

Saving North America's Grizzly Bear Ecosystems

And some new ideas on bear attacks

Steve Herrero is a professor in the environmental science program of the faculty of environmental design at the University of Calgary, Alberta, and a leading spokesman and advocate for ecosystem management, especially in the wilderness parks of western Canada, where he has conducted many years of research on carnivores. His book *Bear Attacks: Their Causes and Avoidance*, has become a widely-read reference for hikers, biologists, and managers since it was published in 1985. In a recent survey of bear-management and ecology professionals who were asked to name the most important contributions to the bear literature since the 1960s, *Bear Attacks* was the runaway favorite, named more often than any other popular or scientific work.

In September 1995 Steve was the keynote speaker at the Superintendent's International Luncheon of the Third Biennial Scientific Conference on the Greater Yellowstone Ecosystem at Mammoth Hot Springs. John Varley and Paul Schullery conducted this interview during a break in the conference events, at a picnic table in the cabin area behind the Mammoth Hot Springs Hotel Recreation Center. The conversation was interrupted several times by a bull elk, bugling as he passed the table. His bugles have been deleted from the transcript.

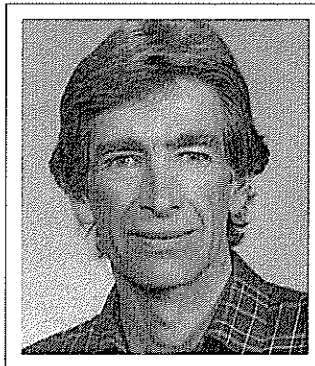


Photo top left: John Varley, Director of the Yellowstone Center for Resources, and Steve Herrero during the course of this interview.

In Case of Bear Attacks

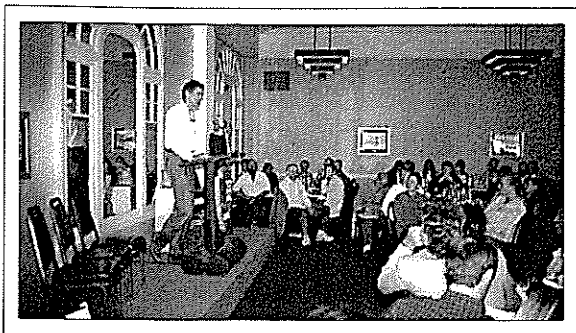
YS: Steve, before we get into our big-picture questions, let's talk about one of your well-known specialties, the study of bear attacks. You've been re-evaluating some traditional approaches to dealing with bear attacks, and I'm sure many *Yellowstone Science* readers would like to hear about it.

In your book *Bear Attacks*, you gave advice on the best way to play dead when near a grizzly bear, suggesting that rolling up in a "fetal position" was probably the best defense. More recently, based on additional information, you've been re-considering that. You now recommend that rather than roll up in a ball, you should stretch out face-down, cover the back of your head and neck with your fingers interlaced, and spread your legs

apart, digging your toes into the ground so that it's difficult for the bear to roll you over.

SH: That's right. And it's based on the fact that grizzly bears often seem to flip people over, which allows the bear to get at that most vulnerable part of the human anatomy, the face. And the face is so delicate, with so many nerves and points where extensive damage can occur, that you really want to be able to protect it. One of the ways of doing that is to play dead.

As you said, the two strategies for playing dead that we've examined are curling up in a ball or lying face down on the ground. Curling up in a ball is the well-known approach that is most often recommended, but I now think that lying face down may be better. I don't think that there is a one hundred percent assurance of this new approach working best all the time, but it seems probable that you are better able to protect your face by lying flat, with your face on the ground, hands behind your neck, and legs spread out. In that position, if the bear tries to flip you over, you're more stable, because



The Superintendent's International Luncheon.

you have a lot of leverage in your legs that help hold you on the ground in that position. And if you do lose your stability and the bear succeeds in rolling you over, you can just continue to roll *completely* over and end up back with your

face down again. I've looked at a couple of incidents in which people have done that and it's worked. So it's hardly something that has been studied scientifically, but it is something that I've played with. In other words, a colleague and I have played bear and person being attacked. Personally, I would certainly do it; I've rehearsed enough that I'm comfortable with it.

YS: What is the latest thinking on what to do if you're charged by a grizzly bear? At that point, it's pretty late to play dead, isn't it?

SH: Playing dead for a charging grizzly bear might even be the *wrong* thing to do. If I'm charged, I am going to stay on my feet until the bear actually contacts me.

YS: But doesn't that risk sending the bear the wrong signal, by suggesting that you're going to accept its challenge and fight back?

SH: I've looked at far too many situations where the bear charged, but stopped only feet away. A lot of charges are only bluffs, but if you run or act submissive at that last minute, you may actually trigger an attack. So I am going to stand there until the bear hits me, and then the moment it hits me, I'm going to play dead.

YS: Some of the old-time hunting writers used to maintain that virtually all charges by brown and grizzly bears were false

charges anyway, and that it was usually best just to stand there and wait for the bear to stop.

SH: The knowledge we have about this may also come from watching the bears interact with each other. If one bear charges another one, and the second turns to run, it's almost certain to get clobbered. But if it stands its ground, the two bears may

go through a lot of roaring and moving around, but most of the time neither of them will get clobbered.

Playing dead for a charging grizzly bear might even be the wrong thing to do. If I'm charged, I am going to stay on my feet until the bear actually contacts me.

There are no guarantees in any of this, but running or showing submission seem to be asking for punishment in those last seconds of the charge. That is why, based on my analysis of the hundreds of incidents we have in our bear-attack data base now, I'm not going to play dead until I've been knocked down.

Managing Habituated Bears

YS: As wildlife watching becomes more popular, and as bear-viewing areas become well known, both bears and people learn more about each other. What are we learning about bear-human tolerances, and how can we apply it more broadly?

SH: That gets us into this whole business of habituation and how safe habituated grizzly bears can be provided you're not camped next to them. Habituated bears are bears that have developed a tolerance for having people near them.

YS: These are what used to be called "tame" bears in Yellowstone, because they let people get very close to them.

SH: Right. The trouble was they weren't tame at all. But habituation can be managed in ways that make it possible for bears and people to be close together, provided that the people understand that they must abide by the rules of the game, and make their actions very predictable so the bears are never surprised.

I spent a large portion of the last two

summers in Alaska, and I've now been to almost all the major bear-viewing sites, so I have a much more personal, intimate understanding of just what can be done through habituation.

YS: Do you mean in terms of using habituation to improve bear watching opportunities?

SH: Yes. Habituation allows a tremendous quality of human experience and at the same time it reduces stress to the bears. You can have bears only two meters away from you, even if they're females with cubs, and still be reasonably safe. But they have to have gotten used to that closeness over a significant period of time, and all human actions have to be totally predictable.

YS: That's all there is to it? Just being predictable?

SH: The other essential ingredient is that there must not be anything that those bears can exploit people for, such as packed lunches. Once it's gone that far, and the bears have learned that they can't exploit people for food, then you can even sit there and eat your tuna fish sandwich with the bears two meters away, and they won't try to take it from you.

YS: We've wondered for years about ways in which we can apply the Alaska experience to Yellowstone, to see if we can find ways to improve bear viewing here. It's already outstanding in some seasons, as you know, but it's necessarily a long-distance business, with bears watched through spotting scopes. We don't even know that we want it any different, but the close-up bear watching that goes on in Alaska intrigues us.

However, part of the folklore, even among bear managers, is that Alaska is different from Yellowstone or Glacier, and that we can't put people and bears that close together down here because of those differences. The difference we hear the most about is salmon; nowhere here do we have the extraordinary salmon runs that, in effect, put those Alaskan bears in such an easy mood. They are enjoying an overload of food when they're being watched up there in Alaska, and not only does that concentrate them in a small area, it makes them less likely to get aggressive about a tuna fish sandwich. At least that's the way the thinking goes. How does all that sound to you?

SH: I think the differences are real. With these richer, concentrated food sources at the salmon streams, the bears have to share space with each other. That means that they have to have a smaller personal distance—what you might call their individual space. They're used to being shoulder to shoulder with each other, and that sets the stage for habituating to people at very close range.

YS: But couldn't it be argued that for 60 years here in Yellowstone, when the bears gathered at the garbage dumps, we were "training" them to have that same small individual space? By the 1960s, there were dozens of bears using a single dump, and they were packed in there close together.

SH: I'm sure you could argue that. But remember the other part that is necessary to make the whole thing work. It isn't enough just to get the bears used to being close together. Human behavior has to be predictable, so that the humans are moving and acting consistently, and not surprising grizzly bears. Besides that, there has to be nothing that the grizzly bears can get from people. In other words, they can't push people around and get food from them.

That's where Yellowstone is so different, because it's such an open system, and a very diffuse system. In the Alaskan bear-viewing areas, managers can control what those bears can get from people. Managers absolutely control food storage in the camp near the viewing area, and absolutely control where and how people move. There aren't any other potential sources of human food for a considerable distance. None of that is true in Yellowstone.

Let me add another corollary of the Alaska work. This is something that's come out very clearly. The managers at McNeil River Falls will allow ten visitors at a time at the bear-viewing platform, and even at that level—even after twenty years of developing habituation and getting these bears accustomed to very consistent human behavior—some of the wariest bears still stay away from the site until the people are gone. They just feed nocturnally. What seems to happen is that you behaviorally structure the population into wary bears on the one hand and bears that aren't wary of people on the other.



Yellowstone's complex road system adds to the potential for bear-human conflict.

When you design a program around people watching habituated bears, you have to take all this into account, and look at what the effects are on bears with different behaviors.

YS: One of the things that has been revealed by the study of grizzly bear habitat use in Yellowstone is that the bears tend to abandon most roadside areas once the car traffic begins. They may use those areas all night long, but only a few habituated bears will stay once there is traffic.

SH: You start off with the proposition that grizzly bears left to their own devices are primarily a diurnal species, who have good reasons to be active during daylight hours. Bears use their vision a lot, whether fishing for salmon or chasing elk; the less light there is, the less effective they will be. So when bears shift their use of the habitat to a more nocturnal pattern, you can be sure that we're having a major influence on their behavior.

YS: The Frenches, (of the Yellowstone Grizzly Foundation), who have observed hundreds of predation episodes in Yellowstone, have emphasized the importance of the bear maintaining

what has been referred to as a "visual lock" on the elk they are chasing. If they lose that, they lose the elk.

SH: And we've observed the same thing

in Banff National Park in Alberta. Our grizzly bears do their elk hunting in the backcountry in the daytime. So the human influence on bear behavior must always be part of the equation in evaluating different interpretive and management options.

But at the same time, you have to be sympathetic to the viewing needs of people, because those viewing opportunities have such tremendous value. Perhaps a combination of a number of management approaches in different areas in a park might work, as would thinking about ways to screen the people and vehicles to reduce the visual impact on the bears.

YS: Another option, though it would be a tough one for Yellowstone with its complex road system, is to control access to certain roads, either by limiting the number and location of vehicles at certain seasons or certain times of the day, or by putting people in buses.

SH: The Denali National Park situation shows that you can get a significant number of bears and other species habituated to

Seeing the bear isn't necessarily the most important experience that people can have. I think that the opportunity should somehow be making a vital connection with the bear's world.

regular bus traffic. Once again, it's not to say that the most wary individual animals aren't affected by the bus traffic on the road.

The apparent success of an approach like that, where the animals are very visible, leads to misunderstandings, though. The first thing people always say is, "Well, we see bears right along the road," or, "Well, the bears come right into town, so obviously our activities don't bother them." That simplistic outlook drives me crazy because it ignores so much that might be happening to the rest of the population while a few bears are willing to hang around near the roads. *YS:* This often comes down to determining just what visitor opportunity is the best one to be provided. The presumption has always been that the best thing, in fact the requisite experience, is to see the bear, and get the obligatory picture of it. *SH:* I don't even know if seeing the bear needs to be the opportunity. Seeing the bear isn't necessarily the most important experience that people can have in that situation. I think that the opportunity should somehow be making a vital connection with the bear's world. That connection may come from the chance to spend time in an area where you can see the elk calves out there running around, and just spend time talking about it all, or seeing the diggings a bear has made, or bear scat. These are ways to make the essential connections without having the great show in the 500 m lens that so many people insist upon. Let's be realistic; if we have to rely on the great show in the camera, we're never going to have more than a few people get into the bear's world and appreciate what wonder is to be had there. But if we try to broaden the interpretive links, for example through the various traces that bears leave in their environment, then people can get a vital, powerful experience just by sharing the land of the bear for a moment. Because they saw bear sign, they know that the bear is there and that they've made a contact with its physical presence that in a way is even more powerful than seeing it a mile away through a spotting scope. With that kind of experience in mind, we can reach a tremendous number of people. *YS:* Perhaps it would be possible to have a 50-yard stretch of road that was made of fine sand or some other soft surface that you could rake smooth every evening. Then in the morning, people could explore it for tracks and other sign.

Saving Grizzly Bear Habitat

But let's move along to other larger questions about bears and conservation. Many of us here are convinced that at least the short-term prognosis for the Yellowstone grizzly is pretty bright. The evidence suggests that the population is doing pretty well.

SH: Yes.

YS: But we don't know anybody, at least not anybody with a reasonably sound perspective on the future, who thinks that the long-term prospects for the grizzly bear in greater Yellowstone are anything but grim. The grizzly bear is resilient enough to handle ski areas, or hard rock mining, but nobody with even half a brain believes that the bear is resilient enough to handle the entire array of civilization encroachment that we're seeing here.

In years like this one (1995), when specific food sources fail or are poor, the bears know how to adjust and find other foods. But we are more and more in the way of that process, so we've got bears in dog food, in horse oats, in bird feeders, and in a lot of other places that are hard on bears. Maybe the big question is, are we kidding ourselves that we can keep the bear for the long term with all these conflicts?

SH: Not necessarily. Never second-guess what the future is going to be like in terms of the possible changes in human behavior. Who would have predicted that smoking behavior would be regarded as it is today, twenty years ago? All we need to do is generate a population that believes that our ecological disruption and dismemberment of natural systems is as deleterious to our health as smoking is, and you'll see a whole lot of behavioral changes in people. In the meantime, by learning what the critical habitat features are, and by studying the movement corridors between them and the way that bears might use them, we have the potential for managing the grizzly bear ecosystem.

As long as there is a future, there is the potential for us to see major changes in human behavior and human expectations in the broader region. And once Americans, Canadians, and people anywhere decide to care, there is tremendous potential for giving back to wildlife and natural systems those areas critical for them—

areas that we've learned about through study. So no, I'm not entirely pessimistic about the future. If I were, I'd probably be doing something else.

YS: There is a population of brown bears, the same species as our grizzly bears, in Italy that you're familiar with; it's a small isolated population of bears that's been through world wars and is surrounded by thousands of armed people and yet it still keeps going. Is that the sort of island ecosystem we're headed for in greater Yellowstone?

SH: Let's hope we're not going that way, because there the bear has been so harassed by human beings over centuries that it hardly even acts like a brown bear anymore; it's as if it is evolving into a black bear. It is small, extremely shy, and nocturnal, and it does everything more like a black bear than a brown bear.

But at the same time, even in that situation there is potential for improvement. The habitat under protection has more than doubled since 1971, and they are managing beyond a park boundary into a greater ecosystem. The only hope for a real future is a continuing improvement in ecological literacy and a continuing appreciation for the value of natural systems in Italy. If that doesn't develop, then the bear's habitat will either be crushed back, or the accumulating development will catch up with it gradually, as is happening here in greater Yellowstone.

YS: But we have some impressive precedents here, in which we were surprised by really big changes in public attitudes. In 1950, who would have predicted that in 30 years most park fisheries would be managed as either catch-and-release or some other very restrictive regulation? People were conditioned to demand dead trout. In 1960, who would have predicted that we would restore fire, or, maybe even more amazing, that we would restore wolves?

SH: What that tells us is we must dream of healthy, sustainable, ecological futures, and we must be convinced that they can happen.

YS: By the way, the Yellowstone Lake crisis, with the discovery of non-native lake trout in the lake, has brought more attention to the importance of the lake's cutthroat trout to the grizzly bear population. We have recently been told that

Yellowstone Lake is the only inland fishery in North America where the native fish are important to a grizzly bear population. Does that statement agree with your experience?

SH: I think that's true. We've got reasonable cutthroat populations in a couple of lakes in Banff, for example, but we have found no evidence of grizzly bears feeding on the spawners. I think it has to do with the overall available biomass in the system. There just isn't enough to really get the bears started on it there, as opposed to here. So yes, I'd agree. I cannot think of another inland fishery situation where fish are as important as they are here. But ironically, this is the last of the great ones. This is the last trout-grizzly bear ecosystem in the lower 48 states.

YS: That seems to add yet another reason to make sure Yellowstone Lake survives in good condition, but situations like our current lake trout crisis on Yellowstone Lake are the sort that can easily lead to despair. We've even heard hard-core, long-time conservationists throw in the towel on this one, and tell us we should just give it up and accept the lake trout. Of course, we don't think we have the legal right to do that, even if we wanted to, but it does suggest the confused mood of the public over what can and cannot be accomplished in saving wild resources.

The Canadian Approach

The point is that we Americans think we have it tough trying to protect the environment, but compared to a lot of other countries, we have some enviable advantages.

How is this whole process of conserving rare animals and endangered eco-

systems different in Canada? You don't have near the environmental legislation we do to help you accomplish things, do you?

SH: Thank you for asking that. It's a hell of a lot tougher in Canada without an Endangered Species Act. We ultimately have to convince local people that habitat protection, mortality management, development management, and many other initially unpopular things are important

enough for people to give up, or at least to modify their short-term resource-development ambitions. It's a lot tougher when you have to fight, in that perspective, day to day, than when you have the overall future of the species as the bottom line for measuring things against. Without an Endangered Species Act, and without a consensus regarding the importance of say, grizzly bears, you don't have the kind of leverage you have here, and there is no baseline against which to develop standards, except possibly population viability.

YS: So who fights the educational battles up there? Is it just the conservation groups who are educating the public? Who speaks for the ecological literacy that we talked about?

SH: It's primarily the conservation groups, and then the national parks.

YS: At Yellowstone's science conference in 1993, Monte Hummel of World Wildlife Fund Canada was one of the keynote speakers, and he explained the Canadian process in terms of building consensus among the interest groups. That seems like the opposite approach from the one taken in the United States, where we seem to move forward through advocacy and confrontation, with one side or the other "winning" each battle, often in court. It is difficult to say which system works best, but it looks as if the Canadians probably know a lot more about consensus building than we do, and more about making do with fewer legal weapons.

SH: Exactly. We have no choice but to build consensus and I'll give you a good

example. We've recently founded what we're calling the Eastern

Slopes Grizzly Bear Project. It looks at grizzly bears throughout the broader Banff ecosystem, a 22,000-km² area with multiple jurisdictions. It's similar to your Interagency Grizzly Bear Committee in scope, but it is not a government-mandated group. It contains representatives from all the jurisdictions that the grizzly bear goes into plus all the major resource-development industries.

So in contrast to being government-

driven, it is much more a grassroots conglomeration of conservation groups, development groups, ranching groups, other resource exploitation groups, and federal and provincial governments. We're bringing all these groups together into a steering committee and trying to build a consensus. We'll look at the map and say, here is where grizzly bears die, here is where their native habitat is, here are the linkages that connect these areas. How can we redesign this whole package to fit the needs of grizzly bears? Of course by taking that approach and using grizzly bears, what we're really doing is buying diversity in large scale for the natural systems of the area.

YS: Monte Hummel stressed that very kind of cooperation and joint public-private leadership. In effect, he said that "We would never expect our government to take the lead." That is a huge difference, a 180-degree difference, from the way we do business in the United States. We simply insist that the federal government take the lead, and we've attempted to empower them to do just that by giving them all these laws—the Endangered Species Act, the National Environmental Policy Act, the National Park Service Act, and many more.

But you raised a more complex question when you spoke of reaching consensus among so many different groups of people. For many people, law and science aren't the central issues at all. The central issues revolve around differing views of the good life, and of the value of nature, and all the emotional, subjective things at stake in these dialogues.

SH: And that is the interesting question: whether the conservation of the future will be driven largely by rational analysis suggesting that it's necessary for our futures, or by some people's emotional, experiential connection with nature.

But I'd like to conduct a little interview here myself, if you don't mind.

YS: That seems fair.

SH: I am curious about how you hope to manage the developments in your regional ecosystem into the future, in terms of the needs of the grizzly bear. Obviously we want the ecosystem to function at the level at which grizzly bear conservation can be a success. But I'm hearing a lot about the major mine [near Cooke

City, Montana] that poses a threat to grizzly bear habitat and other values, and of course there is all the subdivision development in the ecosystem.

YS: And a thousand other threats, with just as many opinions on how serious each of them is.

SH: Right. So how do area managers see this situation, and what are the hopes for preventing the whole greater Yellowstone ecosystem from just being developed to death?

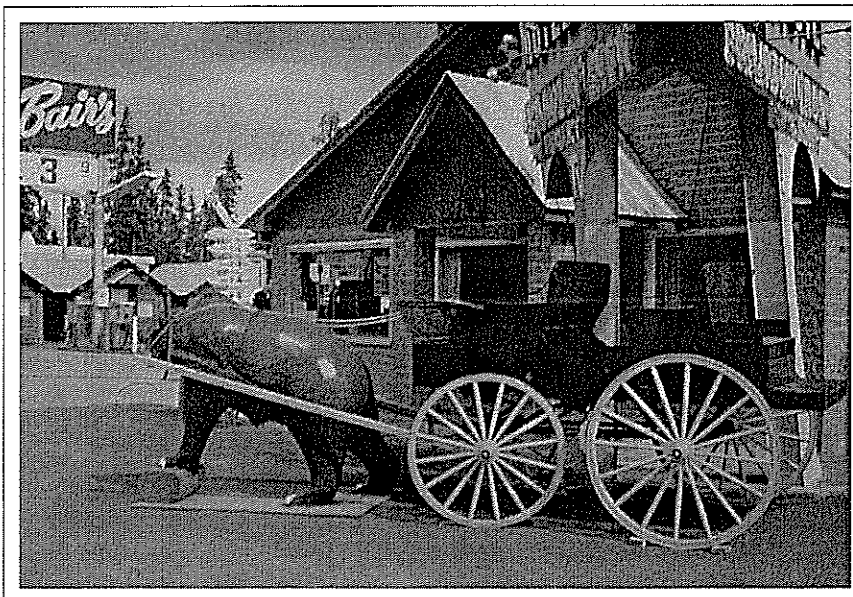
YS: *Yellowstone Science* doesn't pretend to speak for any of the area's land managers, of course, but there are some obvious elements of the situation that we can review.

For one thing, though we Americans have great laws to help protect bears and the rest of the wild setting, we also have a passionately independent ideal of private property rights. Any time a federal or state agency appears to be even thinking about infringing upon someone's real or imagined private property rights, advocacy groups that normally might not even talk to each other will bunch up to object in unison. Throughout the ecosystem management debates, the rhetoric of the federal managers has sometimes been fairly bold, but it has rarely come near private property issues. That's like discussing religion; it falls outside the realm of possible discussion.

But almost a fifth of the land in greater Yellowstone, depending upon your definition, falls into the category of private land. And the uses of that land already threaten not only grizzly bears, but also wolves and much of the best remaining ungulate winter range. The reality has been that the federal agencies are attempting to honor their mandates to protect grizzly bears and other species and systems solely by doing so on federal lands. Many people would argue that they're failing even there, but like it or not, the federal conservation agencies are pinning their hopes on public lands, and largely ignoring the essential private lands, even though some private landowners are almost willfully destructive of the ecological values that are the region's most important single characteristic.

SH: It seems to be a very big challenge.

YS: It will only be overcome if we experience another of those changes in public



Commercial development is obviously one of the most common threats encroaching upon remaining grizzly bear habitat.

attitudes we talked about earlier. What will have to change is the conceptions of individual people about where they live; until they recognize themselves as members of a bigger and more complex community than their own neighborhood, progress will be slow and painful, if it happens at all.

A big change that has come about because of the greater Yellowstone movement of the past 20 years is that many managers are feeling the necessity of looking beyond their own boundaries, and a growing number of citizens are insisting they do so. Thus we see more interagency coordination, though still not enough, between agencies. Thus we also see our superintendent speaking out on the mine and other ecosystem issues that we believe have significant potential effects on the well-being of the park. Ecosystem management may still be a politically dicey concept, but it's seeping into the works from all directions on the practical level.

The tradition of adversarial relationships is slow to die, but here and there are really promising signs of agencies working not only with each other but also with private landowners to find shared interests and ways to serving everybody's needs. The Greater Yellowstone Coalition and others have been promoting sustainability and community planning,

and though we're all only at the beginning of a very long road, it is clear that it's possible to do this right only if we want to badly enough.

SH: I think that we've hit on something that is really important for both countries to consider. There are advantages and disadvantages to the adversarial system of accomplishing things, as it exists in the United States. On the one hand, it has provided you with some excellent strong laws, and on the other hand it has created tremendous divisiveness in the region. There are also advantages and disadvantages of having to make all progress through consensus, the way we do it in Canada. We lack the fundamental legislative mandate forcing us to save clearly defined things, but on the other hand we are getting practiced at hammering out real consensus about how to save what we can all agree we should save.

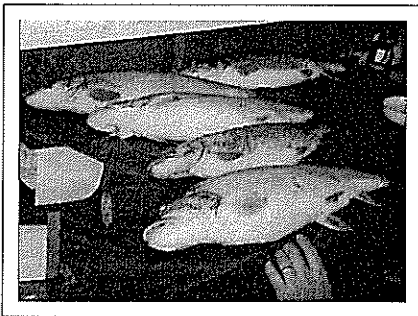
YS: So perhaps what we need is a more creative combination of both systems.

SH: Right. In the future of the greater Yellowstone landscape, you're going to see a lot of things happening on that fifth of the ecosystem that is private. The conservation agencies and conservation groups have the least legal clout on those lands, and that seems like the best place to start working on consensus planning of the sort we have to do all the time in Canada.

Lake Trout Catch Nets Big Ones as Aquatic Threat Looms Larger

The largest remaining inland cutthroat trout population in the world is found in Yellowstone Lake, where it is being preyed upon by nonnative lake trout. Experimental gill-netting continues in an effort to determine the scale of this recently identified threat, and to determine the best means of controlling the lake trout population.

Scale samples indicate that lake trout were illegally introduced at least 16 years ago, but because they usually dwell in deeper water than cutthroat trout, their presence went officially undetected until 1994.



The good news is that most of the fish netted so far in 1996 have come from the West Thumb of Yellowstone Lake. The bad news is that catches include a 32-inch, 12.5 pound mature male lake trout, caught by an angler, and a 33-inch, 20.3 pound female carrying hundreds of eggs. As of July 16, more than 300 lake trout had been caught in gill nets or by anglers this summer.

McIntyre to Serve as Interim Head of Fisheries Staff

Dr. Jack McIntyre, a retired U.S. Forest Service fisheries biologist from Boise, Idaho, has volunteered to serve as the interim head of Yellowstone's fisheries management staff.

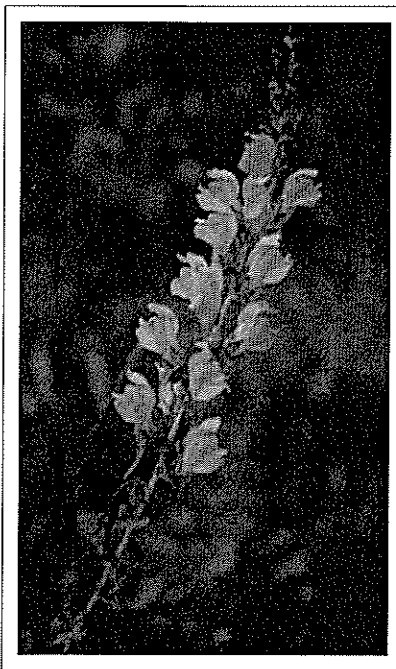
Yellowstone has been fortunate to have a U.S. Fish and Wildlife (USFWS) Fisheries Assistance Office located in the park for several decades. However, due to changes in USFWS programs and funding priorities, the fisheries assistance office will close by the end of this fiscal

year. One of the USFWS biologists has accepted a transfer and joined the park staff, and the Yellowstone Center for Resources hopes to add more permanent aquatic or fisheries biologists to its ranks in the next few years.

Meanwhile, McIntyre arrived in Yellowstone in July to begin supervising the efforts to control lake trout and maintain other priority programs, such as fluvial Arctic grayling restoration and cutthroat trout population monitoring.

Exotic Plants Reach Record Numbers

The number of exotic plants in the Yellowstone ecosystem has more than doubled in the last ten years, according to Craig McClure, West District Resource Management Coordinator. Known exotic plant species now number 172. Exotic plants are one of the most commonly identified threats to the health of native species in national parks. Some of the exotic plants, such as spotted knapweed, can create monocultures and result in soil erosion, desertification, or reduced forage. Many exotics are not palatable to wildlife.



Dalmatian toadflax (*Linaria dalmatica*)

The park uses a variety of control techniques, including hand-pulling and approved chemical spraying. The possible

use of biological controls is also being evaluated. Biocontrol involves the introduction of parasitic organisms that naturally feed on the exotic plants.

To date, rangers have discovered four species of exotics with biological controls that have not been intentionally introduced: a gall fly, *Urophora affinis*, on spotted knapweed; a flower-head weevil, *Rhynocyllus conicus*, on musk thistle; a beetle, *Brachypterolus pulicarius*, and a weevil, *Gymnetron* spp., both seed-reducing insects, on dalmatian toadflax and on yellow toadflax.

Wolf Dynamics

At least 14 pups were born to four wolf packs (Leopold, Soda Butte, Rose Creek, and Nez Perce) this spring, joining the 31 other wolves known to be living in the Yellowstone ecosystem as of July 15.

Nine wolves have died since the reintroduction program began in January 1995. The latest fatalities include the second to result from collision with a truck (the alpha female of the Chief Joseph pack) and two deaths that may have resulted from interactions between packs.

On May 20, the radio collar on the alpha male of the Crystal Creek pack gave off a mortality signal. The dead wolf, found near what was believed to have been the pack's den site in the Lamar Valley, had puncture wounds on its hind legs. Biologists believe he may have been killed by the Druid Peak pack, which has frequented the northern portion of the Lamar Valley and the upper Slough Creek drainage since its release in April. The two remaining members of the Crystal Creek pack are still in the Lamar Valley.

The Rose Creek pack, which was released in 1995, denned along lower Slough Creek, and on June 18 was observed fighting there with the Druid Peak pack. Three days later, a radio signal indicated the mortality of a Rose Creek yearling male. Biologists speculate the wolf, which was in excellent condition at the time of his death, may have also died of wounds caused in the encounter between packs. Both carcasses have been sent to a forensics lab to determine the exact cause of death.

Members of two packs have been captured and are being temporarily penned

in the park in response to rancher concerns about livestock predation. This includes all seven wolves in the Soda Butte pack, which denied on private land in west Rosebud Creek near the Custer National Forest, and two yearlings from the Nez Perce pack, which has ranged apart since its release in April. As of mid-July, efforts were underway to catch the Nez Perce alpha female and four pups seen with her. A fifth pup was wounded in a trap set for the adult wolf and is under veterinary care. This summer, eight sheep deaths have been officially attributed to wolf predation, and it's believed that Nez Perce pack members were responsible.

Inside Yellowstone National Park, visitors again enjoyed wolf watching opportunities, especially in the Slough Creek area during elk calving season in June.

“Greening of Yellowstone” Workshop Scheduled for October



The *Greening of Yellowstone Workshop: Great Ideas for the Next 125 Years for the Park and its Neighbors* will be held October 16-18, 1996, at the West Yellowstone Conference Center. The workshop's goal is to foster more sustainable use of resources in the park and surrounding region, and to promote partnerships to address more efficient energy sources, transportation, waste and water management, and use of biodegradable and recyclable materials.

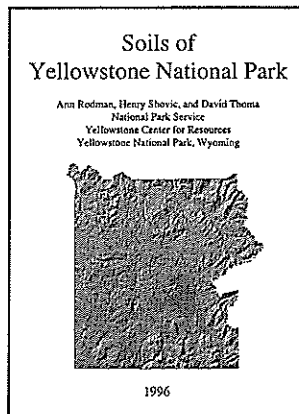
The workshop is jointly sponsored by the National Park Service, the Montana Department of Environmental Quality, the U.S. Department of Energy, Global Environmental Options, and a variety of public and private interests. The registration fee is \$125 per person, including meals and workshop proceedings. Group discounts are available. For more information contact Holly Long, Greening

Workshop, Yellowstone National Park, P.O. Box 168, Yellowstone National Park, Wyoming 82190, (307) 344-2324. Fax (307) 344-2356; email: holly_long@nps.gov.

Proceedings from *The Ecological Implications of Fire in Greater Yellowstone: the Second Biennial Conference on the Greater Yellowstone Ecosystem* are now available. Copies are being sent to all conference registrants. Additional copies may be purchased for \$24.95 (includes tax, shipping, and handling) by contacting Jason Greenlee, International Association of Wildland Fire, P.O. Box 328, 103 East Main Street, Fairfield, WA 99102-0328. (800) 697-3443 Fax (509) 283-2264; email: jgreenlee@igc.apc.org.

Yellowstone's Soil Survey Completed

After eight years of data collection, ground-truthing, and analysis, Yellowstone's soil survey has been completed. The project, headed by Dr. Henry Shovic under a cooperative agreement with the Gallatin National Forest, has resulted in the printing of maps and two documents, entitled *Soils of Yellowstone National Park* and *Landforms and Associated Surficial Materials of Yellowstone National Park*. The reports will be distributed to park staff, cooperators, and Yellowstone's research library; limited copies may be available by contacting Ann Rodman, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, Wyoming 82190, (307) 344-2216.



Obsidian Cliff Becomes a National Historic Landmark

On May 6, 1996, the Obsidian Cliff archeological site between Norris and Mammoth was approved as a National Historic Landmark. Only a few of the historic properties with national significance, as defined for the National Register of Historic Places, are selected for this honor; approval of Obsidian Cliff by the Landmarks Committee took nine years. The Register is a listing of important archeological sites, buildings and locations that have historic or cultural values.

There are several features that qualified Obsidian Cliff National Historic Landmark as a landmark and that make it unique. For nearly 12,000 years, native peoples engaged in the mining and production of stone tools made of obsidian, a volcanic stone commonly found in Yellowstone. Prehistoric peoples traded these tools and raw materials around the continent. As raw material, obsidian could be worked into tools sharper than modern surgical scalpels, and it could be transformed into jewel-like precious objects that continue today to be revered as art and symbols of power and wealth.

One of the most renowned sources of obsidian was Obsidian Cliff. The ancient societies who occupied the area were hunters and gatherers, and the societies to which obsidian was traded varied substantially in economy, settlement, and sociopolitical and ceremonial organization over time and space. Obsidian Cliff includes intact mining features, workshops, and campsites of what can be called one of the first industrial areas by people in North America.

Obsidian Cliff also played a major role in the application and development of techniques for geochemical fingerprinting and dating of obsidian. These techniques, which analyze elemental components of the rock, have subsequently been used to study other types of stone that were culturally modified and traded. Obsidian-hydration dating was introduced by geochemists to American archeology as a new chronometric method with the initial work based on Obsidian Cliff obsidian. These sourcing and dating analyses are now routinely used in American archeology.