Population Status of the Razorback Sucker in the Middle Green River (U.S.A.)

TIMOTHY MODDE,* KENNETH P. BURNHAM,† AND EDMUND J. WICK‡

*Colorado River Fish Project, U.S. Fish and Wildlife Service, 266 W. 100 N., Vernal, UT 84078, U.S.A., email r6ffa_ver@mail.fws.gov

†Colorado Cooperative Fish and Wildlife Research Unit, National Biological Service, 201 Wagar Building, Fort Collins, CO 80523, U.S.A.

‡Colorado Cooperative Research Unit, National Park Service, 336 Aylesworth Hall, Fort Collins, CO 80523, U.S.A.

Abstract: *The razorback sucker,* Xyrauchen texanus*, in the middle Green River (U.S.A.) has been described as a static population consisting of old individuals that will eventually disappear through attrition. Capture data between 1980 and 1992 indicated a constant length frequency despite a slow but positive growth rate of individual fish. Abundance and survival estimates indicated that the population of razorback sucker in the middle Green River is precariously low but dynamic. Although high variation existed among survival estimates, no significant decrease in the population between 1982 and 1992 could be detected. The low level of recruitment occurring in the razorback sucker population of the middle Green River was related to high-flow years, indicating that floodplain habitats may be necessary for survival of the species.*

El estado poblacional de *Xyrauchen texanus* en el río "Middle Green" (EEUU)

Resumen: *La probación de* Xyrauchen texanus *en el río "Middle Green" (EEUU) ha sido descrita como estática consistiendo en individuos viejos que eventaulmente van a desaparecer por atrición. Los datos de captura entre 1980 y 1992 indicaron una frecuencia de tallas constante a pesar de una tasa de crecimiento individual lenta pero positiva para los peces. Las estimaciones de abundancia y supervivencia indicaron que la población de* Xyrauchen texanus *del río "Middle Green" es precariamente baja pero dinámica. Si bien existió una alta variación entre las estimaciones de supervivencia, no se puedo detectar un decremento poblacional significativo entre 1982 y 1992. Los bajos niveles de reclutamiento que ocurren en la población de* Xyrauchen texanus *fue relacionada con años de grandes caudales lo que indica que los hábitats de las planicies de inundación son necesarios para la supervivencia de la especie.*

Introduction

The razorback sucker, *Xyrauchen texanus,* was listed as endangered under the U.S. Endangered Species Act in 1991 (U.S. Fish and Wildlife Service 1991). This fish is endemic to the Colorado River Drainage. Once numerous in the mainstem and most major tributaries (Minckley et al. 1991), this species is now commonly found only in Lake Mohave and the middle Green River drainage between the confluence of the Yampa and Duchesne Rivers (Bestgen 1990). Decline of the razorback sucker has been attributed to physical changes in habitat associated with reductions in flow, alterations in temperature, and establishment of nonnative fishes (Carlson & Muth 1989). Today the middle Green River supports the largest population of razorback sucker occupying riverine habitat (Tyus 1987; Tyus & Karp 1990). This population was described by Lanigan and Tyus (1989) as a remnant stock of approximately 1000 individuals that lacks recruitment.

Razorback sucker are known to congregate and spawn at two locations (Tyus & Karp 1990) in the middle Green River (upstream of the town of Jensen, adjacent to the Escalante Ranch, river kilometers [RKM] 492–501, and at the mouth of the Yampa River, Fig. 1),

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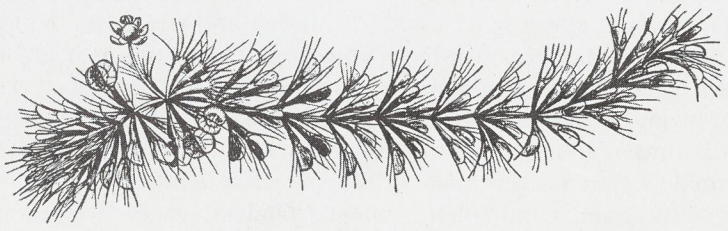

Hybridization between *Catostomus commersoni* (white sucker) and *Catostomus macrocheilus* (largescale sucker) in Williston Reservoir, British Columbia, with notes on other fishes

JOSEPH S. NELSON

Department of Zoology, The University of Alberta, Edmonton, Alberta T6G 2E1, Canada

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Eleven species of fish were obtained in shoreline collections from Williston Reservoir, Peace drainage, British Columbia.

Hybridization is occurring between *Catostomus commersoni* and *C. macrocheilus*, but the 5.8-per-cent estimate of juvenile hybrids is not markedly higher than that observed in nearby, undisturbed lakes several years earlier. No evidence of hybridization was found in the four species of cyprinids, even though some of these species hybridize elsewhere in their range.

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Introduction

Environmental disturbances are frequently associated with cases of hybridization between closely related species. In an earlier study (Nelson, 1968), two species of fish, *Catostomus commersoni* (Lacépède) (white sucker) and *C. macrocheilus* Girard (largescale sucker), were found to be hybridizing under apparently natural conditions in the Pack-Crooked River drainage, a tributary to the present Williston Reservoir. The subsequent construction of Williston Reservoir thus provided an ideal opportunity to determine if environmental change would increase the rate of hybridization. At the same time it seemed desirable, in the absence of other work, to learn something of the relative numbers of inshore fishes shortly after reservoir construction. The changes in the aquatic environment may differentially favour some species and changes in the species ratio, though not necessarily predictable, would not be unexpected. Collections would thus provide some baseline data for certain sites which could be useful in documenting any future changes in species ratio. However, such data would have to be used with caution in future studies in the absence of information on such things as daily and seasonal variation. The purpose of this paper is to document hybridization between *C. commersoni* and *C. macrocheilus* in Williston Reservoir and to note the relative abundance of the other fishes collected.

Description of Williston Reservoir

Williston Reservoir (termed Williston Lake in most tourist literature) was created by the 182.9 m (600 ft) high W. A. C. Bennett Dam on the Peace River, located west of Hudson Hope, British Columbia, about 225 km (140 mi) north of Prince George. The reservoir consists of three elongate arms: Finlay Reach extending north-northwest, Parsnip Reach extending south-southeast, and Peace Reach extending to the east. The first two arms lie along the northern extension of the Rocky Mountain Trench, whereas the latter penetrates the Rocky Mountains. The total length of the three major arms is about 360 km (225 mi) and the width is greater than 8 km (5 mi) in some areas. The largest tributaries, the Finlay, Omineca, Manson, Nation, Parsnip, and Pack-Crooked Rivers, flow into Finlay and Parsnip Reaches. Williston is one of the world's largest man-made lakes and is the largest body of inland water in British Columbia (it is about three times larger than the largest lake, Atlin). In total area the reservoir covers some 1,657.6 sq km (640 sq mi) and has 1,770 km (1,100 mi) of shoreline. Some of the basin was logged before flooding and efforts are continuing to clear floating logs from the reservoir.

The reservoir took approximately four years to fill, during which time the mean annual discharge of about 1,020 cubic m per sec (36,000 cubic ft per sec) was stopped. Flooding commenced December 12, 1967, at about an elevation of 511.8 m (1,679 ft) above mean sea-

level with the 609.6 m (2,000 ft) level reached June 13, 1968, and the 670.6 m (2,200 ft) level reached June 15, 1972. The maximum operating elevation of this hydroelectric reservoir is 672.1 m (2,205 ft) and the annual drawdown is expected to average about 16.8 m (55 ft), leaving a normal low level of about 655.3 m (2,150 ft).

Elimination of peak flows in the Peace River produced detrimental effects downstream in the Athabasca delta region because of unusual topographic features. This effect has been documented by Reinelt (1971), in studies of the Peace-Athabasca Delta Project Group (Anon., 1972, 1973), Smith (1973), Gill (1973), and Gill and Cooke (1974).

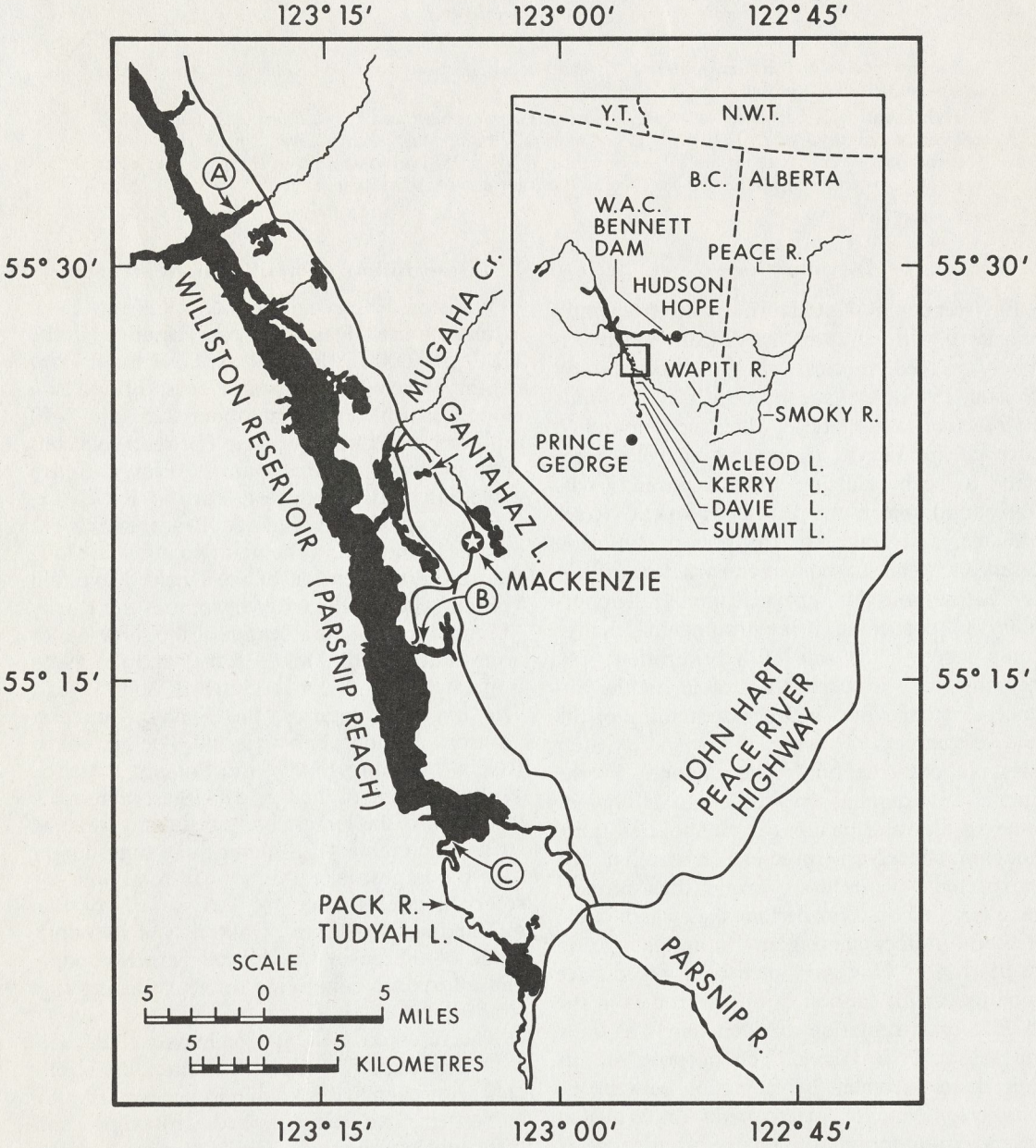

FIGURE 1. Localities from which fish were collected in Williston Reservoir and adjacent lakes to the south. *A*, Blackwater Ferry Terminal; *B*, Finlay Navigation Bay; *C*, near mouth of Pack River.

Materials and Methods

Fishes were collected in the reservoir on July 8 and 9, 1973, with the water level at 670.65 m (2,200.3 ft) and 670.71 m (2,200.5 ft) elevation above mean sea-level respectively. Collections with relatively large numbers of fish were made from three sites on Parsnip Reach (Fig. 1). Rotenone (Chem Fish Collector) and dipnets were used at the sites east of the Blackwater ferry-crossing (Lat. 55°32′N, Long. 123°19′W) (Fig. 2) and east of the Finlay Navigation dock (Lat. 55°16′, Long. 123°08′) because of the numerous logs which prohibited seining. Rotenone was dispersed along approximately 15 m (50 ft) of shoreline at the Blackwater site and 30 m (100 ft) at the Finlay Navigation site. Fish were extremely numerous in shallow water and readily seined [Ace oval net of 4.8 mm ($\frac{3}{16}$ inch) mesh] at the southern site near the entrance of the Pack River (about Lat. 55°07′, Long. 123°06′) (Fig. 3). The shoreline at the first two sites was generally barren (except for logs), wave-swept, and rocky. The latter site was considerably different in that it was protected from wind action and the water was flooding natural ground cover. Collections were also made in Tudyah, McLeod, Davie, and Summit Lakes, along the Pack-Crooked system, on July 9–11, 1973. All fish are deposited in The University of Alberta Museum of Zoology (Williston Reservoir, *UAMZ 3221–3224;* Packed-Crooked Lakes, *UAMZ 3225–3228*). Additional *C. commersoni* and *C. macrocheilus* material deposited in the National Museum of Natural Sciences and The University of Alberta Museum of Zoology, and collected from the Peace River drainage of Alberta (primarily from the Wapiti system), was examined for hybrids.

Specimens of all species (except *C. catostomus*) were examined carefully for evidence of hybridization. Such evidence was found only for *C. commersoni* and *C. macrocheilus* and was based on quantifying several characteristics. The criteria and standards for recognizing hybrids followed the earlier study (Nelson, 1968),

FIGURE 2. Collecting site immediately east of the Blackwater Ferry crossing. July 8, 1973.

FIGURE 3. Collecting site at the southern end of Parsnip Reach near the mouth of the Pack River. Fish were extremely abundant in the shallow miniature bays of this area. July 9, 1973.

although the various characteristics were not combined mathematically into a character index. Dorsal to pelvic fin distance, caudal peduncle depth, degree of peritoneum and side colour, and dorsal ray counts were established as described in Nelson (1968). In this study, much difference was found between the two species in the amount of pigment on the interradial membrane of the dorsal fin. In young *C. commersoni* the interradial pigment is absent or very light, except immediately adjacent to the rays and along the distal fin margin, whereas in *C. macrocheilus* it is well developed and usually extends proximally from the distal fin margin to half or more of the distance to the body. Expression of this characteristic was based on the fractional distance which the pigment extended toward the body on the anterior portion of the fin with it erected so as to stretch the membrane. Specimens judged to be hybrids on the basis of the ratio of dorsal pelvic distance to caudal peduncle depth and peritoneal and side colour also tended to be intermediates in dorsal fin pigmentation.

Results and Discussion

Individuals of 10 fish species were obtained along the shoreline in depths of less than 1.2 m (4 ft) at the three main collecting sites (Table I). In addition, two small specimens of *Cottus cognatus* (slimy sculpin) were collected near the mouth of Mugaha Creek, about 10 km (6 mi) north of Mackenzie. *Thymallus arcticus* (Arctic grayling), *Salmo gairdneri* (rainbow trout), and *Salvelinus malma* (Dolly Varden) were either seen in fisherman's creel or were reported by them to be in the reservoir, and were also reported in the general area in the preimpoundment survey of Withler (1959). No evidence of *Esox lucius* (northern pike) was obtained. Although they were reported by Lindsey (1957) and Withler (1959) to be in the Peace River upstream of Hudson Hope,

TABLE I

Fishes collected from the three main sites in Williston Reservoir

Species	Number	Standard length (cm)
A. Blackwater ferry terminal (*UAMZ 3221*)		
Coregonus clupeaformis	2	2.5– 3.3
Couesius plumbeus	358	2.1– 6.0
Richardsonius balteatus	54	1.7– 7.7
Catostomus catostomus	9	3.3– 5.0
Catostomus commersoni	7	3.8– 4.5
Catostomus macrocheilus	2	3.4– 3.5
Cottus asper	6	3.0– 3.8
B. Finlay Navigation Bay, Mackenzie (*UAMZ 3223*)		
Couesius plumbeus	76	2.9– 7.3
Mylocheilus caurinus	3	4.2– 7.3
Ptychocheilus oregonensis	2	7.8– 8.9
Richardsonius balteatus	58	2.1– 5.5
Catostomus catostomus	17	3.4– 9.4
Catostomus macrocheilus	11	6.8–13.9
Lota lota	2	9.9–12.1
C. Near mouth of Pack River (*UAMZ 3224*)		
Coregonus clupeaformis	1	2.9
Couesius plumbeus	399	2.3– 6.4
Mylocheilus caurinus	204	3.5– 5.1
Ptychocheilus oregonensis	68	2.4– 7.0
Richardsonius balteatus	638	2.2– 6.1
Catostomus catostomus	473	3.3– 6.6
Catostomus commersoni	145[1]	3.0– 5.7
Catostomus macrocheilus	49[2]	3.0– 4.5
C. commersoni × *C. macrocheilus*	12	4.3– 5.8

[1] Five smallest specimens likely of this species, but too small to be used in Figure 4.

[2] Fourteen smallest specimens likely of this species, but too small to be used in Figure 4.

there has never been any evidence of their occurrence upstream of the Peace River Canyon or the present dam-site and they are not expected to be found in the reservoir. To the south of Parsnip Reach, *Prosopium williamsoni* (mountain whitefish) was seined in Tudyah, McLeod, and Davie Lakes, along with most other species found in Williston, whereas *Hybognathus hankinsoni* was taken in Summit Lake. Neither species was taken in Williston, but it would be surprising if populations of *P. williamsoni* did not occur there. Although *Couesius plumbeus* (lake chub) is known from the lakes along the Pack-Crooked system (Lindsey, 1956; present study) it was found in this study to be far more common in Williston Reservoir (percentage-wise and in catch per unit effort) than in the lakes. *C. plumbeus* was also very abundant in Gantahaz Lake (*UAMZ 3220*), a small landlocked lake adjacent to the reservoir north of Mackenzie. *Mylocheilus caurinus* (peamouth), *Ptychocheilus oregonensis* (squawfish), and *Richardsonius balteatus* (redside shiner) were abundant in the south end of Parsnip Reach and are generally very abundant in the lakes of the Pack-Crooked system.

No evidence of hybridization was found between any species except for *Catostomus commersoni* and *C. macrocheilus,* although some of the other species in Williston are known to hybridize in other localities [hybrid combinations between *M. caurinus, P. oregonensis,* and *R. balteatus* has been observed in British Columbia (Carl, Clemens, and Lindsey, 1967)].

A simple graphical analysis of the juvenile *C. commersoni* and *C. macrocheilus* obtained in the largest collection (southern end of Parsnip Reach) clearly shows the presence of many hybrids (Fig. 4). Twelve individuals, constituting 5.8 per cent of the total number, were interpreted as hybrids in an evaluation of all characteristics in all specimens. Although this figure is somewhat greater than the 4.4 per cent obtained in a somewhat comparable analysis based on 248 young from lakes where hybridization was found earlier within the same drainage (i.e., Tudyah, McLeod, Kerry, and Summit), it is within the values found for the general area of sympatry of the two species. In this study two hybrids were also obtained in McLeod Lake and one in Summit Lake (Fig. 4), the three constituting 4.4 per cent of the total. An analysis made of specimens from localities downstream from the reservoir in Alberta revealed approximately five hybrids among 136 suckers (3.7%).

It is probable that most or all of the presumed hybrids are *F1*'s. Some error in identification is possible in the present analysis. Certainly some of the specimens near the intermediate zone in dorsal-pelvic to caudal peduncle depth ratio (i.e., between 2.4 and 2.7; Fig. 4) may be of some hybrid origin (e.g., backcrosses); the present method of analysis would not reveal it. A more elaborate hybrid index or a discriminant function analysis using

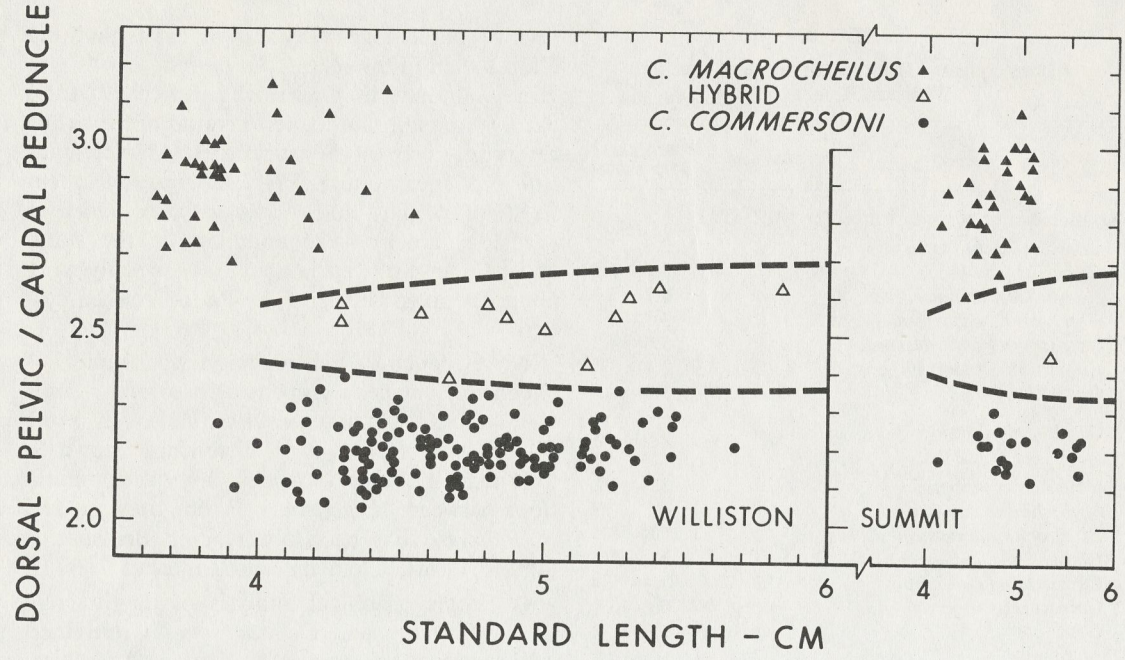

FIGURE 4. Analysis of characteristics used provisionally to identify immature *C. commersoni* (*solid circles*), *C. macrocheilus* (*solid triangles*), and hybrids (*open triangles*) in Williston Reservoir and Summit Lake. The *broken line* encloses ratios not found in specimens of allopatric populations of *C. commersoni* and *C. macrocheilus* (Nelson, 1968, p. 117). Other characteristics were also employed to give identifications accepted here.

additional characteristics would yield a more reliable interpretation. However, the present simple method would give comparable data for future studies attempting to show changes in frequency of hybridization.

Dorsal fin ray counts were not used for the identification of hybrids but ray counts in specimens identified as hybrids (Table II) did not differ from what would be expected from what is known of their inheritance (Nelson, 1968, p. 118). It is interesting to note that the amount of overlap in ray counts in the parental species is greater in Williston Reservoir than it is in Alberta (Table II), largely as a result of an apparent upward shift in their frequency in *C. macrocheilus* in Alberta. The fin ray counts of *C. commersoni* are also higher in British Columbia than found in southern areas of Alberta (e.g., Nelson, 1973). It would be premature to speculate on the significance of this variation at present.

Because of the absence of collections from the same sucker populations in preimpoundment conditions and because of a rate of hybridization similar to that in undisturbed areas, it cannot be stated that the environmental modification has caused an increase in hybridization to date. However, it is also not known to what extent the spawning areas have been disturbed. The parents of the captured specimens may have spawned in rivers above the influence of the reservoir and therefore not have been in a changed environment. Nevertheless, it seems reasonable to believe that some fish would spawn along the shoreline of the reservoir or in new areas in streams because of displacement from old sites or in new creeks which become accessible to spawners with the flooding of old obstacles. It is also possible that the parents of the specimens of minnows and suckers examined were spawning in undisturbed areas at lower reservoir levels, but that fish spawning in the full reservoir will be in modified areas and will hybridize. Also, if densities of minnows and suckers increase in the young reservoir, then hybridization might be expected to increase.

TABLE II

Frequency distribution of dorsal fin ray number in *C. commersoni*, *C. macrocheilus*, and their hybrids

Number of rays	11	12	13	14	15	16	17	Total
Williston, near mouth of Pack River								
C. commersoni	62	76	2	—	----	----	----	140
Hybrids	—	6	3	3	----	----	----	12
C. macrocheilus	—	1	11	20	3	----	----	35
Williston, Finlay Navigation Bay								
C. macrocheilus	—	1	2	6	1	----	----	10[1]
McLeod Lake								
C. commersoni	7	10	—	—	----	----	----	17
Hybrids	—	—	2	—	----	----	----	2
C. macrocheilus	—	—	—	1	----	----	----	1
Summit Lake								
C. commersoni	9	7	3	—	----	----	----	19
Hybrids	—	—	1	—	----	----	----	1
C. macrocheilus	—	—	6	18	4	----	----	28
Peace River drainage in Alberta								
C. commersoni	18	12	1	—	----	----	----	31
Hybrids	—	—	5	—	----	----	----	5
C. macrocheilus	—	—	4	70	31	4	1	110

[1] An eleventh specimen, 10.06 cm, had an unusually short fin with only nine rays.

Detailed follow-up studies are highly desirable in order to make environmental impact statements on future reservoirs more accurate and the resultant suggestions of mitigating adverse effects and predicting beneficial effects more complete. Similarily, consideration of downstream effects (such as the consequences of reduced peak flows on the Peace-Athabasca delta) would have at least made desired remedial action of any deleterious effects much easier to deal with. Information on the effects of the W. A. C. Bennett Dam on migrating fish (such as *Salmo gairdneri*), if any, would have been desirable (even if only to leave documentation on what may once have been there but will be no longer). Such studies need to be conducted before and immediately after dam construction, since adverse effects may not be apparent for long where extirpation of a population is the result.

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Bob–
Apparently this will be published in the proceedings– I think you'll get a kick out of it.
Paul

Trout Family Values

Wild Trout VI Banquet Keynote

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Paul Schullery
P.O. Box 184
Yellowstone Park, WY 82190
1-307-344-7720
FAX 1-307-344-7374
pschullery@gomontana.com

I'm really pleased to be here. For many of us involved in trout over the past quarter of a century or so, the Wild Trout conferences have become landmarks in our professional lives, and it's a real honor to participate like this.

A few years ago I was driving along the Yellowstone River a few miles north of Gardiner, looking for a good place to fish. As usual, it all looked good, so I chose a spot that also had a nice view. I parked my car, and, finding a sort of trail, climbed down the high steep bank to the river. On my way down I noticed a spin fisherman who had spread his gear out on some big rocks and was standing watching the water. There being miles of unoccupied river, I didn't especially mind seeing him, and just assumed I'd pass him and walk upstream a ways.

But as I approached him, I noticed that among his other gear was a huge stainless steel handgun; it was a .44 magnum, but somehow it looked even bigger. Now I have to admit that even in my abruptly increased caution, I experienced the brief surge of disappointment associated with that class of Guy Moments in which you realize that someone else has brought a toy with him very similar to one that you left at home.

But this is Montana. If you run into someone equipped like that, you don't just ask him what he's doing; he might be waiting for the commies (or, even worse, the feds) to come up the river in their black gunboats, and he may just wonder if you're some sort of advanced recon. specialist looking for a skirmish. But as it happened we struck up a conversation, and he seemed pretty normal for a fisherman, so I asked him what he was using the pistol for. He happily explained that he was "shocking suckers." By spotting a sucker and then shooting right next to it, he could stun the fish. He didn't keep them. It was sort of a blast and release approach. He just stunned them and let them drift away.

Now the usual response of a high-strung fly fisherman to this sort of behavior might be condescension: what a dumb thing to do! Only a stupid redneck would waste time on something so pointless, instead of the eminently reasonable practice of snagging a fish in the

mouth with hooks hidden in chicken feathers, playing it to exhaustion, and *then* letting it drift away.

But my own boyhood experiences out on the fringes of sporting propriety asserted themselves. In an instant, I was reminded of my pre-gunpowder years when I haunted the brushy margins of a small Ohio town with a BB gun and no idea at all of what I was legally allowed to shoot at. The finest moments of that time—that is, the closest I came to approaching something like real sport—were spent with a friend trying to shoot minnows in the local canal. This provided a special challenge, because in order to hit a small, moving minnow, one had not only to lead it properly, but also to correct for parallax; the deeper the minnow, the bigger the correction. I got pretty good at it.

And so my response to this fellow was sympathetic, if still cautious. I said, "That, uh, sounds like fun. Is it legal?"

He took the question well, though it apparently hadn't occurred to him to wonder about such a thing here in Montana. In fact, his reaction was pretty impressive: rather than pause to worry that he might be breaking the law, he immediately tried to imagine why it *shouldn't* be legal, and the only thing he could come up with by way of objection was that the slugs, lying in fairly shallow water, might find their way into the digestive tract of some other animal, causing lead poisoning. Where we stood, surrounded by high banks, there was no risk of a bullet skipping across the water out into an inhabited area. We talked about it a little more, and I moved on. Of course I wondered if he really used the gun for trout, too, but I had the good taste not to ask.

As a nature writer I've devoted a good bit of energy to asserting that we should respect these so-called trash fish as much as any other animals, and to wondering why we don't. But here was a wonderfully stimulating approach to the non-sport fish.

Judging from this guy's attitude, it was clear that to him that suckers were appropriate targets because they were good for nothing else. They were biological junk, so they were essentially exempt from ethical consideration. Suckers had no moral context. For many years, suckers have swum around in those murky waters out beyond the boundaries of our sporting consciousness. Then this guy came along and ventured out there onto the frontier of sporting definition and, whether illegally or merely extralegally, pioneered a way to turn them into a sporting quarry—a way that might even involve letting them live after he had had his sporting way with them. That's almost never achieved with a gun, so I don't mind admitting that I was impressed.

Over the past several centuries, we sportsmen have engaged in such adventurism

countless times. Every day, someone somewhere is testing a tradition, rearranging a personal sporting code, or simply trying something that seems new even if it probably isn't. Some of these people are eventually hailed as great philosophical pioneers, and others just get arrested. But they're all part of the great chaotic flow of ideas and techniques by which we redefine sport.

This conference is a great testament to this evolutionary process. I know that you all value native trout for other reasons than sport, but sportsmen continue to be the primary driving force behind trout management, and it must be some measure of their changing values that those of us who work for the management agencies are spending more and more time worrying about native fish. But like the sucker shocker I met that day, we probably have a lot more to worry about than we have time for.

For some years now, I've spent a lot of time studying concepts like "native," and "wild," and "wilderness." Our culture's perception of nature has changed dramatically in the past 30 years. The rise of environmentalism, not only as a major political force but also in academic disciplines ranging from conservation biology to resource economics to environmental history, has stimulated a very exciting and unsettling dialogue on the relationship between humans and the rest of the world.

Consider our perception of wilderness. Traditionally, and in many circles even today, we tend to define wilderness as a kind of pure natural Eden—a place outside of our control and free from the kinds of human interference that would occur in a settled or "civilized" landscape. Until very recently most history textbooks portrayed North America prior to 1492 as a "pristine" wilderness. Then, oddly, they acknowledged that it was a wilderness with people living in it. Humans lived there, these textbooks implied, but they were innocent primitives, subsisting on what they grew in small gardens and what they could take from nature's overflow: roots, berries, fish, and the occasional deer or elk.

Well, we will be a long time sorting out how it *really* was, but it's already clear that for thousands of years Native Americans were aggressively managing and reshaping large parts of what we think of as North America's "native ecosystem." After all, there were probably at least seven million people living in North America in 1492, and more than that in South America. All you have to do is think of the food they required, and the sewage they produced, to realize that this may have been a wonderful place, but it probably wasn't pristine, and it surely wasn't Eden.

It is partly because of these new revelations about human influences on ancient landscapes that modern resource management dialogues bog down in endless semantic

swamps. We may know more, but we keep applying our traditional values to our new information. Some people point to the pervasive human effects on the planet's landscape over the past 10,000 years and announce that there is no such thing as wilderness, that nothing is wild any more. Predictably, they follow this assertion with "therefore, we have to do this or that to the landscape," usually something to make more money or satisfy some moral or religious imperative they hold dear.

Other people attempt valiantly if inconclusively to persuade the rest of us that we must somehow rethink all of this so that humans are fully integrated into the rest of nature—that when it comes to nature, there is no qualitative difference between an osprey, an otter, and a dry-fly fisherman. These assertions are likewise supported by equally heartfelt moral, religious, or economic impulses.

I wish all these philosophers the best; they're on a noble quest, and in the long haul they'll probably have more effect on public attitudes about nature than all the ecological studies we place so much faith in. I just wish they were paying more attention to trout, because we have some wonderful questions to answer about trout and how we choose to deal with them.

Sixty years ago, Albert Hazzard defined a wild trout as one that was planted in the stream when it was small; by growing up and surviving there, it became wild. Over the years since then, we came to regard that as too easy a definition; we wanted our trout to be several generations in residence before they were wild.

But wild isn't the same as native, and among managers, conservationists, and apparently a growing number of fishermen, native is getting to be a pretty important word. As we have introduced non-native fish not only to fishless waters, but also to waters containing native fish, we have lowered a kind of ecological eggbeater into some glorious native ecosystems, resulting in changes that, though they may have been wonderful for fishermen, were disastrous for these beautiful little worlds that had been cranking along just fine since the last ice age without our help.

Those of us who love trout and trout fishing are going to take an increasing number of hits for this behavior; we already are, so I think it's worth considering how we look to people who value nature and nativeness for other reasons. We go into a trout stream or lake and we roll rocks and build deflectors and otherwise reshape it to our purposes. We introduce non-native sport fish whose qualities we prefer. We either ignore their effects on the native fish, or actively seek to remove those natives, perhaps even introducing non-native forage fish to further complicate the evolutionary crapshoot we've set in motion. We do all these things, and in no time at all we're celebrating the high quality of the "wild trout fishing" we have created. In

some circles, of course, humans by definition can't create something wild in the first place, but in even more circles, there's not much wild about such a manufactured fishery.

On the other hand, our growing interest in native fish seems to be the next step in reconsidering what really constitutes a wild trout. Managers who sustain huge, complex fisheries through non-native or exotic species, whether those species are fresh from the hatchery or 100-year resident populations, have been made pretty nervous by the native trout recovery movement, and they have reason to be, because the logical consequence of this new direction is revolutionary. We're exercising some pretty major value judgments here. We appear to be heading toward a new definition of wildness, admitting that in fact the wildest trout is the one that is the evolutionary product of the ecosystem in which is lives.

We therefore seem to have recognized a new standard of authenticity, one that has as much to do with preserving native ecosystems as with preserving native trout. It's a big assignment, and in many places it is more or less impossible with today's technology and social needs, but it gives us reason to dream about the fishing we may have someday in the future. In short, since Hazzard's time, wild trout fishing has become more and more a setting-dependent sport.

Anyone who has read Walton knows that for centuries, fishing writers have stressed the importance of the surroundings—of fishing in beautiful places, whether their definition of beautiful required a manicured rural countryside or a howling wilderness. But now, the fish and the setting are becoming more integral; the best setting, according to this new view, is the setting that still has the trout that developed there in the first place, whether they have survived continually or we have restored them.

But we still have some hard questions to answer, and some hard decisions to make. Letting trout be totally wild, and enjoying them on the terms that "totally wild" implies, isn't as simple as it sounds.

It is a common human vanity to assume that the earth as we see it today is somehow a finished product. Fishermen tend to presume something like that. But all the processes that shaped the modern American landscape, whether geological, biological, or climatic, are still acting today, unless we change them or stop them. Nature isn't done with our trout streams. We're still mighty uncomfortable with all those things that ecologists think of more neutrally, as disturbance. We've eased off on killing trout predators, but we still hate spring floods, debris flows, fire, anchor ice, and everything else that may kill fish or put the water out of shape for fishing. We're still a long way from accepting wild, native trout on the terms of the world that created them.

In 1988, Yellowstone's wildness put fishermen's attitudes about wild trout to the test, and a lot of us who claim to prefer our trout wild got pretty low grades in that test. Though fires on this scale have been shaping this landscape for thousands of years, we got pretty ticked off about the short-term aftermath of that shaping process. In 1989, we found some of our favorite trout pools surrounded by blackened forests, places that, though already covered with the first new green growth, would lack the old photogeneity for many years, probably longer than our remaining lifetimes.

For these people, picturesqueness and stability were more important than naturalness, and I do have some sympathy for them. If you only had a few days to spend here, and that week a summer thunderstorm washed a huge amount of loose ash down through your favorite stream, the fires of 1988 would seem like a pretty awful thing. You might object that maybe trout fishing shouldn't be quite *this* wild.

But even if the thousands of fire-fighters who spent the summer here had been able to stop these fires, I'm convinced it would have been a bad idea. No one can claim to care more about Yellowstone fish and fishing than I do, or to feel more indebted to these wonderful streams for all they've added to my life, but here, at least, we can define wild trout as trout that live in a really wild place—not a perfect wildness, but a remarkably good imitation of a North American landscape prior to the arrival of Columbus. Those same summer thunderstorms were also washing nutrients into the streams, and jump-starting vast and vital ecological processes across the landscape. I refuse to believe that even if we were able, we should short-circuit all that just so that trout can see my dry fly better.

The poet Robinson Jeffers asked: "What but the wolf's tooth whittled so fine/ The fleet limbs of the antelope." Far less poetically but at least bluntly, I would ask: What but the wild river's unbridled power shaped/ Every single quality we love in trout? The very forces that had so much to do with creating the trout we admire—the violent extremes of environment that provided these species with the tests that turned them into our favorite fish—are a critical part of their wildness.

I have benefitted beyond measure from the things we do to trout streams and trout in the name of good fishing. From the highest smallest Sierra creek to the lowland rivers that empty onto the eastern Piedmont, I've immersed myself in the joy of this great pursuit and the wonder of the fish that I am always surprised to catch. But I'm enough of a naturalist to know that there's some difference—some tangible and important difference—between the brook trout I catch in the Sierra creek and the superficially identical fish I catch in the Blue Ridge. Neither fish is less a marvel, but in evolutionary terms, one has the weight of thousands of years behind

its occupancy of its little pool and the other just arrived shortly before I did. Context makes the catching different in a way that matters to me even if it doesn't lessen my delight at catching a fish at all.

I don't always give a lot of thought to all this as I fish. But every once in a while, when I pause to admire a brook trout taken from a Yellowstone stream, I get a flash of memories of the Blue Ridge, the Green Mountains, the Smokeys, or some other place where I've similarly admired its kin. Then my mind is off on another rumination of how far these trout traveled on their own, and how much farther they came with our help, and I can't help feeling that we'd have been better off if we'd never taken them anywhere.

So in the past few years I've come to some conclusions that I have to admit surprise me. They come from trying to integrate my feelings about the natural world generally with my love of trout fishing. I've decided that if an adequately powerful fish deity came along and gave me the choice, I'd probably prefer that the Madison River contained the kind of cutthroat and grayling populations that Lewis and Clark found here.

If I had my druthers, I'd rather that today's Letort contained the tremendous populations of native brook trout encountered there by George Gibson, one of our first sporting journalists, when he learned to fly fish on that stream in the 1790s.

I'd rather find today's Ausable full of the Michigan Grayling that Fred Mather caught there in the 1870s. As much as I enjoy fishing for them, I'd give up browns and rainbows and brookies in a lot of places if I could have the real thing instead.

I recognize that on the immediate practical level, this is an academic exercise, if not sheer fantasy; those non-native fish are here to stay, and I'm not going to avoid any of those streams because they don't have native fish. I may be a purist but I'm not stupid, and having an ideal does not mean abandoning reality; it means keeping perspective, and knowing the difference between wonderful trout fishing and wild trout fishing.

In our urge to protect native trout we are struggling toward a kind of authenticity that we long sensed was lost to us. We are not alone in that impulse. Our society, through a raft of protective legislation sponsored and passed by people who care about nature without necessarily caring about fishing, has decided that native life matters. The realities of our technological limitations and our social preferences ensure that native trout restoration and native trout fishing purism aren't likely to change too many things too fast. But it should help us to have ideals of this sort, however unachievable, against which to measure our progress in the real world.

It should also help us in a world where more and more people are suspicious of us

anyway. Fishermen still tend to think of themselves as harmless types, doing this peaceful thing in beautiful places, but the entire world is now the sphere of conservation biologists and other people who place a previously unimagined premium on ecological wholeness. In the eyes of many of these people, earlier generations of fisheries managers and fishermen are now seen as the chief culprits in the diminution or destruction of thousands of native aquatic systems. The precious few remaining waters that are still in pretty good shape are guarded jealously, often by people who haven't the slightest interest in fishing; they just love native systems.

Of course we also need to be on better behavior because fishing is getting increasing attention from the same people who are currently making life so hard for hunters—people who just can't imagine what fun it could be to kill fish, and who may regard catch and release as an even greater moral outrage.

Our own values are under attack by people who see themselves as enjoying nature in a superior way, one in which the beauty and wonder of nature are best appreciated without such direct hand-to-mouth use of its creatures. Few minds ever change in such debates, but the extent to which we successfully defend our own values will probably be the extent to which we aggressively care for the kinds of values we find in native trout ecosystems. In doing so, we will also show we are still the best friends that wild trout have.

Acknowledgments: Some portions of this essay appeared in different form in *Trout* magazine and in my book *Searching for Yellowstone: Ecology and Wonder in the Last Wilderness* (Boston: Houghton Mifflin, 1997). Most of it will appear, in different form, in my book *Royal Coachman*, to be published by Simon & Schuster early in 1999.