R.M. Gifford, Chief, Law Enforcement.

W. Brock Conrad Jr., Director, Wildlife and Freshwater Fisheries; John E. Frampton, Game Management; H.J. Logan, Fisheries; Thomas S. Kohlsaat, Nongame and Heritage Trust; Thomas A. Curtis, Dennis Wildlife Center.

Dr. Paul A. Sandifer, Director, Marine Resources; Dr. Edwin B. Joseph, Regional, National and Scientific Affairs; Charles M. Bearden, Office of Conservation, Management and Marketing; Dr. Victor G. Burrell, Marine Resources Research Institute.

AN EQUAL OPPORTUNITY EMPLOYER.

**GARDENING WITH WILDLIFE KIT** by National Wildlife Federation, 1400 Sixteenth Street, NW, Washington, DC 20036-2266, (202) 797-6800, illustrations, color photos, 1986.

Here's the complete guide to planning and planting your yard to attract birds, butterflies, and other animals with plant materials recommended by expert naturalists. The kit includes a 64-page guide to backyard wildlife attraction, informative plant lists and easy-to-use planning tools, colorful guides to attracting and feeding birds, and a wildlife gardener's journal.

The journal contains tips and suggestions to make sharing your yard with wildlife a rewarding experience each month of the year. Space is also provided to make your own notes for each month.

Gardening with wildlife does not require you to have a biology degree, so leave any misgivings behind and share your world with wildlife.

**TAYLOR'S POCKET GUIDES: Perennials For Shade, Perennials For Sun, Modern Roses, Old-fashioned Roses, Bulbs For Spring, Bulbs For Summer** by Ann Reilly and Maggie Oster, Houghton Mifflin Company, Two Park Street, Boston, MA 02108, (617) 725-5972. Color photos, climate zone map, index, glossary, 127 pages each, 1989.

Designed for gardeners looking for a handy quick reference, these six **Pocket Guides** include color photos of eighty species, plus specific information on how to grow and use the plants, tips on selecting the right plants for

your garden, and expert advice on planting, maintaining and increasing your collection. Climate zone maps make the books useful in all parts of the country.

**THE WASTED OCEAN** by David K. Bulloch, Lyons & Burford Publishers, 31 West 21 Street, New York, NY 10010, (212) 620-9580. Hardcover, paperback, 6 x 9 format, 160 pages, 1989.

Hypodermic needles awash on popular beaches and a major oil spill in Alaska have brought the ocean pollution crisis to everyone's attention. The oceans and the life they sustain are now at risk.

**The Wasted Ocean** is a reasoned, non-biased exploration of the ominous problems we face today. According to the author, the headline-grabbing events of the past year represent only a fraction of the damage being done to the marine environment on a regular basis. Industrial discharge, plastics, nuclear waste, spoil from dredging, and sewage are routinely being dumped into our rivers and oceans. Fish kills, poisoned seafood, and ruined fisheries are becoming more and more commonplace.

In **The Wasted Ocean**, Bulloch outlines the factors that contribute to the pollution of the oceans. In addition to raw sewage, some 2.3 trillion gallons of "treated" wastewater enter our coastal waters every year. Large oil spills dominate the headlines, but much of the oil in the sea comes from sources usually left unmentioned. Industrial discharges, routine ship operations, and coastal waste are a few of the culprits responsible

for more than 4 million tons of petroleum products that wind up in the oceans every year.

Every citizen must be concerned with the current crisis, and this book is filled with valuable information, including a coastal survey of American shore regions, an overview of the laws that govern pollution control, an agenda for citizens' action, private organizations concerned with ocean pollution, and government agencies responsible for pollution control.

Many of our shorelines have already been destroyed by pollution. Bulloch believes that a motivated public can make a difference and help to protect the fragile ocean environment.

**COHELEACH** by Terry Wieland, Briar Patch Press Inc., P.O. Box 770, Camden, SC 29020, 1-800-227-5998. Color plates, drawings, hardbound, 11 x 12 format, 176 pages, 1989.

If a picture is worth a thousand words, readers will find a lifetime of fascinating reading in **Cohelach**, a book that presents the first in-depth look into the exciting life and career of wildlife artist Guy Coheleach.

Author Terry Wieland provides an absorbing study of both Coheleach the artist and Coheleach the man. Interesting and insightful captions reveal not only what inspires and motivates the artist, but how he creates his beautiful paintings of everything from tiny owls to towering giraffes.

**Cohelach** is a fitting tribute to this renowned artist. The hardcover book is also a striking first volume in **Masters of the Wild**, a history-making series that will ultimately include the greats in sporting and wildlife art. 🦋

# READERS' FORUM

## Personal Involvement

I read with great interest John Davis' editorial (Biosphere) in the March-April issue. In August 1979 a few concerned citizens in Murrells Inlet began an eight-year struggle to stop what we believed to be a horrendous mistake—approval by the state of a new marina and fish factory that became known as the Triska Marina.

In 1987 the S.C. Supreme Court ruled that even though a mistake might have been made when the state initially issued the permit, it could not be withdrawn and, therefore, they allowed the project to go forward. We were heartbroken and felt that the "war" had indeed been lost.

Today, almost ten years later, the project remains dormant. Serious questions about its financial viability as well as a heightened awareness of the inlet's delicate environmental balance have prevented the project's completion. In spite of our initial loss, what we perceived in 1987 as the war may now be just a battle.

Our case study is an example of your call for "personal involvement." Thanks for strong support of the very special quality of life we all enjoy in South Carolina and our obligation to "stand up and be counted" to preserve it.  
*A. T. Quantz Jr.*  
*Murrells Inlet*

## Save Our Streams

Reading "Troubled Waters" (March-April) left me with a gnawing emptiness in the pit of my stomach—the way one feels after losing something very dear.

I've backpacked and fished almost all of South Carolina's backcountry headwater streams and it makes me ill to see these resources damaged or lost. What can be done to save our endangered coldwater fishery? I feel so helpless, especially here in Charleston.

I joined the Saluda River Chapter of Trout Unlimited when I found out one existed. Knowing that other people really do care about our trout streams has given me hope. As a result, we are currently attempting to form a Charleston chapter of Trout Unlimited.

I want to commend you on your keen interest in this subject. Please help us maintain public interest and concern over these wildlife areas.

*Keith G. Farley, O.D.*  
*Mount Pleasant*

## An Untold Story

Thank you for the most disconcerting but very accurate description of the plight facing our mountain waters. The sad story of the loss of one of South Carolina's truly natural treasures—her cold, cascading trout streams—had gone untold.

The article is really an understatement when one considers what has been lost here in our mountains in the last few years.

Hydroelectric projects have gone forward without a glimmer of thought about alternatives that cost much less, supply the same amount of electricity, and allow our rivers and streams to continue to work their magic.

I personally witnessed the death of Howard Creek, the

stream destroyed by the Bad Creek Project. Before the project, I would watch the huge brown and rainbow trout, 20 inches and longer, migrate up the stream to spawn. I visited Howard Creek periodically and watched the mud and siltation choke the last bit of life from this untamed miracle of creation. It was a veritable man-made disaster when this prolific resource was destroyed for yet another hydroelectric project.

We have only a few miles of mountain trout waters left in South Carolina. "Troubled Waters" should alert the entire state and help bring about permanent protection of this unique resource so that our generation will not one day be maligned for allowing such destruction to occur when alternatives were readily available.

*Thomas Cloer Jr.*  
*Pickens*

The trend is unmistakable. Developers, including Duke Power Company, will not be satisfied until the once wild and scenic hills and streams of South Carolina are tamed. This saddens me. While a student at Clemson, I spent many carefree hours wandering in the mountains of Oconee and Pickens counties. Is it fair to take this option away from us and from future generations?

We must work toward preserving wild and scenic habitats. The public needs to be better educated about habitat loss caused by development. Currently, this is not as popular as hazardous waste issues. However, general habitat

destruction may have a far wider and longer lasting effect than hazardous waste sites.

*Jeff Jackson*  
*Camillus, New York*

Thank you for the article "Troubled Waters." Hopefully it will increase awareness of the problems being experienced in the streams of South Carolina.

As pointed out, "siltation, sewage treatment and illegal dumping can affect even supposedly pristine streams." This is happening all too often in mountain and other streams in the state.

An 18-month study by the President's Commission on Americans Outdoors recommended that "We need initiatives to protect rivers all across America." They further specified that "Water is more precious than gold ... Rivers for recreation are a scarce resource ... We can establish local partnerships to clean up and protect our rivers ... We can give special help to metropolitan rivers ... We should protect free-flowing rivers for recreation ... We can learn to respect river resources and treat them with care." These ideas are pertinent for South Carolina as well as the rest of the country.

Local chapters of Trout Unlimited are working to monitor and improve the situation in coldwater streams while other organizations are active in these and other streams. But our numbers are few. Everyone needs to become involved to avoid losing our fragile resources.  
*Tony L. Bebbler*  
*Columbia*



### Starry Night

Jim Fenwood's recent article on light pollution ("Light Up the Night," May-June) reveals an aspect of preventable pollution that should be considered.

Twenty years ago, I used to walk down the lane to my grandma's mailbox for her. That starlit lane was so dark I once walked right into a tree I knew was there. I would lie on the ground and watch meteor showers and the stars. I learned a great deal about my relationship to this universe from that glorious painting above. That view today is not the same because of Columbia's glow and the many yard lights.

As Mr. Fenwood suggests, we can easily improve this predicament. I personally believe that yard lights in the country benefit the burglar far more than they do the citizen. At the very least they can be designed or modified to shed light only on the yard below.

Further, light pollution must be recognized as an aesthetic problem similar to billboards. We should petition our legislators to pass laws requiring that new lights be directed downward and that shields cover existing lights. Perhaps a fund could be created to distribute covers at no charge.

We must recover the night or the next generation will be able to see only the brightest of the stars. We can only wonder about the pure skies of a century ago.  
*Robert B. Wilkinson Jr.  
St. Matthews*

### Start 'em Out Early

Five-year-old Wes Cheatam started turkey hunting this year.

On April 3, his dad called in an adult gobbler and three jakes. One shot from Wes' 20 gauge killed two jakes—an eleven and a twelve and one-half pounder.

The son of Johnny and Nancy Cheatam of Edgefield, Wes beat his dad's record by two years; his father was seven years old when he shot his first turkey.

*Jake Cheatam  
Edgefield*

### Note From a Neighbor

Your publication makes this Tar Heel proud to call you neighbor. I wish you continued success.

*Robert Kelly  
Mebane, North Carolina*

### Letters From Afar

May I and my wife say how much we have enjoyed your magazine. We cannot open it quickly enough on arrival.

We have now visited South Carolina four times in the last five years, and we cannot get over the beauty of the state and the friendliness of the people. The wildlife is so wonderful. My lasting memory on our last evening before returning home was of the mockingbird giving us his full repertoire.

As an amateur photographer I greatly admire your pictures and have learned so much from you. You must have some skilled photographers.  
*R. Balstet  
Cheltenham, England*

Having received my second issue of *South Carolina Wildlife*, I must express my gratitude for this exceptionally fine magazine. The informative articles and outstanding photographs have

brought a bit of spring to this snow-bound sailor.

*Edwin Price Jr.  
Keflavik, Iceland*

### Rather Depressing

Although your magazine has beautiful photography, I am much more interested in the "life" of animals rather than ways to hurt and kill them. I found many of the articles rather depressing due to content related to the death of animals. As a result, I will not be renewing my subscription.

*Kathy Liburdy  
Clemson*

### Weather Wise

I enjoyed reading Jim Casada's article, "Weather Wisdom." I wanted to add another jingle that my father used when we were planning a family boating and fishing trip:

*Rain before seven*

*Clear before eleven.*

There was many a morning that I would awake to rain only to see the summer sun come out and have a beautiful day aboard the "Project" at Dewees Inlet.

*John L. Porcher  
Seneca*

### Special Mention

We have truly enjoyed *South Carolina Wildlife* and in particular the wonderful photography. But we must tell you that the January-February issue, "A Reflection of Wings," is absolutely spectacular and deserves special mention for the beautiful bird photos.

Many, many thanks for this excellent magazine.  
*Russ and Lorrie Dean  
Mount Pleasant*

### Where's the Bluebird?

An extra feather in your cap for "A Reflection of Wings." Super!

I kept thumbing through (three times) looking for the Eastern bluebird, of which your state has a good supply, but no luck. I did see the bluebird name in print but no picture. How about a reprint and an update!!

*Jim Boozer  
Brevard, North Carolina*

*Editor's Note: The bluebird is one of our favorites, too, but unfortunately we couldn't feature every species photographically in "Reflection." By way of consolation, we are planning an entire natural history article devoted to this colorful songster.*

### Spreading the Word

I've enjoyed *South Carolina Wildlife* for many years. I've carried my copies in boxes to Maine, New York, Virginia, North Carolina and Florida and now back home again to South Carolina. Everywhere I've displayed them proudly for others to enjoy. Many wrote right away to their respective state wildlife departments requesting subscriptions to their magazines. It felt good to get others motivated into making an active contribution toward preserving what we all should hold so precious.

*Archie Niven  
Lancaster*

*Dear Reader: Your letters are always welcome in our mailbox. Our address is Readers' Forum, South Carolina Wildlife, P.O. Box 167, Columbia, SC 29202-0167. All letters will be treated as intended for publication.*

# SWEEPS

Close the fireplace damper—hundreds of these vocal, highly social, warm-weather visitors come swirling through the South Carolina sky like a living black whirlwind, perhaps to settle and rest in your chimney.

by Laurie A. Fenwood

illustration by Ellen Fishburne Seats

Sun's first light summons the dark, winged creature from the depths of its roost. With quick, darting movements it dips, dives and soars, snatching insects on the wing. High-pitched "chips" fill the air as others of its kind join the noisy hunt, the group gaining numbers, then separating as individuals widen their daytime quest for sustenance and spread across the open sky. Brightening sunlight winks glossy-green off the backs of deep brown wings held stiffly and slightly curved; small cigar-shaped bodies twist and turn and glide.

Tiny, twittering aerialists, these—not a throng of bats with their days and nights transposed, but a flock of the gregarious little birds erroneously termed swallows and often called chimney sweeps: the chimney swifts, *Chaetura pelagica*. These acrobatic insectivores are common in the South Carolina warm-weather sky, arriving early in the spring and lingering into the fall. While the birds earn their name from the close, vertical structures in which they choose to nest, their real home is the freedom of the heavens, and they spend their days on the wing.

Almost all swift activities, with the exception of nesting, are accomplished in the air. Their family name, Apodidae, from the Latin for "without feet," reflects their airborne habits. Swifts feed on the wing, court and copulate on the wing, drink and bathe on the wing—even grab the dead twigs necessary to build their nests as they make passes over a likely branch.

They spend more time aloft than any other land bird; some European swifts even spend their nights in the air at lofty altitudes. One banded chimney swift was estimated to have flown 1,350,000 miles during its nine-year lifetime, including round trips to South America where it wintered. Imagine the frequent flyer credits that bird could have racked up if he had flown commercially!

A chimney swift's small, streamlined body is perfectly adapted to rapid but maneuverable flight. Described by some observers as resembling a flying bow and arrow, the swift holds its arced wings in a crescent shape while in flight. The long, backswept wings are models for our small fighter jets (though the military probably prefers the falcon image). A swift's wings are curved and stiffened by short, comparatively massive bones making them more rigid than swallows' wings. The bird's tail is blunt and never forked or broadly fanned in flight. Short, stiff bristles extend backward from the tips of the tail feathers, although they are not usually visible in the field. These spines lend support when the bird clings to a vertical surface.



Ellen Fishburne Seats '89



Wide-mouthed and short-beaked, a chimney swift is an airborne food-trapper. In fact, nearly all its daytime activities are carried out on the wing. Come nightfall, it may join scores of its kind in a swirling reunion before dropping to roost in a brick or stone chimney.



A swift is *pamprodactyl*, that is, able to bring its "big toe" or hallux forward. Although its feet are small and weak, this ability enables the bird to cling to sheer surfaces with its sharp, strong claws.



To brace during vertical roosting, needle-sharp spines project from a swift's ten tail feathers, one from each shaft. These feathers wear down as the bird ages, and an immature bird's tail feather is more rounded and shapely (dotted line) than an adult's.



Swifts' flight seems batlike or jerky when compared to the swooping movement of swallows, and the flight pattern consists of rapid, shallow wingbeats followed by short glides. Contrary to appearances, chimney swifts do not beat their wings alternately, like some aerial kayaker, but move them in unison as do other birds. The wingbeats are so fast, however, that slow-motion and strobe photography were needed to dispel that popular notion.

As a family, swifts may include the fastest-flying birds in the world. A spine-tailed swift was clocked at 218 miles per hour over the Cachar Hills of India by E.C. Stuart-Baker. H.C. Cogswell observed a white-throated swift, a western relative of the chimney swift, avoiding the stoop of a peregrine falcon at over two hundred miles per hour—an obviously highly motivated bird!

Radar equipment similar to the kind used to catch speeders has timed chimney swifts at speeds of fifteen to twenty miles per hour. Blinding speed is not necessary for the chimney swifts' daily life. They just need to overtake dinner and, occasionally, chimney swifts of the opposite sex, since courtship takes place in the air. Often two males will chase one female, or small groups will make flights together. Usually a pair flies rapidly about uttering chipping, twittering calls. Copulation is managed aerially and also occurs at the nest.

**T**he nest site is usually a dark, sheltered space such as a chimney, hence the bird's name. However, swifts were found in North America before chimneys existed here; prior to extensive settlement, nests were built in hollow trees.

Large numbers of swifts may nest communally, though the most common household consists of one pair per chimney. Often the birds return to the same nest site year after year. The semicircular, cuplike shelf is constructed primarily of twigs broken off in flight by the swift's feet. It is cemented to the interior of a barn, silo, open well, air shaft or, of course, chimney at no consistent depth, height or location. The unlined nest is fastened together and to the surface by the bird's saliva. Appropriately, swift salivary glands enlarge during the breeding season to accommodate the need for increased production.

Most species of swifts share this characteristic nest-building style, with variations. One group of Far East swiftlets build their nests entirely of saliva. These birds are called the "edible nest" swifts, and their tiny architectural accomplishments are a much-sought-after Chinese delicacy. The finest nests sell for \$4,000 per pound, rivaling the per-ounce price of gold. The white-nest swiftlet, which produces the most prized nests, builds high on the walls of caves along the coast of Thailand. This little bird was once thought to exist on a diet of sea foam and air rather than insects. Nest harvests are dangerous and the locations closely guarded. All this for the main ingredient in bird's nest soup, which purportedly bestows health, long life, purity, virility and wisdom upon the consumer. It also is touted as a great hangover cure!

Saliva is not the main construction item in North American swift nests. Sticks are. A lot of boiling would be required to make your chimney swift nest soup-tender! The mucilaginous material produced by swift salivary glands is glutinous when moist but hard upon drying. Chemically, it resembles a saturated solution of gum arabic. More prosaically, it's bird spit. This substance cements the twigs together and secures the nest to the chosen vertical surface.

In addition to using this singular construction material, chimney swifts build in places that make them especially interesting to humans—in other words, close to us. It's hard to ignore a family of swifts that maintain their fallen household directly behind the sheet metal shield of an unused fireplace.

When our chimney was selected as a nursery, even the family pets became involved in chimney swift observations. The clatter and noise of two adult and two young

swifts sharing joyful reunions and mealtimes were enough to send a frustrated cat outside to sulk and an annoyed hunting dog out of the room. The unwilling human observers hoped for swift, no pun intended, fledging and evacuation of the premises.

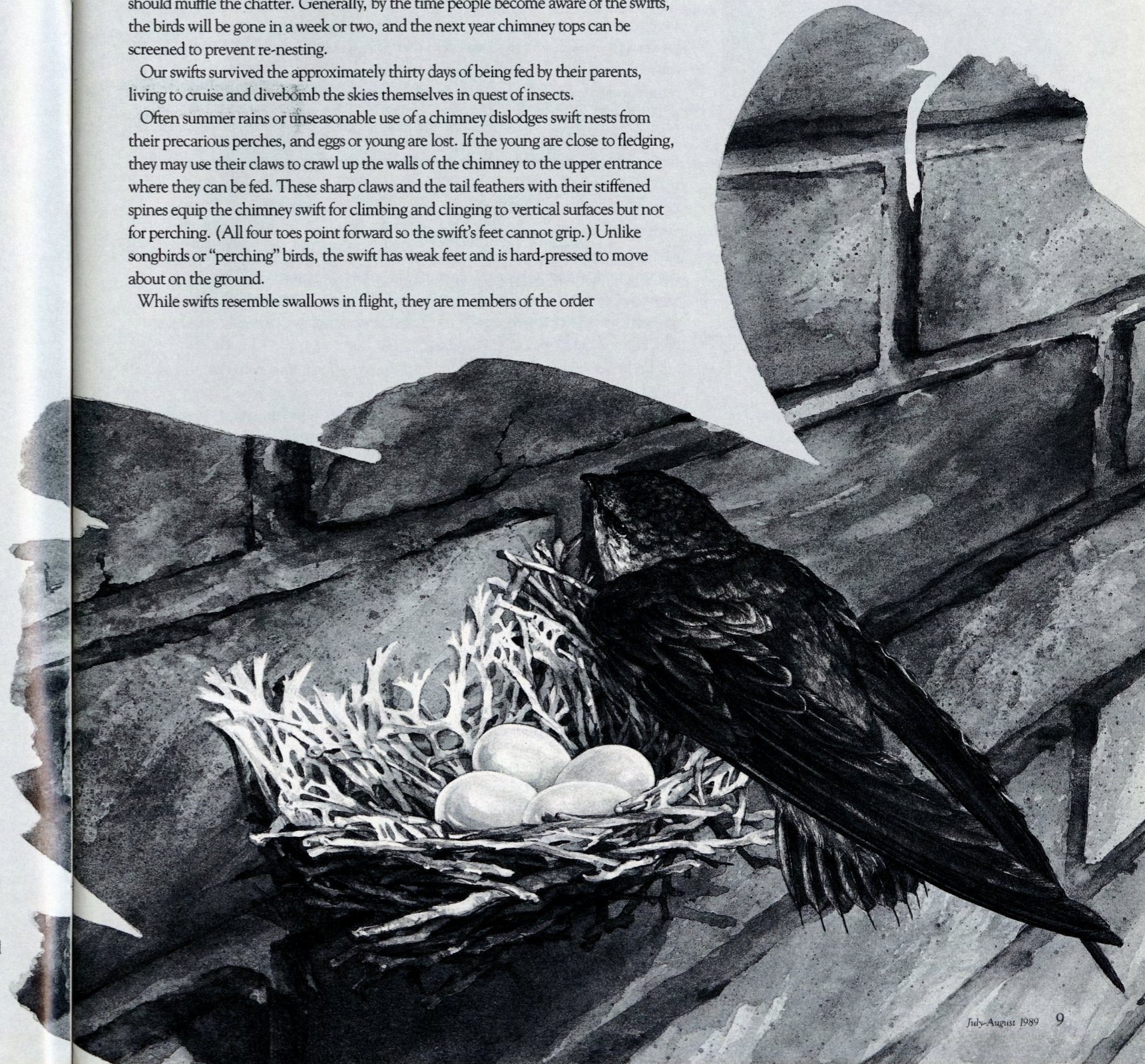
John Cely, biologist with the Nongame and Heritage Trust section of the state wildlife department, receives numerous calls from people disturbed by nesting swifts in their chimneys. As concerned about the birds carrying diseases and parasites (which they don't) as about their commotion, residents often summon the real chimney sweeps to rid the structures of nests, sometimes with young in them. Cely points out that this is not only illegal but also inhumane. If the clamor of hungry youngsters surpasses tolerance, a piece of plywood against the fireplace opening should muffle the chatter. Generally, by the time people become aware of the swifts, the birds will be gone in a week or two, and the next year chimney tops can be screened to prevent re-nesting.

Our swifts survived the approximately thirty days of being fed by their parents, living to cruise and divebomb the skies themselves in quest of insects.

Often summer rains or unseasonable use of a chimney dislodges swift nests from their precarious perches, and eggs or young are lost. If the young are close to fledging, they may use their claws to crawl up the walls of the chimney to the upper entrance where they can be fed. These sharp claws and the tail feathers with their stiffened spines equip the chimney swift for climbing and clinging to vertical surfaces but not for perching. (All four toes point forward so the swift's feet cannot grip.) Unlike songbirds or "perching" birds, the swift has weak feet and is hard-pressed to move about on the ground.

While swifts resemble swallows in flight, they are members of the order

Built by both sexes, nests are unique constructions of twigs and saliva glued to the inside of a chimney, silo, air shaft, barn or hollow tree. Some nests have been found in open wells and cisterns. Generally, four pure-white eggs are laid, one brood per season. Hungry hatchlings can be raucous, but they will soon vacate their nursery, and tolerance of the commotion is strongly advised.





Chimney swift, *Chaetura pelagica*

**Description:** Small, with batlike, jerky flight. Both sexes are a uniform greyish-black in color with a lighter throat area. In flight resembles a winged cigar. Mouth is wide, short-beaked. Has a short, spine-tipped tail used to prop bird on vertical surfaces and comparatively long, narrow, back-swept wings. Wingspread varies from about 12 to 12.75 inches and overall length is approximately 4.5 to 5.5 inches. Average weight for an adult is .8 of an ounce, about the same as a decent-sized cherry tomato or 2 mini-snack boxes of raisins.

**Distribution and habitat:** Generally our only Eastern swift, summering from southern Canada through the Dakotas, east to the Atlantic Coast and southward to Texas and Florida. Winters in Peru after flying around the Gulf of Mexico. Usually seen flying overhead in the spring and summer months in pursuit of insects. Also observed during twittering courtship flights and prior to roosting when the flock may circle their chosen chimney or air shaft for many minutes before descending.

**Feeding habits:** Catch their food entirely on the wing. Flies, ants, beetles, termites and spiders are taken as well as other insects. Swifts are believed to consume many harmful insects such as engraver and potato beetles.

**Reproduction:** Copulation takes place in the air and at the nest. Two to 7 white eggs laid during May through July. Both sexes incubate the eggs for 18 to 21 days. The young change from bean-sized naked nestlings to fully feathered fliers during a 30-day period.

Apodiformes, as are hummingbirds. More distant relatives include the nightjars or goatsuckers, nocturnal insect-eaters. With their short bills and wide gapes swifts resemble nighthawks and whip-poor-wills, but they are considerably smaller, about five inches in length to the whip-poor-will's nine inches. Though swifts feed primarily in the daytime, parent birds may forage at night to meet the demands of hungry young.

Swifts eat only insects and spiders. Flies, beetles, ants, termites and spiders are all caught in flight and consumed or taken to the young. Swifts, like martins and swallows, are esteemed as consumers of insect pests. They are not a host of bedbugs, as was once believed.

Chimney swifts are migratory, not surprising behavior for an insectivorous species. However, their winter destination was a mystery until the 1940s. One very old theory proposed that swifts and swallows spent their winters buried in the mud. Another stated that they spent cold months hibernating in hollow trees. In 1944, band returns indicated that the birds winter in eastern Peru. Current field guides continue to indicate that area as the wintering grounds for all chimney swifts.

Small groups of chimney swifts are noticeable most of the summer months as they flap and twitter over open areas, towns and cities. But they are especially interesting in the fall when they congregate before migrating. Chimney swifts move south in large flocks and attract attention by their communal roosting behavior. Hundreds or even thousands may spend the night in a chosen chimney, air shaft or hollow tree. This great flock provides a fascinating spectacle as the birds whirl and chatter around the structure, rotating above the opening like a slow avian tornado. This can go on for twenty minutes or so as sunset approaches. Abruptly, the lower birds dive into the structure with a swirling motion. The rest of the flock follows, resembling a film of dark chimney smoke shown in reverse.

John James Audubon was interested in chimney swift roosting behavior, though he called them "swallows." On one trip to Louisville, Kentucky, he went to great lengths to explore one huge, hollow sycamore roost site. Unable to find out much by climbing the tree and poking around in it with a long stick, he hired someone to cut a hole in it through the mass of detritus at its base. At night Audubon returned to the tree to view its interior. Carefully illuminating the cavity with a lantern, he reported that "swallows" covered the entire inside of the enormous tree, packed neatly against one another for their night's rest.

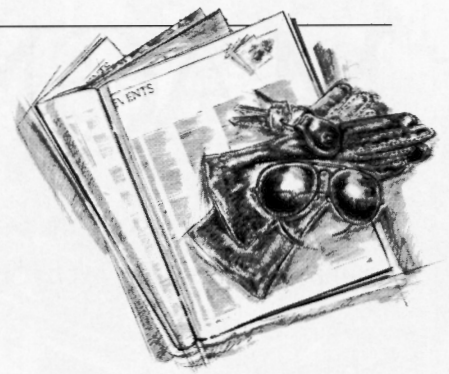
After collecting about one hundred he left without disturbing the remainder. From this sample he calculated the number of birds roosting in the sycamore. His estimate (and his math looks very sound) was nine thousand. Audubon revisited the tree in cold February weather to confirm that no swifts spent the winter there. His account of another visit five years later noted continued use of the tree. Finally, the swifts' "ancient tenement" was felled by a severe storm.

Worldwide there are eighty-three species of swifts, nine in North America, and four are found in the United States. In South Carolina we have only the chimney swift. It doesn't have the flashy black-and-white pattern or speed of its western canyon-dwelling cousin, the white-throated swift. But its habits and behavior have allowed this species to live near us in relative harmony, providing wonderful summertime porch-sitting entertainment and pest control service. Breeding bird surveys show that chimney swift numbers have increased slightly in the East; with tolerance and a plentiful supply of insects, the little chimney sweep will continue to thrive in our state. 🦉

*Laurie Fenwood is a biologist with the U.S. Forest Service on the Chattahoochee National Forest in Gainesville, Georgia.*

*Thanks to Clemson University's Stan Miller for assistance with illustration reference.*

# EVENTS



## JULY 11-14.

**Coastal Zone '89 Symposium.** Omni Hotel, Charleston. The world's largest symposium on coastal management issues, with an estimated 1,700 scientists, engineers, and policy makers in attendance, will focus on finding solutions to coastal management problems; lectures, exhibits, field trips; registration required. Contact Donna Gress, S.C. Coastal Council, 4280 Executive Place North, Suite 300, Charleston, SC 29405, 744-5838.

## JULY 14-23.

**Beaufort County Water Festival.** Beaufort. Talent shows, dances, parade, sailing regatta, "Blessing of the Fleet," Lowcountry supper. Contact Joy Boston, P.O. Box 52, Beaufort, SC 29901-0052, 524-0600.

## JULY 22.

**S.C. Outdoor Ethics Conference.** Florence-Darlington Technical College, Florence. Addresses problems facing today's conservation-concerned Carolinians. Speakers include Nature Scene's Rudy Mancke. Contact Linda Renshaw, P.O. Box 167, Columbia, SC 29202-0167, 734-3859.

## JULY 23-25.

**Fee-Hunting Symposium.** Clemson University, Clemson. The purpose of this symposium is to exchange information on income generated from selling access to wildlife on private lands in the South; topics include fee-hunting systems, management, trespass laws, liability and insurance. Cosponsored by Clemson University Aquaculture, Fisheries and Wildlife Department; the state wildlife department and Clemson Cooperative Extension Service. Contact Dr. Greg Yarrow, Clemson University, Clemson, SC 29634, 656-3117.

## AUGUST 4-5.

**Ed Brown Rodeo.** Blacksburg. Bareback riding, saddle bronc riding, calf roping, steer wrestling, women's barrel racing, trick riding, rodeo clowns and more. Contact Edward Brown, 505 South Charleston Street, Blacksburg, SC 29702, 839-6239.

## AUGUST 4-6.

**Greer Family Festival.** Greer. Arts, crafts, entertainment, hot-air balloon rides,

storytelling and children's theater centered around a family theme. Contact Greer Chamber of Commerce, P.O. Box 507, Greer, SC 29652, 877-3131.

## AUGUST 5.

**Big Daddy Fishing Tournament.** Santee. Enjoy friendly competition for everyone; trophies awarded to junior members of the winning teams during cookout. Contact Mike Davidson, Route 1, Box 79, Santee State Park, Santee, SC 29142, 854-2408.

## AUGUST 10-12.

**Palmetto Upstate Festival.** Woodruff. Arts, crafts, storytelling, tennis tournament, talent show, hot-air balloon rides, costume parade, antique car show. Contact John Hodge, P.O. Box 522, Woodruff, SC 29388, 476-3363.

## AUGUST 12-19.

**Waccamaw Riverfest.** Conway. Citywide event features river raft race, bass tournament, children's games, wildlife exhibits, arts, crafts, entertainment. Contact Debby Brooks, Conway Chamber of Commerce, P.O. Box 831, Conway, SC 29526, 248-2273.

## AUGUST 19.

**Pull-It Festival.** Saluda. Parade, contests, prizes, arts, crafts, musical entertainment, historical tours and delicious food. Contact Rudolph Mitchell, Route 1, Box 152, Saluda, SC 29138, 445-8798.

## AUGUST 19-20.

**Foothills Festival.** Easley. Arts, crafts, international food fair, road races, entertainment. Contact Jane Horne, 301 Wellington Road, Easley, SC 29640, 859-5598.

## AUGUST 26.

**Summer Soiree.** Anderson. Summer celebration featuring international food fair, mime, magic acts, children's activities, road race, entertainment. Contact Diane Lee, 405 N. Main Street, Anderson, SC 29621, 224-8811.

**Summerfest.** York. The family can enjoy historic house tours, antique/craft fair, classic car show, road races, fireworks. Contact Terri Versen, Greater York Chamber of

Commerce, P.O. Box 97, York, SC 29745, 684-2590.

## SEPTEMBER 2-4.

**Pioneer Farm Days.** Dacusville. Displays of steam engines, old tractors, antique farm equipment at Roberts Field. Contact Röss Dover, Route 5, Easley, SC 29640, 269-3903.

## SEPTEMBER 3-4.

**Labor Day Fun.** Simpsonville. Carnival rides and games, cultural arts performances, children's activities, antique car show, arts, crafts, entertainment. Contact Sheila Harmon, P.O. Box 605, Simpsonville, SC 29681, 963-3791.

## SEPTEMBER 4-10.

**S.C. Apple Festival.** Westminster. Whitewater rafting, road race, craft show, apple orchard tours, beauty pageant, square dancing, antique show and sale, parade, entertainment. Contact Denise McCormick, P.O. Box 206, Westminster, SC 29693, 647-9985.

## SEPTEMBER 7-9.

**Firemen's Fun Days.** Snelling. Family-oriented festival includes clogging, carnival rides, 24-kilometer race, sports tournaments, musical entertainment. Contact Billy Mew, Route 3, Box 264, Barnwell, SC 29812, 259-5552.

## SEPTEMBER 16.

**"Hooked On Fishing, Not On Drugs" Fishing Rodeo.** Hilton Head Island. Parents and kids, 15 years old and under, enjoy a day of fishing together; bait and poles provided; prizes, awards, food; free to the public. The HOFNOD program is sponsored by the wildlife department and the Harry Hampton Wildlife Fund. Contact Captain Donald Pinckney, 563-2302, or Donna Swygert, P.O. Box 167, Columbia, SC 29202, 734-3954. 🐟

*NOTE: Dates are subject to change, so call before traveling to an event. All area codes: 803. To list an event, please send information three months in advance of the magazine's publication date to Tricia Way, South Carolina Wildlife, P.O. Box 167, Columbia, SC 29202-0167, 734-3972.*

# MAGNUSON ACT

*In its twelve-year history, the federal Magnuson Act has had a tremendous impact on offshore fisheries, an impact finally being felt by South Carolina anglers.*

*by Pete Laurie*





12-13. Charter and headboat anglers, as well as commercial fishermen, benefit under the Magnuson Act, which manages fishery resources out to two hundred miles offshore. More importantly the act's provisions conserve vulnerable marine species by protecting them from exploitation.

**F**or years, offshore fishermen knew they could depend on catching king mackerel — sometimes a lot of them — when nothing else would bite. Kings roamed the South Carolina coast from spring to fall, providing good action and even better eating. Beginning in the 1970s, a dozen or more king mackerel fishing tournaments sprang up, some drawing thousands of anglers and offering huge cash prizes.

During the summer months, small Spanish mackerel, less predictable than kings, traveled in giant schools often so close to the beach that fishermen in small boats could fill their coolers.

Local anglers occasionally heard tales of commercial fishermen with purse seines and gill nets harvesting tons of both mackerel species off Florida, but Florida seemed far away. Meanwhile local populations of kings appeared undiminished, and fishermen did not associate a drastic decline in Spanish mackerel with a distant and unseen commercial fishery. When the U.S. Congress passed a bill that became known as the Magnuson Act, offshore anglers in South Carolina were too busy catching mackerel and other abundant species to pay much notice.

*The Magnuson Act* was signed into law in 1977, but most South Carolinians remained unaware of its existence or its potential impact until they were jolted by the closures of the recreational harvest of king mackerel and Spanish mackerel in 1987 and 1988.

Originally called the Fishery Conservation and Management Act, and later renamed the Magnuson Fishery Conservation and Management Act in recognition of the efforts of U.S. Senator Warren Magnuson of Washington on behalf of this legislation, Public Law 94-265 ushered in a new era of marine fisheries management for the United States.

In 1976, as Chairman of the National Ocean Policy Study, South Carolina's Senator Ernest F. Hollings strongly supported the Magnuson Act, stating, "The people of the United States — heirs to some of the richest fisheries resources in the world — find their own heritage being rapidly depleted by foreign fishing fleets."

At the time, the United States claimed jurisdiction over fishery resources out to twelve miles offshore, although domestic fishing fleets annually harvested thousands of tons of fish and shellfish from beyond the twelve-mile limit. Beginning in the 1950s and 1960s

foreign fishing vessels moved into these offshore waters to compete with domestic fishermen for the abundant resources.

Earlier, several Pacific coast nations of South America had claimed jurisdiction over fisheries resources out to two hundred miles offshore, a move denounced by many other nations including the United States, which wanted no barriers placed on its far-ranging tuna fleets. But by the mid-1970s Hollings and others recognized the need for swift and dramatic action to preserve ocean fisheries from overharvest.

Citing one commercial fish species after another that had been decimated by foreign fishing fleets in waters off the United States, Hollings concluded: "The U.S. two-hundred-mile fisheries jurisdiction in conjunction with a management regime would permit fish stocks to be regulated on a broad regional basis — taking into account the natural migration of fishes through artificial jurisdictional boundaries — cooperatively by the states and the federal government through the creation of regional compacts.

"By effective control of foreign and domestic users of fish stocks, the United States will be able to apply sound management procedures involving collection of data, assessment of stocks, the determination of realistic maximum sustained yields, and the allocation of such stocks among the several users."

The Magnuson Act accomplished two things: it declared U.S. jurisdiction over fishery resources out to two hundred miles offshore, and it created eight regional management councils to establish fishery management plans for the two-hundred-mile zone, which became known as the Exclusive Economic Zone (EEZ).

Under the act, foreign vessels were required to petition for allocations of fish-harvesting privileges within the EEZ. Working with the departments of Commerce and State, the councils determine the annual allowable harvest by species. The optimum yield is estimated based upon the best information available. Domestic harvesting and processing capacities for each fishery are then estimated, and if the optimum yield is not exceeded, the remainder can be allocated to foreign nations.

Actual allocations to foreign nations are based upon many factors including past compliance with U.S. fisheries regulations, cooperation in opening foreign markets to U.S. fisheries exports, and historic dependence on the fish resources sought. Nations

receiving allocations paid poundage and permit fees totaling \$49.6 million in 1986.

U.S. observers are placed aboard foreign vessels fishing in the EEZ to monitor harvest and observance of U.S. regulations. Strict reporting regulations allow the U.S. to track the location of each fishing vessel and to determine the extent of the harvest. Violations of U.S. regulations can result in fines, seizure of catch (and in severe cases seizure of the vessel) and recommendations against future allocations.

The South Atlantic Fishery Management Council, based in Charleston, covers the four-state region of North Carolina, South Carolina, Georgia and the east coast of Florida. This council and the seven others created under the act (New England, Mid-Atlantic, South Atlantic, Caribbean, Gulf of Mexico, Pacific, Western Pacific and North Pacific) have developed more than twenty-five complex fishery-management plans, and another dozen or so are in various stages of completion.

Since the implementation of the Magnuson Act the calculated optimum yield of the EEZ has risen significantly in part due to the recovery of fish populations following the establishment of more stringent harvest restrictions. At the same time the allowable level of foreign harvest has declined so that domestic fishermen have benefited—to the point that the percentage of fish taken by foreign nations from the EEZ declined from 72.5 percent in 1977 to less than 5 percent in 1987.

Historically, the somewhat limited fisheries resources off the South Carolina coast have attracted little foreign fishing pressure, so the main impact of the Magnuson Act locally has been the fishery management plans developed by the South Atlantic Fishery Management Council.

Each plan goes through a step-by-step procedure that includes a series of public hearings held throughout the four-state region before final approval by the Secretary of Commerce. The entire process often requires several years but allows for considerable public input.

Fishery management plans for mackerel, billfish and snapper/grouper rank among the major accomplishments of the South Atlantic Council. The Snapper/Grouper Plan, which went into effect in 1983, provides long-term management for these bottom-dwelling fish, which support South Carolina's recreational headboat fishery and a multimillion-dollar commercial fishery in the four-state region. A recent amendment to the Snapper/Grouper Plan prohibits trawling over live bottom areas. These areas support delicate, slow-growing corals and sponges and provide vital habitat for juvenile and adult fish. Trawl nets can severely damage live bottom areas and recovery may take many years.

The Mackerel Plan has had the most immediate impact on South Carolina fishermen and locally has been the most controversial of the South Atlantic Council's fishery management plans. The Mackerel Plan established a "fishing year" that runs from April 1 to March 31 and sets commercial and recreational allocations on an annual basis. Based upon "the best available information" the plan initially allocated 76 percent of the total allowable catch of Spanish mackerel to commercial fishermen and only 24 percent to recreational fishermen.

More recently the South Atlantic Council approved the



14. King mackerel, being weighed and readied for processing at top, and Spanish mackerel are presently monitored and managed conservatively by the South Atlantic Council, established by the Magnuson Act. Ultimately, the seafood-consuming public also benefits from careful regulation of offshore fisheries.

implementation of a 50-50 annual allocation of Spanish mackerel between the commercial and recreational sectors with the recreational allocation raised in steps. As the mackerel population and the total allowable catch increase, excess would go toward the recreational harvest until the 50-50 split is achieved. This change in allocation must also be approved by the Secretary of Commerce.

Another amendment to the Mackerel Plan prohibits the taking of king mackerel by purse seines and other types of nets since the annual commercial quota can be taken by hook and line fishermen.

The Mackerel Plan takes a regional approach to these highly migratory fish. The regional councils were established in part to manage migratory stocks such as mackerel. A state-by-state approach to managing migratory species is seldom effective since the fish, of course, pay no heed to state borders. However, it is important that the individual states enact legislation so that management practices applied to offshore waters will be consistent with those in state waters (from the beach out to three miles). South Carolina has been

a leader in this area, closing state waters for king or Spanish mackerel whenever federal waters are closed for either species. Both North Carolina and Georgia are considering similar measures.

In the fall of 1987 the council determined that the recreational allocation for Spanish mackerel had been reached and the recreational fishery was closed. In the fall of 1988 the recreational harvest of both king mackerel and Spanish mackerel was halted, and the annual Arthur Smith King Mackerel Tournament almost had to be canceled.

At Senator Hollings' request the council agreed it would notify fishermen before closing the mackerel fishery, and the tournament went ahead as planned. In both 1987 and 1988, the commercial fisheries for these species, which take place primarily off Florida during the late fall and winter, remained open until the commercial allocations were reached.

For many South Carolina anglers this was their first introduction to the Magnuson Act, and it brought home the finiteness of ocean resources and the need for reasonable management practices. While the populations of king mackerel have remained fairly high and Spanish mackerel have rebounded since the Mackerel Plan went into effect, the South Atlantic Council intends to maintain a conservative approach to mackerel until recovery is more complete.

*The South Atlantic Council's* most recent plan, the Billfish Plan, prohibits commercial fishing for and sale of billfish and sets size limits on blue marlin, white marlin and sailfish. These measures were deemed necessary to protect billfish from commercial exploitation and to require the release of small fish below spawning age. The Billfish Plan was developed jointly by five of the regional councils with the South Atlantic Council playing the lead role. It was opposed by the commercial sector because it set a precedent by allowing only recreational harvest of a group of related fish.

Most local anglers are aware of the depleted stocks of Atlantic billfish and support the Billfish Plan. Because of angler concern, tag and release of billfish has increased dramatically in recent years, even during fishing tournaments. This year, the S.C. Governor's Cup Billfishing Series rewarded the tag-and-release efforts of participants in five selected tournaments, further promoting conservation measures.

The South Atlantic Council also has established special management zones around artificial reefs in South Carolina and Georgia to protect these areas from commercial exploitation since they were built by the states to accommodate recreational fishermen but lie outside state jurisdiction.

The South Atlantic Council works closely with the various states within its jurisdiction and is made up of representatives from each of the four states. Council members are nominated for three-year terms by the states' governors and include members of the recreational and commercial fishing industries and representatives of conservation groups and consumer advocates.

Three individuals are nominated to each available council position, and the Secretary of Commerce chooses one based on certain minimum qualifications. In addition each state is represented by the principal state official with marine fishery management responsibility and expertise (or his designee), which gives the councils long-term continuity. Maximum citizen participation is ensured through public hearings in each state.

*The South Atlantic Council* has on occasion funded research projects conducted by the South Carolina Wildlife and Marine Resources Department, such as the tagging of white shrimp to trace their migration. The council relies on the results of department offshore sampling projects in developing fishery management plans.

The Magnuson Act has been reauthorized four times since 1976 and must be reauthorized again by September 30 of this year. While it is unlikely that the U.S. Congress will fail to reauthorize the act, a number of amendments to the act have been proposed. One of the amendments proposed by a number of the regional council chairmen, as well as other individuals, would regulate the tuna harvest. The original Magnuson Act did not cover tuna because the U.S.'s worldwide tuna fleet feared reprisals from other nations if those nations were restricted from harvesting tuna along the U.S. shores. Such reprisals might have prevented U.S. commercial fishermen from harvesting the highly migratory tuna along other coasts.

Because the long lines used to catch tuna also incidentally catch billfish and swordfish, the councils have had difficulty managing these populations without interfering with the pursuit of tuna. The inclusion of tuna under the provisions of the Magnuson Act could benefit South Carolina's recreational offshore anglers by reducing the incidental catch of blue marlin, white marlin, sailfish and swordfish. Since almost all other coastal nations now have established their own two-hundred-mile limits, arguments for excluding tuna from management under the Magnuson Act no longer carry much weight although segments of the tuna fishery still oppose the inclusion of tuna.

The U.S. worldwide tuna fleet has decreased to half the number of boats that fished for tuna in the 1970s, but there is a growing need to manage domestic stocks of tuna, especially yellowfin. With the reduction of swordfish, many domestic longliners are turning to yellowfin tuna, a species of growing interest to South Carolina's recreational anglers as well. Unregulated harvest could greatly deplete the stocks of yellowfin tuna.

Because of the debate on tuna and the consideration of other amendments, the Magnuson Act may be reauthorized without major modifications for only one year instead of the customary three years. The one-year authorization would give Congress time to decide which major amendments to adopt. Over the years the Magnuson Act has been modified by numerous amendments and, while not perfect, is considered the most important fisheries legislation ever enacted.

Senator Hollings said, "I look back on my cosponsorship of the Magnuson Act as one of my proudest legislative accomplishments as a senator.

"Residents of South Carolina and other coastal states may feel the impact of the Magnuson Act more directly, but in this age of increasing world population and decreasing ocean resources, all Americans need to appreciate and support our efforts to conserve our offshore fisheries, both commercial and recreational.

"The Magnuson Act has stood the test of time. The fact that after thirteen years it remains intact as the vital force to manage our valuable offshore fisheries attests to its strength and durability. It is a good example of constructive government action designed to preserve a vital natural resource—our coastal fisheries—for generations to come." 🐟

"I pass through the pores of the ocean and shores.

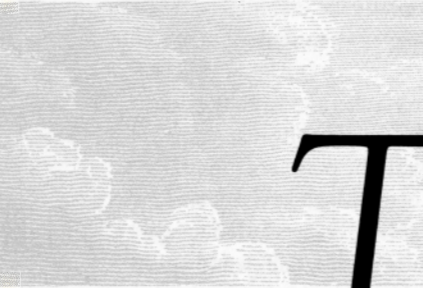
I change, but I cannot die."

— Percy Bysshe Shelley

"The Cloud"

# Daughters of Earth and Water

by Linda Renshaw



**T**ake a tad of imagination, add a little awareness of the sky, and embark on a few solitary moments of fanciful musing out in the field or the boat, or a lively family discussion in the car. What child—or lazy adult, for that matter—has never fancied bears, camels and winged horses sailing freely across the daytime heavens, in the guise of cloud formations?

These wondrous heaps of water vapor and ice crystals we call clouds can also give valuable clues to approaching weather conditions. They provide advance information to the fisherman who knows to watch the western sky for the thunderheads that will send him off the lake, the farmer anxiously searching for the same billowy towers to water his fields, and the office worker uncertain as to whether or not to carry an umbrella.

Revered in mythology, associated with the spirits of the dead by the Pueblo Indians, and representative of God's power and presence in the Old Testament, clouds are also the subject of countless ancient chants and aphorisms. Many of these are borne out by science and experience, and all of them have to do with forecasting the weather:

*"A round-topped cloud, with flattened base, carries rainfall in its face."*

*"Mares' tails and mackerel sky, never long wet and never long dry."*

*"If the sky beyond the clouds is blue, be glad, there is a picnic for you."*

Of colors ranging from pure white to pitch black and shapes from whipped-cream mounds to flat sheets of grey, clouds are vital links in the dispersal of moisture over the earth. They are part of the never-ending water cycle of evaporation, condensation and return to the land.

Constantly in motion—growing, climbing, descending, evaporating—these misty piles are both creators and creations of weather. Their formation depends on the amount of humidity in the air and the temperature of the surrounding atmosphere. In turn, they shade the sun's fierce glare and dictate when the drought will break.

While there is surely nothing certain about using clouds to help predict the weather, scientists spend a great deal of time studying the sky, and the changing shapes and action of clouds play a major role in modern meteorology.

Moist air, evaporated from lakes, oceans and rivers or from damp soil and plants, rises and becomes cooler. As the temperature drops, water vapor and ice crystals form around microscopic particles called condensation nuclei, becoming more dense, up to about 2,800,000 droplets per cubic foot. In the process, the swelling drops gain visibility: a cloud. The sequence of events surrounding the formation of this structure provides forecasters with vital clues to the movement of fronts and impending precipitation.

Ask the man on the street to describe a cloud, and the response would probably be along the order of "white, puffy, lamb's-wool" images. A look at the various cloud classes and their general appearances yields a different picture.

Clouds are grouped by the World Meteorological Organization into classifications based on a system devised in 1803 by Luke Howard, a London-born pharmacist. He gave Latin names to the three main forms of clouds: stratus ("layer"), cirrus ("curl" or "hair"), and cumulus ("heap"). These names have been combined with various prefixes for the terms now used to group clouds by appearance and height into genera and species, much as are plants and animals.

17. Rain-building cumulonimbus clouds.









**M**eteorologists have also adopted numerical codes that correspond to the level of the clouds' bases above the earth at temperate latitudes: low (below 6,500 feet), middle (between 6,500 and 23,000 feet), and high clouds (above 23,000 feet). These reporting codes are widely used today, especially for aviation weather forecasting, but the system of ten named classes of clouds is preserved in popular literature and taught in the schools.

The low-based clouds fall generally into four categories. *Stratus*, a layer cloud resembling a smooth, uniform sheet, hangs like dirty grey fog above the ground. Often this is only about two thousand feet thick and may be only five hundred feet above sea level. Intermittent drizzle (or snow if the air is cold enough) usually falls from stratus clouds, but many times the precipitation evaporates before it reaches the ground. If the layers break into fragments, the resulting formation is called *fractostratus*. Stratus clouds shattering early in the day with patches of clear sky between indicate fair weather.

*Stratocumulus* are also low-level clouds but have a more wavy appearance. Soft- to dark-grey in color, these are generally shallow and heavy and may cover the skies for seemingly endless dreary days, neither producing moisture nor allowing the sun's rays to penetrate.

The puffy marshmallows generally depicted as "clouds" are called *cumulus* and can be heaped into great piles, their bases low but their well-defined tops rising to twenty thousand feet or more. The animals we imagine cruising the skies inhabit these clouds. Cumulus clouds may be small, floating gently along, or large and cauliflower-shaped with flat bottoms. During settled weather, these are benign and dot the tranquil skies prized by artists and backpackers.

Cumulus clouds occurring over land when large condensation nuc-

18-19. Pushed by rising air currents, *cumulus* towers billow up from flat-bottomed *stratocumulus* cloud layers. Floating above are middle-height *altocumulus* clouds, a type dappled in texture and often associated with the term *mackerel sky*.

20-21. Above, an unusual, well-defined rain shaft slants from a *cumulonimbus* formation over John's Island. At any given time, roughly half of the earth is covered with clouds, often of the kind shown at right, *cirrocumulus*, high ice-crystal structures.

lei are absent are candidates for modern rainmaking efforts called seeding. Silver iodide particles released into the updraft of the cloud or "dry ice" strewn directly on the surface introduces artificial nuclei, with varying degrees of success. Experiments in these procedures have proven exciting at best and controversial at worst; the potential is there but much more experimentation and understanding are needed.

Thermal convection currents, which occur when the air's temperature is lower than the earth's, surge upward and promote condensation, producing dense cloud formations that grow lofty and may soon

yield showers. During disturbed periods of weather, cumulus can quickly transform into the next, most spectacular type of cloud.

Upcurrents in *cumulonimbus* or shower clouds may reach speeds of a hundred feet per second or more; if the air entering has some natural rotation, a funnel cloud may be produced and a tornado (over land) or waterspout (at sea) can result. The top of a cumulonimbus cloud soars into colder regions, sometimes as high as forty thousand feet or more, and the water vapor in the cloud freezes into ice crystals. The leading edge blurs, spreads and often assumes an anvil shape. Heavy rain, thunder and lightning follow, and a thunderhead is in full bloom.

The sun's rays backlighting one of these enormous clouds can be one of nature's most enthralling sights. With a blackened base trailing sheets of rain and a ragged tower laced with streaks of lightning, a cumulonimbus cloud in action is awe-inspiring. But even this mighty mass is fleeting, and as its moisture is released, its shape alters. Sometimes the anvil breaks away; sometimes the whole tower dissolves, perhaps to be replaced by another. Eventually the storm passes.

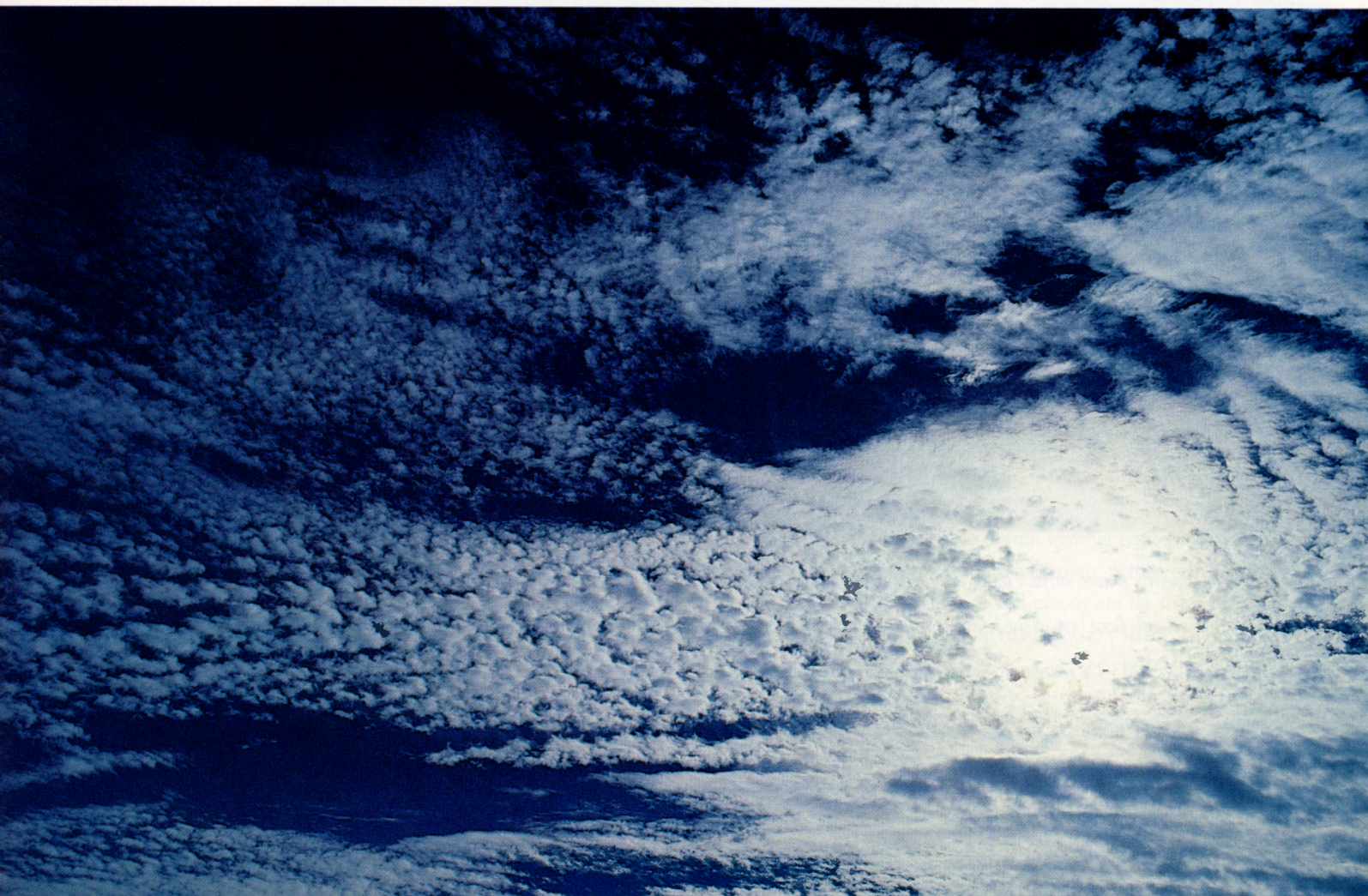
The three middle- or intermediate-level cloud types generally create an overcast sky. *Altostratus* is a thick, layered, irregular cloud through which the sun may shine weakly (leading to the description "a watery sun"). The layers may appear as a grey sheet and are gener-

ally high enough that they are composed of ice crystals. Depending on other conditions, such as wind velocity and direction, these clouds can herald prolonged rain or snow.

*Altostratus* clouds are thicker and dappled in texture. They may appear as if arranged in shaded, lumpy rolls but have the rounded configuration their name implies. This is the "mackerel sky" of the adage and bears out the suggested unpredictability, scientists apparently attaching no weather significance to them. These clouds are made up of water vapor rather than ice and can produce the optical phenomenon referred to as a corona, a ring around the sun or moon, not to be confused with a halo (which results from light refracted through ice crystals).

*Nimbostratus* clouds bear rain and are either dreaded or welcomed, depending on the needs of the beholder. They form a dark, thick layer, the base lowering and yielding steady rain or snow. Beneath this dense, deep-grey blanket may scurry small broken clouds, termed scud or fractostratus.

Another dappled form of cloud associated with the term "mackerel sky"—this one occurring at high levels—is *cirrocumulus*. Broken into delicate, wavy patterns, these clouds have a lovely feathery structure and are clear, shadowless white. They are composed of ice crystals, as are all the cirro-class clouds. Combine this type with west-





22. Lake Murray's calm surface lends itself well to the pastime of cloud-watching. Brightly lit by the setting sun, cirrostratus clouds float high in the heavens, and the lower, darker formations with clear spaces among them are stratocumulus. WIS-TV meteorologist Jim Gandy, who assisted with photograph identifications, said curving wave clouds, caused by air masses following the earth's ridges, may often be seen in the mountains; fog, a type of very low cloud, is common and persistent near the sea.

erly winds, and the outlook is for fair, bright weather; if the clouds thicken and lower, rain generally follows within twenty-four hours.

Cirrostratus clouds lend a vague, milky cast to the sky. This thin veil creates the halo that is often visible around the sun, a ring that can have colors bright as a rainbow or be broken into fragments. Despite its frequent appearance, such a halo is said to presage bad weather. ("If the sun is in his house, it will rain soon.") The cloud layer may remain barely discernible, separate into straight filaments, or thicken into cirrocumulus with the approach of a storm center.

Finally, cirrus clouds are the silky, far-away wisps that resemble streaks or bands. Ice crystals trailing from them lead to the name "mares' tails" and can curve like hooks with tufted heads. Ascending hooks are said to indicate storms and winds; descending hooks call for calm and dryness. These very high clouds are usually a product of low humidity and travel at great speeds. They are very early indicators of an approaching warm front, bringing with it wind and possibly rain.

Add to these ten classes the myriads of scientific types devised by weather-watchers: cumulonimbus mamma, altostratus translucidus and cirrus uncinus, among others. Then consider wave clouds and convection clouds, not to even mention fogs—a whole other story. Clearly, the sky's the limit, and devotees of these misty configurations have enough to occupy them for lifetimes.

While cloud-watching and analysis can be a fascinating pastime, obviously cloud study alone is insufficient to predict upcoming weather. Indeed, all the technology available to contemporary meteorologists combined with cloud observation and consideration of Uncle Jake's corns doesn't permit accurate forecasting. Lack of reliability, however, will never prevent us from casting anxious glances toward the heavens whenever an outing is planned, nor should it.

In fact, the simple act of looking to the clouds can have merit on its own, a philosophy embraced by a Boston nonprofit organization called For Spacious Skies. Through teaching kits distributed to schools all across the country, founder Jack Borden hopes to help children see the sky and its clouds as a limitless source of imagination and inspiration. In its ten years, the program has encouraged students' creative writing, artistic skills and general sensitivity to nature and has received nationwide publicity and acclaim.

Researchers tell us that this latter half of our twentieth century has been 10 percent cloudier than the first half. Exactly why is uncertain—pollution, jet contrails and overall weather patterns are given as possible causes. Whatever the reason for their increase, the masses of water vapor and ice crystal we call clouds are up there for the watching, one moment a beguiling mass of woolly fleece, the next a towering menace.

Clouds are at once the stuff of poetry and the keystone of meteorological prognostication. Nature's atmospheric offerings are ours for the taking—we just need to look up. ☁

Up and down ... swell after swell after swell ... hell ad infinitum, ad nauseum. The day becomes a battle fought inch-by-inch, and only the sea can win.

**T**he day holds promise.

The sun smiles, rising out of the sea in vivid streaks of red and gold as we head eastward against a rolling, incoming tide. Fresh and energy-laden, the ocean air spices each breath with a delicious sense of exhilaration and adventure. We will catch fish this day, I am sure.

I glance at Spike, our host and captain, as he guides the boat deftly over the rise and fall of the wind-pumped swells.

"We'll start at the wreck," he yells over the engine's rumble.

"How far?" I ask.

"Not far."

I begin to ready the tackle, tying on grubs and bottom rigs as Spike has instructed. By standing spraddle-legged, with knees bent, I can ride out the roll and pitch fairly well.

"Must be my old surfing instincts coming back," I think, with no little sense of pride at mastery over the sea.

I am wrong. Without warning, as we roller coaster along, an insistent and inescapable message churns upward from my stomach, "Dear fool, you forgot your Dramamine."

With mounting concern I yell to Spike, "How far to the wreck?"

"We're about halfway."

"I'm not gonna make it," I confess.

"What do you mean? You sick?" His question is accompanied by a quick look that adds, "How can you be sick already? We haven't even gotten started yet."

He relents. "Okay, we'll go to the light. It's much calmer there."

It is not calmer there and I am in deep trouble. Wistfully, I remember the battalion of drug stores we passed on the way to Edisto Island. Drug stores with shelves groaning under now hopelessly distant supplies of Dramamine.

While Spike's idea of calm water is dreadfully awry, his instincts about fish are obviously on target. There are fish at the light, lots of fish. Blues are there, and trout, and spadefish—striped, deep-bodied bruisers who make your wrists ache like you've been outgunned in an arm wrestling contest. The action is fast and furious, but I hardly know or care.

I seek refuge in a boat seat that soon represents a mother's bosom. Cheek jammed against the gunwale as if welded there, I keep my eyes tightly closed as if in pain. (I am in pain.) In this manner I can barely resist the unrelenting attack of the sea.

This is to be a struggle like one might witness between untalented but inspired football teams. Fought in the trenches, inch by inch, the guys who can endure the most pain win. Mentally, I dig in for a long siege.

In the grip of such misery, the mind often goes on a search-and-destroy mission, dwelling, however fleetingly, on a variety of strange subjects. This shouldn't be surprising, really, for such mental leapfrogging springs directly from a desperate will to live.

Descending rapidly into an emotional dungeon, I pray for sleep, a blessed unconsciousness, a temporary anesthesia, but none is forthcoming. In the absence of anesthesia, I seriously evaluate euthanasia. The family would grieve, certainly, but they would recover, perhaps sooner than I think.

Then guilt. "Tighten up, you wimp! This won't last forever. Be strong. Handle it!"

"What would my father do? He would will himself to feel better." A full-blooded Italian, he has terrific will. He would not, by God, let the ocean do this to him. He would resist magnificently and direct this energy at the sea itself. He would intimidate the waves with that look of his, that cold-eyed, Godfather's stare. The swells would meekly subside and Dad would feel better at once.

Unfortunately, I am not of my father's ilk, not possessed of his iron will. I am only half Italian and no ocean will shrink from my measly stare. No, I am at the mercy of the waves.

I sense something close to my face and open my eyes to see Rob, Spike's ten-year-old son, who chants, "Ice cream and spaghetti with mustard and cold pork chops." He grins broadly, a freckled gargoyle, and I fantasize about throwing him overboard. Alas, I haven't the strength.

"When has this happened to me before?" I wonder. Then I remember: years ago, a fishing trip with Dad and a guy from his office. The man, who worked for my father, steered us out to sea and into the teeth of a South Florida gale. An enormous wave (it was a tidal wave, I think) washed straight over the bow, soaking everything and leaving six inches of water on the deck. Being the youngest, I was elected to bail.

Head down below the gunwale, no horizon for reference and breathing chestfuls of gas fumes, it wasn't long before my internal gyro gave up the ghost. As I bid my lunch goodbye, I could see the compassion in my father's eyes. Finally, he said, "Let's go in," and we immediately turned for home—orders from the boss.

I know better than to ask to go in, this time. Spike once condemned his wife Denise to lie on the deck, sick to the point of despair, for half a day. He finally relented and headed in because, I suspect, the fish stopped hitting. Denise did not tell me this story. Spike did.

I look up from my misery and see my Danny, my delightful middle son, who is having the time of his life. Fast to a pulsing spadefish, using his grandpa's fine old Orvis 100, he has never seen action like this. He is torn, feeling guilty for having such a hell of a good time when his dad is so sick.

Knowing this makes me feel worse. I manage a smile, just as the spadefish snaps Danny's rod tip to the surface and I am relieved to be forgotten.

I hear a boat approaching and Spike cleverly announces, "Hey, here comes somebody." Now, I am embarrassed and I consider raising my head and pretending I've been asleep. No, I am on the brink of complete digestive disarray and I cannot, must not, raise my head.

I hear, "Got a sick one, eh?" No one responds, perhaps because they don't know what to say.

The answer is obvious. If only I could spit back, "What does it look like, you chunk of seaweed? Transcendental meditation? Man and boat wedded by the sea? Yes, by God, I am sick. Yes, I am the sick one

# THE SEA DEVIL

by Rick Leonardi



of the sea. Any more comments and I may slither from this chair to bless your boat and deck shoes!"

I hate myself. I am sure that I am ruining everyone's fun, although I can hear them laughing. I sense bodies dancing around me, multiple fish on at once, delightful, delirious confusion. I hear fishing lines so taut they hum like guitar strings, accompanied by fish tails drumming a beat on the deck. I hear soft drinks being snapped open, effervescing like tiny whales blowing into the stiff ocean breeze. I hear these things, but I do not see them because to open my eyes is to invite instant trouble.

I want to take part. I want to enjoy this, to share in it, to take pictures of it. How could I forget? How could I become so self-absorbed? I am the designated photographer. No one will take pictures if I don't.

"I will not be sick any more," I tell myself. "I have had enough!"

Miraculously, my stomach settles into low gear. I do actually feel a little better. Cautiously, I open my eyes and detach my cheek from its spot on the gunwale. "I can do this, I will do this," I coach myself.

I stand up and three amazed looks greet me. "Hey, I feel fine," I announce. With increasing conviction (and volume) I decree, "I feel great and I'm not gonna be sick anymore!"

Danny beams and hands me a fishing rod. His father has been resurrected. I see pride in his eyes, pride that his old man has beaten the sea. Cocky now, I think, "I am my father's son. I have whipped the devil's own ocean and I am feeling terrific."

Spike says, "How 'bout scooping the dead shrimp out of the livewell while you're baiting up."

Without a thought, I slide gracefully over to the aerated well and lift the lid. It is as if I have released a demented genie as the suffocating stench of dead bait envelops me. I stagger backward, but the pungent fog follows me like an unpaid bill. My stomach shifts into the wash cycle once again and I slink back to my post: port side, rear seat, cheek planted firmly on the gunwale.

Before shutting my eyes I throw Spike a look that I sincerely hope will kill; the hint of a smile crosses his innocent countenance. Lord, I have met the devil and I am forsaken!

Gradually, the sound of a motor invades my subconscious and interrupts a vivid nightmare in which I am being chased by the long-haired, dirty-faced operator of a whirling carnival ride called the Octopus. I have no desire to ride the Octopus and I am fleeing desperately, but the carry is gaining on me.

The engine that rescues me is, in fact, our own. "Rick, the tide has come around and you'll have to drive the boat up to the anchor for me," Spike says.

I sneak a glance at my watch. We have been anchored for five hours. During this period, I have been paralyzed by a stomach that has migrated steadily upward and now rests snugly against my collarbone. A mere distraction, a slight loss of concentration, and I will turn loose the goose.

"Drive your own boat, Simmons."

The glorious sound of the engine grumbling to life lifts my spirits and, finally, the hull settles into the steady tickety-tack of the channel as we leave the infernal swells behind.

"Hallelujah! I have made it. Was there ever any doubt? Say, guys, did we catch any fish?"

Rick Leonardi is a sport, a sportsman, and a free-lance writer from Greer.

# GREENHOUSE

ORANGE GROVES IN CLEMSON, THE CHARLESTON PENINSULA UNDER WATER, A MONSOONAL SOUTH CAROLINA WHERE COTTON AND MAGNOLIAS NO LONGER GROW—THESE MAY NOT BE TOO FAR-FETCHED. POTENTIAL GLOBAL WARMING EFFECTS DEMAND THAT WE LOOK AT HOW OUR ACTIONS TODAY WILL AFFECT OUR LIFESTYLE TOMORROW.

BY MIKE LIVINGSTON

**B**ETTY SMITH STARTS HER CAR IN SAN FRANCISCO

... the vast Gobi Desert moves forward infinitesimally against massive tree-planting efforts by the Chinese to halt its advance. Juraj Janosik fires up the furnaces in a Prague steel mill ... Adriatic waves lap slightly higher at the dikes of Venice. Julio Rameriz fells a mahogany tree in the rich Brazilian rain forest ... a striped bass gulps harder for dissolved oxygen in the deep waters of Lake Murray.

The everyday actions of these three people—multiplied by those of a billion others working and playing, running machines and consuming products in our modern, industrialized civilization—threaten to alter the very chemistry of Earth's atmosphere and turn the globe into a giant hothouse.

The specter of global warming and the complex mechanics of the "Greenhouse Effect" have scientists glued to their computers. The computers, however, are not smart enough to truly model the intricate wheels on wheels of the world's climate. Experts often disagree on the masking effects of clouds, the ingestion of carbon dioxide by the oceans' phytoplankton or the melting away of heat-reflecting ice and snow.

There is no question, though, that for the first time in the history of this planet and its climate there is a new player at the table: man. And unless he parks his cars and airplanes, shuts down his factories and spares the tree from the ax—all unlikely prospects—it is probable that our children and grandchildren will look up at different skies. And those skies will vault over South Carolina as well as South Korea and South America.

Man, who began his claim to fame as a simple toolmaker, has learned to work big, even at the atmospheric level. Since the Industrial Age began in earnest about a century ago, world population has more than doubled. And to satisfy all those needs and wants, factory furnaces have been burning fossil fuels night and day, sending heat-trapping carbon dioxide into the atmosphere. It is that simple waste product, produced also by millions of fossil fuel engines, that will account for about one-half of the expected global warming.

The other major contributors are the clearing and burning of tropical rain forests for agriculture and ranching (with the tragic destruction of countless species) as well as the general deforestation of the globe. More than 27 million acres of tropical forest are permanently lost each year. As forests vanish so does a major sponge for carbon dioxide.

In addition, atmospheric warming is accelerated by chlorofluorocarbons (CFCs), man-made chemicals notorious for destroying the ozone layer—the fragile membrane of gas that shields our planet from cancer-causing ultraviolet rays. Each CFC molecule is twenty thousand times as efficient as carbon dioxide in trapping heat, so their contribution to the Greenhouse Effect is far greater proportionally.

CFCs are used worldwide for refrigerants, propellants and cleaning fluids. In the United States alone there are 100 million home refrigerators, not to mention millions more air conditioners. Considering the swelling ranks of consumers in emerging Third World countries who, like us, want to keep their foods cool, it is likely that the damaging presence of CFCs in the atmosphere will increase.

All in all, the physics of Mother Earth dictate that energy in and energy out must match over the long run or the planet will grow hotter or colder. In short, we're making it run hot.

Answers to the questions of how hot and what a hotter earth will be like depend somewhat on whom you ask. The best computer models, such as one at the Goddard Institute of Space Studies in New York City, put the global temperature nearly four degrees Fahrenheit higher by the year 2020. That would make the earth warmer than at any other point in historical time. Indeed, the century from 1875 to 1975 is regarded by some scientists as one of the warmest overall in four thousand years.

*27. Satellite photography and computer models help analyze and predict the long-term effects of a warming of our world — as much as four degrees Fahrenheit by the year 2020, experts believe.*







PHILIP JONES



MICHAEL POSTER

28. Local manifestations of man's activities, pollutants spew from factories to foul the air near Savannah National Wildlife Refuge and automobile exhaust hazes the skyline of downtown Columbia. Carbon dioxide from fossil-fuel engines, CFCs and deforestation combine to pose an invisible threat to the entire world's climate.

ALTHOUGH NOT ALL catastrophic, some of the implications of the

Greenhouse Effect, presuming nothing is done to mitigate them, are enormous: the inundation of coastal areas; the potential destruction of regional agriculture through heat and drought; significant loss of forests as well as other plant and animal species that cannot migrate or adapt to climate change. As elsewhere, the skies over South Carolina bear watching.

"There will be some changes, although I don't expect we will see some of the more dire predictions," said State Climatologist John Purvis of the Water Resources Commission.

"Global warming, however, will change the heat balance between land and water, and it is entirely possible our general storm track in the upper atmosphere—the upper westerlies—will move north. That will likely mean less rain in our area and hotter, drier weather generally. I would think the warmer weather will come earlier and stay longer."

Purvis, like others, issued the caveat that there may be some unknown feedback effects. The oceans with their vast quantities of phytoplankton may metabolize much of the CO<sub>2</sub> and the clearing of the great rain forests of the tropics may slow, but then, maybe not.

The many "buts" and "maybes" of this complicated subject are also the province of Dr. Dale Linville, agricultural meteorologist at Clemson University. He, like Purvis, sees a shift in temperature and rainfall patterns for South Carolina.

The tropics will move outward—that is, upward and downward from the equator, he said, predicting that the state might develop a more monsoonal climate, such as that of the Indian subcontinent and Africa, where rainy seasons are rainier and dry seasons are drier. Summers, which will begin a month or so earlier, will not be hotter than now because the energy will go into the weather system for evaporation. One good thing: there will be no long stretches of hundred-degree-plus days.

"I expect our seasons will be along the lines of six months dry and six months wet," Linville said.

One looming aspect of climatic change, incidentally, will be the shifting northward of the hurricane-breeding waters in the Atlantic Ocean. This phenomenon could bring more of the cataclysmic storms into South Carolina—a state already long overdue for a major storm, not to mention one of the "great" hurricanes such as the monster of 1893, which killed three thousand in the Lowcountry. With an expected rise of the sea levels, a hurricane in South Carolina would take on a whole new meaning. A cursory study by the S.C. Sea Grant Consortium predicted that about 50 percent of the buildings on the state's coast would be severely inundated by a major hurricane.

"We also will have to adapt our agriculture to a shorter growing season," Linville continued. "We might have to plant more tropical-type crops. For instance, we could grow more corn, which was developed in Mexico, and fewer soybeans, which will have many disease problems. The growing season might be too wet for cotton. We are looking at shorter-season crops such as millet, okra, peanuts, melons and papaya. Who knows? I might be looking out my window at a Clemson orange grove one day."

The Greenhouse Effect is not all gloom and doom, particularly for agriculture. Plants feast on CO<sub>2</sub> in photosynthesis and give off



PHILIP JONES

*Hurricane David, 1979.*

**A** MORE MONSOONAL CLIMATE WITH HIGHER SEA LEVELS AND THE SHIFTING NORTHWARD OF THE HURRICANE-BREEDING WATERS COULD BRING CATAclySMIC STORMS TO SOUTH CAROLINA, A STATE LONG OVERDUE FOR A MAJOR HURRICANE.

oxygen, so the question of how climate change and the direct effects of carbon dioxide on crop yields will combine is a crucial research question for the present day. In fact, several Clemson scientists are already studying these matters in controlled chamber facilities such as SPAR—the Soil Plant Atmosphere Research unit. There is every reason to believe that increased atmospheric CO<sub>2</sub> could cause a worldwide boom in the size and yield of plants.

At the same time, agricultural regions are expected to shift northward. Crops grown in southern climes already are near their high-temperature tolerances and could be stressed by the expected warming and drying. And if cropland decreases in the South, irrigation demand for remaining acreage is likely to soar. This could pose a serious problem in South Carolina, where groundwater pumpage is already heavy, particularly in the coastal plain. In fact, the availability of good water promises to be one of the critical environmental questions of the imminent 21st century.

Biologist Dr. Wade Batson, who, it is said, knows every plant in South Carolina not only botanically, but personally, laments that the Greenhouse Effect will likely doom some species that are locked into specific habitats.

“If it gets warmer and drier here, as it looks like it may, that would be devastating to many of our native species that are highly adjusted,” he said. “Beech trees grow from the mountains to the seacoast, but our *Magnolia grandiflora* is locked in the coastal plain. You can say good-bye to them. I also worry about what will happen to our mountain evergreens, which are already on the decline because of acid rain and disease.”

Batson also predicts a change in South Carolina’s pine population,

which could have a major impact on the state’s forest industry. Warmer and drier conditions will cause loblollies to migrate northward out of the middle piedmont and into areas where shallower soils would likely stunt the trees’ growth. Meanwhile, in a kind of arboreal musical chairs, the slash pine, which thrives in dry, sandy soil, would probably take up new residence in the coastal plain. Hardwoods and tupelo gums which now cover the coastal plain would not fair well, he noted.

“I will predict that by the year 2000 or sooner there will be a greater awareness of the criticality of these issues,” he said, “but by then we probably will have reached the point of no return. We will have lost much of our natural heritage.”

Perhaps the most worrisome speculation centers on how the world’s oceans are likely to respond to the expected warming. Most greenhouse experts predict an average global temperature rise of three to eight degrees Fahrenheit by the middle of the next century. Heating causes water to expand, and rising sea levels would threaten low-lying coasts. Eventually, perhaps in another century or so, mountain glaciers and polar ice caps would add even more volume to the swelling seas.

A major study by the Environmental Protection Agency points out that the Southeast, with its wealth of beaches and wetlands, would be hit especially hard. A one-meter rise in sea level would destroy 40 to 65 percent of the South Atlantic wetlands—a disastrous blow to the myriad wildlife species that depend upon these habitats.

Although nobody knows for certain what the oceans will do, a study of the Charleston area conducted by Coastal Engineer Tim Kana and others postulates a “low scenario” rise of 2.9 feet by the year 2075 and a “high scenario” of 5.2 feet. “The estimate of 2.9 feet implies that Charleston could lose 50 percent of its marsh by 2075,” concluded the study. “The area of ‘high marsh’ would decline from 2,300 to 700 acres, while the area of ‘low marsh’ would decline from 5,400 to 3,200 acres. The high scenario of a 5.2-foot rise implies that Charleston could lose 80 percent of its marsh by 2075.”

Low marsh is usually defined as that area flooded at least daily. In the Southeast, such marsh is dominated by stands of smooth cordgrass (*Spartina alterniflora*) and lies in the zone up to about three feet above mean sea level (6.5 feet in Charleston). High marsh, most of the remaining watery zone, is flooded daily to biweekly and supports a variety of species, notably glassworts, spikegrass, saltmarsh hay and black needlerush.

The impact of sea level rise on South Carolina’s wetlands will largely depend on whether or not new marsh will be allowed to form as existing areas are flooded. The study’s estimates of loss were made on the assumption that wetlands would migrate naturally inland. But if those areas are developed and protected with levees and bulkheads, then virtually no new marsh could develop and the net loss would be much greater—a loss of *all* high marsh with a five-foot ocean rise and all but 750 acres of low marsh. And it is low marsh that dominates the intertidal areas in the Southeast and has a substantially higher rate of biological productivity and flood dampening.

Wildlife associated with coastal wetlands are not expected to fare well if the sea takes away their habitat—habitat where, incidentally, one-third of all endangered species make their homes.



TED BONG

“WE ALREADY HAVE A PROBLEM with the loss of dune area breeding grounds for loggerhead turtles and, obviously, if people put up bulkheads and riprap to keep out the sea, that problem will escalate considerably,” said Ed Duncan, environmental affairs coordinator for the state wildlife department.

“But all the creatures that use our marsh lands—the egrets, herons, wood storks, marsh hens, and so on—would really suffer if these wetlands flood. A sea level rise of three to five feet would probably eliminate all of our coastal impoundments. Even though they are diked in, it is not feasible to raise them, so we could lose 70,000 acres of coastal waterfowl environment. And these impoundments, both private and public, support probably 90 percent of the state’s duck population. Those wetlands also provide habitat for alligators and shore birds. The bald eagle, particularly, is found in association with impoundments.”

The flooding seas also will be ruinous to an aspect of the marshes only lately appreciated, yet vitally important: their function as nurseries. For it is there that the food chain of the sea begins with the detritus of the marsh grasses. These waters are the protected cradle for shrimp, crabs and oysters and the growing grounds for seatrout, channel bass and flounder and many other denizens—some valuable commercially, and all valued as food for commercial species.

“The general consensus is that there will be a substantial reduction in the available fisheries population,” said Duncan. “There will be a dramatic change.”

The people who live along the state’s shoreline and tidelands, a population whose numbers are greatly increasing yearly, would be wise to consider now the coming changes. A modest rise of sea level vertically can translate into much larger numbers laterally, depending on the grade of the land.

“These impacts will, of course, occur below Charleston as well,” said Kana. “In our report, we created a data set that can be applied anywhere—just take the elevations and adjust the tide range. In Beaufort, for example, the tides run about one foot to 1.5 feet higher than in Charleston, where the range is 6.5 feet above mean sea level. A simple generalization would be to worry if your property lies eight to ten feet above current mean sea level in the area.”

Kana pointed out that sea level rise is one of the components of beach erosion. On South Carolina’s “Golden Goose” Grand Strand, the erosion rates have been historically low—less than one foot per year—but the erosion that occurs there is blamed on the rising Atlantic.

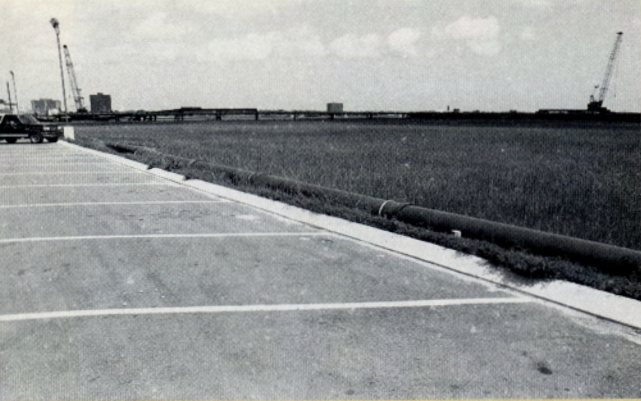
“Many of the problems with the upper coast stem from development encroaching too far onto the beach,” Kana said. “Building walls has been the typical response to rising sea levels along the East Coast, and that has an impact on the high tide beach. If the beach continues to erode, we will lose that part of it. This is a bad consequence of armoring the shoreline, and it also interrupts the sand-sharing system by which sand moves off the beach during storms and is carried back onto it by wave action later.”

The inexorable press of the sea will not stop at land’s edge. Salt water will come inland, changing the delicate chemistries of habitats. Floodplain forests now inhabited by deer, turkeys and waterfowl will convert to salt marsh. Species forced to retreat inland will be caught between the advancing ocean on one side and the paving machines of expanding human populations on the other.



TED BONG

30. Forestry and agriculture, both major money-makers for the state, will feel the effects of warming temperatures and fluctuating rainfall. Loblolly and slash pines may exchange growing places, and tropical-type crops with shorter growing seasons could replace cotton and soybeans.



PHILLIP JONES

Salt marsh, Ashley River.

**B**Y EDGING SALT WETLANDS WITH CONCRETE AND ASPHALT, OUR COASTAL DEVELOPMENTS PREVENT THE MARSH FROM MIGRATING INLAND. THUS WE LOSE THE MARINE NURSERY GROUNDS AND FLOOD CONTROL THAT THESE WETLANDS PROVIDE.

“As habitat is diminished, eventually some of our animal and plant populations will be lost,” said Duncan. “They just can’t keep crowding into smaller and smaller areas. They run up against the factor called ‘carrying capacity’ and something happens. With humans, it is typically famine or disease. With animals, their gene pool gives way and they die out.”

The effects of higher temperatures and generally drier conditions could likely also stress the state’s surface waters. There is no doubt that we will be stressing groundwater. The main worry is low stream flow and poor dissolved oxygen content in rivers and lakes. Even now, there are naturally occurring fish kills because of these conditions and, if the future gets much hotter and drier, that could increase. The effect is not linear, but exponential. That is, each degree rise in temperature results in a much-higher increase in biological and enzymatic activity such as decomposition, an oxygen-consuming process. Also, the ability of water to hold dissolved oxygen decreases as temperature rises. Everything depends on the degree of change.

“In some scenarios,” lamented Duncan, “the Greenhouse Effect could eliminate the state’s freshwater fisheries. Striped bass, for instance, are particularly vulnerable to warm temperatures, and the risk becomes greater as the fish grow larger. If they can’t find cool water they’ll die off, as we’ve seen in Lake Murray.” Trout, walleye and smallmouth bass are also “coldwater fish,” added Duncan, and could suffer with too much of a temperature swing. The biological tuning is very fine for some species. For trout, the upper limit in water temperatures is 65 degrees Fahrenheit. Beyond that the fish

perish, especially if also subjected to low, oxygen-poor stream flow.

Geologic history reveals that slight variations in the earth’s average temperature can result in dramatic environmental changes. For instance, at least nine times in the past million years massive ice sheets have invaded from the north and mantled much of North America and Europe, and nine times they have withdrawn. Meanwhile, all of human civilization has taken place within a relatively benign climatory period of about ten thousand years—hardly a tick on the geologic clock.

“Putting the whole issue in a global perspective is difficult because of its global nature and the sort of time scales we’re talking about,” said Margaret Davidson, director of the S.C. Sea Grant Consortium. “Geological time is in tens of thousands of years, but ours is so short—maybe even five or ten years. And the time scales of elected officials are even shorter because they are always worried about running for office. So we are compressed to nanoseconds when it comes to talking about decisions on this subject. Talk about the low scenario to a local planning official and his eyes glaze over. He’ll tell you he’s got people chewing on him about an upcoming annexation or something.”

If the effects of the greenhouse phenomenon are to occur, as more and more scientists say they will, then the time to make decisions is now, argued Davidson. But people, she said, sit and wait. It is their nature to want to see immediate tangibles to base their decisions upon. Yet the infrastructure of civilized society—the roads, sewers and systems of everyday life—that will be installed in the 1990s should be designed to take these predictions into account. But that sort of thinking, she said, is hard to find.

“Also, there are a number of hazardous waste sites that would be flooded,” she continued. “And if we prevent the marsh from migrating inland and continue to pave parking lots behind whatever marsh still exists, we will actually exacerbate sea level rise, because marsh is God’s way of controlling flooding. We already have a gradient problem getting water off the (Charleston) peninsula and more concrete will make it worse.

“There are so many zoning, planning and construction decisions to be made now, but try to explain these things to a zoning and planning board. Yet they are designing the infrastructure that will take us up to the time of the observable impact of the Greenhouse Effect.”

Once just a scientific curiosity, the question of global climate change is now being asked in earnest. With all our moonwalking and whizbang computerizing, we still don’t really know what we need to know about this place called home—the earth. Perhaps it will be the planet, itself, that will turn out to be the best teacher on this subject.

For, indeed, if all the contributors to the Greenhouse Effect were to stop in their tracks today, it would be too late. The gases are already up there and there is no way to get them down. Something big is going to happen with the earth in the next fifty to one hundred years and its cause will be, for the first time, ourselves. It is time, way past time, to look ahead with one mind. For it would not be amusing, with these kinds of stakes, to arrive in the future unprepared. ☘

*Mike Livingston is a journalist with The State newspaper and a free-lance writer.*

*Exquisite and unique,*

*jellyfish pulse through all the world's seas.*

*While those that visit our waters*

*are generally fragile and harmless, they*

*should be treated with respect.*

# Jellies

by Dixie L. Anderson and Linda Renshaw

Beyond South Carolina's coastal plain, floating in the salty waters that lap the beaches and inlets, in the surf, and farther out in the vastness of the sea, are domes and cones, umbrellas and sails and ladies' hats. There are ribbons and saucers and bells, their colors ranging the full spectrum with delightful bright greens and blues, murky red-browns and an artist's palette of pastel pinks, blues and yellows. Others gleam in milky whites and sparkling crystals or glow with a warm luminescence.

All are jellyfish, animals older than Methuselah, creatures beautiful and sometimes discomfiting. Simple-structured and seemingly bypassed by evolution, their life cycles are complex and remarkable.

These animals have remained relatively unchanged. Scientists have found fossils of jellyfish one billion years old in the Grand Canyon in Arizona. About two hundred species of true jellyfish have been identified; jellies range through every ocean in the world, free-floating, carried by winds and currents.

Jellyfish can be microscopic in size, or attain the gigantic proportions of specimens found in Arctic seas. These Arctic giants are the largest jellyfish in the world, reaching dimensions of eight feet across with eight hundred tentacles that may hang down over two hundred feet.

A jellyfish (phylum Cnidaria, a group that also includes the corals, sea fans and hydroids) is a flexible bag of a gelatin-like substance simply structured of 93 percent water. All species have four oral arms, variously developed extensions of the mouth opening, and most have a ring of slender tentacles, long or short, around the mouth. These tentacles carry complicated, microscopic stinging cells called nematocysts that are used in obtaining food; inside each one is a barb that shoots out when a small trigger is stimulated. Similar "stingers" are often located in the stomach. The body of the jellyfish is covered with an outer skin to protect the jelly cushion and an inner skin that makes up the lining of the stomach. Between

these two skins is the thick layer of jelly that makes up the solid body.

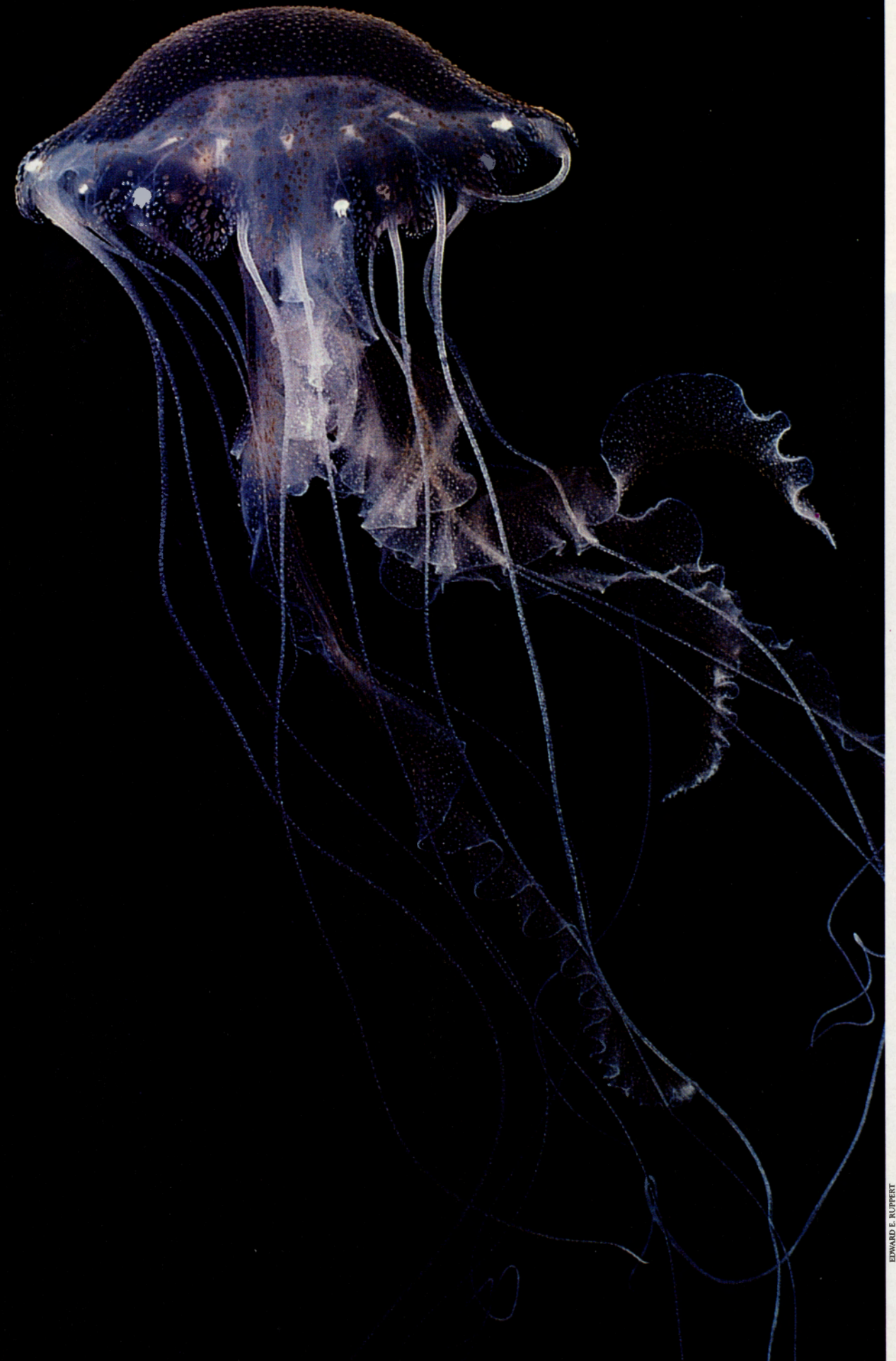
The animal's radially symmetrical body has a diffuse nervous system with concentrations of nerve cells and sense organs on the margin of the bell. The marginal concentrations control the limited self-propulsion of the creature as it floats through the water. Tightening and relaxing, the jellyfish's "bell" opens and closes like an umbrella, beating as many as twenty to one hundred times a minute. This method of movement doesn't take the jellyfish far, and trips of any distance are controlled by currents and winds.

Some jellyfish are known to sink as the sun rises and resurface as the sun's rays diminish. They also sink to avoid disturbances throughout the water column: strong currents as well as any commotion on the surface, such as storms and even boats.

While the jellyfish pulses through the water it consumes nearly anything that happens to blunder into its veil of tentacles, including tiny crustaceans, small fishes and other planktonic organisms. It digests food and disposes of wastes rapidly. Food is conveyed to the mouth by the tentacles, which act like fishing lines as they stretch down and out. They shoot their minute, harpoon-like stingers into any animal they brush against, and the poison contained in the barb paralyzes or stupefies its prey. The stinging cells are potent enough to kill fish as large as the jelly itself.

Jellyfish may eat other jellies, but never the same species as themselves. If there is a shortage of food, the animal shrinks and loses tentacles only to grow them again when the food supply increases.

Once a jellyfish is washed up on the sands of the coast, it probably is dead and will not revive if returned to the water. The gelatinous substance of some larger varieties is tough and may often be encountered on the summertime beach. The washed-up jellyfish dry as the sun hits them and become shriveled and tough. The tentacles, however, are still capable of releasing their venom for up to several days, and the sting of a dead jellyfish can be as painful as from a living one.



33. Brackish estuaries and coastal waters of high salinity are home for the sea nettle, *Chrysaora quinquecirrha*. Four ribbon-like, fleshy oral arms, common to all true jellies, are clearly differentiated from the trailing tentacles of this nettle. A juvenile spider crab is barely visible within the bell, probably feeding on the jelly's tissue.

34. Ruffled and fringed, the lion's mane jelly, *Cyanea capillata*, is a winter-months visitor in our waters. Specimens in the cold North Atlantic can grow to a formidable eight feet across, dangling tentacles the length of an ocean-going vessel.

35. (Top) Multi-branched tentacles extending from the four corners of its umbrella characterize the box jelly or sea wasp, *Chiropsalmus quadrumanus*. (Bottom) The moon jellyfish, *Aurelia aurita*, has short, fine tentacles and four distinctive horseshoe-shaped gonadal organs visible on its bell.





RICHARD S. FOX



RICHARD S. FOX

For such a simple animal, the life cycle of the jellyfish is rather complex. Reproduction involves two separate processes, sexual and asexual, the latter with juvenile jellies quite literally stacked like hotcakes on the ocean bottom.

Breeding time varies from one species to another, and prime conditions depend on the amount of oxygen in the water, temperature, salinity, and availability of food supply. Generally, reproduction begins as the waters warm. There is speculation that the cycles of the moon may also influence the breeding time.

Jellyfish can be either male or female, the eggs or sperm produced in gonadal tissue. In the sexual method of reproduction, fertilized eggs dropped from the female's mouth slide down and adhere to her oral arms until they are hatched. They may be visible at this time, resembling yellow freckles. The eggs may also simply be released into the water.

In about two days, the eggs develop into free-swimming larvae called planulae. After a period ranging from a few hours to several days, the planula sinks and establishes itself on a firm surface on the sea's floor. There, the second or asexual reproduction begins. The planula, through the addition of tentacles, transforms into a polyp. The polyp develops a mouth and can eat and exist for several years on the bottom of the sea.

During these years the asexual process is completed as the polyp reproduces by budding off tiny jellyfish, one on top of the other, stacking like flapjacks. When these "pancakes" reach the appropriate size, they break off from the stack and swim away, becoming mature, free-floating, bell-shaped jellyfish or medusae with life-sustaining tentacles hanging from the bells. The name medusa comes from Greek mythology, comparing the creature with its hanging tentacles to the woman whose hair was turned to snakes by a jealous goddess.

The polyp also can produce others like itself, which in turn can reproduce in the same manner, budding off medusae or polyps.

Part of nature's grand scheme, jellyfish are themselves consumed by other creatures. Giant sunfish eat jellyfish, nibbling away at their edges. Sea turtles eat them, too, keeping their eyes closed to protect them from the stings of the tentacles. Frigate birds swoop over the waters to consume jellyfish, and Asian people eat jellies with the stingers removed.

Small fish that are immune to the jellyfish venom can find protection by swimming and hiding among the hanging tentacles. Some of these tiny fish have even been observed swimming inside a jelly's stomach.

With their gelatinous bags and filmy tentacles, jellyfish are easily recognized as such, but to most people, all species look alike and are commonly misunderstood and considered poisonous. In fact, most of the species found in South Carolina's waters are harmless to man.

The jellyball or cannonball jellyfish, *Stomolophus meleagris*, is the most common of its kind in our area, seen especially in the summer and fall near the mouths of estuaries and along the coast. Considered a nuisance by commercial fishermen, large numbers of the animals can clog nets and hinder trawling. This jelly is attractive, white with a brown band around the border, and its eight- to ten-inch body is firm and deteriorates slowly when washed ashore. Multiple mouths dangle from the center of its high-domed bell, but the jellyball has no tentacles. It can generally be handled safely by humans and is used as bait by anglers.

Similar to the jellyball but less abundant and common is the mushroom jelly, *Rhopilema verrilli*. It lacks the brown band and is from two to eight inches larger than *Stomolophus*. Generally seen in the lower reaches of estuaries during winter and spring, the mushroom jelly has several appendages that hang from its lower surface. Its toxin is not harmful to humans.

A non-venomous species, the moon jelly, *Aurelia aurita*, lives in all seas at all temperatures and may be found here infrequently in summer and fall. Colorless and ranging in size from six to twenty inches, the moon jelly is generally the size of an open hand. This gelatinous disc is thick at the center and thin at the edges and has numerous very short tentacles. Four fleshy, ribbonlike oral arms surround its mouth. A pink (male) or white (female) four-leaf-clover shape is readily visible on this jelly's umbrella during breeding season, and each of the "leaves" is a pouch to hold sperm or eggs. The moon jelly's size may cause alarm among swimmers, but its sting is so mild it is seldom detected by humans.

Two species of box jelly, so-called because of their cubical shape, occur in South Carolina inshore waters in late summer. Also referred to as a sea wasp, *Chiropsalmus quadrumanus* is about five and a half inches wide and is transparent with a branched tentacle at each of its four corners. Its stinging cells are powerful, and the box jellies should be avoided. *Tamoya haplonema* is smaller, about two to three inches, with very firm jelly, but has a single elongated tentacle extending from each of its corners rather than the branched tentacles of *Chiropsalmus*. It is not certain whether this species is venomous to humans, but it should be treated with respect. A species the Australians call the box jelly, *Chironex fleckeri*, has caused numerous fatalities. While it lives primarily off the Australian coast, it is regarded as one of the most venomous creatures in the sea.

Lion's mane jellyfish, *Cyanea capillata*, prefer colder waters and reach their abundance here during the late winter and early spring. It is this species that grows to such great proportions in the Arctic seas. Most of these pink-brown-red-blue long-tentacled jellyfish seen along our coast are four to ten inches across. The tentacles are clustered in eight groups on the underside of the umbrella. Arrestingly beautiful as they pulse through the water, large aggregations of lion's mane jellies have been sighted at sea covering acres of water. Washed up on the beach they dry to a dark brown. Their sting is one for swimmers to avoid.

Sea nettles, *Chrysaora quinquecirrha*, are our most frequently encountered venomous jellyfish, most commonly during the warmer months. The jelly's flat, saucer-like disc is about six inches in diameter and is generally brown or red, although some may appear whitish. Adults have twenty-four or more tentacles and four long oral arms. Sea nettles have historically been a major nuisance in the Chesapeake Bay, and in 1966 an act of Congress authorized funding to research jellyfishes and to find a means of controlling nettles' numbers.

One species commonly thought of as a jellyfish belongs to the same phylum, but a different class. The Portuguese man-of-war, *Physalia physalis*, was named by English sailors who observed huge masses of them in the seas off Portugal and felt they looked like convoys of small sailing vessels. Rather than being one animal, the Portuguese man-of-war is a colony of individuals, both polyps and medusae, each performing different functions.



36-37. South Carolina's most common jelly, the jellyball, *Stomolophus meleagris*, is a frequent find for beach-walkers. This firm-fleshed jellyfish has no tentacles; spaced around the brown band of its bell are eight sensory capsules. The spider crab clutching the feeding apparatus of the jellyball shown above may eventually nibble itself out of transportation.

This infrequent visitor to our coast has a ten-inch blue float that is filled with gases; from this float the members of the colony bud to form the entire animal at maturity. The "sail" stays atop the water, and numerous tentacles may extend to sixty-five feet below it. The creature's nematocysts remain intact for long periods of time even after its removal from the water and should be studiously avoided. Research has proven that the Portuguese man-of-war is seldom a killer of humans from its venom alone; however, its sting can be so painful it will cause unconsciousness in a swimmer, and hence, drowning.



Incidentally, our state has a freshwater jelly that occurs sporadically from July to October and may be discovered in farm ponds and quarries. About an inch in diameter and colorless, *Craspedacusta sowerbii* is not a true jelly, but more closely related to the man-of-war. Whether or not its sting is harmful is unknown.

While severe jellyfish stings in South Carolina waters are rare, some people are more susceptible than others to the animals' venom. It is important to learn which species are harmful, and a good guide can be most helpful. An excellent reference to buy at your local bookstore is *Seashore Animals of the Southeast*, by Edward E. Ruppert and Richard S. Fox, published by the University of South Carolina Press. Also, the *Guide to Common Jellyfishes of South Carolina*, authored by Dale R. Calder and Margaret Callison Pridgen, is available from the S.C. Sea Grant Consortium, 287 Meeting Street, Charleston, SC 29410.

Knowing which species to avoid can be "an ounce of prevention," but the "pound of cure" is sometimes still necessary.

When you find a jellyfish that has been washed up on the beach, remember that the tentacles of some dead jellyfish can still sting, so never pick one up.

An encounter with a jelly while swimming can be unavoidable. Should you be stung while in the water, get out. Once stung, large red welts will appear, and there are probably minute pieces of tentacles still attached to your skin. These must be carefully and immediately removed.

Don't rub the affected area. If possible, pour alcohol over the skin where the sting is, or use commercial meat tenderizer made from a papaya base. You can also apply vinegar, salt, talcum powder, sugar, ammonia or hot dry sand. Simply pour the chosen material over the sting. Don't rub it in. This will stop new stings, and when the pain has subsided, cautiously scrape the area with a rough towel, a stick or a knife. Never scrape the stings away with your hands; you will simply be moving the microscopic stingers to another part of your body.

When you have scraped the stingers off, wash with soap and water. Never use fresh water on stung skin until the stingers have been removed.

If pain persists, or should infection occur, consult a physician.

Fear of the jellyfish's sting should never spoil our appreciation of the animal. After all, it is we who are the intruders into the domain of these fragile, delicate sea creatures. When they are in residence in the waters of your choice for a swim, change the exercise to a walk on the beach. Observe and identify the species washed ashore on our coast; investigate their colors and configurations. When the jellies have moved on, everybody back in the water! 🐠

*Dixie Anderson, a free-lance writer from New Jersey, has authored a series of East Coast seashore wildlife articles and a children's book.*

*Special thanks for editorial assistance to Richard S. Fox, professor of biology at Lander College at Greenwood and co-author of Seashore Animals of the Southeast, and Dale R. Calder, curator in charge, department of invertebrate zoology at the Royal Ontario Museum in Toronto, Canada.*



# CAROLINA'S OWN

by Henry Hemdon

**S**outh Carolina is many things to me—teacher, nurturer and confidant. I was born of her sons and daughters and raised in her traditions—Carolina's own.

I have seen the springtime so beautiful and full of hope, the fall just as lovely with its color and coolness. I have seen both sides of Carolina, her azaleas and her sourgrass. I have felt the heat of her summers, almost unforgiving in the parched dryness until the life-giving rains fall on her again, and I have felt the bone-creaking chill of her winter mornings afield.

My daddy, too, is South Carolina's son. Like so many other farmers, his attitudes change with the seasons and the crops. He will accept what she gives and never turn his back to her.

Every morning just at sunrise, he has stood and looked across a field to the rising sun behind our house. No matter the forecast sunny and mild, or wet weather and mortgages due, my daddy has always been there. He stands so tall—Carolina's own.

There's always Mama. She's the one who spanked little boys and who cooks the best cracklin' corn bread, hot and steaming as she takes it up. She is a daughter of South Carolina, raised in the old Southern family traditions. She knows how to do so many things; she provides the special touches that make our house a home.

I have seen the black gently turn to grey in this woman's hair. I have stood by in silence and watched as she endured the pain of the farm, the job of raising me, and the turmoil of her own feelings—through it all she has always placed her family first and has never complained. This same woman has put breakfast on the table for forty-some-odd years, rarely missing a day. Yes, Mama, too, is Carolina's own.

Stop for a moment and think of South Carolina's abundance and all she has offered to each of us—her air, clean and pure as the snow on the mountains that have stood so long; her earth, hot and rich and fragrant; her forests, alive with bird song. Sit on her shores and bask in her allotment of

*Our roots go deep into her soil; our allegiance is pledged to all about her that is natural and good. Each day she reminds us of who we are, what we are, where we belong.*

*Blushing first-light caresses fields and woods — a Carolina homestead, solid anchor in the stormy workings of the world, always ready to welcome and refresh and revive.*

sunshine. Run along her coasts as a small child or as an adult. It's still beautiful, still fresh, still Carolina.

I have taken deer stands along forgotten roads on crisp November mornings and watched the squirrels play, savored the solitude, and listened to the hounds as they tediously worked a track until the warning exploded with the full cry of the pack. I have seen ducks zigzag in, through skeletons of trees against the morning sky, and had my humility restored on the cornfields of a dove shoot. This is absolute excitement, Carolina-style.

Some of the best meals served anywhere are at hunting club suppers, feasts everyone should experience at least once in a lifetime. The older men usually plan these get-togethers and try to play a little cards—their time with the boys.

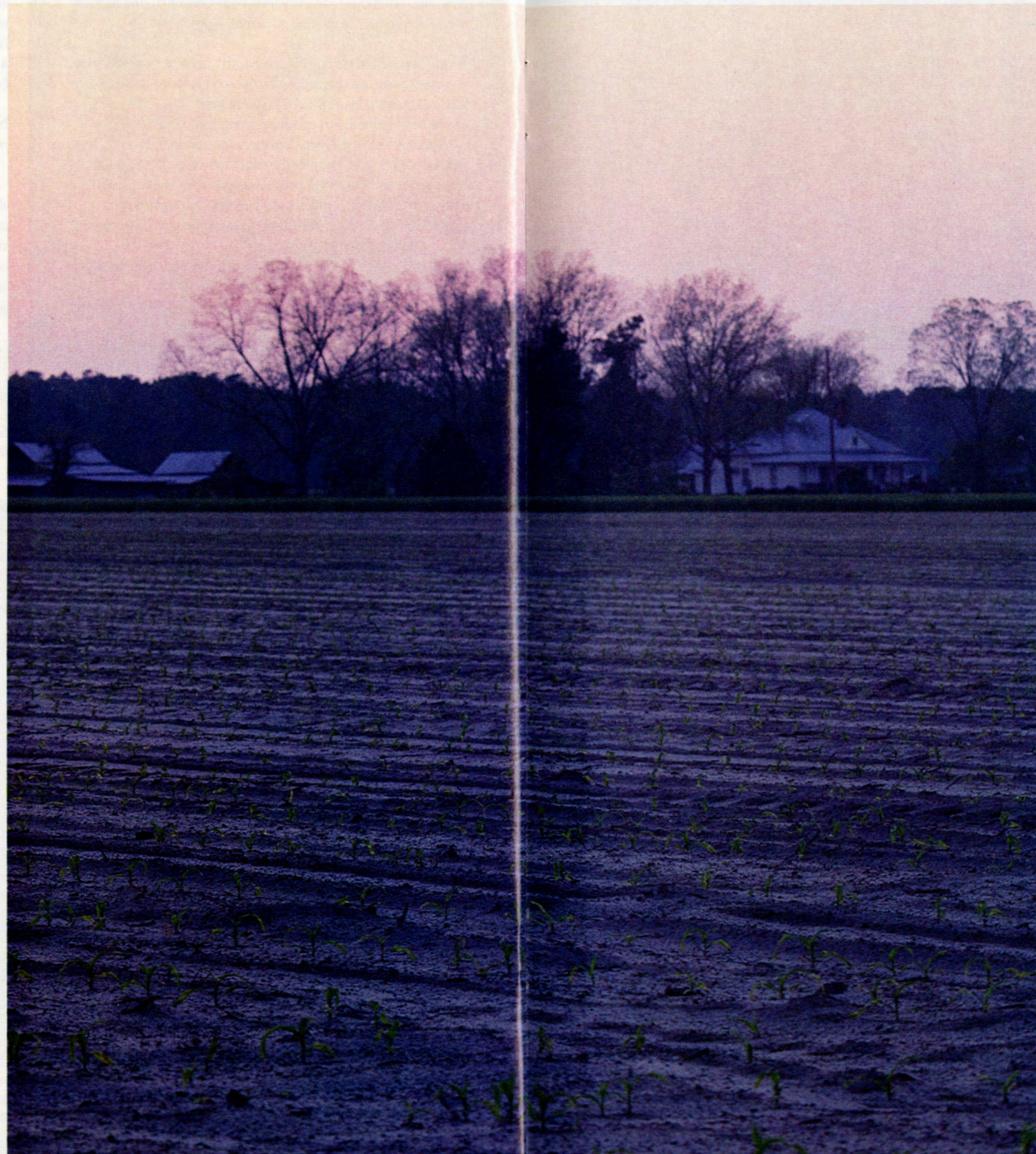
I doubt that the health department would give our hunting club an "A" rating. Inspectors don't get to eat those hot buttered grits, soaked in brown onion gravy, complemented by golden-brown doves, fish or deer.

The Edisto River runs close to my home. I have allowed myself its pleasures many times, sometimes to swim in the cool black water, other times to reap its harvest. Here the redbreasts are big and full of fight, while the bass and jacks swirl from under a bank or bush to attack a well-thrown lure.

I respect the God-fearing nature of South Carolina's people, and His integration into everything we do. I see God's work in the beautiful blackwater rivers. I see it in the oak ridge where my house shall one day stand. I see it in the love with which my mama cooks and sews and in the weathered brow and firm voice of the man I call Daddy.

South Carolina has offered so much to me, and to us all. The beauty she possesses and the toughness she invokes through hard lessons give her people a quiet resolve and fortitude that make us what we are—Carolina's own. 🐾

*Henry Hemdon, from Bamberg, is a recent graduate of the University of South Carolina in criminal justice. His first love is the farm; his second is hunting.*





# SUMMERTIME STRIPERS

*While most of us retreat to air-conditioned homes to escape summer temperatures and humidity, an increasing number of persistent anglers seek hot action below the surfaces of South Carolina's big lakes.*

by Jim Goller

photography by Michael Foster

**Q**uestions flicker through the mind like the orange glow of the boat's LCD in the dim light of dawn. Is the boat drifting? Is it time to change to fresher baits? Is there enough ice in the herring tank to ... did that stern rod just twitch?

Squinting hard reveals nothing. Another glance at the sonar display shows only the black marks of the live herring, dangling below, near the edge of a sunken river channel.

Without warning a black line moves rapidly onto the screen and into the marks made by the baits. The effects of rising at four a.m. are forgotten. Adrenalin is pumping even before the exaggerated "ZZZZ-Z-Z-Z-Z!" of a reel signals a fish stripping line against the drag.

Lunge for the rod. Lift it in one sure motion from the holder. Set the hook hard.

Linked to man by a thread of ten-pound monofilament, the fish feels the barb and plunges toward the depths of the channel. Thirty, forty, fifty, sixty yards and still it sounds. Then, almost as suddenly as it began, the first run is checked.

It's a good fish — play him carefully. Though the fight seems longer, slightly more than four minutes after the rod tip went down, a ten-pound striped bass comes to the net.

It's a sure cure for the summer doldrums. Stripers are hooking more and more anglers on fishing live bait deep in South Carolina's big lakes.

For many years, fishermen had to travel to the famous Santee-Cooper lakes to pursue this species. Viable striped and hybrid bass fisheries have become reality in lakes from South Carolina to Southern California thanks to propagation and stocking methods pioneered by the South Carolina Wildlife and Marine Resources Department.

While different lakes dictate different catch techniques, live bait fishing is a popular choice among anglers in the Palmetto state. Bait fishing for striped bass in South Carolina impoundments requires a combination of skill, patience, the right equipment and bait, and more than a little luck. While our lakes may not regularly produce trophy fish in the thirty-pound-plus class, liberal creel limits and abundant populations ensure good catches for almost all persistent anglers.

Live blueback herring are the preferred bait for striped and hybrid bass in lakes Hartwell and Thurmond and for the stripers in lakes Murray, Marion and Moultrie. In lakes Wateree and Greenwood, use gizzard and threadfin shad, gathered by castnetting in shallow coves. Shad also are sometimes used in Thurmond and in the Santee-Cooper system where herring are becoming increasingly scarce.

On lakes Hartwell and Thurmond, live blueback herring are not available for sale and must be caught by individual fishermen. Both professional guides and recreational fishermen make the trip each morning from these waters to Lake Richard B. Russell's tailrace to catch bait. When the turbines are operating, castnetting for bait is a relatively easy task.

On Lake Murray herring can usually be purchased from May through September near the SCE&G public ramp on the Irmo side, and on the Santee-Cooper lakes, commercial fishermen supply bait to fish camps for resale to anglers. Recent declines in herring traveling through the locks at Pinopolis Dam prevent most Santee fishermen from catching their own bait by jigging gold hooks, but this technique is used on Lake Murray at the power company intake towers and can be almost as much fun as fishing itself. (Most anglers won't say the same for castnetting after throwing an eight-foot net several times and hauling it up fifty feet or more.)

Although not as quick as castnetting in producing large quantities of blueback herring, jigging gold hooks can be good sport, is less expensive for fishermen than costly nets, and requires far less skill. Tie eight to ten small gold hooks about four inches apart on a light leader with weight attached, and jig them at the depth the bait is holding.



*Each lake has its bait-catching hotspot.* On Lake Murray it's the dam intake towers. In summer herring range from twenty-four to over seventy feet deep there, depending upon water temperatures.

Asking other anglers the correct depth can speed the search process. However, bait can be hard to catch if water is not being pulled through these intake towers for power generation.

Once in the bait, the gold hooks are jigged with a short twitching motion throughout a long upward sweep, not unlike vertical jigging with a spoon. The herring bite the gold hooks, which resemble miniature prey, and some are snagged by the hooks. It's possible to haul up two to six baits at one time with this method. Some fishermen file their hook barbs to lessen damage to these delicate baitfish. Many anglers jig off the bow while a rigged bait is dropped off the stern for a little fishing action.

It's a known fact that healthy bait catches fish and there are as many opinions as there are methods of preserving the health and liveliness of herring and shad. The consensus, however, is to use an aerator to ensure proper oxygenation of the water and rock salt in the bait tank to harden the delicate scales, preventing scale loss. (Table salt contains iodine and should not be used.)

Loss of scales on a baitfish results in an unnatural appearance, and a hungry striper or hybrid will often turn away without striking. Many anglers use commercially prepared additives to harden scales and to remove chlorine and ammonia from the water.

When purchasing bait, take water from the lake and chill it to a temperature of 58 to 62 degrees Fahrenheit for herring and 60 to 64 degrees for shad. Chilling involves adding commercially bagged ice, which contains chlorine, harmful to the bait and thus requiring a bait additive to neutralize the chemical. Some fishermen are lucky enough to have access to well water without additives, and this usually comes from the ground at 65 to 67 degrees, requiring little ice to lower to the proper temperature. Ammonia introduced into the water by the baitfish themselves becomes a problem only if the bait is kept for long periods. Manufacturer's recommendations are provided for all additives, and a pound of rock salt per thirty gallons of water is generally sufficient, but some will argue for more or less.

Many devices are available to aerate and oxygenate water in the bait tank. Popular paddle-type aerators stir the water to a froth at the top to introduce oxygen, but these can cause scale loss. More and more anglers are choosing the bubble-aerator, which emits a continuous stream of oxygen-rich air into the tank through a standard aquarium air stone or through a specially designed bubble hose. This seems to reduce scale loss but may not provide sufficient oxygen for holding large numbers of bait. A sure sign of oxygen starvation in herring and shad is the telltale "pink nose." When evident, the bait will not live long nor will they catch fish.

Tank design is important, with thirty-gallon round and oval tanks preferred, allowing the bait to swim naturally throughout the water

column. A square design prompts the fish to “bunch up” in the tank’s corners, often resulting in oxygen starvation. The spinning blades of paddle aerators create a current and force the bait to swim “upstream” in round or oval tanks, keeping them spread out, an argument in favor of this type of aerator.

The best way to ensure optimum results with any tank/aerator combination is through trial and error. Many fishermen opt to build their own bait tanks rather than spend two hundred dollars or more for a commercially produced tank with aerator.

*With lively, healthy bait* assured, the angler can turn his attention to tackle. Level-wind reels seem the first choice, with their smooth, reliable star drags. They allow bait to be dropped easily and quickly in free spool to depths sometimes exceeding fifty feet. Many choose wider-spool models, holding three hundred yards of line or more, with clickers to alert the fisherman to strikes.

A rod to use with live bait should have enough backbone to handle a twenty-pound-plus striper, but it must have a limber tip to ensure proper bait presentation and reduced resistance to the fish as it strikes. Too much tip resistance or too heavy a drag setting will sometimes cause the fish to drop the bait and prevent hookups. A limber tip is also handy in rough water, acting as a shock absorber for the bait and helping keep it alive when suspended from a rocking boat. Live bait rods are usually around seven to eight feet in length, and some are designed just for this type of fishing.

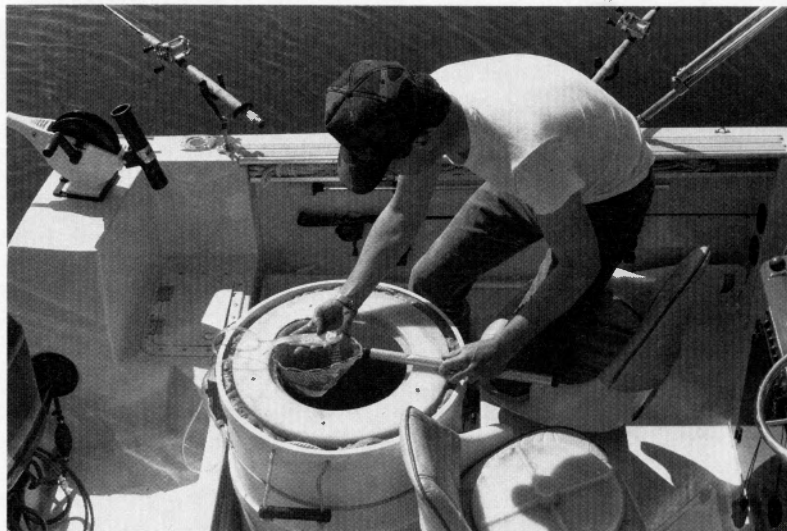
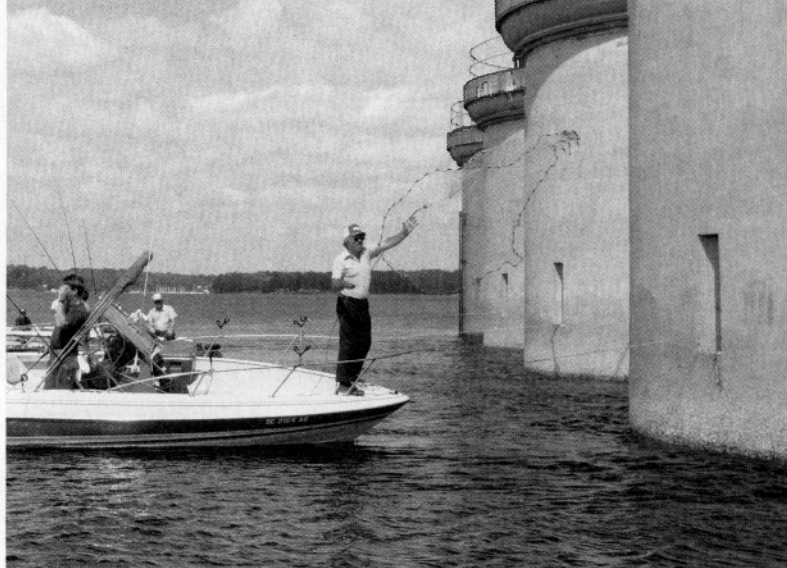
Line size is dictated by three factors: average size of fish caught, water clarity and underwater obstructions. Hybrids and stripers are wary fish and in clear water will shy away from lines in the seventeen- to twenty-pound range.

Many Lake Murray fishermen and professional guides have switched to lines in the eight- to ten-pound range to increase hookup percentages. Fishermen in Lake Moultrie tend to use lighter, less-visible lines than those in Lake Marion because Moultrie was cleared before filling and has fewer stumps. A lost fish or two is far better than not having the fish take your bait at all, and light line surprises most anglers in the size of fish it will handle under proper drag settings.

Terminal tackle includes a shock leader from eighteen to thirty-six inches (longer in rough water) tied to hooks from No. 2 through 4/0, honed razor sharp. Stripers and hybrids have tough mouths, and dull hooks may result in lost fish. The leader is attached to a swivel ahead of which is a sliding egg sinker weighing three quarters of an ounce to an ounce and a half. Some light-line anglers simply clamp split shot well ahead of the hook to further prevent spooking the cautious stripers, while allowing the baitfish to swim freely.

Much emphasis is placed on the use of rodholders in catching these powerful bass. Anyone who has lost rod and reel overboard to a hard-hitting striper will extol the virtues of rodholders, and multiple fish on simultaneously can be harrowing for the angler without them. Fixed and adjustable models abound—built to grip the rod at the right angle for proper bait presentation while allowing easy rod removal when a strike occurs.

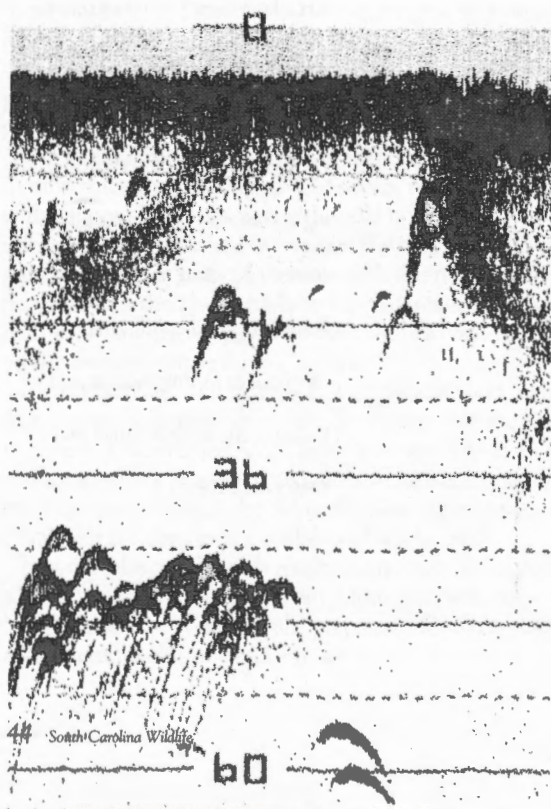
Some of the best have a plastic coating to grip securely while protecting delicate rod surfaces. Most can be easily removed from the boat for storage or when boating with the family. These holders place the rod horizontally, parallel to the water, allowing the fish to pull maximum flex in the rod with minimum resistance early in the strike. In many cases the fish hooks itself on the initial pull-down, and the angler simply lifts the rod from the holder and reels the fish in toward the net. One of the most exciting aspects of bait fishing is watching a fish bury the rod tip in the water, line running and clicker screaming.



40-43. *Live bait fishing is the key to Lake Murray’s hot-weather striper action. Herring can be purchased near the dam or caught by jigging gold hooks or casting eight-foot nets near the intake towers. Keeping the fragile herring in good condition is essential to fishing success and requires special bait tanks and water additives.*



44-45. A good graph or LCD allows the angler to see what's happening below, as in this deep-water readout showing fish suspended at 42 to 60 feet, below a cloud of baitfish. Action can be frantic when a school of hungry stripers decides to attack the baits. Eight- to twelve-pound fish quickly fill a cooler with memories and delicious fillets.



Summertime fishing for stripers and hybrids can be as easy as calling a local fish camp or bait dealer to find what depth and area the fish are holding and simply dropping a fresh bait down to them. More often needed, however, are a good depthfinder and a basic knowledge of the lake's structure. A trip just to scout a new lake and talk to the locals without wetting a hook or to go out with a professional guide can be important, especially for the inexperienced. Picking up a contour map of the lake and searching the mentioned "hot" areas with a depthfinder usually pay off in fish the next trip out.

Depthfinders are invaluable tools for locating fish. Popular for many years among serious fishermen and professionals, the paper chart recorder renders a permanent, detailed image of underwater fish habitat, but at a higher initial cost than other types and with the added expense of graph paper. Rapidly gaining acceptance is the liquid crystal display depthsounder, but there is a slight loss of detail with this instrument and no permanent record to study later. The flasher is still a favorite because of its low cost and simplicity, and the video sounder with monochrome or color display is gaining acceptance. Video units, like some LCDs, are somewhat susceptible to the sun's glare. Video units should also be protected from moisture.

Whatever your choice or budget, learning the system's capabilities will help you find fish and learn lake contours. Many fishermen are able to identify the species, relative fish size and whether or not the fish are feeding, based on the experience of many hours on the water watching their depthfinders.

For that's the key to success: get out and get fishing. As the water temperature warms in late May and early June the striped bass are usually off their spring spawning run (even hybrids simulate spawning) and tend to congregate in deep water. Fish can be caught into August by anchoring on deep points, dropoffs and humps off the main river channels, and by fishing over suspended fish. Staying in suspended fish requires skill and a trolling motor to keep up with moving schools.

When the water warms over seventy degrees, stripers and hybrids seek the thermocline level for comfort and food, and this is the right depth in which to catch them. The thermocline is easily seen on a depthfinder, showing up as concentrations of bait and large fish and is consistent in depth on any given day. Paper chart recorders can easily mark the thermocline if the sensitivity is adjusted high enough.

After finding where the fish are holding and at what depth, anchor the boat and lower baits to that depth or just above it. (Most fish species will travel up to take a bait, but never down to it.) Hook baits through the back, the "lips" or the nose. It's important to handle herring and shad carefully when hooking to prevent scale loss, and wetting your hands before touching the bait helps.

Check baits regularly for freshness and scale loss and replace often. A dead bait won't catch fish and neither will a bare hook. Baits coming from a tank at sixty degrees and lowered into eighty-degree summer surface water can go into shock and usually don't live long on the hook.

Set multiple rods at different depths to determine the right depth for that particular day, and "freeline" a bait along with the down rods. Freelineing involves simply tying a hook to the line with no weight or swivel, attaching a bait and casting it away from the boat to swim naturally at whatever depth it chooses.

Chumming is a popular technique when fishing just off the bottom



at anchor. A striped bass feeds in part by smell, and this trait is passed on to his hybrid cousin. Save dead baits and cut them into small pieces to throw overboard and lure nearby fish. Some anglers frown on this practice, thinking they will overfeed the fish and reduce their catch ratio. Anyone witnessing a school of hungry stripers feeding on shad in shallow water during cold weather would probably dispute this theory, as these fish sometimes eat until they regurgitate their stomach contents and then go on feeding. Stripers and hybrids are voracious feeders, and often the chumming excites the fish into a feeding frenzy.

Another technique used when fish are being marked on the depthfinder, but will not take a bait, is to vertically jig a small spoon into the fish. Not only will the spoon catch its share of fish, but it can stimulate them to feed on your live bait.

For most hot summer anglers, the fish seem to bite best from dawn until around 11:00 a.m. and again in the late afternoon until dark. Cloudy, overcast skies are best and will extend these hours somewhat. Stripers and hybrids are unpredictable, and it's not unusual to catch fish for days in a row and then have a day when you can't buy a strike. Many blame moon phases and "bluebird" skies for

this trend as well as changing weather with the passing of fronts. If scorching summer days and heavy fishing pressure get to you, night fishing can be productive and you may have the lake to yourself. Most night fishermen report their best luck from midnight until just before dawn.

In August and September, many anglers drift with the wind for fish suspended over deep water. It can be difficult to judge what depth your bait is drifting, and several rods set at different depths are helpful in finding fish in this situation. Once a fish hits, all rods can be set to the productive depth. Freelineing baits while drifting may also produce fish. A trolling or kicker outboard motor is sometimes necessary to continue catching fish when the wind dies.

Many anglers disdain fishing with live bait, but there's no denying that the technique produces fish, even when all else fails. When it's hot and humid and bass fishermen are back on the bank in the shade, it's the perfect time for stripers and hybrids. The temperature isn't all that heats up on South Carolina's lakes in summer. ☀️

*Jim Goller is circulation director of South Carolina Wildlife and a devoted striper fisherman.*



# SPRINGS ETERNAL



*Magical powers are attributed to them; families travel miles and stand in line to partake of their offerings. Crystal-clear and bubbling from deep within the earth, natural springs are sought for their purity and healing qualities.*

by Jim Fenwood

**S**outh Carolinians tend to take water for granted. With an abundance of shimmering lakes, blackwater rivers and whitewater mountain streams, we don't even begrudge an occasional tourist the chance to fish, swim, or perhaps raft the Chattooga. Worries about diminishing water tables, guzzling city sprawl, and parched riverbeds are things for folks west of the Mississippi to fret over.

It takes a record dry summer like the "Great Drought of '86" to get our attention. When our gardens shrivel, our taps slow to a drip, and hay for our cattle has to come by train, we look up at a cloudless blue atmosphere and remember with a hint of anxiety that all of us depend upon natural forces as inconstant as the weather.

At such times there's something reassuring about springs. During the driest days of 1986, though creekbeds cracked and stockponds shrank, my favorite spring-fed haunts retained their carpets of ferns and wild raisins. Supplied by ancient rains, the flow remained undiminished, always within a few degrees of the same temperature year-round.

Visiting a spring in the paralyzing heat of an August afternoon is a rejuvenating experience. The water is cool and the source apparently inexhaustible. The knowledge that it is neither

chlorinated, fluoridated, nor blessed with the sanction of official testing seems to sweeten the taste.

We insist upon attributing magical powers to spring water. Despite a greater risk of contamination and a level of dissolved solids that may be three times higher than municipal supplies, we gladly stand in line to partake of waters that we believe possess medicinal qualities and exceptional purity. As with all groundwater, the substrates that bear spring water to the surface tend to impart a unique taste and texture. True aficionados of spring water are as ardent as any wine-lover in their attachment to a particularly tasty "vintage."

Tradition has it that long before South Carolina was invaded by white men, Indians made their camps at a spring near what was to become Spartanburg. Taking advantage of the same spring's reputation as having "peculiarly fine therapeutic value for disease of the digestive and eliminative organs," the Whitestone Mineral Springs Company began bottling and selling the water. An early company brochure advised, "If you are in ill health with indigestion, dyspepsia, or other digestive troubles, or if you are troubled with diseases of the kidney or bladder you should not hesitate to use Whitestone Mineral Water very freely." No doubt, the advertised calcium sulfate content of 10.721 percent was in large part responsible for its cathartic powers.

Some of this country's biggest tourist attractions have grown up around places where water issues forth from the ground. We haul our families to Silver Springs, Florida, for vacationing and our arthritic bones to Georgia's Warm Springs for bathing. Closer to home, we tote our plastic jugs to any number of less-famous springs.

Most of these won't show up on your road atlas, but U.S. Geological Survey topographic maps are dotted with their names. Many are little more than trickling seeps, but their presence on the map is a measure of their importance to those who first settled the region.





MICHAEL FOSTER

46. Small, spring-fed lakes like Shealy's Pond sustain the distinctive lush vegetation of ever-wet, sandy spots.

47. A mountain spring may be visited frequently enough to warrant its own dipper. Although untested and untreated, spring water is touted as refreshing and therapeutic.

48-49. Once discovered, springs have often been channeled and their surroundings refined to suit their users' needs. Simple wooden and rough-cut stone steps lead down to Jews Harp Spring, but more formal structures characterize others. The name of Oconee County's well-known roadside spring is boldly engraved in its mantle, and Middleton Plantation preserves an example of an eighteenth-century springhouse. Constructed to refrigerate perishables in the chilly waters, these little houses offered a cool retreat in the swelter of a Carolina summer.



It's no coincidence that many of South Carolina's plantation homes were built near springs. Often the spring was opened up and its flow channeled into a series of runs and shallow pools. A springhouse was constructed over these to protect the precious supply of fresh water and provide a primitive means of refrigeration for perishable foods like milk and butter. Cool water circulating around earthenware crocks afforded some protection from Lowcountry summer heat. A tour of the Middleton Plantation grounds just outside Charleston provides an opportunity for a look at a restored and functional springhouse.

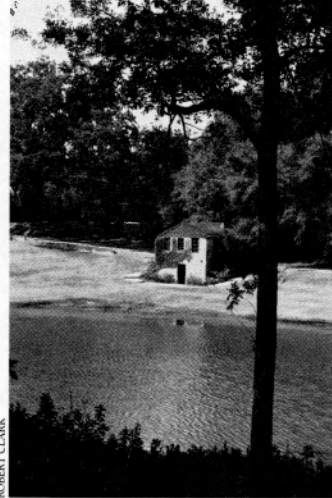
Many spring names echo those of local landmarks and once-prominent families. Near Mountain Rest in Oconee County, a thirsty traveler can find relief at Moody Spring, gushing from the earth beside Highway 107. The spring inherited its name, not because of a contrary disposition, but from the Moody family who once lived in what is now the Sumter National Forest. The U.S. Forest Service maintains the spring and provides a picnic area for visitors who stop for a drink. In post-Civil War days, however, the Moodys exacted a price for this privilege. Travelers on the "Turnpike" (as Highway 107, then a private toll road, was called) had to pay to water their livestock or themselves.

Some names suggest the physical characteristics of surroundings or of the water itself. Healing Springs, near Barnwell, was christened for the imagined curative virtues of its waters. In Union County, Jews Harp Spring earned its name from the shape of the hand-cut stone enclosure that channels its flow. Built in the 1860s by mason J.E. Sheridan, eight stone steps lead down to the bubbling spring. Once the primary source of water for Orange Hall Plantation, it flows undisturbed today even as the crumbled plantation ruins turn slowly to rubble.

Other spring names are grist for the imagination. In an account dated 1867, the Reverend Robert Wilson describes the size and abundance of fish inhabiting "Pooshee Spring" about forty miles from Charleston. He mentions the mythical "Cymbies," water spirits of Lowcountry folklore, but gives no clue as to the origin of the spring's name. We can only speculate about Badwell Springs, but the name is evocative enough for me to resist any temptation to sample its outflow. As for Double Springs ... well, you figure it out.

Ancient theories regarding the origin of springs were almost as numerous and varied as springs themselves. Plato postulated vast underground seas of boiling mud, while Pliny insisted that the earth's waters were blown by subterranean winds. Saint Thomas, for his part, was convinced that water was drawn to the tops of high peaks "by the power and virtue of the stars."

Modern understanding of their true nature began around 1661. Pierre Perrault, caught with his hand in the government till, ended an undistinguished bureaucratic career in the service of Louis XIV and dedicated his life to scientific study. In his "Origin of Springs," Perrault was the first to demonstrate that rainfall



ROBERT CLARK



PHILIP JONES

alone was sufficient to account for the flow of rivers and streams, spring-fed and otherwise.

We know now that springs owe their existence to the law of hydrostatics, occurring wherever underground water, squeezed between impermeable rock layers and seeking its own level, finds an outlet to the surface. In the mountains of South Carolina, we find these outlets in a top layer of weathered Precambrian granite and gneiss. In the piedmont, this layer is likely to consist of gneiss and schist. Springs in the coastal plain poke their way through deposits of sedimentary sands and clays dating from as long ago as the Cretaceous Period (90 million years) to as recently as 10,000 years.

Because of the consistent and unique conditions that prevail around them, several extraordinary plant species are associated with South Carolina springs. The bunched arrowhead (*Sagittaria fasciculata*) is considered rare enough to warrant protection as a federally endangered species. It and the small flowered heart leaf (*Hexastylis naniflora*), now under review by federal authorities for addition to the endangered list, occur only in a small portion of the North and South Carolina piedmont.

In 1986, concern for the bunched arrowhead led The South Carolina Nature Conservancy to purchase Mark Hall Farms near Travelers Rest. Site of the largest colony of the plant, it lies in the middle of the arrowhead's fifty-mile range. Here, spring seeps provide a muck bottom and the constant, slow-moving flow of water necessary for the plant to flourish. Farm ponds, pastures and roads have destroyed most other colonies. Rampant real estate development threatens the few that remain. The Mark Hall Farms site was purchased from the Conservancy by the state wildlife department using monies from the Heritage Land Trust Fund and has been dedicated as a Heritage Preserve.

Today, at a place that I and other locals keep secret and visit periodically, water from rain that fell days or years ago, perhaps long before the dams were built to create South Carolina's big reservoirs, spills from an iron pipe driven into a moss-covered bank. On a blazing summer day I will follow a snaking gravel road to the spot. There, ignoring admonishments of "Water Not Tested," I take my turn at the gurgling spigot. If I am lucky, I will have the place to myself. With a cup of well-aged rainwater in hand, I will drink a toast to Plato and Perrault and all others who believe that springs are indeed special places. ☘

Jim Fenwood is a wildlife biologist with the Southern region of the U.S. Forest Service in Atlanta.



ROBERT CLARK



July-August 1989, Vol. 36, No. 4

*Rock hounds, hikers and cascade fans, here's a Field Trip for you: the moderately strenuous Raven Cliff Falls Trail. We'll enter the heart of the Mountain Bridge Recreation and Wilderness Area, a project managed jointly by the state wildlife department and the S. C. Department of Parks, Recreation and Tourism. Caesars Head State Park is at its center, and our starting point lies one mile beyond the park headquarters. Leave your car in the lot beside U.S. Highway 276, and cross the road to the trailhead. Allow about three hours for this 4.4-mile trip.*

**1** Walk downhill toward an old pond site, past a fern-filled ravine off to the right. Be aware of birds' songs all around us—the park naturalist has recorded sightings of 145 species, from pileated woodpeckers to blue-grey gnatcatchers to American goldfinches, so your field guide will get plenty of use.

We pass a Northern red oak with a large, lumpy fungus or burl on its trunk. Growing at the tree's base is a rhododendron where last year an indigo bunting nested. Walk across the old dam and notice behind it the alders and a silverbell tree, with its four-winged fruit. Here we can get a first look at a plant common along the trail, wild hydrangea, with its flowering white "heads" and leaves with white undersides. Two species of rhododendron grow in the glade surrounding the little creek below us, *Rhododendron maximum* or rosebay, the larger-leaved plant, and *R. minus*, often called Carolina rhododendron. We will see many of these shrubs today.

Downed American chestnut trees, victims of the blight that devastated this once-dominant forest species, flank the trail. These logs may have been lying here intact as long as four decades, since the stout wood resists decomposition. Blight attacks the bark of a

sprouting tree, killing it, so American chestnuts no longer achieve great size here. However, we'll pass many other healthy, full-grown trees at this wetter elevation: sourwoods, hickories, yellow poplar and white oak.

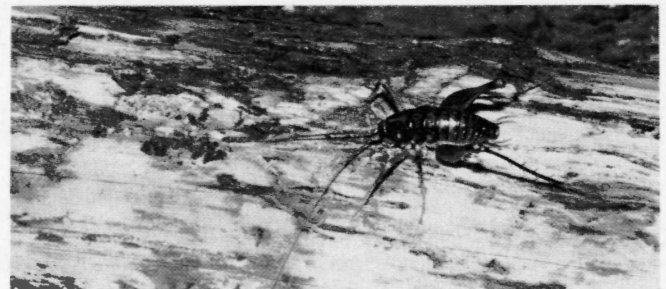
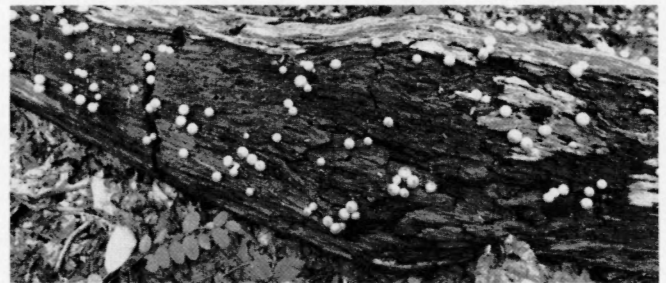
The trail splits around a tree, and we tread on some sizeable rocks in our path, samples of the many metamorphic types we will see (and walk on). This kind of stone has had its structure changed over time, the result of pressure and heat, and much has crystallized.

American chestnut log.



Most rocks will be granitic gneiss (pronounced "nice"), but the sparkling, flaky rocks are mica schist, large sheets of which are called isinglass and were used in years past for small window panes.

Feast your eyes on the spectacular view off to our left, toward the southeast. We are at the edge of the Blue Ridge Mountains, on what is known as the Blue Ridge Escarpment. Great diversity in vegetation results from this part-piedmont, part-mountain habitat.



Puffball fungi; camel cricket.

**2** We climb up and up, our first steep hill. Pause by a little dogwood growing almost vine-like against a larger, grey-barked tree. This is a sourwood, and an old row of yellow-bellied sapsucker holes circles it. The dogwood trees in the mountains have been stricken by a fungal disease, and unfortunately many in this area stand dead or dying, their bark peeling off in sheets.

Look beneath small rock outcrops for the burrows of one of the park's common mammals, the Eastern chipmunk. This striped little critter can frequently be spotted sitting upright on a fallen log, gnawing acorns and nuts held between its paws, or scurrying through the dry leaves on the forest floor. Watch also for the stout, pale-brown stalks of squaw-root, a parasite that grows on the roots of oak trees, and the snowy white flowers of snakeroot.

A dead hickory fallen across the path reminds us of the place in nature's plan of decomposing plants. Bracket and puffball fungi grow liberally on rotting logs, and beetles and larvae feed on the decaying matter as camel crickets creep along the length of a bare



trunk. Snags still standing upright provide hollows for cavity-nesting birds like woodpeckers and chickadees.

Approach an area where the trail is shored up along the left side, the walkway thick with rosebay and Carolina rhododendrons. Just beyond the thicket, look out across to the large rock outcrop, our next destination.

We stand in a somewhat different type of habitat because of the rocky terrain. These massive boulders are of the same metamorphic-type rock as Table Rock and the Caesars Head outcrop, granitic gneiss. Rocky soil here enables growth of trees that prefer a higher, drier habitat—the gnarled and crooked chestnut oaks and the pitch pines—and the beautiful mountain laurel. A little farther along, two short paths to small rocky



*Granite boulder.*

*Raven Cliff's majestic falls cascade 450 feet through vegetation unique to the wet, cool habitat surrounding a waterfall. The trail's other plant communities are rich with showy perennials such as the white snakeroot below.*



overlooks beckon to the left; back on the main trail we enter a large mountain laurel thicket. Massive boulders lie adjacent to our path, opportunities to linger and sun in the company of the soaring birds, vultures and hawks, that may sail past.

**3** Just beyond another chestnut oak, steep wooden steps have been constructed to help prevent erosion of the trail. Down at their base, we see more rhododendron, confirmation that we've moved to a lower elevation. To our right, the trunk of a maturing chestnut oak has grown flat and molded to a huge rock's shape, an example of this hardy species' ability to adapt.

We walk downward; enjoy it, for a steep climb lies just ahead. (Also remember that downhill now means uphill on our return trip!) Galax and trailing arbutus, typical mountain species, lie along our path, and we step over the exposed roots of trees and some fallen tree trunks that help keep the trail from eroding further.

Now into a steep ascent. To rest, stop at a tree that's down across



EMILY SHORT

*Wild azalea.*

most abundant understory plant, the huckleberry, is evident here. This short shrub with its small, elliptical leaves provides food for several woodland creatures, including black bears and ruffed grouse. Hooded warblers are known to nest in huckleberry thickets.

Up to this point we have been on a portion of the 120-mile Foothills Trail. A fork to the left continues the Raven Cliff Falls Trail, marked with red blazes on trees; taking the right fork and following the blue-blazed Foothills Trail means about an additional twelve-mile hike to Sassafras Mountain. We've come 1.4 miles from the trailhead; we turn left and hike for another three-quarters of a mile to reach the falls. The wider, deeper path we step onto was a carriage trail during the heyday of the nineteenth-century resort hotels. Guests were transported by this roadway to view Raven Cliff's spectacular cascade.

From here the downward slope is gentle. Soft humps along our trail mark the tunnels of Eastern moles, the earth cracked at the surface to trace the animal's burrowing.



*Boulder outcrops and openings along the trail offer beautiful panoramas, this one across a valley toward rugged Raven Cliff Mountain. Matthews Creek runs far below, on its way to join the Saluda River.*

the trail, about the halfway point on the trail. Surrounding us are two showy rhododendron species, commonly called wild or pink azaleas and flame azaleas. These or any other shrubs or wildflowers must not be picked or dug, no matter how appealing they are—leave them for the next visitors.

Climbing, climbing, and at last leveling off for what seems a stroll by comparison. This is the top of the ridge, close to 2,900 feet; on either side of the walkway is a downward slope. The park's

4 Soon we encounter rocks again, then the trail widens to a breathtaking overlook. Below runs Matthews Creek, down and into the wooded valley known as the Dismal, to join the Saluda River. Straight out and slightly to our left rises Paris Mountain (see Field Trip, November-December 1988); near it is the city of Greenville. Directly across from our overlook stands Raven Cliff Mountain (from here we can't see the falls), and at our extreme left is Caesars Head's granite outcrop. Soaring birds ride the air currents below us: vultures, broad-winged and red-tailed hawks, and possibly a raven.

As we resume our hike, investigate the steep trailside. Small holes may have been burrowed out by short-tailed shrews, and the larger ones by chipmunks. Nests of the worm-eating warbler can be found built right into the banks. The ovenbird, one of the most abundant summer birds in the park, makes a shallow depression in the earth for its eggs, but you have to look closely to find this nest.

Becoming more eroded and heading downhill, the trail takes a sharp left turn, then curves to the right. We've been walking through piedmont vegetation typical of the southeastern face of the mountains. In contrast, we now see more mountainous plants—hemlocks, Fraser magnolias, serviceberry and sweet pepperbush. Ruffed grouse may be heard drumming along this stretch during the morning and evening, especially if it's foggy.

Beyond a cool, shady rhododendron thicket and to our right stand twin chestnut oaks. Listen for the sound of water rushing, not the falls yet, but a tributary of Matthews Creek. Just around the bend a fallen black locust lies along the trail. This is a common tree in the park, thus locust borers are also common. These beetles lay their eggs in the black locust's trunk and feed on goldenrod in the fall. Now the whisper of the falls begins to blend with that of the creek.

Enter an open area and follow the main trail loop, resisting the



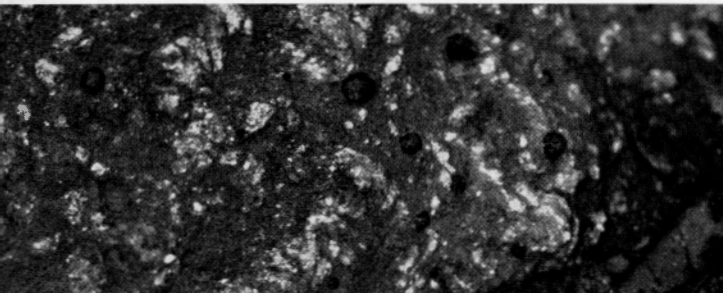
*Fallen black locust tree; locust borer.*

temptation to follow a steep shortcut to the right. After curving around, turn left onto the falls path; we will return to this point.

As we near the observation platform, look down at the shiny, flat rocks we tread upon. These are mica schist, and studding these stones are tiny black mineral dots—the hard crystals called garnets. While not of gem quality, they are still of interest, but don't try to pry these out, as we'll soon find the stones lying loose on the ground and you can examine those more closely.



*Mica schist with garnets.*



**5** At the platform, sight of the majestic cascade of Raven Cliff Falls awaits. Stop here to appreciate the beauty, photograph the falls and have lunch. (Remember not to litter; pack out all your trash.) A warning: yellowjackets may be present, and those who are sensitive to the insects' stings should be prepared.

Across the gorge, Raven Cliff's waters drop about 450 feet. To the left of the falls nest the namesake ravens, in a dense, wild tangle on the rock face. Above the falls, Matthews Creek is a native brook trout stream; below are mainly found rainbow trout. The terrain surrounding the falls is rugged, and the mountain's coves abound with wildflowers and shelter many species usually found farther north. While a branch off the Foothills Trail leads to the top of the falls, it is unmarked and interested hikers should consult the park naturalist.

When you've enjoyed your rest in this peaceful place, depart the platform by the falls path, back up to the trail. Turn left, and after walking about thirty feet begin searching for loose garnets scattered on the ground. The rock formerly surrounding them has broken down, and the harder gemstones remain, some of the larger ones clearly showing the twelve or twenty-four sides typical of these crystals. Remember to leave them for the next visitors.

**6** Time now to retrace our steps, following the trail back to our starting point. On the way, be especially observant and watch for more of the special plants that thrive in this habitat. About thirty different species of ferns grow in the park, including the unusual, vinelike Hartford or climbing fern and the walking fern, which roots and forms new plants from the tips of its arching leaves. Watch for the sweet-shrub, with its shiny-green, opposite leaves and its distinctive fruits, pods that contain large seeds favored by the golden mouse. This attractive little creature has a prehensile tail and lives in the shrubs near its food source.

Probably as many as forty other mammal species may be visible at various times of the day to the sharp-eyed, the most abundant being deer mice. Raccoons, opossums, deer and Eastern wood rats are occasionally seen, and visitors may be treated to a rare glimpse of a woodland jumping mouse, a bobcat, a striped or a spotted skunk, a grey fox, or perhaps even a black bear.

Reptiles and amphibians are more often seen. Timber rattlesnakes and copperheads are only infrequently reported, but Eastern garter snakes, black rat snakes and ringneck snakes are common. There is a great diversity and abundance of salamanders, among them the Northern dusky, the mountain dusky, the green, the seal and the large black-bellied salamanders. The one most likely to be seen on the trail or beneath fallen logs is the Jordan's salamander, recognized by its solid black color. Occasionally, after a rain, a newt slithers along the trail.

**7** Once more cross the old dam site and head up the steep hill toward the trailhead, checking the ground beneath your feet. This is a good place to find quartz crystals. Again, these are not top-quality stones but are fun to find and examine.

Time and inclination permitting, you may want to camp near this beautiful trail so you can visit the falls more than once. While camping is not allowed at Raven Cliff, there are sites designated on the Jones Gap Trail, which leaves from the corner of the parking lot where we began our hike. Campers must register at park headquarters or at the other end of Jones Gap Trail.

Before leaving the Raven Cliff area, make a stop at the nature center, overlook, country store and picnic area at the Caesars Head State Park headquarters. Many nature walks, special programs, demonstrations and festivals are scheduled at different times of each year. For information, write 8155 Geer Highway, Cleveland, SC 29635, or call (803) 836-6115.

—Linda Renshaw

*Field Trip acknowledges with thanks the assistance of Irvin Pitts, park naturalist at Caesars Head State Park.*

South Carolina Wildlife magazine announces its 1989 Young Outdoor Writers' Competition for students in grades five through twelve. Principals and teachers should receive entry information by August 31. If your school has not been contacted, write Young Outdoor Writers' Competition, SCW magazine, P.O. Box 167, Columbia, SC 29202-0167. 🐾



# ROUNDTABLE

## DIRECTIONS: STEWARDSHIP OF OUR WETLANDS

**M**ysterious and dreary, home to evil spirits, source of debilitating “miasmas”—such were our predecessors’ views toward wetlands.

Our ancestors were well-intended; to make what they perceived as wastelands productive, they would drain, dike and fill. They also were industrious; current studies



Once deemed wastelands, wetlands are now recognized as the richest of habitats. A plan for preserving South Carolina’s wetlands is currently being developed by the governor’s Freshwater Wetlands Forum.

estimate the loss of more than half of the wetlands that existed in the contiguous United States at the beginning of European settlement. An estimated 80 to 99 million acres of wetlands remain nationally.

We too must share the blame, for despite a greater understanding of the values provided by these transitional areas between land and water, our nation’s freshwater wetlands continue to disappear. Estimates of losses from the mid-50s to the mid-70s averaged almost one-half million acres per year.

Recognizing this responsibility, Governor Carroll A. Campbell, who served as vice-chair of the National Wetlands Policy Forum, has formed a Freshwater Wetlands Forum charged with implementing a no-overall-net-loss wetlands policy in South Carolina. Its 37 members, from the public and private sectors, have also been instructed to develop a single regulatory definition for wetlands, identify those wetlands, and recommend a protective program administered by a single state agency.

In its simplest definition, a wetland is any area covered with shallow water or composed of saturated, oxygen-poor soils for at least part of the year.

Vegetation, when present, is

generally of a type that demands wet conditions for survival.

In South Carolina, our best-known wetlands are the salt marshes—critical as sources of food and nursery grounds to fish and shellfish and as habitat to countless reptiles, mammals and birds, including waterfowl and many endangered species. So vital are these tidal salt and brackish areas that we have enacted laws to protect and manage them.

However, wetlands also include numerous inland areas—marshes, swamps, bays, bogs, sloughs, potholes, backwaters, mud flats and shoals. Some, including Carolina bays, are isolated from other water bodies. Others, like bottomlands and backwaters, are associated with rivers, lakes or streams. All are vital to the well-being of our water, fish and wildlife resources and to our enjoyment of those resources and the out-of-doors.

Freshwater game fish such as largemouth bass and sunfish depend upon these waters to spawn and grow. Our native wood duck and the Eastern wild turkey depend heavily upon swamps and bottomland hardwoods. Each unique wetland type supports its own diverse array of animal and plant life.

We know that wetlands are special places for recreation and exposure to the wonders of the world. Hunting, particularly waterfowl hunting, is directly associated with wetlands. Fishing too, through game and forage species’ requirements for spawning and nursery grounds, also directly benefits from wetlands conservation. Finally, researchers, classroom and conservation groups and those who enjoy bird watching and

wildlife observation also rely upon wetland habitat.

These inland wetlands act as buffers against the erosion of adjacent lands as well as against the effects of floods and storms on downstream areas. Wetlands store water during flooding, then gradually release this water, reducing flood crests and lessening downstream damage. Alteration of floodplain wetlands has been proven partly responsible for some of our nation’s recent flood disasters.

We also know that inland wetlands filter sediments, serve to recharge vital groundwater supplies, and are among the most biologically productive areas on earth.

South Carolinians are fortunate. Our rate and type of development have been such that until recently it was easier to work around many wetlands than to alter them. We estimate that nearly one-fourth of our state may be categorized as wetland at some time during the year, although not all agencies use the same criteria for identifying wetlands.

We are just beginning to take the necessary actions to assure that this percentage will not dwindle as it has throughout much of the rest of our nation.

It is essential that landowners, developers, conservationists, scientists and government work together for a clearer sense of public policy concerning these wetland resources. Together we can assure that the enormous economic, environmental and recreational values are utilized and passed on to future generations of South Carolinians. 🐾

—James A. Timmerman Jr.  
Executive Director, SCWMRD

**Hooked  
on fishing!**  
NOT on drugs.

## OUTDOORSMEN ENLISTED FOR WAR ON DRUGS

Law enforcement officials are calling on South Carolina's outdoorsmen to help blow the whistle on drug outlaws.

Every year criminals plant illicit marijuana gardens in remote areas visited by hunters, hikers and fishermen.

Clandestine pot patches have been discovered in wildlife management areas, within the bounds of state parks and on national forest lands.

Last year, the U.S. Forest Service launched an all-out offensive against pot producers. Nationwide, agents conducted 3,280 raids, seized more than 400,000 marijuana plants and arrested 543 growers.

Recent eradication efforts in South Carolina indicate that marijuana cultivation is more widespread than once supposed. According to Jim McGivney of the Drug Enforcement Administration, "South Carolina ranked eighth in the nation for the number of plants seized in 1987. Agents discovered 100,000 marijuana plants during a single raid in Dorchester County. The number declined quite a bit in 1988 because the drought made growing conditions unfavorable, but we

expect to see a big increase this summer as a result of intensified eradication efforts by the Governor's Drug Task Force."

Sixty law enforcement officers, including 10 from the state wildlife department, serve on the multi-agency "raid team" formed by the governor in 1988. Agents are now conducting sophisticated surveillance operations in many parts of the state aimed at apprehending suspected pot farmers.

According to Conservation Officer Gary Street, "Outdoorsmen alert to clues of illegal drug activity often prove to be our best allies." Telltale signs of marijuana cultivation include new trails or paths into remote areas; discarded fertilizer sacks, garden tools or flower pots; plastic pipe or hoses used for irrigation; evidence of individuals camping or living in areas not frequented by the public; and attempts to camouflage an area from aerial surveillance.

Anyone discovering a marijuana patch should note the location as accurately as possible and leave the area immediately. Do not enter the cultivated area under any circumstances—exploring the site may disturb important evidence or trigger explosive booby traps intended for "patch pirates." Contact the local sheriff's department or the Governor's Raid Team at (803) 737-8303/9000. 🐾

---

*Hunters under 16 years old must complete a hunter education course before they can participate in any hunting activity on Carolina Sandhills National Wildlife Refuge.*



**LIGHTNING**, feared for its destructive power, is also beneficial—as one of nature's ways of fertilizing the soil.

*Every gardener knows the importance of nitrogen to plants. Although nitrogen is abundant (78 percent of the earth's atmosphere is nitrogen), most living organisms cannot use it in its gaseous form. In a process called nitrogen fixation, lightning causes nitrogen in the air to combine with oxygen molecules to form nitrogen oxides. These compounds are then carried to the soil dissolved in rainwater.*

*Nitrogen fixation is also carried on by microorganisms. Plants of the legume family (alfalfa, peas, soybeans, etc.) contain nitrogen-fixing bacteria, which take nitrogen from the air and convert it into nitrogen compounds.*

*Scientists had previously estimated that lightning was responsible for less than 10 percent of the earth's supply of fixed nitrogen. But recent studies at the New Mexico Institute of Mining and Technology estimate that approximately 100 lightning flashes occur worldwide every second, producing roughly one-half of the earth's supply of fixed nitrogen. 🐾*

## PRICE OF WATER MAY SOAR, STUDY WARNS

Water bills could rise more than 600 percent over the next 10 years unless steps are taken to make local suppliers more efficient, warns a comprehensive study by Clemson University.

The 210-page report, the culmination of four years of research, states that South Carolina could experience a water crisis by the year 2000 unless small, inefficient water systems are consolidated. Of the 342 systems in the state, 320 serve an average of fewer than 5,000 users. More than half of the systems appear to be operating in the red, according to the report.

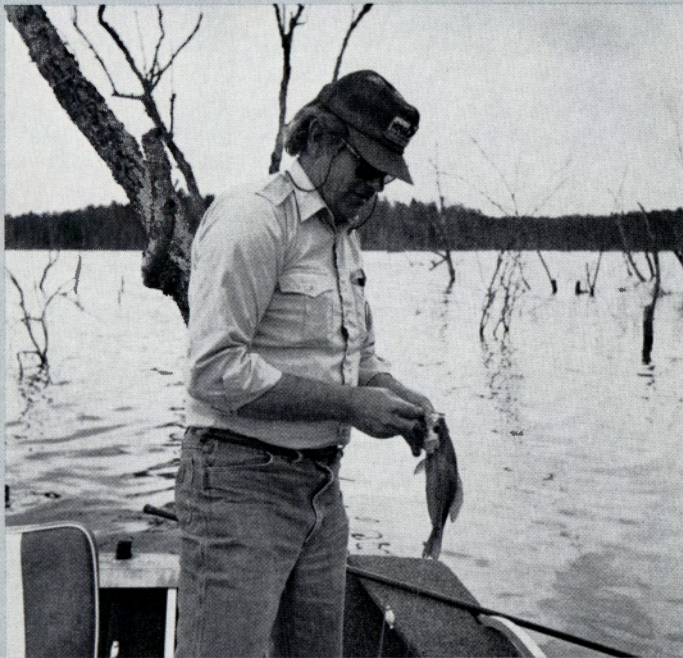
"Water is drastically underpriced," said Dr. James C. Hite, who coordinated the study. "If federal subsidies were to be completely withdrawn—and that process is under way—the cost of water in rural areas would be very, very high. The average family in Allendale could end up paying \$110 a month for water."

The report states that South Carolina has more than enough water "in most years" but is ill-equipped to deal with recurring drought. "We have enough treatment capacity for the next 30 to 40 years if we can build a consolidated, efficient system," Hite said. "If we stay with the present structure, water bills will average \$60 to \$70 per month. A consolidated system could provide water for \$15 to \$20 a month." 🐾

---

*At the current rate the world's population will double in 40 years.*

# ROUNDTABLE



Sunglasses and a cap are just what the doctor ordered to shield eyes from harmful UV radiation.

## DOCTORS PRESCRIBE SUNGLASSES, HAT

Protecting your eyes from the sun's glare is more important than ever as more ultraviolet (UV) radiation now passes through the earth's tattered ozone layer, eye-care experts say.

According to an article in the *Journal of the American Medical Association*, "The long-term effects of ultraviolet light on the eye are of increasing concern as many people live longer and spend more of that time in outdoor recreation and as the diminishing ozone layer filters less UV light." Studies suggest that chronic, lifetime exposure to UV contributes to the development of cataracts.

Ultraviolet radiation is strongest in open or "reflective environments" such as lakes and beaches, the article states. For

this reason fishermen should be especially careful to shield eyes from the sun's rays.

Tests indicate that ordinary sunglasses are very effective in filtering out most UV radiation. *Consumer Reports* tested 180 pairs of sunglasses ranging in price from \$2 to nearly \$200. The results: "Virtually all the models we tested, from the cheapest to the most expensive, did a commendable job of reducing ultraviolet rays." One note—sunglasses must fit closely to be effective, experts say.

In addition to wearing sunglasses, donning a brimmed hat or baseball cap can cut ocular exposure to UV light by half to one fourth, according to Dr. Hugh Taylor of Johns Hopkins University. As a rule of thumb, he says, if there's enough sun to cause sunburn, you should protect your eyes. ☀

## SANTEE STRIPERS MAKING A COMEBACK

Santee-Cooper's world-famous striped bass fishery had been mysteriously declining for years. Now, however, the bass are showing signs of recovery.

"We now have more and larger stripers than we did in 1984 when we began stocking fingerlings and initiated an 18-inch minimum size limit," explained District Fisheries Biologist Miller White, "but the population is still well below the 1960s level."

Until recent years, Santee's striper fishery was self-sustaining; however, natural production has declined by 80 percent since the early 1980s.

"In 1984 we began stocking stripers in Santee-Cooper to correct a situation where we've got very low natural production but much greater fishing pressure than in the past," White said. Since stocking began five years ago the state wildlife department has released more than 6 million striper fingerlings in the lakes.

"We have some intensive, long-term studies under way to determine why the natural production of striped bass has declined so drastically," said White. "We're stocking fingerlings to make up the difference, but the fishery has not recovered as much as we had hoped." ☀


## RAINBOW TROUT SPAWN IN MIDLANDS RIVER

Trout anglers in the midlands have long boasted about the stretch of "mountain" stream that flows within sight of the state capitol, but a discovery made last spring on the Lower Saluda River may swell their pride a bit more.

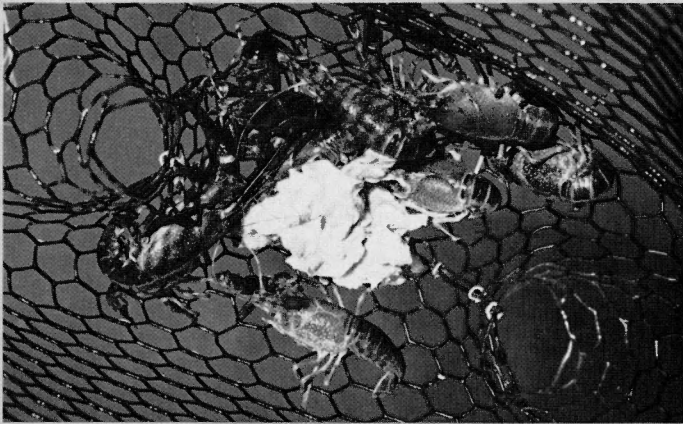
In March, Fisheries Biologist Gerrit Jobsis captured a 6-week old rainbow trout while electrofishing the river for survey purposes. The catch was the first documented evidence of natural trout reproduction in the Lower Saluda, a river that has been stocked with trout for years.

"Catching one trout of this age indicates that trout spawning is probably not commonplace in the Lower Saluda, but it does show the potential when conditions are right," Jobsis said. "Improved water quality in the river may well be the key for successful trout spawning to become more common, which is an exciting possibility for a river in the middle of South Carolina."

To survive, rainbow trout require clear, cold water—abundant in the mountains but rare elsewhere. Cold water spilling from the depths of Lake Murray allow trout to inhabit the Lower Saluda. ☀



**OPERATION  
GAME THIEF**  
**1-800-922-5431**  
**STOP GAME AND FISH VIOLATORS**



Aquaculture could become a \$50 million industry in South Carolina over the next five years. Pond-reared crawfish are harvested using a wire trap baited with a chunk of fish.

**FARM-GROWN SEAFOOD IS WAVE OF THE FUTURE**

Aquaculture, the aquatic version of agriculture, will satisfy the nation's growing appetite for seafood, predicted a marine scientist with the state wildlife department.

"Aquaculture has become the fastest-growing segment of U.S. agriculture," said Dr. John Manzi, senior marine scientist at the Marine Resources Research Institute in Charleston. He reported that people's eating habits are changing to include more fish and shellfish and that the growing demand will be met by aquaculture operations because the world's oceans are at or near their maximum sustainable yield.

Agricultural economists at Clemson University estimate that aquaculture could become a \$45 to \$50 million industry in South Carolina over the next five years. Of the 60 aquaculture ventures currently operating in South Carolina, 35 raise crawfish, 25 catfish, and 10

shrimp. Researchers also see great potential for pond-produced clams, redfish and hybrid striped bass.

"The Marine Resources Division began aquaculture research in the early 1970s and has since become a leader in the field," Manzi said. 🐟

---

*Swordfish can achieve speeds of 55 mph; sailfish, 68 mph.*

---

**REEFS AND WRECKS POPULAR WITH DIVERS, FISHERMEN**

South Carolina's artificial reefs and offshore shipwrecks are favorite destinations for diving enthusiasts as well as saltwater anglers.

"Recreational SCUBA diving has become a popular sport in South Carolina's coastal waters over the past ten years and many of our artificial reefs are frequented by sport divers," said Mel Bell, coordinator of the state wildlife department's artificial reef program. "These

underwater habitats are rewarding places for divers to visit because solid structures attract a variety of colorful marine creatures."

Scuttled ships, bands of tires and concrete pipe create artificial oases on the flat, featureless ocean floor. Hard surfaces are rapidly colonized by algae, barnacles, sponges and corals and offer hiding places for crabs, starfish, sea urchins and juvenile fish. These in turn draw larger fish sought by hook-and-line anglers and spearfishermen.

"May through October are the peak months for reef use, both by fishermen and divers as well," Bell said. "Conflicts sometimes arise on peak days, but these can be avoided if everyone uses a little common sense and courtesy. Divers should move their boats after dives and not stay anchored over a structure during their surface intervals. And fishermen should allow divers a chance to make a dive after they have caught a number of fish or if fishing gets slow."

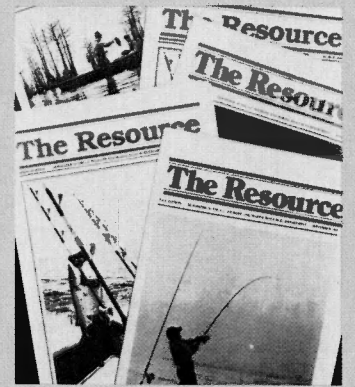
Sport divers can assist the artificial reef program by sharing with marine biologists their observations of reefs' physical condition and fish populations. According to Bell, "Divers can be a big asset by serving as additional underwater eyes for us."

For more information on the Divers' Assistance Program, write or call the Marine Resources Center, P.O. Box 12559, Charleston, SC 29412, 795-6350. 🐟

---

*Fish sleep—some so soundly they can be lifted out of the water before awakening.*

---



**THE RESOURCE**, a biannual tabloid published by the state wildlife department's Division of Conservation Education and Communications, is available to South Carolina residents free for the asking.

The purpose of *The Resource* is to directly communicate with all boaters, hunters, fishermen and other outdoor enthusiasts in the state about opportunities for outdoor recreation, new laws or regulations affecting sportsmen, and activities of the S.C. Wildlife and Marine Resources Department (SCWMRD).

The *Resource* is published in the spring and fall of each year and is mailed to approximately 60,000 subscribers.

The publication is free to South Carolina residents, but subscription requests must be made in writing. (Buying a hunting or fishing license does not automatically add your name to the mailing list.) Send requests to *The Resource*, P.O. Box 167, Columbia, SC 29202. Out-of-state readers may subscribe for \$2 per year. Make checks payable to SCWMRD. 🐟

# ROUNDTABLE



Endangered gopher tortoises have been granted a new haven by Westvaco. The 140-acre Whitener tract near Ridgeland affords the burrowing reptiles an ideal home.

## STATE'S RAREST REPTILE GAINS NEW REFUGE

The gopher tortoise, a burrowing reptile in peril of extinction, now has a better chance for survival thanks to an agreement struck last spring between Westvaco Corporation and the state wildlife department.

The forest products company agreed in April to set aside 140 acres of its property that had been identified by department biologists as "ideal tortoise habitat." Under the state's Heritage Trust Act, private property that harbors endangered plants or animals can receive protected status by a voluntary registration agreement. Registered sites remain in private hands, but owners agree to protect and manage the land for the benefit of its endangered inhabitants.

Fewer than 2,000 gopher

tortoises remain in South Carolina, said Nongame Biologist Steve Bennett. Named for its gopher-like habit of burrowing, the tortoise's underground domicile may extend 30 feet in length and be 10 feet deep. Bennett noted that many other animals take refuge in the tortoises' cool, dark burrows, including lizards, frogs, rabbits, snakes—even quail.

Gopher tortoises are also protected on the department-owned Tillman Sand Ridge Heritage Preserve in Jasper County. 🐢

---

*Nearly 700 of America's plant species may become extinct by the year 2,000, according to a recent survey conducted by the Center for Plant Conservation. A total of 3,000 plants in the U.S.—8 percent of the nation's plant species—have been identified as endangered.*

---

*A white-tailed deer's hearing is 60 times more acute than a human's.*

---

## OFFICERS SOLD ON WARNING DEVICES

All 240 patrol cars and trucks used by state conservation officers are being equipped with deer warning devices after a year-long test proved the devices are effective.

"We're convinced that they work," said Fritz Jolly, fleet safety and training officer with the state wildlife department. "We tested the devices on 35 vehicles and in almost every case the drivers encountered fewer deer. Any deer that were seen were usually running away from the road."

Deer warning devices (also called wildlife warning devices) are small, bullet-shaped accessories that are attached to the front bumpers or grills of cars and trucks. At speeds greater than 30 mph the wind-activated whistles produce an ultrasonic signal inaudible to the human ear but capable of alerting animals such as deer of an approaching vehicle up to 400 yards away.

According to the state highway department, 2,686 accidents involving deer were reported last year in South Carolina. Deer are crepuscular, which means they are most active at dusk or twilight, a time when drivers don't see as well and when lights are most likely to confuse the deer.

Deer warning devices are available to motorists at retail stores that sell auto parts, including Western Auto and K-Mart. 🐢

## PLANT A TREE, COOL THE GLOBE

Global warming may be the most serious environmental crisis of our lifetime. Yet the response to this global problem is not beyond the reach of ordinary Americans.

The American Forestry Association (AFA) has launched a nationwide campaign encouraging citizens to help cool the globe by planting trees. According to AFA Vice President R. Neil Sampson, "Our goal is to get 100 million trees planted in American cities and towns by 1992."

Trees serve as vital processors of carbon dioxide. During photosynthesis, trees take in carbon dioxide, release oxygen, and store carbon, thereby reducing the buildup of heat-trapping gases in the atmosphere. On the average, a forest tree absorbs about 13 pounds of carbon dioxide a year.

Sampson said planting trees is a positive step anyone can take—right in their own backyard—to help cut down on the amount of carbon dioxide in the atmosphere, which is the leading cause of the Greenhouse Effect.

"If 100 million trees sounds like an insurmountable number, keep in mind that the citizens of Los Angeles planted one million trees in the three years prior to the 1984 Olympics," Sampson said. "We're challenging every state in the Union to double what Los Angeles residents accomplished."

For more information write Global ReLeaf, American Forestry Association, P.O. Box 2000, Dept. GR2, Washington, DC 20013. 🌳



Columbia was among 19 South Carolina cities recognized for efforts to preserve urban trees. The capital city spends almost half a million dollars on tree care each year.

**S.C. "TREE CITIES" HONORED**

Nineteen South Carolina towns have been awarded the title "Tree City USA" by the National Arbor Day Foundation.

Towns qualifying for the honor are Aiken, Beaufort, Camden, Charleston, Cheraw, Columbia, Conway, Florence, Greenville, Hartsville, Iva, Lancaster, Marion, Pelion, Rock Hill, Spartanburg, Summerville, Sumter and Winnsboro.

To be named a Tree City USA, a town or city must meet four standards. It must have a city tree board or department to oversee tree care; it must have a tree ordinance regulating planting, maintenance and removal of trees; it must annually spend at least \$2 per citizen on its tree program; and the mayor must officially proclaim the observance of Arbor Day.

"Protection and care of the state's valuable urban trees is on the increase and public awareness and support for urban forestry is strong," said State Forester Leonard Kilian.

Local governments around the state have responded to concerns voiced by the public about the loss of trees in urban and suburban areas. Last fall Charleston's City Council passed a new zoning ordinance protecting the city's "grand trees"—those measuring 24 or more inches at a point 4.5 feet above the ground. The city also hired a tree ordinance officer to enforce the new restrictions.

Similar measures enacted by Charleston's County Council ban clearcutting of commercial lots and offer developers incentives to save large "centerpiece" trees.

"Mature trees are too valuable to lose because of insensitive clearing," said Steve Dykes, Charleston County's senior planner. "Not only do they beautify our surroundings, but trees also purify the air and reduce energy demands."

Three large shade trees, for example, can cut air-conditioning bills from 10 to 50 percent. And one acre of trees filters about 13 tons of pollutants from the air every year.

**LOGGING CURTAILED TO SAVE RARE WOODPECKERS**

The U.S. Forest Service has imposed a partial ban on clearcutting on national forest lands in nine Southern states to protect the endangered red-cockaded woodpecker.

The new policy forbids clearcutting within three quarters of a mile of woodpecker colonies in order to protect the birds' nesting and foraging habitat. Each such zone affects some 1,117 acres, and foresters estimate that the restrictions could curtail timber harvest by 40 percent on some national forest lands.

The clearcutting ban does not apply to three national forests where the woodpeckers are numerous, including Francis Marion forest near Charleston. Francis Marion has been described as ideal habitat for the rare birds and hosts the nation's second-largest population, with 487 colonies.

Forest Service officials said the action is the most drastic ever taken by the agency in the Southeast to try to reverse an alarming decline in the numbers of an endangered species.

Once abundant, only a few thousand red-cockaded woodpeckers remain in isolated populations from North Carolina to Texas, mostly on national

forest lands. The roost cavities in which the birds live are almost always excavated in living, mature pine trees (80 to 120 years old). Wildlife biologists attribute the woodpecker's decline primarily to the loss of old-growth pine forests in the South.

The Forest Service imposed the restrictions in response to legal action by an environmental group. According to Doug Honnold, an attorney with the Sierra Club Legal Defense Fund, "In the past three decades, clearcutting on national forests has removed many of the old trees on which the woodpeckers depend for food and shelter. We initiated legal action to force the Forest Service to fulfill its obligations to the red-cockaded woodpecker under the Endangered Species Act."

Honnold said that despite 18 years as a federally listed endangered species, the red-cockaded woodpecker continues to decline in number. Three populations have disappeared in recent years, including one group that inhabited South Carolina's Sumter National Forest.

*Rain forests occupy only 7 percent of the planet's total area but support nearly half of all living species.*

**GLOBAL**  
 You can make a world of difference.  
**RELEAF**

# ROUNDTABLE



Preserving the natural beauty of South Carolina's rivers and streams is the aim of the state Scenic Rivers Program.

## SCENIC RIVERS ACT APPROVED

1989 may prove a landmark year for river conservation in South Carolina thanks to a new law designed to strengthen and enhance the state's Scenic Rivers Program.

The South Carolina Scenic Rivers Act of 1989 was passed by state lawmakers in May and provides for a number of sweeping changes aimed at making the Scenic Rivers Program more effective. Begun in 1974, the program is charged with the laudable goal of preserving the natural character of South Carolina's outstanding rivers "for the benefit and enjoyment of present and future generations." In the 15 years of the program's existence, however, only two river segments totaling 15 miles have gained protected status.

"In the early years of the

program the most effective means of protecting rivers were not fully understood," said Barry Beasley, manager of the Scenic Rivers Program for the state Water Resources Commission. "Rivers were declared eligible for protection without first gaining the necessary local support."

Under the new guidelines, local advisory councils will be established to allow area landowners and residents greater voice in the designation and management of scenic rivers. In addition, the state General Assembly must now ratify scenic river proposals made by Water Resources. "This requirement will provide more opportunity for public involvement through the legislative process," Beasley said.

The program has also been hampered by a lack of funding, so the new law establishes a Scenic Rivers Trust Fund for voluntary donations to purchase

buffer areas along designated rivers. According to Beasley, "The Scenic Rivers Program is and will continue to be voluntary, dependent upon landowners donating easements along scenic river corridors." 🐾

## TRASH LONG-LIVED, EVEN IN THE GRAVE

Researchers digging into the problem of waste disposal have uncovered a surprising fact: burying garbage in a landfill is a great way to *preserve* it!

Dr. William Rathje, an anthropologist at the University of Arizona, excavated several major landfills and found organic matter such as food and yard waste completely intact, even after 10 years of burial. Grass clippings were still green and carrots still orange.

The very slow rate of biodegradation is attributed to the design of sanitary landfills. Modern facilities are purposely kept dry to prevent water from percolating through the waste and possibly causing groundwater contamination. Research shows that the microorganisms responsible for breaking down organic matter require a 65 percent moisture level, but solid waste entering landfills typically contains only 25 to 30 percent moisture.

Based on these findings, scientists are cautioning government officials against supposing that the garbage glut will suddenly disappear simply by requiring manufacturers to make products biodegradable. The better way, experts say, is to make items recyclable, thereby keeping them out of the waste stream altogether. 🐾

## NEW LAW MANDATES DEGRADABLE YOKES

Starting next year, all plastic six-pack yokes sold in the nation must be made of degradable material, according to a new law enacted by Congress. The aim is to protect birds, fish and other wildlife that can ingest or become entangled in the plastic, often fatally.

The legislation is the first by Congress to require degradability, although 17 states already have similar laws. Florida, for example, will ban all plastic shopping bags that do not degrade in 120 days beginning next year.

While degradability makes sense for some plastic products, making all plastics degradable could work at cross-purposes to making them recyclable, which ultimately conserves more resources.

Like metal and glass, many types of durable plastic can be recycled into useful products rather than taking up space in a landfill. Polyethylene terephthalate (PET) is a plastic used to make soft drink bottles. The world's largest recycler of PET is Wellman Industries in Johnsonville, S.C. Last year Wellman recycled 100 million pounds of plastic bottles, converting the plastic into fiberfill for pillows, vests and sleeping bags. 🐾





Last year in South Carolina, Reynolds Aluminum recycled 2.4 million pounds of aluminum cans—enough to fill 170 tractor trailers.

**RECYCLING CATCHING ON AS DUMPS OVERFLOW**

The American penchant for throwing away any- and everything has at long last come face to face with a shortage of space to throw it.

Nationwide, Americans produce 400,000 tons of trash every day, making us the world's leading discarders. Approximately 80 percent of the nation's municipal solid wastes end up in a landfill.

Landfills in this country are closing at a rate that averages about one per day. More than half of America's cities will reach their landfill capacity in the next decade. Disposal costs are ballooning, and the "not-in-my-backyard" syndrome makes siting new dumps difficult.

In South Carolina, there are presently 65 permitted landfills, most county-operated. Nine landfills are full, and several more will reach capacity in the next five years.

As landfill capacity dwindles and cost of trash disposal soars, recycling is becoming the prudent choice for state and local governments. Ten states

now have mandatory recycling programs and more than 600 communities nationwide have some type of curbside collection program. In Charlotte, N.C., for instance, 16,000 of the city's 97,000 single-family dwellings can put recyclables out at the curb for separate pickup, and officials plan to expand the service citywide.

Florida last year passed one of the broadest recycling laws in the country, designed to cut the state's solid waste levels by 30 percent over the next six years. The law targets for recycling virtually every type of garbage—plastic, glass, newspaper, used tires, oil, even yard trash.

A legislative task force charged with developing a plan to reduce the amount of trash piling up in South Carolina's landfills is considering Florida's law as a possible model. The committee is scheduled to present its recommendations to the state legislature by January 1990. ♣

*Americans throw away 16 billion disposal diapers each year, accounting for 2 percent of the total waste stream.*

*Leakage from some 90 million car air conditioners is the single largest source of ozone-damaging CFC's in the U.S.*

**CONDITIONS IDEAL FOR OZONE POLLUTION**

Hot, stagnant air—common in South Carolina during the summer—provides a perfect incubator for ozone, a highly toxic gas that causes serious human health problems and damages forests and crops.

In the upper atmosphere ozone is produced naturally and is beneficial because it shields the earth from harmful ultraviolet radiation from the sun. But closer to the ground the gas can make life miserable and dangerous.

Ozone is created at ground level when hydrocarbons and nitrogen oxides—from auto emissions, factories and other sources—react with sunlight in hot, still air. South Carolina's swelling numbers of motorists are supplying increasing amounts of the raw ingredients, while the state's geography and climate—the combination of nearby mountains, light winds and frequent temperature inversions—ensure that much of what is released into the air just sits there, brewing in the sun's heat.

South Carolina is blanketed by stagnant air more often than any other state in the eastern U.S., providing ideal conditions for the production of ozone. A growing number of the state's cities and towns exceed safe ozone levels during summer months.

Concentrations of the gas tend to be greatest in areas downwind of large cities. York County residents breathe unhealthy amounts of ozone several days each year because of pollution from Charlotte, N.C. Likewise, smog from the Greenville-Spartanburg area causes trouble downwind at Clemson.

Many communities now considered exempt from ozone danger may in fact be at risk. Current standards set by the federal Environmental Protection Agency raise a red flag when the ozone level exceeds 120 parts per billion (ppb), or 120 ozone molecules for every billion molecules of air. But recent studies indicate that exposure to ozone at less than 80 ppb can cause respiratory problems, especially among children.

In addition to jeopardizing human health, ozone pollution causes an estimated \$2.5 billion to \$3 billion worth of damage to U.S. soybean, corn, peanut and cotton crops. Foresters suspect the gas is one factor that has stunted the growth of loblolly and shortleaf pines by 20 percent over the last 10 years.

To combat the problem, state health officials are considering requiring yearly automobile emissions inspections to ensure that pollution control devices are in working order. At the national level, Congress has until August to reauthorize the Clean Air Act or extend (for the third time) the deadline for states to comply with federal pollution laws. ♣

*A single brown bat can consume 600 mosquitoes in one night.*



# ROUNDTABLE

## ECO-FOCUS: THE WASTEWATER FLOOD

In our last Eco-focus we pointed out that humankind uses waterways for many purposes, one of the most detrimental being to wash away our wastes. We also noted that the amount of wastewater entering South Carolina's streams, rivers and lakes has more than doubled over the past 15 years. Given current trends, this figure may double again by the year 2000.

Today there are 1,322 industries and sewage treatment plants that discharge effluent into our state's surface waters. The state Department of Health and Environmental Control (DHEC) receives approximately 140 requests for new discharge permits every year, of which about 70 percent are granted. If this trend continues, the number of wastewater dischargers will reach two times the current level by the turn of the century.

To deal with the mounting tide of tainted water, more than half a billion dollars have been spent since the early 1970s to construct new sewage treatment plants and upgrade inadequate facilities across South Carolina. While significant improvements in the state's overall water quality have resulted, municipal and industrial discharges continue to threaten the health and usefulness of many water bodies.

According to DHEC's most recent Statewide Water Quality Assessment, 42 percent of South Carolina's rivers and streams do not meet swimmable water quality standards, primarily because of elevated levels of fecal bacteria from inadequately

treated sewage. A report by the Environmental Protection Agency indicated that South Carolina industries spewed more than 341 million pounds of chemicals into the state's waters in 1987. As a result, DHEC has identified 15 water bodies that are "impaired" by heavy metals such as mercury, arsenic, cyanide, lead and cadmium.

Our nation's basic tool for protecting and cleaning up its waters is the federal Clean Water Act, passed by Congress in 1972. Provision 1, Section 101 of the act reads, "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985." This objective is known as the zero discharge goal. In 1989 we are far behind schedule in our attempt to meet this goal. Why?

Old habits die hard and new, clean habits are costly. Some believe the goal of eliminating discharges to waterways cannot be met; others believe it doesn't need to be met. There are indications, however, that waste managers are beginning to realize the necessity of zero discharge.

A number of innovative alternatives are gaining acceptance. Partially treated effluent can be sprayed on farmland or golf courses—which makes great sense in South Carolina where the fastest-growing use of water is for irrigation. Solid matter filtered from wastewater (called sludge) can be composted and recycled as a soil enhancer.

Routing partially treated wastewater through natural wetlands is one new method being applied in coastal South Carolina. This process allows the natural vegetation, bacteria and



*Partially treated effluent can  
be sprayed on farmland or  
golf courses.*

other microorganisms to remove much of the phosphorous, nitrogen and other compounds and allows metals and other contaminants to settle out before the water enters a stream.

However, wetlands used for this purpose must be chosen carefully. Some wetlands support vegetation that is intolerant to drastic changes in water chemistry and could quickly become overloaded. Eliminating direct discharges to surface waters at the expense of altering or degrading natural wetland systems is not acceptable.

While local governments and industry should seek to employ innovative treatment methods,

citizens can help stem the flood of wastewater simply by producing less of it. Municipal sewage is almost 100 percent water. Two-thirds of indoor residential water use is for toilet flushing and bathing. Such usage can be cut 40 percent or more by installing water-saving devices such as restricted-flow shower heads and toilets.

Government regulators who set wastewater discharge limits do so on the premise that "dilution is the solution to pollution." The greater a river's volume, the more pollutants it can assimilate without jeopardizing water quality. As long as adequate rainfall maintains the proper ratio of clean water to pollutants, ecological disasters—such as massive fish kills—are averted.

In recent years, periods of low flow brought on by drought have caused water quality problems in some rivers. Low flows in the Savannah River last summer caused concentrations of fecal bacteria to triple.

Climatologists predict that South Carolina faces a warmer, drier future thanks to the greenhouse effect and the resultant rise in global temperatures. Our expanding population's demand for water will likely require unprecedented withdrawals from surface water supplies. Should this coincide with a substantial reduction in rainfall, low flow may become a chronic problem in many of our state's waterways.

Such a prospect requires all of us—resource managers and citizens alike—to adopt whatever measures are necessary to safeguard the biologic integrity of our rivers and streams.

—Steve Bennett

**RESPECT Caps** are available in international orange, which meets Wildlife Management Area requirements, or camouflage in two styles: fall leaf pattern or our newest cap, featuring the latest in woodland bark camouflage. Winter style, laminated inside for warmth and durability. \$6 each.

**Binders** conveniently store and protect six issues (one year) of South Carolina Wildlife magazine. \$8 each.

# GOOD REASONS

for turning the page and using that convenient order form.



Subscribe to **South Carolina Wildlife** magazine, the only magazine devoted exclusively to all South Carolinians. Six issues per year — (1 yr.) \$10, (2 yrs.) \$18, (3 yrs.) \$25.



## Convenient order form:

Name \_\_\_\_\_

PLEASE PRINT

Address \_\_\_\_\_

City · State · Zip \_\_\_\_\_

Daytime Phone Area Code \_\_\_\_\_ Number \_\_\_\_\_

ITEM DESCRIPTION	QUANTITY	PRICE EACH	TOTAL
<b>1989-90 Sportsman's Calendar</b> — Available August 1		\$ 8	
S.C. Wildlife Magazine <b>Binder</b>		\$ 8	
<b>RESPECT Cap</b> — Bark (One size fits all)		\$ 6	
<b>RESPECT Cap</b> — Camouflage (One size fits all)		\$ 6	
<b>RESPECT Cap</b> — International Orange (One size fits all)		\$ 6	
<b>Tricolored Heron</b> Poster		\$ 5	
<b>Magazine Cover</b> — Beginning with J/F '87	ISSUE:	\$ 5	
<b>S.C. Wildlife Magazine</b> Subscription To order by phone ( <b>magazine only</b> ), call toll-free 1-800-678-7227.	1 year	\$10	
	2 years	\$18	
	3 years	\$25	
<b>TOTAL PRICE</b> ↓			

All orders must be prepaid; make check or money order payable to S.C. Wildlife.  
Send your payment and this order form to: **S.C. Wildlife, P.O. Box 167, Columbia, SC 29202-0167**



## Tricolored Heron

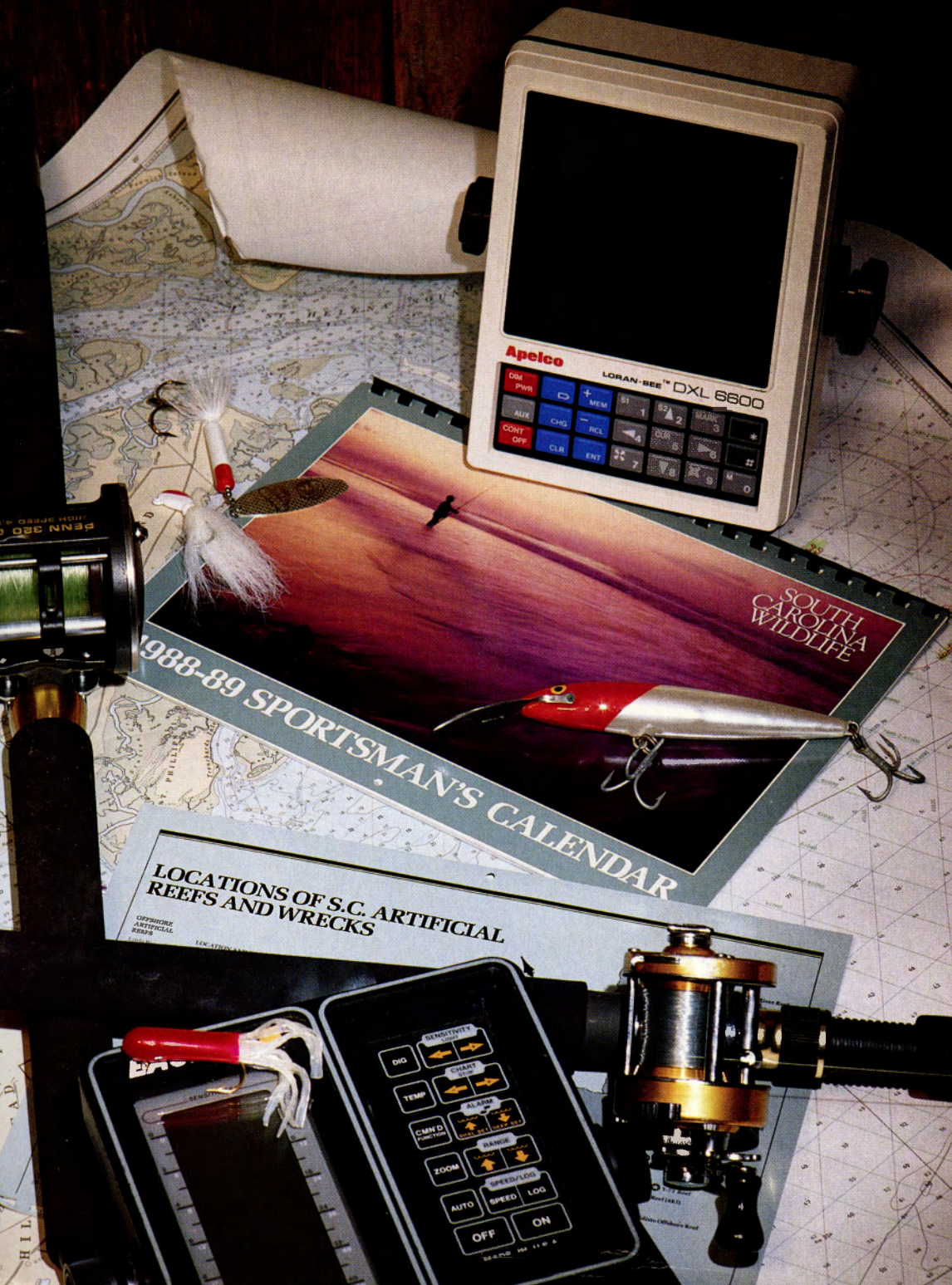
An Exclusive Poster From **SOUTH CAROLINA WILDLIFE**

**W**e are pleased to offer subscribers this superb photograph of a tricolored heron captured on film in South Carolina's Lowcountry by our own Phillip Jones. This limited edition poster is rich in detail and color and comes unfolded, ready for framing.

**At \$5 each, including shipping and sales tax**, we think it's an outstanding value! Order yours today—use the convenient order form above.

# To catch the big ones...

## You need the right equipment!



Success depends upon wise choices ... in equipment and preparation. **Make our 1989-90 Sportsman's Calendar and Almanac an integral part of your tackle.** Plan trips using the Almanac's sunrise-sunset and tide tables, and program your Loran with coordinates of artificial reefs and wrecks. If you're after trophies in the fall, check what you need to break state records on reds, blues, trout and flounder inshore or kings and amberjack at reefs and wrecks ... it's all there in our Almanac.

In winter, great photography reminds you of the action, or the one that got away, while you plan next spring's outings. All this, plus hunting and freshwater fishing information and more, makes our 1989-90 Sportsman's Calendar and Almanac a must for anyone's tackle box.

**Use the form on the opposite page — order yours TODAY!**

