



the news

the journal of Grand Canyon River Guides, Inc.

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Stress and Strain: Squashing Rocks in the Muav Gorge

Michael Collier



Chuck Barnes of NAU Geology suggested that a geologist should seek out a beautiful field area first, and ask questions later. I took him at his word; while stumbling through a master's at Stanford, I chose the Grand Canyon for a thesis area.

Perhaps you've noticed the folds and faults in the Muav at river level near Kanab Creek. The folds come in a number of different flavors: wavy thin-bedded limestones that hang above the river around Last Chance; or stubby little "kink bands", where an eight- or ten-foot segment of bedding is suddenly tipped twenty or thirty degrees steeper than the surrounding rock. Consider the limestone immediately upstream of Olo; a thrust fault blasts out of that wall with all the impatience of a locomotive leaving its tracks. In some places, the deformation is more subtle: walk down a side canyon like Matkatamiba, and you will see

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Tell Me Why

I need to share a bit of my rage with all of you. Many of you have met our Superintendent, Bob Chandler. A great guy, huh? He has shown a level of intelligence, leadership and a straight-shooting, no-nonsense ability to deal and grapple with difficult issues that is rare, if not unheard of in such a high-level bureaucratic position. All of us at GCRG have been delighted to have such a bright and energetic man at the helm of the park, especially with several extremely important issues coming to a head.

Which issues? Here are three big ones for starters:

Glen Canyon Environmental Impact Statement. This process, so many years in coming, will be setting a precedent throughout the country, forcing, for the first time ever, an agency to clean up a mess made back when there were far fewer rules. The ramifications of this process are already sending shudders throughout the West. Grand Canyon National Park needs to stand strong throughout the finalizing of this process.

Overflights. The overflight issue is going thermo-nuclear right now. The industry is growing rapidly here and at parks throughout the country. The decisions made here in the next year or two will set precedents throughout the country. Again, we need a strong, well informed Superintendent at the helm.

Grand Canyon General Management Plan. The GMP alternatives are currently under consideration and the final plan will be chosen and implemented in the next couple of years. The entire future direction of the visitor experience at the rim will be decided. Again, without a strong Superintendent, the process, and the Park, will suffer.

And more: The Air Quality issue... the choice of a new head of Resources at the Park... all coming up soon.

So here's the outrage: the NPS has decided to move Bob Chandler to San Francisco. Just as with Jack Davis, the previous Superintendent, Chandler is being transferred after only two years; barely time to get up enough speed to be effective. This means the Superintendent during this most critical of times will be starting from zero. At a time when continuity and clear vision are essential, the leadership will continue to yo-yo. IS THIS ANY WAY TO RUN A PARK?

It's not a new problem- it's chronic. The NPS is set up to discourage devotion to any one place. Those who move from place to place every year or two, remaining in a perpetual state of figuring out where they are, are the ones who get raises. Those who find a position or a park that they want to devote themselves to can no longer get a raise. Their career

stagnates: the Workman Syndrome.

What's more, in choosing a replacement, the NPS is limited to the Federal hiring system, designed with good intentions to be completely impartial, but extremely limiting in terms of finding the appropriate person for the job.

The transfer of Chandler is a decision of Roger Kennedy, the new director of the National Park Service. Chandler did not want to leave. Nor should he. The chances of us getting another Superintendent of his caliber are slim. The time it will take his replacement to get up to speed is time we can ill-afford to lose.

The Superintendency of Grand Canyon should not be treated in such a cavalier fashion. The system needs to reward good work and devotion to a place. The decision to move Bob Chandler at this time, as well as the system that lead to it, should be rethought. Now. And if, indeed, a new Superintendent is to be chosen, great effort must be taken to find someone of very high caliber who can and will do the job and be allowed to stay there. Immediately.

I am livid. You should be too. Grand Canyon deserves more respect.

Write:

Roger Kennedy, Director, National Park Service
Bruce Babbitt, Secretary of the Interior
Washington, DC



Brad Dimock

...but thanks anyhow

Be that as it may, that Bob Chandler is leaving, we would like to applaud the job he did in such a short time, the many positive changes in attitudes and stances taken at South Rim, the openness and even-handedness of his tenure. We envy the Presidio, where he is headed, and hope someday to feel Bob's impact throughout the park system from the high level to which he will undoubtedly rise.

A sincere and hearty thanks from all of us.

the news

...is published more or less quarterly by and for Grand Canyon River Guides.

Grand Canyon River Guides

is a non-profit organization dedicated to

Protecting the Grand Canyon

Setting the highest standards for the river profession

Providing the best possible river experience

Guide Membership is open to anyone who has worked in the river industry.

General Membership is open to everyone.

Membership dues:

\$20 per year

\$100 for 6 years

\$195 for life

\$277 Benefactor

Please save us trouble and renew before you're due.

General Meetings are held each Spring and Fall. Board of Directors Meetings are held the first and third Tuesdays of each month. All interested members are encouraged to attend.

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We need articles, poetry, stories drawings, photos, opinions, suggestions, and more.

Written submissions should be 1500 words or less and, if at all possible, be sent on a computer disk. PC or MAC format; Word Perfect or Word are best but we can translate most programs.

Deadlines for submissions are the 1st of January, April, July and October.

GRAND CANYON RIVER GUIDES

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Workbook Issued for Grand Canyon GMP

Superintendent Robert Chandler has issued the Preliminary Alternatives Workbook describing the four considered alternatives for Grand Canyon's General Management Plan scheduled for a record of decision in 1995.

It's obvious Superintendent Chandler and his staff have put megahours of serious labor into disseminating the information found in the Workbook, a large format 26-page document full of big colorful maps, diagrams and highlighted boxes, all of them crammed with pertinent information.

The four alternatives range far and wide, all the way from no action (#1) to distributing visitors equally throughout the park (#4). Alternative 2 would minimize in-park expansion. The 3rd choice contrasts resource preservation with the visitor's experience.

The North and South rims, and also Tuweap, will be changing. That is plain to see. Perhaps even more interesting than the alternatives are the planning assumptions and proposals common to all of them. These include upgrades, improvements and other innovations with wilderness management, air quality, resource preservation, mass transit (South Rim), road and trail restoration, housing and dining, wayside exhibit upgrades, and on and on and on. There's nothing that hasn't been thought about here.

Quite a handful. Not a casual read. But a really important read. There's a time limit thrown in there also. You gotta read fast.

Get one of these Workbooks today, right away. Get one and read it. Digest all this information. Figure out how you'd manage Grand Canyon (and good luck, Pard) and which alternative you like—or maybe you don't and have one of your own. Fine. Do it! Return your Response Sheet by November 15th, the deadline. Write Superintendent Chandler at Box 129, Grand Canyon, AZ 86023, to request a Workbook and to return your Response Sheet.

In the meantime, plan on attending one of the Open House presentations offered by the Park Service to learn more about the alternatives. Four open houses are scheduled. (see box)

Superintendent Chandler needs our help. Do it.

Shane Murphy

GMP Open Houses

KANAB

October 21
11:30AM—9PM
Red Hills Motel

TUSAYAN

November 3
11:30AM—9PM
Quality Inn

FLAGSTAFF

November 4
11:30AM—9PM
Little America.

PHOENIX

November 5
5PM—9PM
Hyatt Regency.

Modus Operandi

We all love a good bullshit session. Some of the best I can recall were in the cool shade of the harbor at Havasu on hot July days, the drag bag tied out in the cold river water off the outside boat. Pick a target, any target. The Dam was always a favorite, and our outfitters, sure. And we didn't forget the Park. Even our passengers took a lick or two. It was a social thing. But when we boarded our boats to leave we still loved the river, the Canyon, and our jobs.

Five years ago that same love of job and place was the glue that brought together Grand Canyon River Guides. Right away we were faced with the formidable task of transforming some of the material from those summer sessions into action. We had to learn how to do that. We needed to be respected, we needed to be listened to, and we needed to survive. Sitting around griping wasn't going to get us there. Since that time we have had a hundred board meetings, we've put in thousands of hours in thought and debate, sat in at dozens of meetings with everyone from Earth Firsters to U.S. Senators. We now have over 1000 members. What developed has become GCRG.

A few months ago my good friend and long time boatman, Terry Brian, sent us a letter. In it he encouraged us to take stronger stands, especially on issues with the Park and outfitters, to use the power of the organization to directly better the pay and benefits of guides. To become more of a union, to get more radical, apply more pressure. After all, we've devel-

oped quite a bit of muscle over the years. And we come from the tradition of the monkeywrench gang. His views are not unique. I know many out there share them. But I don't and I'll tell you why.

GCRG has tended to take the high road, to work more for quiet solutions, to join in constructive alliances. There are notable exceptions. The Park's proposed alcohol policy and decision to ban a

guide for minor regulation infractions are two. But at the same time we have worked hard with the Park and Outfitters to develop a working relationship that pays off in a thousand different ways. The GTS, Courtesy Flyer, recycling program, and new resource monitoring trips are examples of that. So are efforts to get medical insurance and profit-sharing introduced in the different companies. We have encouraged high quality within the guide community and encouraged Park and outfitters to recognize and reward our worth. All of the targets of those Havasu bitch sessions- Park, Dam, outfitters, and others- have at one time or another wished we'd just go away. But just as often they are happy to sit down and listen to what we have to say.

We haven't taken this road just because we're nice guys and gals, but because we felt it was in our best interest. The biggest difference between our old bitch sessions and a GCRG board meeting is that now we're expected to be part of the solution. To come up with what works not just what doesn't. Issues today are complex and it's not easy to keep black and white clear. All too often we find that our adversaries on one issue become allies on another. When our goals overlap, antagonism only serves to hurt us. I don't doubt that we could force considerable concessions from both Park and outfitters on a variety of issues if we chose to do so. But I am convinced that to do so would entail a cost far greater than the gain. For everything won, twice would be lost. The truth is our fate as an industry is intertwined: guides, Park, and outfitters. We may not always be in harmony, but the shape of our future depends more on our agreements than our conflicts. The sooner we recognize that, the better for all.

Without a doubt Grand Canyon River Guides has come of age. We are part of the solution. In doing so we also become fodder for those sessions in Havasu, or Kanab, or Joe's Place in Flag, or anywhere guides get together. And that's just fine. The Board asked Terry to rewrite his letter as an editorial for the newsletter and I hope he does. He has a lot of good points to make and his differing views are evidence of the health of this organization. If ever a time comes when we don't hear from others out there who think things could be done better, we're in trouble. Just because nobody cares.

Tom Moody



River Ride

*A jagged craggy dry and quiet landscape
Deep of steeply terraced buttresses of stone
Layered up and stepping down
Chiseled into a most magnificent chasm.
The sculptural end product of all that time
Upon cycles of shifting water and life
Holds the river peacefully meandering away
Flat and binding to the will of this earth maze.
And then the river rises gloriously breaking upon itself
Thunderous and joyfully responding to the squeeze of a loving canyon.*

*The sun and my passing by eyes ride the river
And like a kaleidoscope juggle every cut shape and shadow.
Milky rust and bisque against steel blue and hazy purple.
Diamonds on the water, manganese in the sky.
The descending scale of the canyon wren,
The swooping of the swallow.
These are cues to a passion within.
My sense of beauty is inflamed,
I regain the steadiness of my soulfooting
When I feel this rapture of being alive.
A lizard tucked in the shade of a rock crevice laughs at me - knowingly.*

*Standing at the rim, I am suspended.
The nothingness, the air, that gigantic gentle peace
Captured there within the canyon.
What safety it affords.
It filters out all that I have become, all that I do.
I am free from my own history like a child.
Just before I leave I breathe it in.
It gravitates to my bones.
And when I return to the place from which I came,
I am different.
There is now a big open space in my spirit where I dare to dream.*

Patti Auguste Hallowell



Overflights

The 1987 Overflights Act directed the National Park Service to impose flight restrictions over Grand Canyon. They were also to study impacts generated by overflying aircraft, and to prepare a report for Congress to determine whether or not the new rules had substantially restored natural quiet to the Park. Although that report is long overdue, preliminary findings from the research were made available at the SFAR Oversight Group Meeting in Las Vegas on September 16th. The study includes acoustic profiles and visitor surveys in Grand Canyon, Haleakala and Hawaii Volcanoes National Parks.

ACOUSTIC PROFILES

Although 15 river sites and 8 rim sites were studied, the only results distributed at the meeting were 2 studies of approximately 3 hours in duration. One was at Deer Creek Falls and the other near the Little Colorado confluence.

The confluence lies beneath a flight corridor with commercial routes for both helicopter & fixed wing tours. 23 aircraft were audible during the 3-hour study period, which was divided into intervals of approximately 20 minutes. Aircraft were audible during every interval, varying from 13% during the quieter periods to one in which aircraft could be heard 94% of the time.

The site across from Deer Creek Falls, which lies within Shinumo "flight-free zone", (no aircraft below 14,500 feet MSL), was much quieter, although far from noise-free. On 9/3/92 during a 3-1/2 hour period, 13 aircraft were audible. During one 20-minute interval, aircraft could be heard 36% of the time; only during 3 intervals was there no aircraft heard.

DOSE-RESPONSE STUDY

Plotting noise levels is the easy part; determining how much they annoy visitors is much more subjective. Let's say you ask a river passenger:

"Is that airplane disturbing you?"

"Well, I hadn't noticed it... but now that you mention it, yeah."

How much of the emotional response is generated by the question, and how much is actually a result of the stimulus we are attempting to measure? Several air tour operators have expressed concern that negative responses to aircraft noise have been inadvertently solicited in this way.

The research depicts widely differing sensitivities to aircraft, depending on duration of visit, location, percentage of time aircraft is audible, background noise, group size, and the number of screaming babies

nearby. Annoyance levels rise with decibel levels of overflying aircraft; the trick is to determine the decibel range needed to stop annoying people.

There was only limited data available from the acoustic and dose-response studies; researches promised that a forthcoming "Executive Summary" report will be much more extensive.

GROUND VISITOR SURVEY

Most Park visitors reported hearing or seeing aircraft, with exposure varying with the type of visitor use. Many visitors reported that the sound of aircraft impacted their visit, again varying among user groups.

Type of Visitor	How Many Aircraft Did You Hear? (average # during visit)	% Annoyed by Hearing Aircraft (moderately or more)
Summer Frontcountry	3	23%
Summer Backcountry	5	35%
Fall Backcountry	10	47%
River: Motor	4	30%
River: Oar	13	57%

More than 90% of all visitors rated natural quiet as one of the most important reasons

for visiting the park. Yet many visitors reported that aircraft noise reduced their opportunity to experience it.

Visitors Reporting Interference With Appreciation of Natural Quiet	
Summer Frontcountry	14%
Summer Backcountry	39%
Fall Backcountry	48%
River: Motor	22%
River: Oar	52%

AIR TOUR PASSENGER SURVEY

According to the survey, the main reason visitors took sight-seeing flights was to see the Park from a "truly unique perspective".

One very interesting statistic was that 88% of air tour passengers also visit the park on the ground. A common assertion by the air tour industry,

Most Important Reason for Taking Air Tour	
To see the Park from a truly unique perspective:	66%
Only way to see the Park in time available:	23%
To experience a unique activity (ride in aircraft):	8%
To see areas that health or physical disabilities otherwise would not allow:	3%

that their passengers impact park resources less than on-ground visitors, becomes moot. In addition, the complaint that air tour passengers aren't paying their entrance fee to the Park is also largely incorrect.

Half of the visitors who toured by land and air indicated that the visits were equally important to their overall enjoyment. One-fourth felt that either the air or ground visit was most important.

PRELIMINARY CONCLUSIONS

Most visitors recognized the value of some types of aircraft activity over the National Park System.

Almost all agreed that Park Management flights were appropriate.

Opinions concerning sight-seeing flights varied with the type of visitor.

Perceived a Moderate to Very Large Benefit of Sightseeing Flights over National Parks	
Summer Frontcountry	69%
Summer Backcountry	54%
Fall Backcountry	47%
River: Motor	65%
River: Oar	46%
Air Tour Passenger	95%

Type of Aircraft	Type of Visitor		
	Motor	Oar	Air Tour
Military	62%	82%	58%
Private Aircraft	60%	81%	50%
Commercial Passenger	37%	50%	39%
Sightseeing Tour	37%	61%	7%
Park Management	6%	10%	5%
Emergency Services	4%	1%	1%

In general, both land and air visitors favor management of aircraft activity. If restrictions were determined to be necessary, they favored use of quieter aircraft, and restricting the number of flights, airspace, and time of day. Less favorable options were flying higher altitudes, and limiting days of the week or seasons of the year.

WHAT'S NEXT?

The National Park Service is hoping to have a final report within a couple of months. Then there will be more meetings to decide just what to do about it, and that won't be easy. The air tour industry has become increasingly defensive, environmental organizations increasingly aggressive, and the governing agencies are caught in the middle, often with their hands tied by conflicting laws and regulations.

What we need now is open communication, good suggestions, and a cooperative effort to find a balance somewhere in the middle. There have been positive signs. After angering the environmental community

with some fairly outrageous remarks less than a year ago in favor of air tours, FAA's Robert Trout has shown a pronounced attitude shift. At a recent program for continuing education for pilots he stressed the need for "throttling back" over noise sensitive areas. He asked pilots why they protected their ears with "...those fancy \$500 headsets? Because you're LOUD, that's why."

In a meeting last summer with Dan O'Connell of Kenai Air, we spread a map of Grand Canyon across the hood of his car and discussed what routes might be less invasive.

"I don't want to fly over here", he said, "I know I'm making people mad. But they say I have to."

Grand Canyon is a big place, we agreed. Let's work it out.

Jeri Ledbetter

Poison

I really shouldn't have slept under that ledge. The resident black widow didn't like men and let me know it. Then the scorpion stung me as I was packing up to move. Heading towards the crapper I stepped on a buzzworm and got nailed pretty good. "That about does it," I thought. This just isn't looking like my day. Time to get out of here. So I stumbled to the boat, pulled out the radio and called for a chopper. Meanwhile I grabbed a handful of Ibuprofen and washed it down with a pint of Jack to dull the pain.

When I got to the clinic on the South Rim, the doc called the Arizona Poison and Drug Information Center (APDIC) in Tucson to figure out what to do with what was left of me.

Things like this can happen in the Canyon. Without APDIC they wouldn't have a happy ending. The bad news is that without our help APDIC will shut down in January unless the state legislature votes to fund it.

APDIC is a free statewide service with a toll free number for emergency access: 1-800-362-0101. It has been helping Arizonans since 1980, and handled over 70,000 calls in 1992. By treating people at home, it saves us millions of dollars every year.

How to help? Contact the Alliance to Save the Poison Information Center (ASPIC) at 1-800-599-8684. It can provide you with petitions, names and addresses of your legislators, and other information.

Kenton Grua

The EIS: Past and Future

The crowd impatiently shuffled its feet as the BuRec official slowly got up from his folding chair and made his way to the podium. Once there he stared for a moment at the audience, cleared his throat, and slowly addressed the questioner.

"Would you repeat the question?"

The young woman dressed in river shorts and sandals patiently rephrased her question. "How will these changes affect the beaches of the Canyon?", she demanded.

"It is our opinion that the proposed rewind will have little effect on the river below Glen Canyon Dam," he replied. "The capacity will be raised by only about 5% over present levels. It's simply a routine maintenance procedure."

The young woman was not satisfied. "But why are you increasing the maximum discharge if it's just routine maintenance?," she said in exasperation.

But the official had already left the podium to return to his seat. The moderator moved to the podium and turned to the freshly seated official. "Can you answer that Bill, or is that better addressed by Jim?." Glances were exchanged between the five seated officials and the first slowly made his way back to the podium.

The crowd seated in the auditorium of Flagstaff High School was getting tired. The public meeting on the proposed upgrading of the generators at Glen Canyon Dam had already stretched to three hours and a long line of those with comments stretched back behind the young lady at the microphone. The mood was confrontational and not pleasant. The BuRec officials looked as though they felt their only hope was to wear down the antagonistic audience; they never expected to have this kind of turnout. But the crowd came away from that meeting anything but worn out. Instead, that meeting and more like it galvanized opposition. Public involvement in the operation of Glen Canyon Dam and the effects on the Colorado River through Grand Canyon had just begun.

That meeting took place in the early 80's and a lot has taken place since that time. Interestingly enough without the debate over the upgrading of those generators, there might

never have been the opportunity to question the operation of Glen Canyon Dam itself. Built before the 1969 National Environmental Policy Act (NEPA) the dam needed no Environmental Impact Statement (EIS) and no mechanism existed for the public to criticize or affect it's release of water through Grand Canyon. That fortuitous opening set us on a path of 13 years of study and political controversy.

From the beginning, the public has been a driving force. Today we stand at the other end of that process. In the next few months the draft Environmental Impact Statement and its Preferred Alternative will be issued by the Bureau of Reclamation for public comment. Public

comment, *your comment*, is very important at that time. But to be involved you must be informed. This article is intended to summarize the process from that meeting to the present; to bring all interested in the issue up to date. When the draft EIS is issued, *the news* will print a detailed analysis so that we can generate well informed commentary.

GCES I

As the public outcry over Glen Canyon Dam grew in the early 1980's, pressure increased on the Bureau of Reclamation (BuRec) to make changes in the operation of the dam. The loudest criticism was voiced over the high range of fluctuations that caused the river to rise and fall many feet on a daily basis. On December 8, 1982 in response to this outcry, the Secretary of Interior James Watt directed BuRec to initiate a series of scientific studies looking at alternative ways to operate the dam. The studies were deemed the Glen Canyon Environmental Studies Phase 1 (GCES I) and a young BuRec biologist named David Wegner was put in charge.

From the beginning, GCES was strapped by the lack of a well-defined goal. The Studies were never designed to lead to a decision. As stated in the Final Report of GCES Phase 1 they were directed to answer two questions. Are current operations of the dam, through control of the flows in the Colorado River, adversely affecting the existing river-related environmental and recreational resources of Glen Canyon and

Conclusions of GCES I

- 1) Some aspects of the operation of Glen Canyon Dam have substantial adverse effects on downstream environmental and recreational resources.
- 2) Flood releases cause damage to beaches and terrestrial resources.
- 3) Under current operations, flood releases will occur in about one of every four years.
- 4) Fluctuating releases primarily affect recreation and aquatic resources.
- 5) Modified operations could protect or enhance most resources.
- 6) Our understanding of the relationships between Dam operations and downstream resources is not complete.

Grand Canyon? Are there ways to operate the dam, consistent with Colorado River Storage Act (CRSP) water delivery requirements, that would protect or enhance the environmental and recreational resources?

The water delivery requirements were few; deliver 8.23 million acre-feet of water annually, maintain minimum flows of 1,000 cfs in winter and 3,000 cfs in summer, and stay within the designated powerplant capacity of 31,500 cfs. Outside of these constraints, releases were based on power demands from customers spread across the western states. Many environmentalists complained that the studies were completely controlled by the Bureau, who had no obligation to act on its recommendations. They demanded instead that a full blown EIS be done, a document that would force the Secretary of the Interior to make changes. In the midst of the debate, the studies began.

The Grand Canyon is a complex place and the task was daunting. Wegner divided the studies into three areas; biology, sediment, and recreation and the first research trip launched from the Ferry in April of 1983. As it turned out, 1983 was not the best year to study "normal" operations from Glen Canyon Dam. Lake Powell, near capacity, was hit with a severe and sudden winter runoff in that year. Floods above 50,000 cfs raged through the Canyon that summer for the first time since the dam closed its gates 20 years before. On the rim debate raged over what exactly GCES should be studying. The utilities that purchase power from Glen Canyon, from whose revenues the studies were being financed, argued that the objective was to study fluctuating flows and not the flooding that was taking place. Many scientists and the environmental community felt the opportunity to study the floods was too valuable to pass up. Wegner and his crews pressed on, modifying their studies to try to record the changes that were taking place. The Colorado spent most of the next three years at or above maximum powerplant releases. This afforded the GCES scientists only a limited period for studying the dam's normal fluctuating flow pattern. The period of flooding complicated the final results of the studies and precipitated fierce debate over its conclusions. At the same time it provided immensely valuable understanding of the river system at higher flows. It changed the very way we thought about the dam and its effects. It showed us that high water releases, in the absence of thick, rich, pre-dam sediments were the most destructive way to send water through the Canyon. In January 1988 the GCES I Final Report was published. The results were inconclusive. While the studies concluded that dam operations, especially high, clear-water floods, did adversely affect the river downstream, they also

recognized that further study was needed.

The Glen Canyon EIS

The conclusions of GCES I did little to quell the controversy. In its Summary and Principal Conclusions it stated, "This study was not intended nor designed to lead directly to changes in dam operations." However, if BuRec thought that the public furor would die, they were disappointed. No sooner had GCES I been completed than renewed calls were made for a full EIS on the operations of the Dam. The Bureau of Reclamation resisted. However in August of 1989, bowing to litigation brought by the National Wildlife Federation and the Grand Canyon Trust and to a strong grassroots letter writing campaign, Secretary of the Interior Manuel Lujan ordered an Environmental Impact Statement. The Bureau of Reclamation was designated the lead agency with the responsibility for writing the EIS while the National Park Service, U.S. Fish and Wildlife Service, AZ Department of Game and Fish, Western Area Power Administration, the Hopi and Navajo tribes were considered cooperating agencies. The core of the scientific work would be coordinated by a newly funded GCES II with Dave Wegner again at the helm.

Grand Canyon Protection Act states:

- that Glen Canyon Dam shall be operated to protect and restore the downstream resources of Grand Canyon National Park,
- a long-term monitoring program be implemented to measure the health of the river system,
- orders immediate implementation of protective interim flows.

The Grand Canyon Protection Act

A timetable for completion of the EIS meandered like the stream it studied. Initially the studies were to take only two years but the realities of the complex job ahead led to continual revisions. Concern rose over the time needed to complete the EIS and the ongoing damage to the Canyon prompted a call by GCRG and others for *interim flows*. These flows would be designed to slow or stop damage to the Canyon until the EIS was completed and a final decision rendered. Calls for less damaging flows were a common part of public scoping sessions held in AZ, UT, and Washington, D.C. during March of 1990. Late that month Senator Bill Bradley (D, NJ) sent a letter to Secretary Lujan requesting interim flows. In early April Representative George Miller (D, CA), a strong proponent for Canyon protection, introduced the Grand Canyon Protection

Interim Flows

Still in effect today, interim flows limit the maximum release to 20,000 cfs, minimums to 5,000 cfs, ramping rates to 2,000 cfs up and 1,500 cfs down, and daily changes not to exceed 5,000 cfs.

Act (see inset). Under this and the pressure of the grassroots letter writing campaign, Secretary Lujan ordered interim flows initiated in August 1991.

The Grand Canyon Protection Act passed both houses of Congress in late 1991 but differences within the bill were not reconciled before the end of the Congressional session and the bill died. These differences focused on who would pay the bill for the studies and long term monitoring programs. The House version placed that burden on the users of power from

EIS Draft Statement: What to look For:

The draft EIS will be composed of three important parts, here's a quick look at each:

Preferred Alternative: This section will make a concrete recommendation to the Secretary on the future operations of Glen Canyon Dam. In keeping with the wording of the Grand Canyon Protection Act, the thrust of the preferred alternative will be to protect, enhance, and restore the resources of Grand Canyon National Park. The alternative will establish operating criteria for the dam, probably a combination of low fluctuating and steady flows, and set maximum up and down ramp rates, maximum and minimum releases, and daily maximums on fluctuations.

Long-Term Monitoring: The GCPA stipulates that a long-term monitoring program be established to evaluate the effectiveness of changes in the dam's operations and monitor the health of the river ecosystem. This section will determine the degree and scale of future research in the Canyon.

Adaptive Management Program: Given the dynamics of the system and the gaps in our understanding of it, this may be the most important piece of the EIS decision. This program will be designed as the management tool to take information gathered by the monitoring program and make further changes in dam operations to benefit downstream resources. Look for who will make future decisions on dam operations and how they will do it.

the dam while the Senate tapped general treasury revenues by forgiving repayment of loans that financed construction of the dam. The bill was reintroduced by Rep. Miller and Senator McCain (R, AZ) in January of 1992. Throughout that year GCRG and other environmental organizations pushed hard for passage, feeling that the bill would settle once and for all the question of whether power or downstream resources had priority in dam operations. Finally, on the night of October 30, 1992 during the heat of the Presidential campaign, George Bush signed the Act into law.

Meanwhile, scientific research intensified in the Canyon. More than 150 research trips floated the river during 1992 and 1993 collecting data for the EIS. On the rim, public meetings were held while a BuRec writing team worked to come up with

alternatives for the draft EIS. Native American interest and involvement increased as the Bureau of Indian Affairs, Hualapai, Zuni, Havasupai, and San Juan, Kaibab, Shivwits, and Utah Paiute joined the Navajo and Hopi tribes as cooperating agencies. These agencies met on a bimonthly basis to discuss issues and provide an ongoing public forum for this important process. In the winter of 1992-93 the EIS writing team issued several draft EIS alternatives. These alternatives were designed to provide a wide range of scenarios for future operation of Glen Canyon Dam. Because of mounting evidence of damage to Canyon beaches due to severe fluctuations in releases from the dam, attention focused on two alternatives in particular. These are the *Low Fluctuating Flow* and *Seasonally Adjusted Steady Flow* alternatives. In February 1993 the cooperating agencies agreed to support the "Low Fluctuating Flow" alternative for inclusion into the draft EIS. The lone dissenting cooperating agency was the U.S. Fish and Wildlife Service (USFWS). Mandated to enforce the Endangered Species Act, the USFWS felt that fluctuating flows, especially during the warm summer months, would jeopardize the nursery habitats for the Canyon's endangered Humpback Chub. It appears that a recent compromise has been reached that will propose the study of experimental steady flows during the summer months to allow further study of Chub habitat, while allowing low fluctuating flows the remainder of the year.

The Draft EIS

That is the trail we have followed to this point. Any Environmental Impact Statement terminates in a decision. In the end, Interior Secretary Bruce Babbitt will decide on future operations of Glen Canyon Dam. To make this important decision he will depend on two separate opinions, one scientific and one public. Within a couple of months the Bureau of Reclamation will issue the *Draft Environmental Impact Statement*. Then there will be 6-8 weeks for public comment. That's where you and I come in.

The EIS is essentially a public process. While it guarantees that a decision will be made, it provides none of the judgements necessary to make it a sound decision. It tries to provide the information necessary to make a wise and measured decision, and relies heavily on the input of citizens like us to help show the way. It is therefore important that we who are interested in the Grand Canyon take advantage of the opportunity to learn as much as possible about this complex issue, and then make our judgements known.

Tom Moody

The River Wild

More like the Budget Wild; at \$40 million it's the most expensive river trip in the world. Universal Films is footing the bill in order to present the first major motion picture that revolves exclusively around a whitewater raft trip. The trip journeys through a fictitious river gorge in Montana called the River Wild, (the Kootenai River in Montana and the Rogue River in Oregon.)

The River Wild, huh? It sounds like a Disneyland ride, the very image we guides despise, portraying river trips down pristine, free-flowing rivers. Luckily for the movie, a behind-the-scenes crew, like Brian Dierker, Scotty Davis, Jon Wasson, and Steve Jones, have been crucial players in adding authenticity to an otherwise "typical Hollywood" screenplay. Because of a dynamic assemblage of river and climbing experts, excellent acting, and an open-minded director (Curtis Hanson), the movie has the makings for a suspenseful, action-adventure story that attempts to draw the audience into what river running is all about.

The story revolves around a family on their river vacation that takes a turn when circumstances careen out of their control. Meryl Streep plays Gail, a boatman, mother, wife, and dog-lover who is the heroine. After years of living in Boston and feeling lost in her marriage to Tom (David Strathairn), a geeky architect, she attempts to save her marriage by organizing a family rafting trip in honor of her son's birthday. The whole family, including the dog, journeys down the river Gail guided on long ago. Emotional tensions fly as Tom finds he resents the river and everything it represents. It is Gail's past, her core, and the complete anathema to the ordered, meticulous Tom. Several days into the trip the action really picks up when they encounter the BAD GUYS (Kevin Bacon and John C. Reilly). This is where the family vacation gets weird and Hollywood steps in. There's hairy whitewater running, cliff scaling, chase scenes, emotional family bonding, and yes, even bloodshed, Hollywood style.

So, what does all this have to do with us?

Despite crazy Hollywood antics, this river movie is timely. Boatmen from all around the country are congregated to advocate environmental activism in saving rivers to Hollywood elitists. Meryl Streep, who pulls in some \$30 K a day for rowing and acting, seems to deeply identify with our love of rivers and our desire to protect them for the future. Thanks to Brian and Scotty, she and others are fully aware of GCRG and the on-going research in the Canyon. They will no doubt be players in the future, not only for Grand Canyon, but for rivers all over the world.

Kate Thompson

Legends

For two humpback chubs, stunned and netted on another river, stuck with pins and implanted with transistors in the name of their own preservation

*You ancient fishes
You streams of light
You slippery dreamers
We need you
even after we sent in catfish
dammed your floods
chilled your currents
stole your backwaters
poisoned you
Oh native children
hang on*

You errant mysteries

*Chubs with high arched backs
lifting toward a haze of golden light
like banners
billowing in a twilight sky*

*Suckers chimera gaping
in the thick stills
mailed sides veiled in silt
scarcely glimmering*

*Colorado squawfish
fabled giants who hurl like lances
up the dark currents
to tangle genes
so fingerlings can drift down
glittering from backwater to backwater
and end up home
in ancestral fiefdom*

*You who revel in spring's torrents
and August's warm slackenings
plunge into cataracts
still yourselves in floods
You who can breathe mud
into silver*

*You who know
what it is to be filled with grace*

You must hang on

*How else can we know the night
will shelter our dreams forever*

from

Waterlines

to be
published
this fall
by
red lake
books

Ann Weiler Walka

Adaptive Management: the Role of the Guides

A few months ago, I found myself representing GCRG at the Bureau of Reclamation headquarters in Phoenix. The occasion? An all day informal consultation meeting with people concerned about how the dam shall be operated in the future. This was BuRec's first stab at satisfying important wording of the Grand Canyon Protection Act... "The Secretary [of Interior] shall consult with... [among others] the general public, including representatives of academic and scientific communities, environmental organizations, the recreation industry, and contractors for the purchase of federal power produced at Glen Canyon Dam" for the development of long term monitoring programs, the EIS, and interim flows. That's the law.

The night before the meeting, I found myself sitting in a smokeless back room of the Sierra Club office with several other representatives of environmental organizations. We were brainstorming a strategy for the meeting. I found myself privately wondering if I was an environmentalist, recreationist, or power consumer. I wasn't sure which hat to wear for GCRG and didn't want to paint us into a corner, so I mostly just listened.

The next day's public consultation meeting was convened by BuRec (Rick Gold, et. al) and the NPS (Supt. Chandler, et. al). They had already decided who would be the most appropriate organizations to represent as conveners to Secretary Babbitt, but not everybody agreed, particularly the Indian tribes and environmentalists. But, things went along OK. We talked about Adaptive Management of the dam and how this particular consultation process will feed into that process. Somebody asked Rick Gold when the Adaptive Management Work Group process would begin. He said he thought that this was it!

It gradually dawned on my poor brain that I was attending the initiation of the new and uncharted process for future dam operations. As we groped along, it became apparent that figuring out the best way to manage the dam-controlled riparian system was not going to be nearly as simple as fighting to pass the GCPA. It's no longer a simple yes or no, stop or go deal. Despite these complexities, it occurred to me that, more than any other organization, GCRG represents a broad array of the public most directly affected by the operation of the dam. So, I'll put the question to you. What do you care most about? Riparian biodiversity and species preservation, clean energy, lower power bills, or being able to get your boat through Hance. What do you want for the canyon—seasonally adjusted steady flows or low fluctuating flows? The Draft EIS will have been delayed a couple of

months. But when it does come out, it will need public input based on real world needs and experience, specifically, yours. This is the future and we are it. See you there!

Andre Potochnik



Kingman Wins!

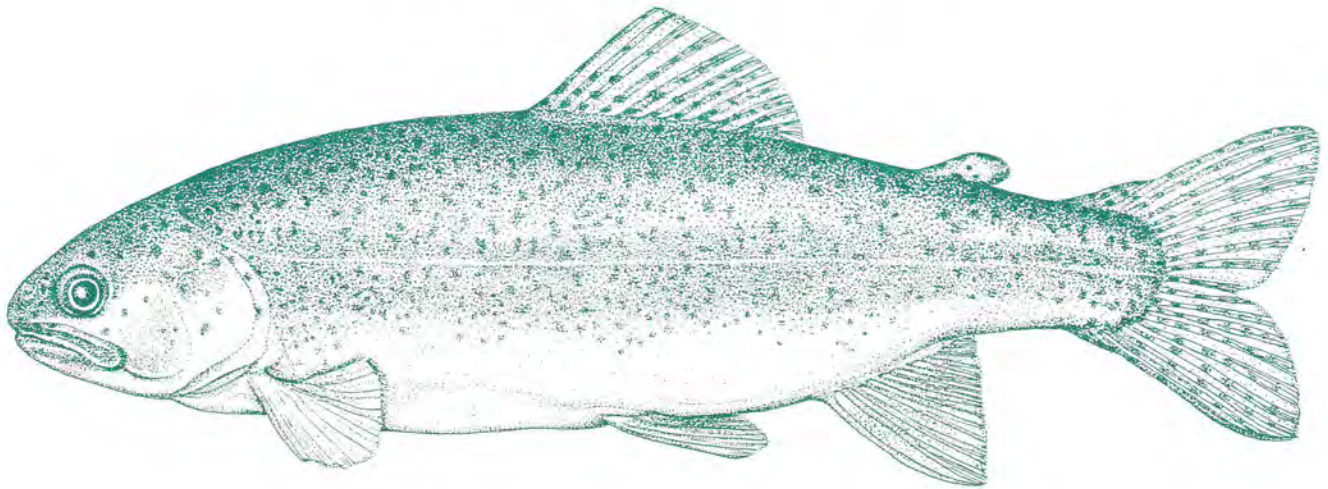
The latest (and we hope, last) update on the NAFTA Highway is that the trans-canyon route, extending I-17 northward from Flagstaff, has been scrapped in favor of the more economical and hard-lobbied US 93 option through Kingman. The ADOT I-17 Extension Feasibility Survey was completed at the end of June. This report recommended against the trans-canyon proposal. The reasons were largely economic. The I-17 Extension route was estimated to run between \$1.04 billion and \$2.1 billion, compared to the \$835 million to \$1.07 billion price tag to complete the work through Kingman. In addition, ADOT recognized that the logistical hassles and negative environmental impacts of trying to build a superhighway across the fragile lands of the Colorado Plateau would be great.

Many people feel that the main reason the Kingman alternative seems more attractive is due in large part to the unified lobbying effort of that town. They wanted this road from the beginning and set out to get it. There was no opposition. Northern Arizona, on the other hand, was divided. Environmentalists and many business owners fought the idea, while other businesses, truckers and several city councils largely supported it. Enough opposition was raised that the Kingman faction was stronger. Our thanks to the Grand Canyon Trust and other people who put up the good fight. Had they not, things might have gone differently.

Christa Sadler

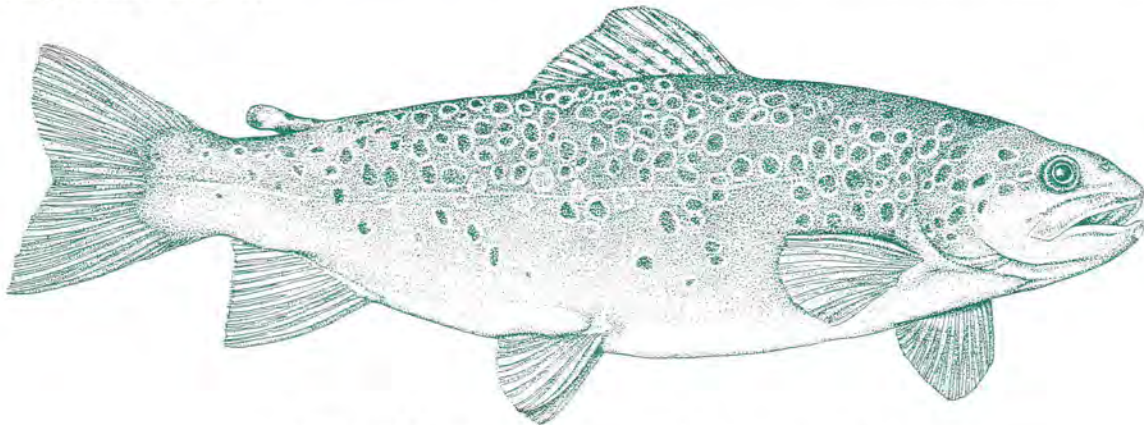
NON-NATIVE FISHES OF GRAND CANYON

a selection of nine exotic species



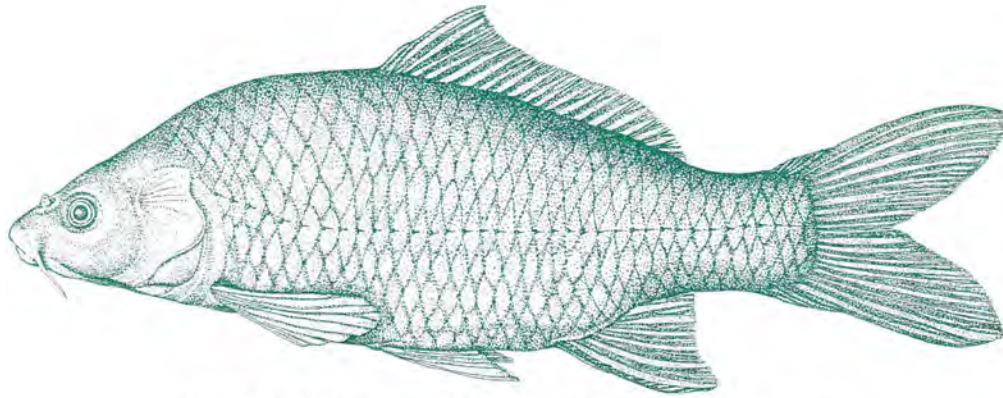
RAINBOW TROUT (*Oncorhynchus mykiss*)

Abundant in upper Grand Canyon. A silvery, soft-rayed trout with small, irregular black spots evenly distributed over the body, head, and fins, and a light orange-pink lateral band. Cutthroat trout, (*Oncorhynchus clarki*) are golden-bronze with regular round spots, greatest in number toward the tail, and a reddish-orange throat slash. Rainbow trout are managed as a blue ribbon tailrace fishery between Glen Canyon Dam and Lees Ferry, with hatchery fish released periodically to augment natural reproduction. Spawning in Grand Canyon occurs Octoberber to March, with large females depositing up to 3,000 eggs. Hatching occurs in 60 days at temperatures of 45°F. Maximum size is in excess of 10 pounds in Grand Canyon. Diet generally consists of insects and freshwater amphipod (*Gammarus lacustris*), although fish in Grand Canyon also absorb fats from millions of microscopic diatoms attached to green algae (*Cladophora glomerata*). Rainbow trout are found throughout Grand Canyon, but numbers are greatly reduced below turbid inflows such as the Paria River and Little Colorado River. They spawn in tributaries throughout the canyon in winter, such as Bright Angel, Shinumo, Deer Creek, Tapeats, and Nankoweap, where they provide an important food source for bald eagles. Rainbow trout probably prey on young native fishes, and compete for the same food, but the degree of competition is unknown.



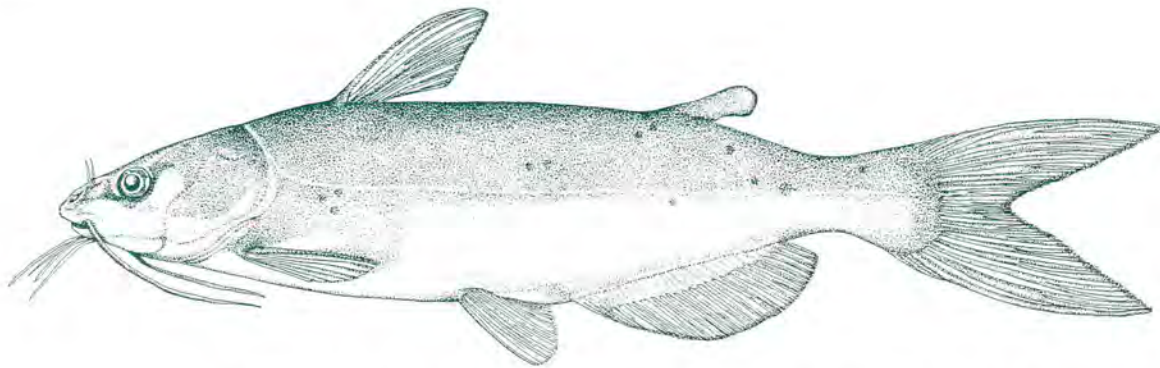
BROWN TROUT (*Salmo trutta*)

Locally common in middle Grand Canyon. A silver to greenish-brown soft-rayed trout with a yellowish belly, and small red spots surrounded by bluish halos. Most common in and near Bright Angel Creek, where the species spawns from October through March. Large females deposit 3,000 to 6,000 eggs, that incubate in 50 days at 50°F. Maximum size in excess of 15 pounds in Grand Canyon; world record 50 pounds. More tolerant to warm water and turbidity than rainbow trout. Also, tend to be more predaceous at a smaller size. Diet consists of insects, freshwater amphipods, and small fish. Uncommon in tailrace between Glen Canyon Dam and Lees Ferry. Brown trout prey on small and young native fish, but the degree of predation is unknown.



COMMON CARP (*Cyprinus carpio*)

Common in Grand Canyon and abundant in upper Lake Mead. A robust fish with large scales, dark golden body, more than 12 dorsal rays, toothless jaws, and a barbel at each corner of the upper jaw. The first ray of the dorsal and anal fins is spinous and strongly serrated. May attain a weight of 80 pounds. "Mirror carp" and "Jerusalem carp" have few very large scales. Spawning occurs in small aggregations with females releasing thousands of eggs, and young hatching in 4 to 6 days at 60°F. Carp feed on the bottom, vacuuming insects, algae, and organic matter. Carp are the most widespread and abundant non-native fish in North America, first introduced in 1872, from Germany. Carp were imported into the U.S. by the U.S. Fish Commission under President Ulysses S. Grant, as a valued food fish, and quickly raised and distributed to many states from 1879 to 1896. This wide distribution enabled the species to take hold in most drainages of North America, where it is commercially harvested in some regions, but considered a pest in most parts of the country. Carp are locally abundant in sheltered habitats of the Colorado River Basin, particularly in off-river impoundments, backwaters, and sand-silt tamarisk-lined banks that now dominate the Colorado and Green rivers. In Grand Canyon, carp probably constitute the greatest biomass of any species. Another large Asian cyprinid, the grass carp or white amur (*Ctenopharyngodon idella*) attains 100 pounds in weight, and is reported from the lower basin.



CHANNEL CATFISH (*Ictalurus punctatus*)

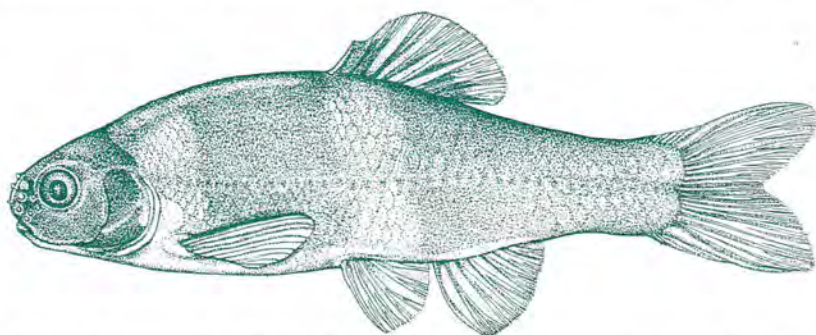
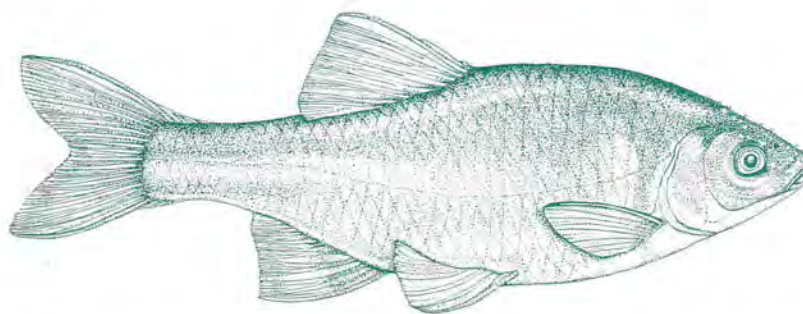
Locally common in Grand Canyon. Channel catfish were first introduced into the Colorado River near Moab, Utah in 1919 by active sportsman and public figure, Horace Stone Rutledge. The fingerlings were received from a hatchery in Kansas, with approval from the Bureau of Fisheries in Washington, D.C. They are common in some tributaries and tributary inflows of Grand Canyon, such as the Little Colorado River. Channel catfish are abundant in the middle reaches of the upper basin, particularly in canyons such as Desolation Canyon on the Green River and Ruby Canyon on the Colorado River. Their abundance declines progressively downstream to the confluence of these two rivers, but increases significantly in Cataract Canyon, indicating an association with rock substrate and swift canyon areas. The young are very numerous along shallow shorelines and backwaters, while juveniles and adults are abundant in eddies, often in sympatry with chubs. Their impact on the native fishes is unknown, but their abundance and omnivorous diet suggests competition and possibly predation. Although channel catfish are reported to reach nearly 50 pounds in weight, the largest specimens from the Colorado River are less than 10 pounds, although individuals of up to 20 pounds are reported from Lake Powell and Lake Mead. A close relative of the channel catfish-blue catfish (*Ictalurus furcatus*)-are reported, but unconfirmed, from the Colorado River basin. Blue catfish lack the dark spots of the channel catfish, and have 30-35 anal fin rays, compared to 24 to 29 rays in (*Pylodictus olivaris*), and are common below Lake Mead.

RED SHINER

(*Cyprinella lutrensis*)

Rare in upper Grand Canyon, common below Separation Canyon. Adult red shiners are usually deep bodied and laterally compressed, steel blue above and silvery below with orange fins. Breeding males are metallic blue with bright red fins and tubercles on the head and body.

Spawning may occur twice in one year as water temperatures approach 65°F. Maximum size about 4 inches. Red shiners typically have eight or nine anal rays, whereas sand shiners typically have only seven. Red shiners were probably introduced into the Colorado River in the early 1900's incidental with bass and sunfish from the Illinois River bottoms, or in bait buckets. Red shiners are the most common fish species in the upper basin, found primarily in backwaters and shallow sheltered habitats. They are tolerant of high turbidity and siltation, and avoid waters that are continuously clear or cool. The species is implicated in predation and competition with the native fishes because of its great abundance in the Colorado River Basin.



FATHEAD MINNOW

(*Pimephales promelas*)

Locally common in Grand Canyon. A small robust minnow with a maximum size of about 4 inches, and characterized by brassy color. Males are robust with a black band around the body, and prominent pimple-like "tubercles" on a large head. Females are

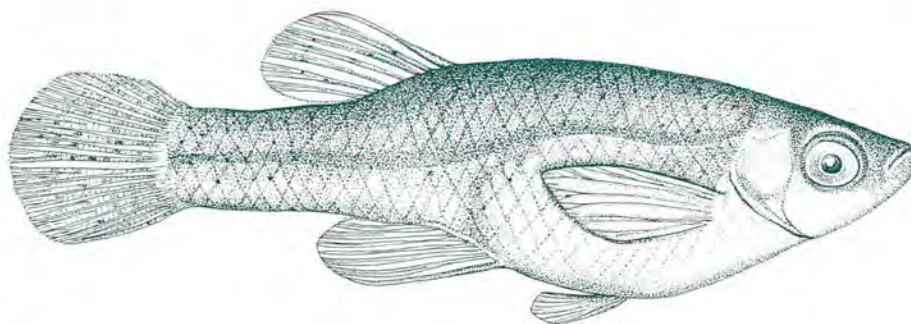
smaller and less robust. Fathead minnows are widely distributed in the warmer middle and lower regions of the Colorado River Basin. Their mode of access was probably via bait buckets, since the species is so popular as a bait fish for crappie and largemouth bass. The species may have gained access into the drainage as early as the late 1800's incidental in seine hauls of bass and sunfish brought to the west from midwestern drainages. Fathead minnows can be very abundant locally in small pools and quiet areas. They thrive in warm, turbid waters, and can survive high temperatures and low oxygen levels better than any other species in the Colorado River, except perhaps black bullheads. The impact of the fathead minnow on native species is unknown, but like the other small cyprinids, it is implicated as a potential competitor and predator.

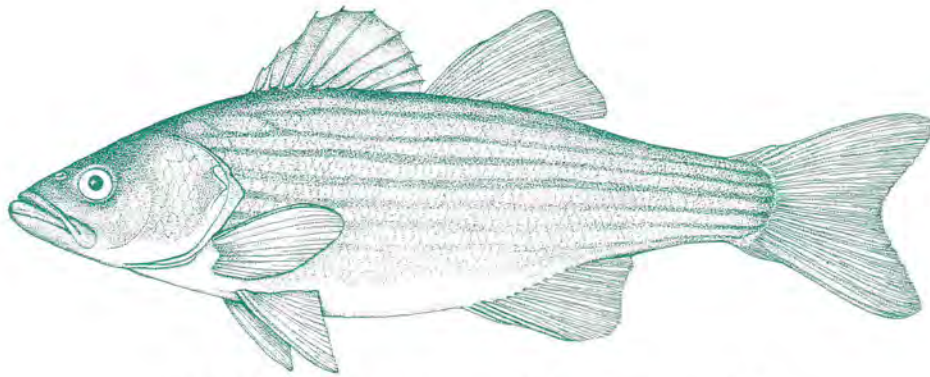
MOSQUITOFISH

(*Gambusia affinis*)

Locally common in tributaries of the lower Colorado River in Grand Canyon. A small, delicate greenish fish with a robust belly, upward mouth, and square tail.

Maximum size about 2 inches. Mosquitofish belong to the family of livebearers or viviparous fish. The males are distinguished by an elongated anal fin which is a highly-specialized rod-like organ, or gonopodium, used to internally fertilize the female. Up to 300 embryos develop internally within the female and the young are born live. All other species of fish in Grand Canyon are oviparous-producing eggs that are fertilized after leaving the body of the female. Mosquitofish were first introduced into the Colorado River in the 1930's. It is native to the central United States from southern Illinois and Indiana to Alabama, and the lower Rio Grande in Texas. It has been distributed extensively since the 1950's by mosquito abatement districts to control mosquitoes, and has received world-wide attention in helping to combat the malaria-carrying forms. It does not tolerate prolonged cold conditions (<40°F) and does not occur extensively in northern regions, although it is tolerant to warm temperatures and low oxygen conditions. The low numbers and insectivorous diet of this species probably do not pose a major threat to native fishes.



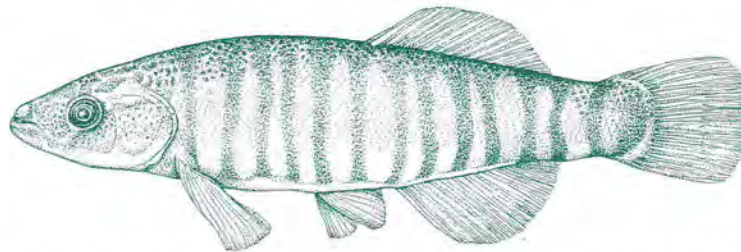


STRIPED BASS (*Morone saxatilis*)

Occur in June, July, and August in small numbers in Grand Canyon, during spawning migrations from Lake Mead. Have been caught as far upstream as the Little Colorado River. A spiny-rayed fish with green back, white belly, silvery sides, and 6 to 8 black, lateral, horizontal stripes. Maximum size about 50 pounds in reservoirs, 100 pounds as sea-run form. Females generally ascend turbid rivers to spawn in spring, depositing thousands of tiny eggs that incubate and hatch as they drift back to the lake. Striped bass were first introduced into Lake Mead in the early 1970's and into Lake Powell in 1974 to alleviate a decline in spawning and nursery habitat of largemouth bass and black crappie. Threadfin shad, a consistent and dependent forage for stripers, were also introduced. Striped bass have been a very successful sport fish, and are highly sought by trophy fishermen. A decline in threadfin shad sometimes sends striped bass populations into decline in numbers and condition of individuals, as seen in Lake Powell in 1982-83 and 1985-88. Rainbow smelt (*Osmerus mordax*) have been proposed as an alternate forage for stripers in Lake Powell. The impact of striped bass on the native fishes of the Colorado River has not been determined. Predation of native fish could be occurring during spawning ascents, or when native fishes enter the lake inflows inhabited by the species.

PLAINS KILLIFISH (*Fundulus zebrinus*)

Found primarily in tributaries of the Colorado River in Grand Canyon. A small cylindrical, minnow-like fish with black vertical bars. Maximum size about 5 inches. Killifish are known as "topminnows" because of their habit of skimming along just beneath the surface of the water feeding on insects and other small invertebrates. The top of the head and forward part of the back are broad and flat and the mouth is tilted upward so that it opens at the upper surface of the head to facilitate surface feeding.



The species is easily distinguished by the presence of a seemingly massive protruding lower jaw with many teeth, thus the name "cyprinodont" which means "toothed carp". Plains killifish, (*Fundulus zebrinus*) and plains topminnow (*Fundulus sciadicus*) are reported as incidental in the Colorado, Green, and White Rivers of the upper basin, and rare in the San Juan River. The plains killifish has a dorsal fin base situated above or forward of the anal fin base; usually 13 to 16 dorsal fin rays; 40 or more lateral line scales; and 12 to 13 dark vertical bars on the sides of the body. The plains topminnow has a dorsal fin base situated above the anal fin base; usually 6 to 11 dorsal fin rays; 38 or fewer lateral line scales; and without vertical bars or horizontal streaks. Plains killifish may compete with small native fishes for food.

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Grand Canyon River Guides is a non-profit organization dedicated to:

- * Protecting the Grand Canyon *
- * Setting the highest standards for the river profession *
- * Providing the best possible river experience *



River Sociology

Shane Murphy

Being a First Timer, a Dude, in Grand Canyon, is an innocent enough occupation. Especially on a river trip. Grand Canyon, no matter how many times *that person* has been on a river, no matter how many rivers they have ever been on, is startling, overpowering, wondrous in the Colorado's passage through it.

Next, as best I can tell, comes the fact that everybody hails from someplace. Everybody has a frame of reference, some prior experience to draw from, a story to tell. But: nobody ever came from such a huge, mystic and primal place as Grand Canyon. No. Never. Hence, there is no frame of reference—none whatsoever—for those first encountering Grand Canyon. Immediately everything is foreign, surreal, a huge blast of primal color, each step tenuous without escape or rest, nothing but excitement or nightmare or the grating edge of both, most of it barely comprehensible, with the balance absolutely mindboggling.

That is why there is such confusion on a Grand Canyon river trip! That is why the River Experience is, oftentimes, so dumbfounding to the uninitiated. That is why newcomers, over the course of the first few days, are unable to fully comprehend the vast, sometimes terrible landforms and logistics laid waste before them. That is my theory as a boatman.

Not to worry. Old Pro's, boatmen for instance, are, themselves, prone to exhibit heavy confusion in this same regard. This is especially true when dehydration, with all its devious mind-set-behavioral-affect weirdnesses, sets in after a hard, hot, day guiding a boat through huge rapids. Further note that Old Pro's guard against dehydration much as Alexander would tend Bucephalus prior to fierce battle: you give Bucephalus water, lots of water, and you don't ride too

hard for too long. Yes. Among the few, the brave, and the mighty, dehydration is to be challenged, conquered, busted to smithereens every time, at all costs. Charrgggeeee.....

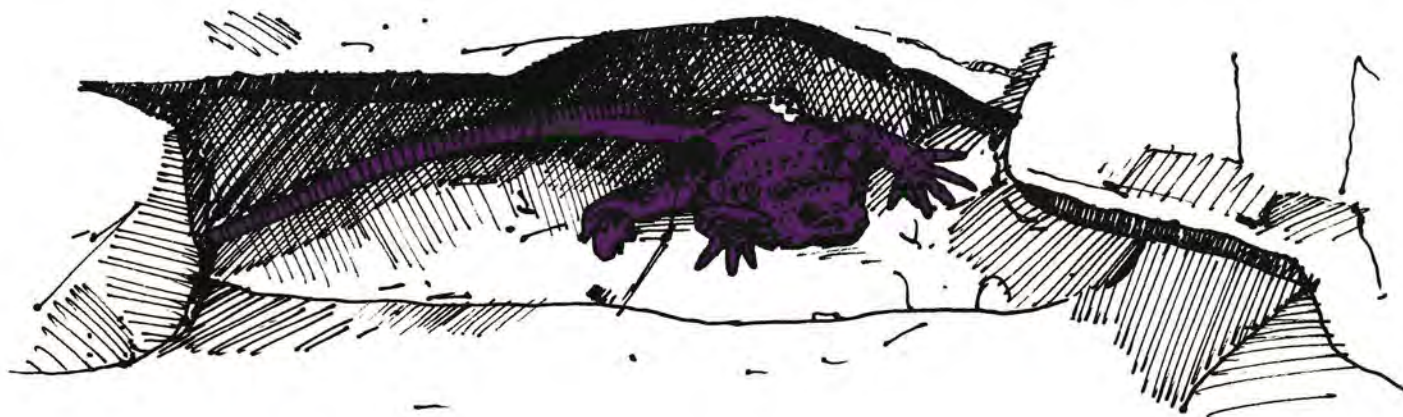
But, hey, it happens. That is the reality of Grand Canyon. That is why, no matter who you are, Boatman or Dude, you can get lost there.

Caught completely unawares he, or she, perhaps both parties under study, will speak before thinking. Sometimes it is instructive to observe these goings-on. There is something to be learned in everything; occasionally, multiple lessons present themselves.

I herein submit a detailed analysis of one such situation. Everybody gets into the act and nobody looks too good in the end. But, anyway...

From the days when upstream hydro releases were entirely radical and Grand Canyon beaches were slipping away fast, comes this story. Of a particular September morning our group floated past the abandoned damsite at River Mile 40. There, the 20 people on my boat engaged in an involved discussion about snowpacks and reservoirs. We focused on dams and water releases designed to meet electrical demands. We touched on the legal requirements of interstate compact agreements, Acts of Congress and, after finding a decomposing sandbar, which was not difficult to do, spent 10 minutes on 'beach erosion in Grand Canyon.'

At the time I said something like, "Folks, what we have here is man-made erosion caused by 10'-15' 'tides' frothing downstream from Glen Canyon Dam. Every damned day Glen Canyon manufactures electricity with water. When nearby Planet Earth needs it, the penstocks are opened-up and Glen Canyon's turbines are, one after another, brought on line. Downstream, no matter where you are, the river rises and falls



washing our sandbars away, a grain at a time, grain by grain, beach by beach. That means we're loosing our beaches. I'd like you to write your congressman..."

Everyone was reverentially silent. It was, I figured, a profound moment in their lives, full of stark, cosmic realizations, dramatic leaps in mental processes. I imagined them returning home enraged, there to toss half their wanton electric appliances into the trash. They would think hard the next time they fired-up their electric toothbrush or hairdryer or whatever; hopefully they would never use the whatever-it-was ever again. Better still they would, each and every one of them, get off the grid, convert to solar power, composting toilets, a dedicated recycling program, the works. Yeah! Go get 'em, guys.

Later it was dinnertime. And, there we were: 74-Mile camp, river right, the place I call THE Snake Pit, second day of a 7-day trip, everybody deep into their pork chops and mashed potatoes and fresh garden salad and cobbler with whipped cream. Full moon; rising, warbling river; lovely—absolutely gorgeous—evening, alpenglow, all-that-stuff. WOW!!

This next part is difficult to tell. It begins with a passenger's question:

Does the full moon influence the canyon's tides?

And ends with the *coup de graux*, the Trip Leader's rejoinder. Kindly recall this response as issuing from the partially dehydrated, mostly deranged, end of the season and I-am-crazy-mind-of-a-river guide:

NO! Those are caused by the dam,
GODDAMNIT!!...er...Glen
Canyon..uh...DAM??.....upSTREAM(quick
pointing)...its..its...uh...water—
YEAH!!(giggles)..uh...(scratches forehead)...

Both of em' just about flat-footed as could be. So it goes.

White Water WFR

Salt River Rafting will be sponsoring a *Whitewater Wilderness First Responder* course at Senaca Lake, near the Salt River Canyon northeast of Phoenix. It will run February 26 - March 6, (one day longer if you're an EMT and want a *Wilderness EMT* card).

Cost is \$350; send a \$150 deposit to hold a spot to:
attn.: Robert Bond
Salt River Rafting
7111 E. First Street
Scottsdale, AZ 85251-5307
(602) 941-4222

Autumn Extravaganza

We've got quite a collection of events lined up for this Fall in and around Moab. Here are a few details:

Thursday: Green River, Utah

We'll meet at 1PM in the afternoon at the John Wesley Powell River History Museum, at the east end of the bridge. If you haven't been there yet, now is the time. There are some great exhibits, including an old Galloway style boat, Don Harris' *Mexican Hat* and others. Green River historian Roy Webb will be there to elaborate on what we see, tell stories and answer questions. Don't miss it.

About 3PM we'll go next door to Holiday River Expeditions' warehouse. Dee is hosting an open house and will have an informal presentation/question and answer session on the new *Wilderness First Responder* courses.

Afterwards we'll head over to Ray's Tavern and socialize, maybe even have a burger and a beer.

Friday: Pack Creek Ranch

Ken and Jane Sleight have graciously offered to host our meetings at their magnificent ranch. (Be sure to read the Pack Creek story on the next page.)

We'll be setting up our cook tent about noon-ish and have set aside all afternoon for brainstorming about the weekend, telling stories and visiting with old friends. Ken has put out an A.P.B. on old time boatmen, so we're expecting to see quite a few faces from yesteryear's rivers. After dinner we'll have stories, and perhaps some movies or slides. Don't miss it.

Saturday: Pack Creek Ranch

About 9AM we'll begin our fall GCRG meeting. We've got several presentations to make, a lot of news to bring you up to date on, and a few topics to discuss that we need your input on.

After lunch we'll begin formulating some sort of Upper Basin Guides Association. We can base it as closely or as loosely on what GCRG has done as you all like. What we really need here is a lot of energy and input. Hopefully by the end of the afternoon there'll be enough of a consensus to nominate a steering committee for Sunday morning's meeting.

Dinner, Party, Old timers rendezvous part II, stories and some sort of show will follow. Perhaps a bring-your-own-instrument concert/dance.

Sunday Morning: Pack Creek

About 9AM we are hypothesizing the first meeting of the new formed Upper Basin Assn. But frankly, things will be out of GCRG's hands at that point. What happens is entirely up to YOU. We'll help out in any way we can.

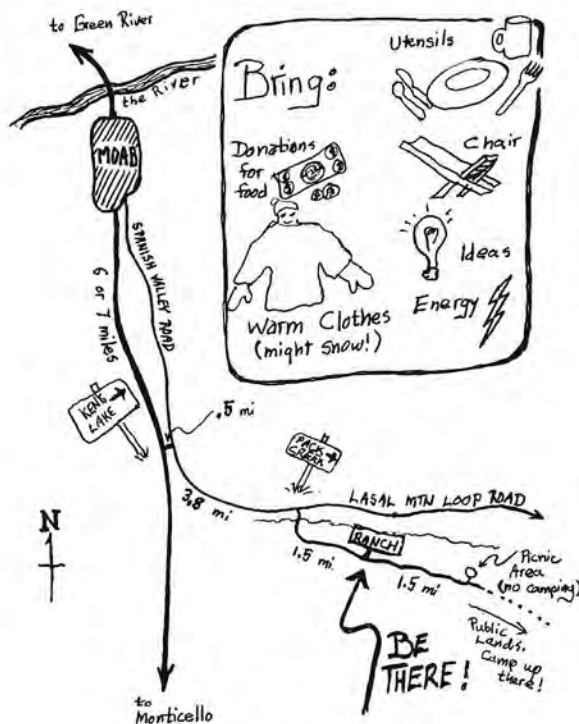
After lunch, we'll break down our equipment, clean up any messes we may have made, and move out.

In the afternoon, Canyonlands Field Institute will be putting on an Endangered Fish Seminar at no charge. The location is uncertain right now- perhaps at their offices in town.

Monday and Tuesday: the River

The plan is to have an overnight bring-your-own-boat float trip from Dewey Bridge down to Moab. The tentative camp is at the incomparably beautiful Onion Creek beach, where we can watch fall turning to winter on the LaSals, sunset on the Fisher Towers, and continue our plotting and scheming. Do come.

Any questions? Contact Jimbo Buckerood at Outward Bound: (801) 259-6002



Gear Swap

Canyonlands Field Institute will be holding a fund-raising outdoor gear swap at the Moab community center all weekend. You get 80%, they get 20%. Call Sharyl Kinnear-Ferris at (801) 259-7750 for details.

About Pack Creek

Ken and Jane Sleight run this former working ranch as a guest ranch. It's right at the foot of the LaSal Mountains, has a stream running through it and offers a fine vistas of the orange canyon cliffs in the valley below. Paradise.

Ken, one of the elder statesmen of the river running community made the mistake of offering to host this fall's gathering and we took him up on it.

Here's the deal:

We'll be using the grounds from mid-day Friday through mid-day Sunday, at no charge. GCRG will be supplying meals based out of our cook tent. Donations graciously accepted. You get to help cook and clean up! Cool, huh?

Accommodations

For the typical boatmen on a tight budget, the best deal would be to camp just up the road beyond the Forest Service picnic area on public land. No charge.

Or you can mooch off your friends in Moab.

Local hotels will have economical off season rates.

For those who'd like to stay on the premises, we have the ranch reserved for Friday and Saturday nights. Here are the rates:

Bed in a cabin: \$30/person/night

Camping on the premises: \$15.50/person/night (includes shower, jacuzzi, etc.)

Day use of spa facilities: \$7/person/day

(bear in mind that it's normally over \$100 a night.

Bear also in mind that the cost of maintaining sewage and fresh water facilities is extreme)

Ken and Jane have extended the deadline for deposits, so send in a \$20 check if you want to stay on the premises. Note: The cabins are nearly full!

Since the GCRG folks will be boating 'til then, contact Leann at Pack Creek: (801) 259-5505 or write: Box 1270, Moab, UT 84532

Alcohol

Welcome to Utah. Pack Creek comes under the restaurant regulations. We have promised to be very careful about following them because we don't want to get anyone into trouble. Here are the rules:

Bring your own. One can only drink spirits purchased in Utah. Neither Pack Creek Ranch nor GCRG can sell or serve you any. Simple enough.

The Sleights are being most generous to let us come. PLEASE, one and all, play by their rules and don't abuse their hospitality. Anyone that gets out of line will have their heads pinched off by a committee of their peers.

Yeah, But How?

A brief foray into atmospheric optics, by Cynta deNarvaez

I have been fascinated with the obvious of late. In the past I have seen things I could name, and because I could name them or had some vague understanding of their processes, I left my curiosity at the door. Well, not any more! After experiencing the meager monsoon display this summer, I began missing the atmospheric drama that normally accompanies August - especially rainbows. As I started looking into rainbows, other skyward optical phenomena that had been nagging, unanswered questions in the past became interesting once again. Why is the sky blue? Why is the Moon's sky always dark? How do stars twinkle? Why does the sun flatten out when it sets? Why is there a puddle of water seen with mirages? Is there really such a thing as "The Green Flash?" And what in tarnation is lightning?

To understand these and other light-oriented concepts, several basic physical laws and processes must be defined. First the definitions, then the descriptions and explanations.

Optical physics

Basic properties of light within our atmosphere

Light and waves: Isaac Newton discovered that in a vacuum light waves travel with maximum velocity and in a straight line. Light is emitted (radiated) from the sun and travels in a straight line until it hits an obstruction like our atmosphere. It is the reflection, refraction and diffraction of these waves that cause us to see atmospheric optical displays like rainbows, green flashes and earthbound mirages.

Light waves have different lengths or "frequencies." There is still a question as to whether these "waves" are really only waves of "energy," or are actually "particles" as Einstein contends; for they seem to have the properties of both. For simplicity's sake, we will call them waves here. Within the visible range, light beams appear white, yet when they are dispersed we see a display of color.

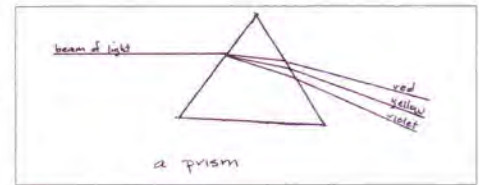
Newton took a beam of light and shined it into a prism. The beam travelled in a straight line until it hit the glass of the prism, a new "medium." Once it hit this new medium, the light beam deflected with colors splayed at predictable angles. It then continued on in a new direction until it hit the other side of the prism. As the beam reacted to this different medium, glass to air, it dispersed the colors within the light beam even more into a "spectrum." This color, or electromagnetic spectrum, displays the full range of visible wavelengths of light in order; bordered by ultraviolet

below and infra-red on top.

Reflection: We witness reflection in mirrors, on polished surfaces and on water. Images of objects are bounced back from a medium because none of the light waves were absorbed by that medium.

Refraction: This is the process of Newton's beam of light through the prism. The speed of the beam, or wave, depends upon the properties of the medium.

The speed of the beam through air is faster than through



glass (a denser medium) so the light "bends." because the "refractive indices" of these media are different. The shorter waves, violet and blue, are refracted more than the long red waves, and there is a separation of colors. Refraction is the unidirectional bending and slowing of the light energy after it has come in contact with an obstruction (like a new medium or level of pressure).

Diffraction: This is when a wave gets squeezed together, as though through a small lens (like a water drop) and, when exiting, is diffused or spread out. Rather than the wave remaining in its wavelike pattern, it gets broken up - like the white light beam entering the prism.

Radiation: This is the spread of light from a center; the emission of waves from a central point. In this instance, the distance from the Sun to the Earth is such that the waves seem almost parallel as they hit the planet.

Inhomogeneity of atmosphere: Our atmosphere is made up of air and air is made up of particles. The density of air is variable. The density is affected by several factors: the barometric pressure; the amount of moisture in the air (more moisture, more density), the altitude; air has weight and so is affected by the gravitational pull of the Earth (every climber knows there is more air near the surface of the Earth than at higher altitudes), and lastly, air is affected by temperature and pressure (hot air expands, cold air compresses, hot air can absorb more water than cold air, etc.). To make matters more interesting, air particles are

continually colliding against one another. Besides there being large levels and pockets of different pressures, densities and moistures, there is a constant movement of pinballing particles causing momentary "blobs" of air. So, unlike water, air is inhomogeneous; it fills its "space" inconsistently; thickly, sparsely and/or turbulently. This inhomogeneity affects the way light waves enter our system and, just like the prism, effects our optical perception of light waves and the objects they attempt to represent, i.e. "twinkling" stars..

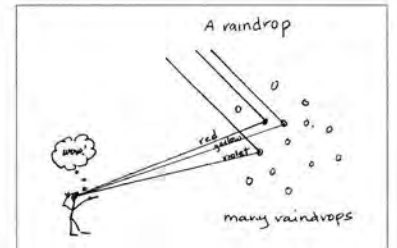
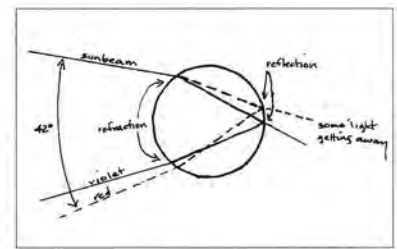
Color and the way we see: Our eyes have been outfitted with rods and cones with which we discern shape and color. Cones specify bright light and so are color receptors while rods react to dim light and are shape or perspective detectors. The colors we see are the absorption or reflection of specific wavelengths of light as they strike an object. When the entire light wave is absorbed, we see black; the absence of color. When the light wave is reflected we see white, light diffusing and all colors overlapping. In many cases, different frequencies of light waves are reflected or absorbed as a result of the chemical makeup of an object. For example, most plants appear green because the pigment (chemical compounds in the skin of a plant) absorbs all the colors of the light spectrum but the green frequency. So if you try to grow a plant using green light, it will either change color, or if it grows at all, will do so feebly. The chemical makeup of the minerals within the Hermit Shale absorbs all the wavelengths of light but red. This red wavelength has been bounced back, reflected from the rock, and stimulates the cone receptors of our retinas. Not all the colors we perceive are made by this absorption or emission process. The color in the wings of blue birds has an entirely different cause not to be propounded here. The sky also has its own reasons for being blue, but this will be discussed later.

Atmospheric Optics

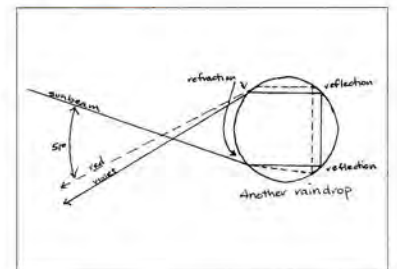
Rainbows: Rainbows are the large scale representation of the refraction and reflection of light by raindrops. Descartes first figured this process out in 1637 using glass spheres. As the beam of light first enters the raindrop (diameter: 200 micrometers), it refracts (is bent) and as the light diffuses, the colors separate and head toward the opposite wall of the drop. Here, part of the light escapes out the back, while the rest is reflected to the lower portion of the raindrop. Here it refracts even more as the dispersed light finally exits and becomes a point within a great sky spectrum of color.

Imagine entire walls of raindrops all reflecting different wavelengths of light at different points on the

Earth's surface and one series hits you. A spectrum is represented when higher droplets reflect red, orange below that, yellow below them and so on. Violet and blue, of course are refracted most and so they are reflected from the bottom portion of the rainbow. This single reflection event is called a "primary rainbow". These have the brightest images. For primary rainbows there is a consistent angle of 42 degrees from Sun to top of rainbow (red color) to observer. And because the angular diameter of a rainbow remains constant to the observer, we can never fit the entire thing into a 35mm camera; as we step back to fit the full rainbow into the frame, the color display moves with us.



Secondary rainbows occur when sunlight hits the rain at a higher angle and, because of the angle of incidence, the light beam reflects twice while inside the droplet.



Secondary rainbows are always above primary ones. Their color spectrum is reversed (violet and blue on top) because of the extra reflection. They have an angle of 51 degrees from Sun to rainbow to observer, and are fainter in appearance because more light has had a chance to exit due to the second reflection. Supernumerary bows are the faint arcs present within primary bows. These are simply interference bows; small concentrations of minor light energy.

There is an inconsistency of brightness around rainbows. Rainbows are a concentration of light through a raindrop, yet there is other visible light emerging within the primary bow and above the secondary bow. This comes from the extraneous light rays hitting all the droplets from every angle. There is a dark area between the rainbows where the brightness has been reflected from. This is called the "Alexandrian Dark Space."

White rainbows: Occasionally these rainbows can be seen from airplanes, but also from the ground in clouds and fog. The key is that the water droplets must be quite small, 10 micrometers (or 10 millionths of a meter in diameter). This allows for the diffraction of light. The light beam hits the small droplet, which acts like a lens and squeezes the light in such a way

that the bands of color within the beam spread out and overlap, reflecting all the light energy and the color is received as white. To witness one of these you must look 40 to 42 degrees from the top of the shadow of your head on the ground. This is known as your "antisolar" point and is the domain of all primary bows.

Red rainbows: These are placed high in the sky as the sun is setting. As the sun descends, its rays travel through more of our atmosphere and as we sequentially lose light waves (from violet to red) we witness a color display known as a "sunset." The intense reds of the sunset reflect off high clouds with a specific diameter of raindrop - 10 micrometers. So when the sun is low on the horizon, an otherwise "white rainbow or cloud rainbow" appears red because of the selective properties of the atmosphere on the sun's beams.

Lunar rainbows: According to Robert Greenler, Professor of Physics at the University of Wisconsin-Milwaukee, there are lunar rainbows. However, to produce enough light to have a rainbow, the Moon must be full. The light from the Moon is a reflection of the sun's rays and does not itself have the necessary intensity. Needless to say, lunar rainbows are quite faint. Greenler says these bows have color but appear white because of this lack of intensity. The process is the same as with solar rainbows however; the same 42 degree angle, the same raindrops, only at night.

The deep blue sky: Violet/blue waves, being the smallest, are more strongly refracted than red ones. Infrared waves are able to dodge atmospheric particles while ultraviolet light gets pummeled and scattered by them. When "scattered," this blue light is reflected in all directions and we see "blue sky". For this same reason, Leonardo da Vinci, the father of perspective, when asked how to put depth in a painting merely said, "Add a little blue." Seeing a long corridor of canyons corroborates this opinion.

It always puzzled me as a child why photographs on the Moon were always taken during the evening. The Moon has no atmosphere (no air particles to scatter light), so its sky always appears black.



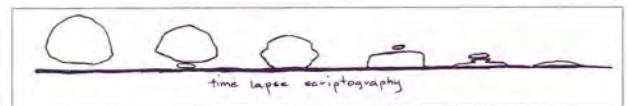
Crepuscular and anticrepuscular rays: Occasionally, when the sun is rising or setting, it is possible to see the sun's rays looking like they have

been blasted through a colander. These are the same kinds of events pictured on the covers of religious magazines. It looks as though the sun's rays are emanating from a central point directly within the cloud, not from a point 93 million miles away. If, as

we already know, the sun's rays hit the Earth almost parallel to one another, then what is going on? We are being fooled by the optical illusion of da Vinci's point of perspective; at distance all things converge to a central point. In this instance, the central point of light is displaced due to the redirection of the solar beam. Crepuscular rays occur when parallel solar beams are funneled down and redirected through clouds, giving the impression that they are distinct beams emerging from a light source within the cloud and that God is on the verge of speaking.

Anticrepuscular rays are only slightly different. Occasionally, when crepuscular beams are visible, they can cover the entire sky. This does not mean that the beams continue to fan out as they do from the (seemingly) original light source. Anticrepuscular beams are the tail end of these beams, culminating at their own point of perspective. As the light beams pass overhead, they converge on the horizon at exactly 180 degrees from the colander clouds.

Distortion of the rising and setting sun: Most of the time, when the sun sets, we see a true image of that golden orb disappearing below the horizon. Yet every now and then, when the conditions are right, we can witness a flattening of the lower half of the sun. If we think of the Earth's atmosphere as a series of flat layers with increasing density due to gravitational pressure, the distortion of heavenly bodies near the horizon becomes possible. Rays of light carrying the image of the sun are bent at the points of entry to these layers due to changes in composition, pressure and meteorological conditions. The air particles within the various layers are being compressed by the weight of the air above as well as being affected by the gravitational pull of the Earth. This increases the density within the lower layers which causes light waves to bend toward the less dense air above. Simply speaking, when the sun is close to setting, refraction will effect the top part of the sun differently from the bottom half. The top half will radiate its image truly, while the bottom portion will send an apparent image. Since the bottom portion of the sun is being seen through thicker, more dense atmosphere, the bottom image is being bent intensely and gives the impression of being squashed or "flattened." The cool thing is that the bottom edge of the sun is actually below the horizon and the bending of light lets us think its still above. It is a little like an atmospheric pressure mirage.



end Part I watch for part II

Greetings From the Ferry

Navajo Bridge Construction

The look of Marble Canyon has changed dramatically since the last news. Some mighty big holes have been dug near Navajo Bridge. Dealing with the passage under the bridge has been fairly uneventful. There was only one minor incident when the closure went past the 11:00 hour and someone floated under when it wasn't safe. It's a good idea to check with the safety boat any time you are passing. There will be work continuing through the fall and winter months and we will have the 11:00 to 1:00 window. They seem to be getting behind schedule. We recently had a Saturday with the window, which may become more common. There is even some muttering about a 24-hour schedule.

Lost Gear

Occasionally we come across equipment left on the ramp; mostly blowers and extension cords. This equipment is not marked with company names so we can't track down the owners. Let us know if you are missing equipment. Label all your gear with your company name. Better yet, take it with you.

Wakeless Worries

Yes, even a motor rig can create a wake. Over the summer it became apparent that many guides were not aware that the area adjacent to the launch ramp is a wakeless area. The buoys upstream from the ramp are wakeless buoys to slow traffic as it approaches the launch ramp area. When you are moving motor rigs on and off the ramp please avoid creating a wake; it erodes the ramp and jostles boats tied up to the courtesy dock.

New Radio Frequencies

The ground to air radio frequencies for commercial air traffic have changed. Go ahead and put a copy of the new ones in your personal, first aid and radio boxes today.

(see box)

We had days this summer when the ramp was very congested. I am impressed at the amount of your cooperation; it makes things work and we appreciate all your effort. Thanks to those of you who responded to letters about your guide cards.

Have a good winter!

Carol and Blu

Emergency Radio Frequencies			
<i>Daytime tour traffic</i>			
East	122.85	Lees to Havasu/Kanab	
Central	127.05	Havasu/Kanab to Diamond	
	119.0	Gnd. Cyn. Control Tower	
West	121.95	Diamond to Pearce	
<i>Airlines</i>			
Los Angeles	135.25	Lees to LCR	7AM-7PM
	128.07	LCR to Pearce	7AM-7PM
	124.2	24hours	
	124.85	24-hours	
Denver	134.15	24-hours	
Albuquerque	128.45	24-hours	
<i>Emergency</i>			
Emergency	121.5	24-hours	

Wuddyathink?

Last time we asked what people thought about backcountry piddling. We didn't get much of a response. At a board meeting Bronco said this:

I tell 'em: Just keep walking up the trail 'til you come to a little dry wash. Walk up it a ways and pee on a bush in the bottom of the wash. Next storm floods away the odor. Meantime, the bush gets a drink.

We received one written response:

I hear that Deer Creek is no longer safe to filter. (NPS Water Quality Survey, June 93" Must be all those back country users. Couldn't be 200-250 river runners per day.

Big Wave

Big wave also had this comment on river peeing:

Wet sand doesn't work. Put it in the River. Anyone notice the green fly-infested slime molds at the "wet-sand" line?

With this issue, the Wuddyathink column is going out of business due to

lack of interest. In it's place will be a new column entitled :

Whydontyathink?

Tell us, in 25 words or less, why.



(continued from page 1)

beds bend gently up a few degrees as you approach the river. Bedding on the other side of the river mirrors this fold: rising from the opposite direction to meet the main canyon walls.

These faults and folds occur within a twenty-five mile stretch of the canyon that begins near Fishtail and ends somewhere below Tuckup. The folds are exposed from river level to perhaps two or three hundred feet up the walls. They are petite in comparison to other folds within the canyon like the East Kaibab Monocline. Their expression is restricted entirely to the Muav, and they are persistently aligned with the canyon no matter which way the walls twist and turn. Since the faults and folds so faithfully follow the river, they can only be reached by boat. Voila: three research permits for four people to spend twenty-one days simply messing about in boats during April, July, and October.

Pat Tierney rowed a boat on the first of those three research trips. At the foot of the Bass Trail, Pat and I came around a corner and saw a naked old man standing knee-deep in the river. As we pulled up, Pat whispered that I wasn't going to believe this. The man- George- bellowed out: "Have you got any women?" Pat said no. George, a true gentleman, was relieved not to embarrass anyone as he took his bath. George was once an Indiana mason; since retirement he had tried his hand at rock-climbing, sky-diving, kayaking (Pat had taught him on Westwater the year before), and most recently hiking. He had been in the canyon for six months now, hiking for three weeks at a shot.

George rode with us the next morning. We spent the day dawdling in upper Elves. Story by story, without self-consciousness, he outlined a life led in honor. At day's end, I was sorry to leave him but we had to push on. Five days later, working at Olo, we watched a Georgie White flotilla blast by, boat after boat after boat. Georgie drove the last triple rig, wearing that leopard-skin get-up. George stood next to her in the motor well.

Geologists frequently get away with wildly waving their arms as they describe "tremendous stresses" that cause rocks to fold and mountains to grow. Excuse me, but *how much* stress? "Hard to say, but certainly a lot." Larry Stevens once treated us to his wonderful analogy of 69,000 elephants pouring through Crystal hole every minute. He was putting his money where his oars were, not just waving his arms about "lots of water." Most geologists are loathe to be so precise.

Peter Huntoon had ascribed the presence of the Muav folds to the underlying Bright Angel Shale being

squeezed up like toothpaste by the weight of the adjacent canyon walls. A nice analogy, but one with some shortcomings: its vertical orientation of force could not explain the thrust faults and kink folds that are intimately associated with other, more gentle folds found in this exposure of the Muav. I suspected that Huntoon was on to something with his toothpaste metaphor, but that the driving force behind the folds would turn out to be a bit more complicated.

The beauty of studying the Muav river-level folds was that the stress that caused the folding was quantifiable: gravity, all 32-feet-per-second-squared of it. Regional stresses of the arm-waving ilk can be discounted because the folding so perfectly follows the river as it snakes southwest past Matkat, south toward Sinyala, and northwest toward Ledges. I idealized that section of the canyon into a flat-bottomed gash with vertical walls (not far from the truth); plugged in the specific gravity of the Muav, Redwall, and Supai; and ground the numbers through a finite-element model in order to relate force to deformation, stress to strain.

The mathematics suggested that the most significant stress on bedrock just under the river would be horizontal, not vertical. This is because rock beneath the canyon walls exerts a horizontally directed pressure on its neighbors as it tries to flatten in response to gravity. Rock just beneath the river, on the other hand, is not vertically compressed; the greatest stress it feels is the laterally directed force derived from rocks beneath the canyon walls.

My father was on the second trip. At the outset, I had discouraged him from bringing a transistor radio; I knew that he would just listen to the Albuquerque traffic reports on KOB. At Nevills on night five, I cooked dinner and yelled to come get it. Nothing happened. I couldn't find Dad, and Jimmy Hendrick was missing too. I yelled again. Still nothing. Ten minutes later on that October night in 1977, Dad and Jimmy erupted up from behind a boulder fifty yards away, whooping and hollering as Reggie Jackson hit his third home run in that year's World Series.

Folds that follow canyon walls are not common. The Meander Anticline in Cataract does parallel the Colorado River, but it has no kink folds and can probably best be explained by Huntoon's toothpaste model. The underlying Paradox salts are squeezed up by the differential loading of canyon walls, bending rock along the way, oozing out along the crest as small salt volcanoes in Red Canyon. Beyond Cataract, examples of other river-oriented folds become difficult to find. Even within the Grand Canyon, the folds are expressed in one place (Fishtail to Tuckup) where the Muav is at river level, but not at another (36-Mile to

Saddle). Why are the folds so rare?

The recipe for river-oriented folds first calls for steep walls (lie on your back at Upset Hotel: you're looking two thousand feet straight up to the Esplanade). Add a limestone with just the right consistency: solid beds separated by thin silt layers. The silt, if wet, would allow the limestone layers to slide over one another, much like the pages in a bending telephone book. Imagine trying to flex a single piece of three-inch-thick wood. Maybe Dan Dierker could do it if Brian were holding the other end; I sure can't. But anyone can easily bend a telephone book of the same thickness because the pages are free to slide past one another. Similarly, the Muav limestone (in lots of layers separated by silt) is much more easily bent than a massive limestone like the Redwall. The direction of force acting upon the rock is critical. If the force is perpendicular to bedding, it will tend to lock up the layers, and prevent them from sliding relative to one another while bending. But if the force is directed not-quite-parallel to bedding, then the layers don't lock up and the limestone is more likely to bend.

Back in the office, I fussed and doodled, crumpling a lot of paper along the way. Engineering equations gradually emerged that related stress to strain. Since

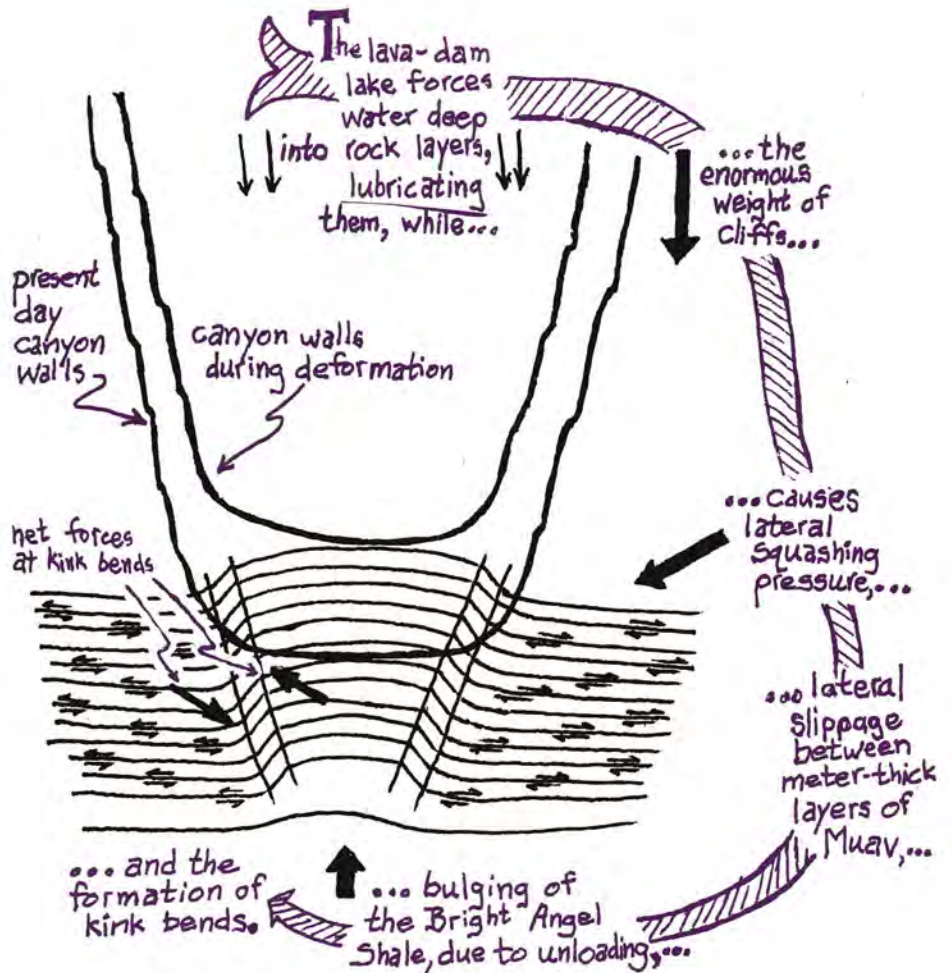
$$[CBI(\frac{2\pi x}{l})^4 \cos(\frac{2\pi x}{l})] - [CP(\frac{2\pi x}{l})^2 \cos(\frac{2\pi x}{l})] = [PSA_1(\frac{2\pi x}{l})^2 \cos(\frac{2\pi x}{l})]$$

then of course

$$v_1(\rho) = \left[\frac{SA_1}{(BB_1^2 + n)(\frac{2\pi}{l})^2 - 1} \right] [1 + \cos(\frac{2\pi x}{l})]$$

I remember a time during graduate school when I lived, breathed, and ate those sort of equations. I once looked groggily out the back seat of a car at snow swirling past the window. For a millisecond, I clearly visualized the snow's movement in terms of the differential equations with which I had been struggling in a dream. Then the circuit breakers blew, smoke poured out my ears, and I fell back asleep. It is fascinating to reflect on those days from this vantage point fifteen years down the road. Did all those variables really make sense to me? Did I speak such a different language then than I do now?

To complete the recipe for these folds, add a dash of raw imagination. Basalt flows plugged up the canyon in the vicinity of Lava Falls about a million years ago, to depths of at least seven hundred feet.



Could this lake have had anything to do with formation of the Muav folds? The river, with its depth measured in tens of feet, is able to wet only superficial horizons of bedrock. Pressures at the bottom of the lake would have been much higher, capable of driving water much deeper into the pores of the Muav. The lake would have been much deeper at Kanab Canyon than back upstream at Buck Farm. This difference in depth and pore pressure might explain the presence of folds in one place and not the other.

The added pore pressure may have been enough to adequately moisten the Muav, and to allow the layers of limestone to glide over one another in response to laterally compressive stresses transmitted from the weight of the nearby canyon walls. In geologic terms, the folding could have occurred in a relatively short time; the mathematics and field observations both point to an "elastic," not "plastic," type of deformation which theoretically occurs at a rate independent of time. According to this "lake" hypothesis, the folding happened a million years ago, before the river eroded

down to its current level; subsequent erosion has exposed the folds where we now see them in the canyon walls.

Hugh Rieck and I each rowed a boat on my third research trip. I had already written the thesis, but my advisor hadn't gotten around to reviewing it before our departure from the Ferry. I was resigned to field checking the work without his comments. Two motor boats pulled alongside near Bedrock, to gab and to ogle the two ladies who were working with us. One of the boatmen was distracted from his ogling by a small plane flying at Redwall level (legal if ill-advised in those days). His distraction turned to downright orneriness when the plane returned and skimmed by at river level. As it passed, a package popped out and a parachute blossomed. I rowed over and fetched the tupperware container: my advisor approved. I jumped up and down, yelling incomprehensibly something that sounded like, "I have a master's degree! I have a master's in Science!"

Wesley Smith, using a bright flashlight and an even brighter imagination, once treated us to a remarkably pornographic shadow show, projected onto the wall across from Ledges. The passengers howled. That same wall brought many of my thoughts about the Muav folds into sharper focus. My equations had predicted that the limestone ought to fold when units about a meter thick were able to slide past one another. Look at that wall next time you drive by: the Kanab Canyon Member of the Muav does indeed seem to have parted into slabs separated by silty planes about a meter apart. Well, *about* a meter. Whose imagination was more fertile, mine or Wesley's?

Equations do not define the Muav folds; they are not a substitute. Instead, I think of them as a light held inside the rock, an illumination that allowed me to inspect the edges, ponder the details, and conjecture about the origin of one tiny aspect of the Grand Canyon.

Education Questionnaire

Thanks for all the response to the education questionnaire that recently went out to guides. We're getting a lot of really good input from it. Let's hear from more of you.

You can expect a summary and perhaps even some action at the Fall meeting, and in the next *news*.

Discounts to Members

A few area businesses like to show their support for GCRG by offering discounts to members. Here are the ones we're aware of:

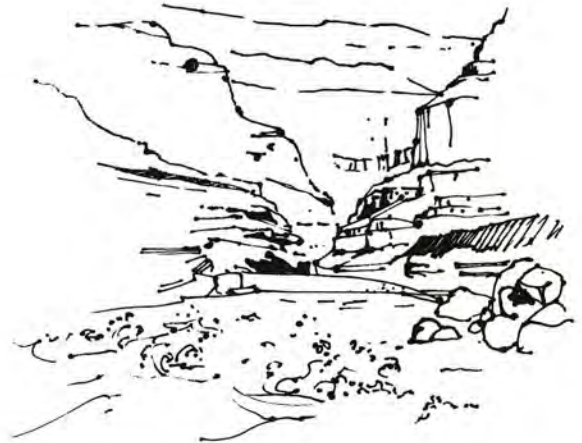
Expeditions 779-3769
625 N. Beaver St. Flagstaff
Boating Gear
10% off merchandise to members

Cliff Dwellers Lodge 355-2228
Cliff Dwellers AZ
10 % off meals to members

Teva Sport Sandals 779-5938
N. Beaver St. Flagstaff
Approx 1/2 price to boatman members
Pro-deals upon approval (approx 1/4 price)
Ask about our winter new products testing program- ask for Adam Druckman

Businesses offering discounts to licensed guides:

Marble Canyon Lodge
Vermillion Cliffs Lodge
The Edge (Flagstaff)
Aspen Sports (Flagstaff)



thanks...

...to all of you for your incredible contributions and energy. Keep it up. Special thanks to Patti Auguste Hollowell and Mary Williams for the drawings

the news is printed on recycled paper with soy bean ink by really nice guys.

The GCRG Board would like to thank all our members whose generous donations over the past year have allowed us to continue our efforts. We deeply appreciate the extra support of the following contributors:

Special Donations (\$500 or more)

Margaret Endres, Tour West Passenger, Florida
Tides Foundation

Benefactor Members (\$277, a dollar per mile)

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- Mark Jensen - CRATE Guide Member, Utah
- Hugh Kieffer - Guide Member, Arizona
- Chuck Mills - Sleight Guide Member, California
- Peter Mills - GCE Guide Member, Utah

Sustaining Contributors (\$100)

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Care to join us?

If you're not a member yet and would like to be, get with the program! Your membership dues help fund many of the worthwhile projects we are pursuing. And you get our lovely journal to boot. Do it today.

<input type="checkbox"/> General Member Must love the Grand Canyon Been on a trip? _____ With whom? _____	<input type="checkbox"/> \$20 1-year membership <input type="checkbox"/> \$100 6-year membership <input type="checkbox"/> \$195 Life membership <input type="checkbox"/> \$277 Benefactor (A buck a mile)* *benefactors get a life membership, a silver split twig figurine pendant and our undying gratitude.
<input type="checkbox"/> Guide Member Must have worked in the River Industry Company? _____ Year Began? _____ Experience? _____	<input type="checkbox"/> \$ _____ donation, for all the stuff you do. <input type="checkbox"/> \$15 short sleeve t-shirt. Size _____ <input type="checkbox"/> \$17 long sleeve t-shirt. Size _____ <input type="checkbox"/> \$.50 GCRG logo sticker. (2 free with membership)
Name _____ Address _____ City _____ State _____ Zip _____	Total enclosed _____

Controlling the Aliens: Ravenna Grass in Grand Canyon

The National Park Service is controlling a non-native grass population in the Colorado River corridor. Ravenna grass (*Poaceae: Saccharum ravennae*) was identified during Glen Canyon Environmental Studies Phase II. Populations of this large (3 m tall), Eurasian bunchgrass dramatically increased in the Grand Canyon from 1987 to 1992. First documented near Lees Ferry in 1981, NAU plant taxonomist Tina J. Ayers and I identified 55 populations between Lees Ferry and Diamond Creek in 1992. Ravenna grass was planted as an ornamental around Wahweap Bay on Lake Powell and the NPS is beginning eradication efforts there. It may have originally arrived at Lees Ferry on a motorboater's bumper in the late 1970's.

Ravenna grass germinates in a wide variety of soil and canopy cover conditions, is highly competitive, and provides little bird and wildlife cover, all of which make it a threat to riparian habitats in the Grand Canyon. Although the threat of ravenna grass invasion to the mainstream riparian zone is significant, the real ecological danger is that this species could invade the Canyon's pristine

tributary and hanging garden habitats.

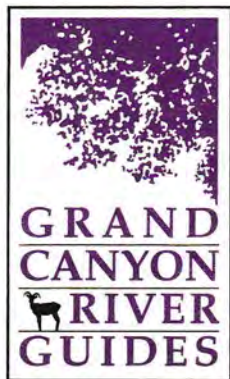
With support from the river subdistrict and logistical support from Canyon R.E.O., a team of Prescott College volunteers armed with shovels and come-alongs mechanically removed more than 1,300 plants in 50 populations during a river trip in March, 1993. Fortunately the root masses are relatively easy to excavate and return visits to removal sites this summer show that excavation is highly successful as a control method.

This species is not yet fully eradicated. We are decapitating this year's seed heads on the few remaining plants to limit dispersal until we conduct the next control trip. Even after all populations are removed (hopefully by next March), we will continue monitoring the river corridor to detect new recruits. So as you cruise the Canyon, if you happen to notice any ravenna grass clumps, please jot down the mile and side and contact the NPS either at GCES or at the Grand Canyon (602 556-7457).



Ravenna grass, a large Eurasian bunchgrass.
Photo Larry Stevens/Hazel Emergency Photo Services

Larry Stevens



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