Jocassee Journal

Information and News about the Jocassee Gorges

Spring/Summer, 2001 Volume 2, Number 1

Water quality in the Jocassee Gorges

The streams and rivers in the Jocassee Gorges watershed boast some of the cleanest waters in South Carolina, due to the geological composition of the area and its relatively undisturbed nature. This issue of Jocassee Journal, funded by the Clemson University Extension Water Quality Program, takes a look at the importance of water quality in the region and its impact on the creatures and plants that live there.

Barbara Speziale and Greg Lucas, Co-editors

Lake Jocassee

Clear, clean waters of Lake Jocassee a popular attraction for nature-based tourism

By Pete Davis
South Carolina State Park Service

"I can't believe how clear the water is! This is the best lake for scuba diving I've ever seen. The water is so clean! We saw two eagles today! The people of South Carolina sure are lucky to have a place as pretty as this!"

These are just examples of the numerous positive reactions that we hear from first-time visitors to Lake Jocassee. Since the opening of Devils Fork State Park in September 1991, the number of visitors has surpassed the 3 million mark. They come from all over the United States but primarily hail from the Southeast.

The number of nature-based enthusiasts has increased each year. Anglers, canoeists, kayakers, scuba divers, bird watchers, hikers and sightseers are examples of the diversity of visitors being drawn to the area.

The protection of the Jocassee Gorges and its surrounding areas is paramount in keeping the waters of Lake Jocassee and its tributaries clean.

How many lakes are left in the Southeast that compare to Lake Jocassee? If one listens to the many visitors to this unique area you would ascertain that the answer would be few if any.

On numerous occasions we've heard Lake Jocassee compared to the untamed lakes of northern Canada and even to the unspoiled lochs of Scotland.

Let's all work together to keep the lake clean and the surrounding forests green. Devils Fork State Park and the State Park Service is committed to doing just that.

(Pete Davis is superintendent of Devils Fork State Park on Lake Jocassee.)

Jocassee stream invertebrates tell a story of sediment impact and recovery

By Ken Manuel
Duke Power Co.

The unique aquatic invertebrate life of the Jocassee escarpment in many ways is attributed to the un-glaciated history and high rainfall of the region. The animal and plant life of this beautiful area has had millions of years to evolve in concert with the slowly changing character of the Appalachian Mountains.

Duke Power Co. is conducting a study, now in its 20th year, of the aquatic invertebrates of Howard Creek, a small South Carolina tributary of Lake Jocassee. This long-term study is conducted to understand the impact of the construction of the Bad Creek hydro-electrical pumped storage project on the macroinvertebrate life of this typical cool-water mountain stream.

As predicted by Duke Power and South Carolina natural resource agency biologists, the aquatic invertebrate life of Howard Creek was severely impacted by Bad Creek Project construction activities. Regardless of the elaborate state-of-the-art sediment control practices followed by Duke Power, invertebrate populations, especially mayflies, stoneflies, and caddisflies plummeted during the peak construction years.

This intensive invertebrate sampling study revealed that, within three years following the end of Bad Creek Project construction, Howard Creek macroinvertebrate population densities recovered to pre-construction levels. The Howard Creek story allows scientists and construction engineers to appreciate how susceptible aquatic invertebrate populations are to watershed soil disturbances, especially in the highly erosive cool mountain stream regions of the Western Carolinas.

Howard Creek is a small, high-gradient cool-water mountain stream, typical in character to many of the streams in the Jocassee region. Duke Power biologist Tommy Bowen is shown sampling Howard Creek riffle invertebrate populations using a Surber sampler. (Photo by Ken Manuel)

Those interested in knowing more about the impacts of stream sedimentation on aquatic life may be interested in reading Sediment In Streams: Sources, Biological Effects and Control by Thomas F. Waters. Funded in part by Duke Power, this 1995 publication, Monograph 7, is available from the American Fisheries Society, 5410 Grosvenor Lane, Bethesda, MD 20814.

(Ken Manuel is an aquatic biologist with Duke Power Co. based in Huntersville, N.C.)

Ecology of the hooded warbler

By Anna E. Huckabee
South Carolina DNR

The Hooded Warbler (*Wilsonia citrina*) is a neotropical migrant that nests in mature oak-hickory and cove forests in Upstate South Carolina. This species feeds on or near the ground and prefers to nest in thicket-forming species such as mountain laurel, rhododendron and switchcane. As the name implies, the species has a black hood that covers the top of the head and wraps around under the chin. Males have a dark black hood while females are more charcoal-colored. However, some older females may have darker crowns and napes. "Hoodies," as they are affectionately called, are abundant all over the Jocassee area. Their sweet songs can be heard echoing from the midstory along the Foothills Trail. The best time to hear the males singing is during the breeding season from May-June when they are actively defending their territories. Despite the alarming rate of decline of many other neotropical migrants, the hooded warbler appears to be holding its own in Upstate South Carolina.

(Anna E. Huckabee is the DNR's Forest Stewardship biologist. She did the field research for her Clemson University master's work in the Jocassee Gorges.)

Hooded warbler nest in a laurel thicket on Sassafras Mountain (Photo by Anna E. Huckabee)

Free-floating algae of Lake Jocassee form the base of the food pyramid

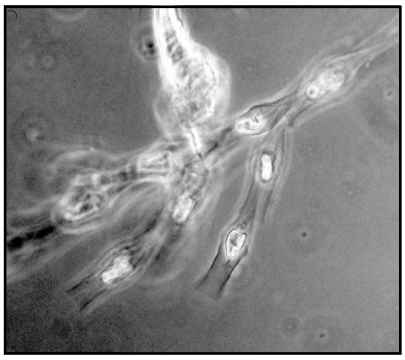
By John Derwort
Duke Power Co.

Algae are among the most widespread and diverse organisms in nature. Free-floating aquatic algae, such as those found in Lake Jocassee, are known as "phytoplankton." Most are microscopic, often less than $1/1000^{th}$ of an inch long.

Phytoplankton contain chlorophyll, the green pigment that uses sunlight energy to produce sugars and, as a waste product, oxygen, for the process known as photosynthesis. Through this process, algae in marine and fresh water environments produce most of the planet's oxygen. Phytoplankton form the bases of food pyramids in lakes and reservoirs, and are grazed on by aquatic invertebrates and forage fishes.

The types and abundance of phytoplankton can provide useful information about the productivity and health of fresh water environments. In lakes with very high nutrients, excessive growth of algae can cause problems such as bad tastes and odors and unsightly "pond scum." When large growths or "blooms" of algae die, the decomposition process can use most of the dissolved oxygen in the water and cause fish kills.

Lake Jocassee is the clearest and most pristine lake in South Carolina. Visual light penetration often exceeds 30 feet in depth, indicating that Lake Jocassee has relatively few suspended particles, such as phytoplankton. From 1987 through 1996, Lake Jocassee phytoplankton were studied to provide information on water quality and productivity. Phytoplankton were identified and counted. The amount of chlorophyll was used as a measure of biomass. Total chlorophyll concentrations seldom exceeded four parts per billion. These studies demonstrated that Lake Jocassee is a reservoir with very low productivity, most likely due to very low nutrient concentrations in the surface waters.



The colonial golden-brown alga, Dinobryon, typically contains one or two golden-brown chloroplasts. (Photo by J. E. Derwort)

Although Jocassee phytoplankton are low in number, their diversity (number of species) is very high, indicating a small but healthy lake-wide phytoplankton community. The most common types of phytoplankton in Lake Jocassee are: green algae, diatoms, and golden-brown algae. A representative alga is shown in the accompanying photo.

(John Derwort is an aquatic biologist with Duke Power Co. based in Huntersville, N.C.)

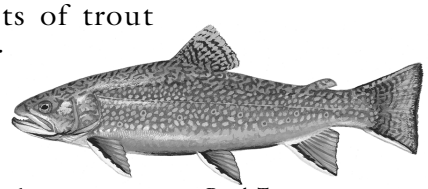
Wild trout flourish in Jocassee Gorges streams

By David H. Van Lear
Clemson University

The Jocassee Gorges encompasses many of the important trout streams of South Carolina. These cool, clear and well-aerated streams pour through the steep, rocky gorges of the Blue Ridge escarpment and provide some of the southern-most trout habitat in the Southeastern United States.

Although portions of these streams may be stocked with hatchery fish, most contain wild trout as well. Because these streams are relatively nutrient poor, fish are generally small but beautiful and feisty. Few wild rainbow trout in Jocassee Gorges streams live more than three years or grow to more than 12 inches. In those streams with brown trout, occasional individuals may exceed 16 inches and a few might be measured in pounds rather than inches. Brook trout, the only native salmonid in the Southern Appalachian mountains, are very small and found in tiny headwaters of some streams in the Jocassee Gorges.

It is not the size of trout in the Jocassee Gorges that stirs the hearts of trout fishermen - it is their beauty and the aesthetic appeal of their habitats. These wild trout are brilliantly colored and sized to fit their rugged environments, which are rocky, generally steep-gradient, low fertility streams surrounded by mature forests of hemlock, white pine, yellow-poplar, and various oaks.



Brook Trout
Salvelinus fontinalis

Rhododendron and doghobble dominate the understories and drape the banks of these whitewater gems, gobbling up the flies and lures of the die-hard trout fishermen who venture back into these hard-to-fish wild places. However, most anglers consider a few lost flies a small price to pay for landing and releasing a 10-inch beauty from a secluded pool of a Jocassee Gorges trout stream.

(David H. Van Lear is a professor in the Department of Forest Resources at Clemson University.)

Jocassee Gorges harbors rare aquatic insects

By John Morse
Clemson University

***Chimarra* larva (caddyisfly). Photo by Eric Fleek, N.C. Department of Water Quality.**

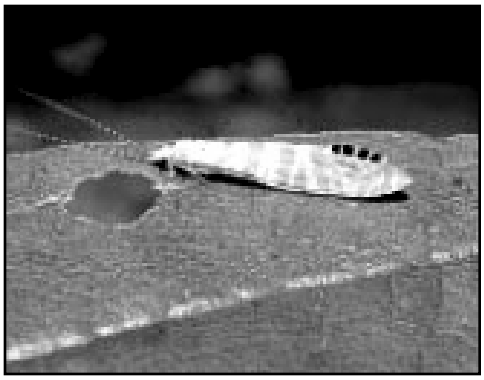
Clemson University researchers have found at least 191 species of aquatic insects in the major streams flowing into Lake Jocassee.

Among these 191 species of aquatic insects are 37 species of mayflies, 10 species of dragonflies, 26 species of stoneflies, 4 species of riffle beetles, and 114 species of caddisflies. At least 28 of the inventoried species are considered rare, endemic, or of limited distribution.

Four species of caddisflies found in Jocassee Gorges are known from nowhere else on Earth, including a snail-shell caddisfly species, a finger-net caddisfly species, and two microcaddisfly species. These four species and a tortoise-shell caddisfly species, also found in the East Fork of the Chattooga River, were unknown to science until recently.

Many other aquatic insect species still remain to be inventoried in the Gorges, including the freshwater bugs, flies, and most beetles.

(John Morse is a professor of entomology and director of the Clemson University Museum of Natural History.)



***Nectopsyche* adult (caddisfly). Photo by Dr. Bill Stark, Mississippi College.**

Jocassee aquatic mammals depend upon clean water for survival

By John Garton
Duke Power Co.

Beaver
Castor canadensis

The Jocassee area has an abundance of wild mammal species, ranging in size from the black bear with individuals in excess of 400 pounds, to various shrew species of which adults may weigh only a few ounces.

We generally associate wild mammals with forested habitats or maybe with the edge habitat between forest and field. A fox in a woodland den, a black bear or white-tailed deer feeding along the edge of a woodland clearing, or a group of squirrel nests dotting a stand of oaks and hickories are some images that readily come to mind about mammals. But there are also those species that have taken to water, either as their major habitat, or as a place to find major food sources. At Jocassee these species depend upon the abundance of quality waters that abound there for their survival.

The most noticeable aquatic mammal at Jocassee is the beaver. Growing to more than 50 pounds, this is the largest rodent native to the United States. Beavers live along many of the streams at Jocassee and along the lakeshore itself. Like many other mammals, they are most active at night and therefore not readily observed. However, the beavers' presence is readily detected along streams from their dam building and tree cutting activity.

Another aquatic rodent at Jocassee is the muskrat, a miniature 2-pound version of the beaver. Muskrats inhabit the lakeshore areas and may also take up residence in beaver ponds. Like the beaver, they dive under water at the first sign of danger.

A large (20 pounds or more) aquatic predator that occurs in the Jocassee area is the river otter. The stars of many nature films due to their "playful" and social behavior, these are sleek and powerful swimmers that feed on fish, crayfish, and other aquatic animals. Although not abundant at this time at Jocassee, populations are generally on the increase. Otters are in the same family as the mink, skunk, and weasel.

In addition to the above species that typically spend much of their time in the water, there are others that do not live in the water but are closely tied to water for their food sources. These include the raccoon and mink, both of which spend much of their nights prowling stream banks in search of aquatic life such as crayfish, salamanders, and frogs. Bats also patrol the stream corridors at dusk to feed on the same hatches of insects that trout depend on for their food.

While the Jocassee area is largely a mountainous landscape; it features water in abundance, waters of numerous mountain streams and the waters of Lake Jocassee itself. The abundance and quality of these waters help create an interrelationship among many aquatic and terrestrial species of wildlife, including some of the area's most notable and notorious mammals.

(John Garton is a biologist with Duke Power Co. based in Charlotte.)

Partners for Trout at work on the Eastatoee

By Wes Cooler
Foothills RC&D Council

Partners for Trout workers look over trout habitat improvements on Eastatoe Creek.

Partners for Trout is working to improve trout habitat in the Eastatoee watershed. The Eastatoee is a major watershed of the Jocassee Gorges and is significant because about half of its course is through private property.

Partners for Trout is sponsored by Foothills Resource Conservation and Development Council, U.S. Fish and Wildlife Service, U.S. Forest Service, Trout Unlimited, S.C. Department of Natural Resources, Pickens, Oconee and Greenville Conservation Districts and private landowners.

At several sites within the Eastatoee Valley, Partners for Trout is working to restore riparian buffers and install in-stream habitat and stream bank stabilization measures to mitigate the effects of thermal loading, erosion and sediment. More than $100,000 of work is currently projected for the next 12 months.

The long-term objective of the program is to upgrade the status of each trout stream in South Carolina by at least one category. On the Eastatoee, the work within the Valley will directly benefit the lower reaches of the river that pass through Jocassee Gorges lands into Lake Keowee.

The Eastatoee is stocked with trout throughout its course in South Carolina and several stretches currently support native trout populations. It has traditionally been a favorite of local anglers because of its accessibility and the beauty of its surroundings.

For more information on Partners for Trout, contact Dave Demarest, Foothills RC&D Coordinator, (864) 467-2775, ext 102.

(Wes Cooler is a retired Army officer who lives in the Eastatoee Valley and is chairman of the foothills RC&D Council.)

Jocassee Gorges natural area named after Jim Timmerman

Dr. James A. Timmerman

The Jocassee Gorges has been named after the man whose vision helped make the natural resources area a reality - Dr. James A. Timmerman Jr., director emeritus of the S.C. Department of Natural Resources.

On Dec. 7, the 2001, upstate land known for black bear and rare plants was officially named the Jim Timmerman Natural Resources Area at Jocassee Gorges. A 1998 South Carolina Senate Resolution and a 1999 vote by the S.C. Natural Resources Board directed the naming of the area in Oconee and Pickens counties.

"Dr. Timmerman had a vision of protection for this property," said John Frampton, S.C. Department of Natural Resources assistant director for development and national affairs. "It was a lifelong dream of his that this land be protected, and it was this dream and his tireless efforts - even after he retired - that helped make the Jocassee Gorges protection project a reality. It's fitting that the area be named in his honor."

Lake Jocassee water quality is excellent

By Bill Foris
Duke Power Co.

Lake Jocassee is one of the most unique waterbodies in the Southeast. The reservoir is one of three impoundments created by Duke Power Co. in the headwaters of the Savannah River Basin that comprise what is commonly known as the Keoweee-Toxaway Electrical Generation Project.

The reservoir, formed in the early 1970s by impounding the Keowee River, is a pumped-storage waterbody, a unique type of hydroelectric facility. During high electrical demand, water is withdrawn from Jocassee at depths of 13-20 meters and used to turn the turbines at the Jocassee Hydroelectric Facility for electrical generation. At night and during the weekends when residential and industrial electrical demand is low, the turbines are reversed and employed as pumps to withdraw and pump water from Lake Keowee back into Jocassee so that it can be used again.

At full pond, Lake Jocassee has a surface area of 7,565 acres, a maximum depth of 109 meters, and a volume of about 378 billion gallons, or around 20 percent more water than Lake Keowee.

Lake Jocassee is one of the clearest, deepest and coldest waterbodies in the Carolinas, and overall, its water quality is excellent. Lake Jocassee contains low to very low concentrations of minerals, metals, and nutrients. In fact, most chemical species are typically found at or near the analytical detection limits of the methodology. Conductivity, which is a measurement of the total dissolved chemical species in the water, is typically below 15 umhos. In comparison, similar measurements in other Carolina waterbodies generally range from 40 to 300 umhos.

Phytoplankton numbers (see algae article in this issue) are also low due largely to the limited amounts of available phosphorus and nitrogen. These unique water quality conditions can be attributed primarily to two features: 1) the geological composition of the watershed which consists of rock types highly resistant to chemical weathering; and 2) the relatively undisturbed nature of the basin. Duke Power has been studying the water quality of Lake Jocassee and its tributaries since the mid-1970s and has not detected any significant long-term changes.

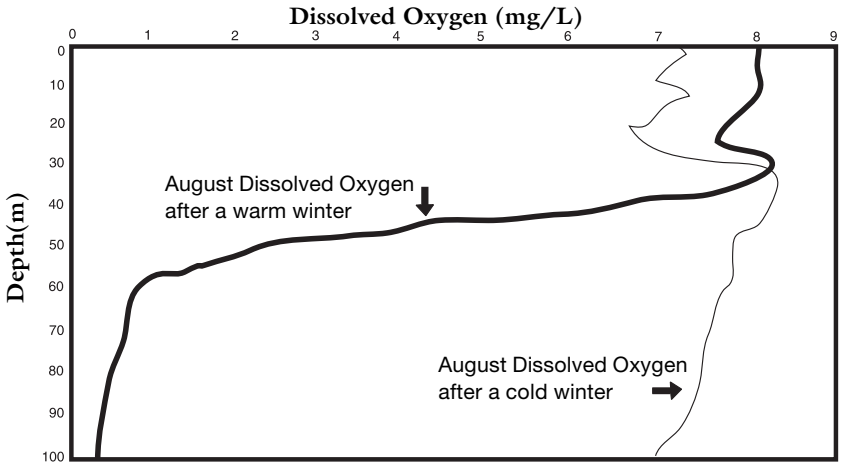


Figure 1. Lake Jocassee August dissolved oxygen following a cold and a warm winter.

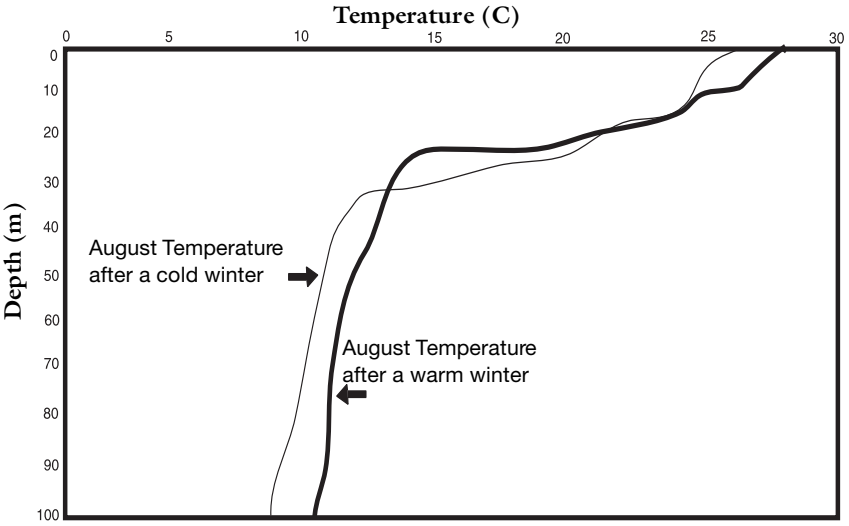


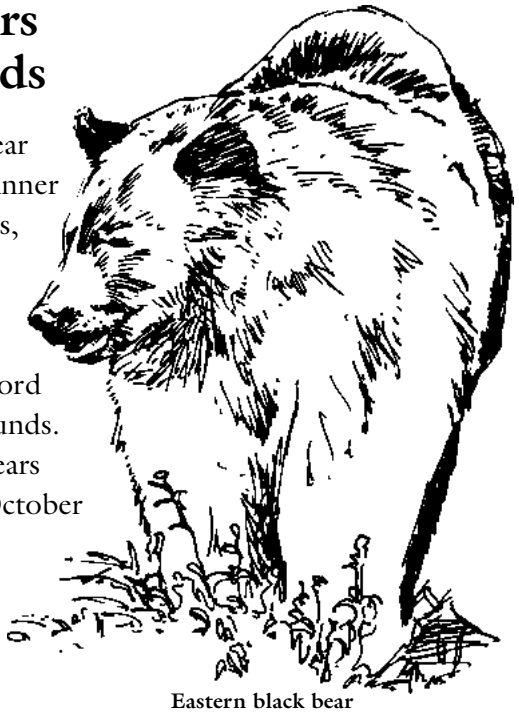
Figure 2. Lake Jocassee August temperature levels following a cold and a warm winter.

Unbeknownst to most people, Lake Jocassee does not mix and reaerate (turn over) from top-to-bottom every winter, as do other lakes in the Southeast. Instead, the mixing depth varies in direct proportion to the severity of winter weather. Lake Jocassee mixes to the bottom only in very cold winters. This variability in winter mixing depth is linked to the lake's maximum depth, and correspondingly, exerts a major influence on year-to-year patterns in certain water quality constituents, including summer concentrations of dissolved oxygen. Dissolved oxygen levels are particularly important in Lake Jocassee because of the presence of a highly successful put-grow-and-take trout fishery managed by DNR.

The importance of winter mixing on summer water quality is depicted in Figures 1 and 2 which illustrate August dissolved oxygen levels and temperature in the main pool of Lake Jocassee following a cold winter and a warm winter. Temperatures are slightly cooler and dissolved oxygen levels are much greater below 30 meters following a cold winter (thin line) than they are following a warm winter (thick line). Dissolved oxygen levels following "normal" winters generally fall somewhere in between these extremes.

(Bill Foris is a limnologist with Duke Power Co. based in Huntersville, N.C.)

Bear hunters shatter records



Eastern black bear
Ursus americanus

South Carolina's bear hunters completed a banner season in the mountains, setting records for the number of black bears taken and breaking the state individual size record by a whopping 104 pounds.

Hunters took 42 bears during the two-week October mountain hunt season, doubling the season record of 21 bears harvested in 1998.

The record harvest included a state record 594-pound bear taken by Darrell Lawrence of Tiger, Ga., during a party hunt near Oconee County's Mountain Rest area. Four bears taken in 2000 tipped the scales at more than 400 pounds, including a 470-pounder taken by Robert Chapman of Pickens.

The hunting season followed a summer filled with numerous bear encounters across the Upstate. At least 10 bears were killed in automobile collisions, including one on I-85 near Greer.

571-acre tract adds access points to Jocassee Gorges natural area

The Forest Legacy Program and the National Wild Turkey Federation made possible a recent 571-acre acquisition that adds important access points to the Jim Timmerman Natural Resources Area at Jocassee Gorges.

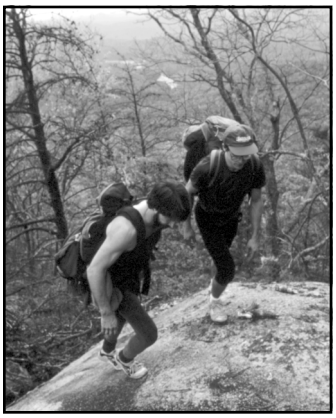
The 571-acre tract, north of SC 11 in Pickens County, is one of the two main access points and the only southern access point for the Jocassee Gorges. The land, called the Shooting Tree Forest Legacy Area, was purchased from Crescent Resources, a subsidiary of Duke Energy, for $1,260,000. Funding for this acquisition came from the Forest Legacy Program in the amount of $975,000, along with a 25 percent match of $325,000 from the National Wild Turkey Federation.

The Forest Legacy Program, a cooperative partnership administered by the U.S. Forest Service, identifies and protects environmentally important private forestlands threatened by conversion to non-forest areas.

Palmetto Trail comments received by DNR on Jocassee Gorges

The S.C. Department of Natural Resources received a number of comments on the proposed Palmetto Trail route through Jocassee Gorges, the majority of them from the equestrian community.

"Most of the comments came from horseback riders concerned that the proposed Palmetto Trail route might eliminate some sites traditionally used by horseback riders," said Billy McTeer, deputy director for wildlife and freshwater fisheries with the S.C. Department of Natural Resources(DNR). "All logging roads that have traditionally been used by horseback riders will be evaluated, and unless environmental concerns are discovered, they will continue to be open. The Palmetto Trail will not change that."



Jocassee hikers will soon be able to access the Palmetto Trail.

The proposed Jocassee Gorges passage of the Palmetto Trail will be an approximately 20-mile corridor that connects Table Rock State Park and Keowee-Toxaway State Natural Area via the Jocassee Gorges. Details of the proposed plan are available on the DNR Web site (www.dnr.state.sc.us) and the Palmetto Conservation Foundation Web site (www.palmettoconservation.org).

Palmetto Trails

Check out

the Jocassee Gorges Web site at:
www.dnr.state.sc.us/wild/jocassee/index.htm

Jocassee Journal

Information and News about the Jocassee Gorges
S.C. Department of Natural Resources
Dr. Paul A. Sandifer, Director
Co-editors: Barbara Spezzale and Greg Lucas
Funding for this publication provided by:
Clemson University Extension
Water Quality Program

For information on subscribing
to the Jocassee Journal contact:
Greg Lucas, SCDNR
PO Box 167, Columbia, SC 29202
Phone: (803) 734-3911
Fax: (803) 734-3951
email: glucas@scdnr.state.sc.us
Website: www.dnr.state.sc.us/wild/jocassee/index.htm

Total cost: $845.00
Total copies: 2000
Cost per copy: .4225

S.C. Department of Natural Resources
1000 Assembly Street • PO Box 167
Columbia, SC 29202-0167

Fish advisory issued for Lake Jocassee due to mercury levels

Lake Jocassee was recently included in a list of 51 water bodies in South Carolina where the S.C. Department of Health and Environmental Control (DHEC) issued fish consumption advisories due to unsafe mercury levels.

The advisory recommends people limit their consumption of Lake Jocassee largemouth bass and spotted bass to one meal per week.

DHEC warns pregnant women, women of child-bearing age, and young children not to eat fish tainted by mercury.

Lake Jocassee, streams removed from impaired waterbodies list

The S.C. Department of Health and Environmental Control recently removed Lake Jocassee and its streams from the 303d list of impaired waterbodies.

Review of the most recent water quality data showed no impairments due to copper or zinc.

Erosion being checked at Jocassee

Work was recently completed by the S.C. Department of Natural Resources to halt erosion at three helipads and a utility building site in Jocassee Gorges.

Improvements have been made at the sites to reroute water runoff, and the areas have been seeded to help stop further erosion, according to Sam Stokes Sr., DNR regional wildlife biologist based in Clemson. When the National Guard returns in May to work in Jocassee Gorges, it will haul 7,000 to 8,000 tons of oversized stone on Jocassee Gorges roads, which will further reduce erosion.

Roads that were constructed in the 1930s and 1940s do not meet Best Management Practices (BMPs) and have been a major source of erosion in Jocassee Gorges. Since the land was acquired in 1997, the DNR has graveled 20 miles of roads, considerably reducing erosion, Stokes said.