

Whirling disease



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WD

don't stock + fish go swax

Robin Knox - really dumb
- sci. review

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171
568
[1999]

Field Exposure of Seven Species or Subspecies of Salmonids to *Myxobolus cerebralis* in the Colorado River, Middle Park, Colorado

KEVIN G. THOMPSON¹

Colorado Cooperative Fish and Wildlife Research Unit²,
Colorado State University, Room 201, Wagar Building,
Fort Collins, Colorado 80523, USA

R. BARRY NEHRING*

Colorado Division of Wildlife,
2300 South Townsend Avenue, Montrose, Colorado 81401, USA

DAVID C. BOWDEN

Colorado State University, Department of Statistics, Room 221,
Fort Collins, Colorado 80523, USA

TERRY WYGANT

Colorado Division of Wildlife, Meeker Service Center,
Post Office Box 1181, Meeker, Colorado 81641, USA

Abstract.—Recent failures in recruitment of rainbow trout *Oncorhynchus mykiss* in the Colorado River in Middle Park, Colorado, USA, led to studies of the effect of the myxosporean parasite *Myxobolus cerebralis*, the causative agent of whirling disease, on the wild trout fishery in the river. During 1995–1996 and 1996–1997, we conducted field exposures of sentinel fish to examine the vulnerability of seven species or subspecies of salmonids exposed to the parasite in the Colorado River. During 1995–1996, brook trout *Salvelinus fontinalis* and Colorado River cutthroat trout *O. clarki pleuriticus* experienced 85% or higher mortality within 4 months of exposure. Groups of fish introduced at greater mean weight or later in the summer tended to survive better than others, but mortality often was severe among these groups during the second summer. By April 1996, dead fish or sacrificed fish representing seven groups were shown by histology to contain mature *M. cerebralis* spores. During 1996–1997, three groups of cutthroat trout *O. clarki* spp. experienced poorer survival than brown trout *Salmo trutta* and rainbow trout introduced at similar weights. Snake River cutthroat trout *O. c. bouvieri* introduced in July survived well and developed fewer *M. cerebralis* spores (prevalence and mean concentration) than any group except brown trout. Rainbow trout parented by fish that recruited after *M. cerebralis* was established in the drainage developed significantly fewer myxospores than those parented by fish that recruited before establishment of *M. cerebralis* ($P \leq 0.0001$), but survival was not different between these groups (87% versus 89%, respectively). The poor performance of parasitized brook trout and cutthroat trout suggests that establishment of *M. cerebralis* in high-country streams may have serious consequences for these species.

Manifestations of what was to become known as whirling disease were first observed in salmonid fishes in Europe at the beginning of the 20th century (Hofer 1903; Plehn 1904). But it would be

more than eight decades before the entire life cycle of *Myxobolus cerebralis*, the myxosporean parasite that can cause whirling disease, was discovered. The landmark work of Wolf and Markiw (1984) demonstrated that the spores found in fish were infectious for the aquatic oligochaete *Tubifex tubifex* where they developed into the actinosporean forms that, upon release, infect the fish. These alternating developmental cycles give rise to spores referred to as myxospores and actinospores in their respective fish and oligochaete hosts (Lom et al. 1997).

* Corresponding author: barry.nehring@state.co.us

¹ Mailing address: Colorado Division of Wildlife, 2300 South Townsend Avenue, Montrose, Colorado 81401, USA.

² Cooperators are the U.S. Geological Survey, Colorado Division of Wildlife, and Colorado State University.

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The malady has been intensively studied

Barry Nehring's 1999 Rpt.

this decline was due to the fact that only 9,200 trout from the CDOW Chalk Cliffs Rearing Unit were stocked into Montgomery Reservoir in 1997 and none in 1998, compared to 32,200 in 1996.

This information is strongly suggestive that aquatic oligochaete worms have the capability to process and/or destroy myxospores of *M. cerebralis*. Indeed, in laboratory studies at the University of California-Davis it has been demonstrated that non-Mc susceptible aquatic oligochaetes are dead-end hosts of the Mc parasite, i.e., the Mc myxospores fire their polar capsules and the infective sporoplasm of the parasite invades the gut epithelial lining, but does not develop any further (El-Matbouli et al. 1998a). What that means, is that if the stocking of Mc-infected trout into standing bodies of water is terminated, the level of Mc actinospore production can decline quite dramatically within a year or two. IF there is not some other source of Mc myxospores to sustain a high level of Mc infectivity. Once again, our empirical evidence suggests that in many cases there is not a "naturally occurring" environmental source. Beaver Creek, Buckeye, and Spring Creek reservoirs are three such examples.

A skeptic may ask, "Is this wishful thinking?" Or, "Can this be substantiated by scientific evidence?" In a controlled laboratory study, Markiw (1986), dosed mixed cultures of tubificid worms with myxospores of *M. cerebralis* in three different experiments. In each case, the worm cultures began releasing TAM spores approximately 110 days (16 weeks) after exposure. In all three experiments production of TAM spores peaked between 30 and 50 days after TAM spore release began, and then declined almost exponentially so that 180 - 200 days after initial exposure production of triactinomyxon spores declined to undetectable levels. Similar testing conducted at UC-Davis showed similar results, i.e., between 100 and 150 days post initial release of TAM actinospores, production of TAM actinospores dropped to undetectable levels. This was especially true among mixed cultures of Mc-susceptible and non-susceptible tubificids (El-Matbouli et al. 1999). A most intriguing result of the research at UC-Davis was that TAM actinospore production was reduced 70% in the mixed culture population compared to the pure Mc-susceptible population (El-Matbouli et al. 1999), indicating that the possibility of using non-susceptible aquatic oligochaetes as biological control agents or "bio-filters" to de-populate available myxospores is a realistic possibility.

This sort of TAM production profile has been repeated literally hundreds of times since then (Terry McDowell, Senior Research Associate, University of California-Davis; unpublished data and personal communication). Our water filtration studies have documented similar production profiles in natural ecosystems, as shown in Figures 1a through 8b in Job 1. In our studies, the peak in the TAM production profile is broader and continues for a longer period of time than in laboratory studies, because the supply of myxospores to the *T. tubifex* population does not come in a single dose as it does in laboratory experiments. Production of TAM actinospores continues as long as there is a supply of Mc myxospores available to Mc-susceptible tubificid worms. In areas of high parasite infectivity that can continue for up to six to nine months as it does at Windy Gap Reservoir.

Colorado River, S. Platte R., and Gunnison R. rainbow trout hit hardest by W.D., yet none of these rivers have been stocked with any hatchery trout for many years. Some with Madison R. - Simply not true

IF no infected fish occur above - then it stocking ceases - all trout die W.D. worms are not infected, no more spores released. ONLY Refers to highly restricted type of water, not streams.

W.D. will go uninfected. Infected fish not stocked.

STATE OF COLORADO
Bill Owens, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE

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John W. Mumma, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192



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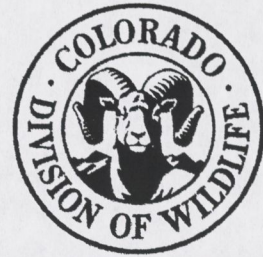
MEETING NOTICE

October 21, 1999

The Division of Wildlife will host a public meeting on November 18, 1999 to discuss current information related to whirling disease and fish stocking. The meeting will begin at 7:00 p.m. at the Best Western – Central, 200 W. 48th Avenue, in Denver.

The purpose of the meeting is to inform the public of the results of ongoing research pertaining to whirling disease and its impact on fishing in Colorado. The Division staff will be making presentations and there will be an opportunity for the public to participate. If there are any questions, please contact Vickie Ta at (303) 291-7355 (e-mail: vickie.ta@state.co.us).

DEPARTMENT OF NATURAL RESOURCES, Greg Walcher, Executive Director
WILDLIFE COMMISSION, Chuck Lewis, Chairman • Mark LeValley, Vice-Chairman • Bernard L. Black Jr., Secretary
Rick Enstrom, Member • Philip James Member • Marianna Raftopoulos, Member
Arnold Salazar, Member • Bob Shoemaker, Member



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Divisional Correspondence Only

STATE OF COLORADO
DIVISION OF WILDLIFE
DEPARTMENT OF NATURAL RESOURCES

TO: John Mumma
Bruce McCloskey
Walt Graul
Steve Norris

FROM: Eddie Kochman

DATE: October 22, 1999

SUBJECT: Trout Unlimited's October 19 News Release and November 18, 1999 Public Meeting

As you know, Aquatic Researcher Barry Nehring has completed work (2nd year of a 2 or 3 year study) on selected small reservoirs. One of the findings suggest that continued stocking of fish exposed to the whirling disease pathogen may aggravate exposure levels in downstream fisheries in some situations. Prior to any recommendations that would influence further stocking of exposed fish, the research results are being reviewed by a number of fishery researchers and pathologists (attached memo). This review will assist the Division in developing any final recommendations on long-term stocking of exposed fish. It must be emphasized that many variables exist in the data, especially an analysis of downstream population impacts. For this reason, careful analysis needs to be undertaken in order to avoid over-reaction. In my judgment, this is exactly what Trout Unlimited (TU) did in their October 19, 1999 newsletter (attached). Unfortunately, TU chose to assume that the research information is conclusive enough to warrant a position that the Division discontinue any further stocking of exposed fish into reservoirs under any circumstances. We are currently stocking 1.4 million catchables and 5.3 million subcatchable fish into so-called "B" waters. Policy allows these waters to be stocked with low exposed fish. Such waters have been stocked for a number of years and are considered positive for the pathogen. Currently, there is a massive shortage of non-exposed fish, and unless those fish are stocked, these waters would receive little, if any, stocking. As a result, any decision needs careful consideration and public input. The first objective is to protect Colorado's fishery resources. But it is also our objective to provide angling recreation through stocking. A balanced and well thought out approach is necessary.

TU's press release, sent to the media around Colorado, attempted to portray the Division as being negligent in its action. It did not relate the peer review process, or the intent for public input prior to any policy change, even though they were aware of the process. In my judgment, TU took advantage of the preliminary information to drive home their continued opposition to stocking of exposed fish. While they are certainly entitled to their position, their approach was not constructive. The "E-Coli" statement was very inappropriate and has caused needless public concern. Fortunately, many media outlets including the Rocky Mountain News and Associated Press chose not to write about this issue until the peer review is completed. Some electronic media did do short stories without talking to the Division. It appears that Charlie Meyers will have an article in Sunday's Denver Post, but to his credit, he took the time to understand all sides of the issue.

To help the public understand the issue, a meeting is scheduled for November 18, 1999, in Denver at the Best Western Central, 200 W. 48th Ave. It will begin at 7 p.m. and conclude at 10 p.m. I am hopeful that members of the Commission can attend and hear the presentations. The intent will not be to take any positions on the issue, but to provide factual information in a constructive manner. Minutes of the meeting will be taken

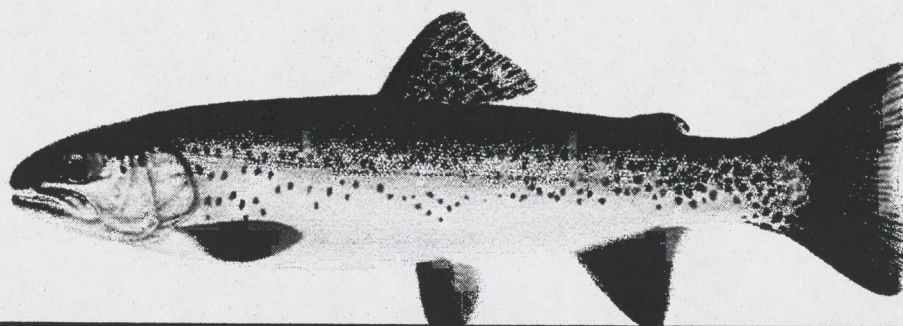
If there are questions, let me know (303) 291-7356.

Attachments

cc: Members, Colorado Wildlife Commission
Greg Walcher, Exec. Dir - DNR
Regional Managers
Aquatic Staff
Eric Hughes
John Smeltzer
Dale Lashnits
Todd Malmsbury

vt

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NEWS FROM COLORADO TROUT UNLIMITED

Contact: David Nickum, Executive Director (303) 440-2937

COLORADO FINDS STOCKING OF INFECTED FISH HAS WORSENERD WHIRLING DISEASE

Effluent from Division of Wildlife hatcheries also found to spread disease

Boulder, CO – October 19 – New research from the Colorado Division of Wildlife (CDOW) suggests that the stocking of infected fish in Colorado's lakes and streams increases the levels of whirling disease infection in the wild. The studies, conducted by the CDOW's top whirling disease researcher, indicate that the Division's current practice of stocking lightly-infected fish in "low-risk" high-country lakes and reservoirs may in fact worsen whirling disease problems for wild trout downstream.

"Trout Unlimited has long opposed the stocking of diseased fish in Colorado's trout waters," said Colorado Trout Unlimited President Dave Taylor. "This research confirms what common sense tells us: stocking diseased fish is bad for cold-water fisheries, and it is time for it to stop."

"Imagine if a meat packer discovered its ground beef was infected with *E. coli* but decided to continue shipping 'slightly contaminated' beef to selected stores due to public demand for burgers," added Taylor. "Selectively stocking 'lightly infected' trout is an equally bad idea."

The new CDOW report documents several locations where levels of whirling disease are very low upstream of locations where infected fish are stocked, but very high downstream of those sites. In addition, at some locations where stocking of infected fish occurred historically but has been stopped, testing of both water and fish has shown drops in the level of infection.

"This research reveals that for some streams, ending the stocking of infected fish helps reduce whirling disease," added Colorado Trout Unlimited Executive Director David Nickum. "It underscores the wisdom of the CDOW's investments in hatchery

Trout Unlimited: America's Leading Coldwater Fisheries Conservation Organization

Colorado Office: 1900 13th Street, Suite 101, Boulder, CO 80302

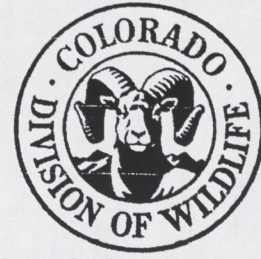
(303) 440-2937 • Fax: (303) 440-7933 • dnickum@tu.org

clean-up and refutes the claim that stocking infected fish won't make whirling disease problems worse."

The report also found high levels of the whirling disease parasite in effluent from settling ponds at state hatcheries on the Cache la Poudre and East Rivers. The report states that the Poudre hatchery is "a major source" of whirling disease spores for the Poudre River. The CDOW is currently designing a hatchery treatment system to address the release of spores in effluent.

With 6,200 members in 26 chapters statewide, **Colorado Trout Unlimited** is the state council of Trout Unlimited, America's leading coldwater fisheries conservation organization. CTU is the state council of Trout Unlimited and is dedicated to the conservation, protection, and restoration of America's trout fisheries and their watersheds. Trout Unlimited has over 100,000 members nationwide.

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Divisional Correspondence Only

STATE OF COLORADO
DIVISION OF WILDLIFE
DEPARTMENT OF NATURAL RESOURCES

TO: Aquatic Staff
FROM: Eddie Kochman *E. Kochman*
DATE: October 8, 1999
SUBJECT: Whirling Disease Management - Policy and Regulatory Process

At the September 14, 1999, meeting of the Aquatic Staff, a discussion was held on the ramifications of recent research findings by Barry Nehring related to whirling disease. Barry was present at the meeting to present the data.

In addition, a similar discussion occurred on September 8, which included John Mumma, Walt Gaul, Eric Hughes and others. The purpose of the data indicates that continued stocking of exposed fish into "B" waters (lakes and reservoirs) may maintain levels of infectivity in downstream fisheries. However, it is recognized that there are numerous variables that may influence any final conclusion, including size of the water being stocked, species composition of the downstream fishery and the level of spore content of fish being stocked. The implications of this data are that there could eventually be major changes in both, existing policy and regulations, related to whirling disease stocking.

The Aquatic Staff will undertake a process designed to develop recommendations which will guide future stocking and management of fish exposed to whirling disease based on validated research.

This process will be undertaken through March 2000. Steps in the process will include:

1. ✓ Conducting a peer review of Barry's data for the purpose of developing agreement on its scientific basis and management applicability. In addition to the peer review, the group would also address priorities for future research.

Lead: Tom Powell
Completion: October 29, 1999

NOTE: If the peer group concludes that the data does not support changes in management or that additional research is necessary, the process will end at this step. Also, the results of the peer analysis will be thoroughly reviewed informally prior to any final Division decision.

2. Complete analysis (SWOT process) of options that deals with long-term management of whirling disease, including possible changes in policy and regulations.

Lead: Phil Goebel
Completion: December 31, 1999

3. Conducting a public review process that includes input on the long-term options and summarizing the input into a report for the Director.

Lead: Phil Goebel
Completion: January 27, 2000

4. Developing final recommendations pertaining to management and policy and regulations for the Director.

Lead: Eddie Kochman
Completion: February 24, 2000

It is important to recognize that the issue of stocking, or not stocking, "B" waters has significant ramifications for both, the Division, as well as private interests. As such any decisions need to be made in a structured manner that includes the objective's sound biology basis and public input. The stated process will accomplish these objectives.

During the process, it will be important that the individual with the "lead" responsibility keep all concerned informed of the progress. Also, the process does not preclude taking immediate steps to reduce the impact of so-called "hot spots" (i.e., hatchery ponds and other sites), or to carefully select "B" waters for stocking of exposed fish.

If there are questions, let me know.

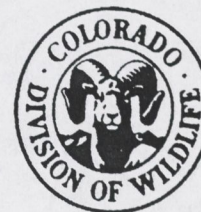
cc: J. Mumma
W. Graul
S. Norris
E. Hughes
T. Malmsbury

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John W. Mumma, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192



*For Wildlife-
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MEMORANDUM

TO: Anglers' Roundtable Members
FROM: Eddie Kochman, State Aquatic Wildlife Manager
DATE: October 26, 1999
SUBJECT: Public Meeting on November 18, 1999

Eddie

The Division of Wildlife will hold a public meeting on November 18, 1999 in Denver at the Best Western Central, 200 W. 48th Ave., Denver, CO 80216. The meeting will begin at 7:00 p.m. and will concentrate on whirling disease research, hatcheries and the stocking of fish exposed to the pathogen.

The Division has been involved in the whirling disease issue since 1987 and one of the most significant questions has been, "Does the stocking of exposed fish further worsen the impact of the disease in streams and lakes?" The answer is not an easy one to obtain, since many variables are involved, including the condition of the habitat, water quality and temperature, species of fish and level of exposure. To answer this question, Barry Nehring has been conducting research on three reservoirs and has also been monitoring a controlled laboratory study with brown trout. In addition, he has also continued research on the impact to selected streams, including the Colorado River below Windy Gap Reservoir.

The Division is continuing to stock fish exposed to whirling disease into lakes and some streams that have the pathogen. This action is allowed by Commission Policy. At the same time, it is the Policy that waters which are free of the pathogen are stocked with negative fish. Unfortunately, there is currently a shortage of negative fish and there will continue to be for some time (see attached charts). The stocking of exposed fish is creating significant angling benefits. For example, Antero Reservoir receives exposed fish and is producing an outstanding fishery. It would otherwise receive very few fish simply because negative fish are in short supply. The question remains as to what is the downstream impact below Antero and other waters from such stocking? If the impact is significant to the point that natural reproduction and survival of fisheries are at stake, then such stocking should be stopped. Barry's research is intended to address this question. I want to caution all concerned that, as with all research, there remains questions and the need for careful consideration prior to final decisions. This is one reason for a peer review and public input on the available data. The urge to make assumptions and over-react is something I hope we can avoid for the benefit of Colorado's fishery resources and anglers.

We will look forward to seeing you on November 18.

Attachments

DEPARTMENT OF NATURAL RESOURCES, Greg Walcher, Executive Director
WILDLIFE COMMISSION, Chuck Lewis, Chairman • Mark LeValley, Vice-Chairman • Bernard L. Black Jr., Secretary
Rick Enstrom, Member • Philip James Member • Marianna Raftopoulos, Member
Arnold Salazar, Member • Bob Shoemaker, Member

WD WATER HABITAT CODE – 1998 LAKE/STREAM STOCKING VERSUS 1990 REQUESTS

Habitat Code	CATCHABLES (>9")				SUBCATCHABLES (<9")			
	LAKES		STREAMS		LAKES		STREAMS	
	1998 Actual Stocked	1990 Request	1998 Actual Stocked	1990 Request	1998 Actual Stocked	1990 Request	1998 Actual Stocked	1990 Request
AAA**	0	43,200	0	71,653	342,667	495,588	17,030	231,410
A	292,310	1,692,679	1,142	644,072	4,153,279	4,206,680	919,344	1,299,160
B	1,505,193	1,238,269	109,342	251,696	3,090,916	5,577,825	3,345,799	1,865,900
C	1,377,332	989,415	38,468	19,800	208,547	1,569,310	11,997	22,000
TOTAL	3,174,835	3,963,563	148,952	987,221	7,795,409	11,849,403	3,294,170	3,418,470
	STOCKED		REQUEST		STOCKED		REQUEST	
TOTAL COMBINED LAKE/STREAM	3,323,798		5,339,598		11,089,579		15,267,873	

** No stocking in 1999 for "AAA" waters will occur.
 Expected full isolation production at 800,000 in 2003

Revised: 10/26/99

CDOW - Hatchery Section
 Summary of 1999 Coldwater Schedule
 For State Hatcheries

	Sub-Catchables			Catchables		
	WD-Neg	WD+	Total	WD-Neg	WD+	Total
1999 Schedule	7,188,577	5,541,450	12,730,027	361,948	2,479,405	2,841,353
for "B" Waters		5,343,650			1,404,916	
from State Hatcheries only.						
Other Sources						
Commercial				116,630		256,630
Federal Hat	2,060,000	75,000	2,135,000		140,000	
Grand Total						
	9,248,577	5,616,450	14,865,027	478,578	2,619,405	3,097,983

Adios to higher-elevation angler success

Kiss Antero, Spinney and Taylor goodbye. Bid a fond farewell to reservoirs such as Lake John, Jefferson and Tarryall. Send a little adios to Georgetown, Willow Creek and perhaps a couple dozen other lakes and streams that form an important core of Colorado's cold-water recreation resource.

What sounds like a fisherman's worst nightmare might at least in part become reality this year under a landmark initiative by the



Charlie Meyers

Outdoors

Colorado Division of Wildlife. The agency is contemplating a plan to combat the effects of whirling disease by ending the stocking of lightly infected

rainbow trout in certain so-called "B Waters."

These higher elevation reservoirs and streams — located primarily east of the Continental Divide but also including such western favorites as Taylor and Willow Creek reservoirs — generally are the last bastions of prime angler success at a time of dwindling hatchery resources.

For nearly a decade, policy allowed reservoirs already exposed to WD to receive stocks of

fish lightly infected with the malady often fatal to young fish. During the current \$12 million renovation of the state's hatchery system, supplies of "clean" trout have been at least temporarily depleted, a condition that will continue at least during the next couple years.

This means the restricted "A Waters" — virtually all of the Western Slope — receive far fewer trout than needed, with a corresponding crash in the catch rate. Meanwhile, an ample supply of lightly infected trout has kept anglers relatively happy on "B Waters." Because most reservoirs don't accommodate natural reproduction, stocking is the only viable way to support both a put-and-take and put-and-grow management strategy.

Now, following a series of meetings ending Monday, DOW managers are prepared to recommend that certain B Waters no longer receive trout containing even the slightest levels of the WD pathogen. Ultimately, the final list remains undecided pending continued consultations by biologists, but some — if not all — of the favorites listed above will be included.

This potential policy turnabout is the result of a recent study by Barry Nehring, DOW's principal WD researcher. Nehring's findings — probable, but not yet conclusive — indicate that stocking infected

fish in three test reservoirs increased the spore load in streams below the dams. Using this information, DOW managers decided to take what may seem like drastic action.

"This is immensely important and there'll be much more discussion over the next few weeks," said Eddie Kochman, state aquatic manager. "If we do things right, our fisheries resource will come out much stronger in the long run, perhaps five or 10 years from now."

Among the factors considered in forming the list is the proximity of the reservoirs to threatened native cutthroat populations highly susceptible to the disease. Other reservoirs that might have made the list — Blue Mesa, Elevenmile and Williams Fork — initially have been excluded because they are primary sources for kokanee salmon, for which there is not yet a clean brood stock. In all, 17 waters are being considered in the Northeast Region, including most of the South Platte River drainage, seven in the west and four in the southeast.

As yet undetermined is which of the targeted waters will receive clean fish and which will get none at all. Any diversion of clean fish from an already thin supply will further diminish angler success on the Western Slope. In every case, the difference between numbers of clean and lightly infected fish will

make a startling difference in angler success.

"We're facing a real crisis over the availability of fish in the short term, but ultimately the protection of the resource must come first," Kochman said. "The question is whether we can survive this kind of hit in fishing success. We don't want to discourage the fishing public."

Recovery could hinge at least in part on the availability of the Snake River strain of cutthroat trout, at least 10 times less susceptible to WD than rainbows. These fish might be stocked without increasing the downstream spore load. In 1998, DOW stocked 1.5 million catchables and 3.1 million subcatchables in various "B" lakes and 109,000 catchables and 3.3 million subcatchables in streams.

There is a promise of light at the end of the fish-production tunnel. Although DOW suffered a major setback over a failed initial attempt to purge the massive Mount Shavano Hatchery near Salida, prospects are good for a sharp increase in clean production by 2002. The projection is for 2 million clean catchables (still less than half as many as needed) and 14 million subcatchables.

Ultimately, any WD-positive fish remaining in the hatchery system will be used to stock low-elevation waters such as Chatfield and Cherry Creek reservoirs.



scores

Sunday

Los Angeles 3, Colorado 2
Dallas 3, Chicago 2
Phoenix 3, San Jose 2, OT
Philadelphia 4, Pittsburgh 4, tie
Nashville 2, Vancouver 1

Monday

Calgary 4, Boston 3, OT
Wash. 8, T. Bay 2
Ottawa 3, Toronto 3, tie
Carolina 3, Montreal 2, OT
N.Y. Rangers 6, Atlanta 3
Nashville 3, Edmonton 2, OT

western conference

Northwest Division

	W	L	T	RT	Pts	GF	GA	Home	Away	Div
Colorado	24	18	7	1	56	137	122	15-5-2	9-13-5	6-1-2
Calgary	23	20	5	1	52	117	136	15-6-3	8-14-2	5-4-1
Edmonton	15	20	13	7	50	127	127	11-5-9	4-15-4	3-2-2
Vancouver	14	23	10	5	43	121	141	7-14-5	7-9-5	1-8-3

Central Division

	W	L	T	RT	Pts	GF	GA	Home	Away	Div
Detroit	28	14	6	1	63	165	126	18-5-2	10-9-4	6-4-1
St. Louis	28	14	6	0	62	142	103	15-6-4	13-8-2	6-3-1
Nashville	18	25	6	4	46	132	147	9-11-3	9-14-3	4-6-2
Chicago	16	27	6	2	40	136	154	8-14-3	8-13-3	3-6-2

Pacific Division

	W	L	T	RT	Pts	GF	GA	Home	Away	Div
Phoenix	26	16	6	0	58	147	127	14-7-		
Dallas	25	18	5	2	57	116	108	12-9-		
San Jose	22	23	6	5	55	139	131	13-9-		
Los Angeles	20	19	7	3	50	140	135	11-9-		
Anaheim	20	23	6	1	47	118	128	12-10-		

Note: One point for a tie; a team scoring a goal in overtime with a victory in the W column; overtime losses will count as a regulation tie.

eastern conference

Atlantic Division

	W	L	T	RT	Pts	GF	GA	Home	Away	Div
New Jersey	30	13	5	3	68	154	115	20-4-2	10-9-3	8-3-1
Philadelphia	25	14	8	1	59	141	109	15-5-4	10-9-4	6-3-1
N.Y. Rangers	20	20	7	3	50	131	129	12-10-2	8-10-5	2-5-2
Pittsburgh	19	23	4	5	47	146	138	13-6-3	6-17-1	4-3-1
N.Y. Isles	11	30	6	1	29	98	153	6-16-3	5-14-3	2-8-1

Northeast Division

	W	L	T	RT	Pts	GF	GA	Home	Away	Div
Toronto	27	16	6	3	63	148	125	18-5-4	9-11-2	7-4-1
Ottawa	24	16	8	2	58	131	118	12-7-4	12-9-4	7-1-3
Boston	16	21	13	4	49	130	142	7-10-8	9-11-5	2-5-3
Buffalo	18	24	6	1	43	124	133	11-10-3	7-14-3	3-6-2
Montreal	16	25	6	2	40	105	119	8-11-4	8-14-2	2-5-3

schedule

Today

Tampa Bay at Buffalo, 5 p.m.
N.Y. Rangers at Pitts., 5:30 p.m.
Phoenix at Carolina, 5:30 p.m.
Edmonton at Vancouver, 8 p.m.
Colorado at S.J., 8:30 p.m.

Wednesday

St. Louis at Ottawa, 5 p.m.
Calgary at Washington, 5 p.m.
Phoenix at Atlanta, 5:30 p.m.
New Jersey at Florida, 5:30 p.m.
Toronto at Detroit, 5:30 p.m.
L.A. at Dallas, 6:30 p.m.

Avalanche defense just

Return of Miller strengthens group

By Adrian Dater
Denver Post Sports Writer

LOS ANGELES — The Colorado Avalanche needs to acquire a big, hard-hitting defenseman to make a legitimate run at the Stanley Cup, ...

confidence," Foote said.

"I mean, Klemm's gotten a chance to play, and he's shown that he can play, and he's got his confidence. I think we've got the 'D.' You've got 'Millsie' coming back, who plays tough, so does

enough to win t

One player
fense immeasu
thinking the Av
Skoula. The roc
shown great po
almost always
forwards. Som
Uwe Krupp

A matter of TU credibility - please avoid misleading, untrue articles on W.D. - Have it reviewed before publishing



Action Line

TU SAYS, STOP STOCKING INFECTED FISH

RECENT REPORT FROM THE COLORADO DIVISION OF Wildlife's (CDOW) top whirling disease researcher, Barry Nehring, has provided new insights into how the disease is spread and how managers can keep from making the problem worse. The report documents higher incidence and severity of disease below several reservoirs that have been stocked with infected fish; where the stocking of infected fish has been discontinued, conditions have improved. — See what actually said

"It is common sense that when we stop putting pathogens into a system, the system improves," said Whit Fosburgh, Director of TU's Coldwater Conservation Fund, which has helped fund the Colorado research. The management implications of this research are obvious: stop stocking infected fish, immediately."

Whirling disease has spread to almost every basin in Colorado because the state knowingly stocked fish infected with the spores that cause whirling disease. After challenges to this policy by TU and others, the state discontinued in 1996 the stocking of infected fish in most areas, although it continues to stock lightly-infected fish in several "low-risk," high country lakes and reservoirs.

The CDOW report documents several locations where levels of whirling disease are very low ^{or absent} upstream of locations where infected fish are stocked, but very high downstream of those sites. In addition, at some locations where

stocking of infected fish occurred historically but has been stopped, testing of both water and fish has shown drops in the level of infection.

The report also found high levels of the whirling disease parasite in effluent from settling ponds at state hatcheries on the Cache la Poudre and East rivers. The report states that the Poudre hatchery is "a major source" of whirling disease spores for the Poudre River. The CDOW is now designing a hatchery treatment system to address the release of spores in effluent, and the state is in the midst of an ambitious effort to eliminate whirling disease from its hatcheries.

"While the state is on the right track in cleaning its hatcheries and curtailing the stocking of infected fish, the research now tells us that an even more aggressive approach is needed," said Colorado TU President Dave Taylor. "Even if it means reduced recreational opportunities in the short-term, we need to stop the stocking and clean up those hatcheries now." ■

The CDOW findings will be featured in an upcoming story in TROUT. For background information, see "The War on Whirling Disease Marches On" from the Autumn '99 TROUT. — be sure it's written on reviewed by Benny

To learn more about the Coldwater Conservation Fund, contact Whit Fosburgh at (703) 284-9409; wfosburgh@nehringtu.org.

definitely no Trout and not actual

True Colo. got bad publicity w/ Taylor's pronouncements

very special situations - uncommon

IF and only IF, W.D. not

present about YOU ARE TU lake - and all trout die w/ no reproduction BY SARA JOHNSON

WHAT TICKLES YOUR FANCY? WHEN YOU ROLL UP YOUR sleeves and get to work, are you happier in a stream, or in a statehouse? Working with your hands, or with your mind? With people, or with fish?

No matter what expertise you have, or what expertise you'd like to gain, if you care about trout and salmon and the places where they live, Trout Unlimited has an opportunity for you to get involved. In each issue of TROUT, "ActionLine" provides a snapshot of some of TU's many volunteer activities underway in communities across the nation.

Ten thousand volunteers in 455 chapters give freely of their time—not just to make more and better fishing spots, but to

shape a healthier future for our cold-water resources. TUers get things done—that's one reason why TU is the largest and most effective trout and salmon conservation organization in the world.

In this edition of "ActionLine," projects from Connecticut to Michigan to Utah illustrate the variety of our volunteer efforts. They also show that the beneficiaries of volunteer work are not just fish and TU members. Local communities and the plants and animals that depend on healthy river systems also benefit. For example:

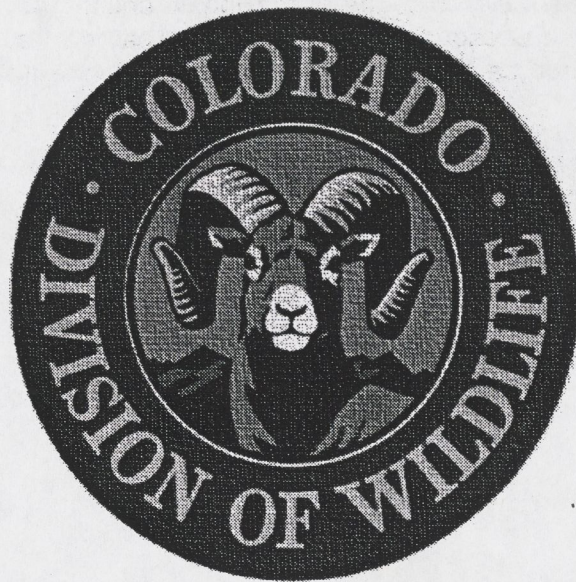
► TU's Utah Council is securing a conservation easement on donated property along the Weber River and will work with the state to restore fish habitat (continued on page 48)



DAVE SCHIROWSKI

Whirling Disease Decision Document and Policy Alternatives

Prepared by the Colorado Division of Wildlife



Revised April 18, 2000

**Preface to the April 18, 2000 DRAFT of the Whirling Disease Decision Document and
Policy Alternatives**

The Colorado Division of Wildlife is committed to a full, open and robust discussion of the issues involving Whirling Disease in Colorado. This document is intended to facilitate that discussion. This draft contains additional information and comments received from biologists after review of the March 28, 2000 revision of this document. Also included in this draft is a new policy proposal, Alternative No. 5. The additional information is underlined in the current draft. This information is designed to further clarify the scope of the issues presented and to provide additional professional perspectives on the Whirling Disease discussion. This document briefly addresses economic impacts of the various alternatives. The economic information will be further evaluated and a more detailed analysis (stocking/relationship to recreational days X \$\$\$\$) will be presented in the June Workshop mailing.

In addition to the Whirling Disease Policy (D-9), the Statewide Fish Management Policy provides further guidance on management of the state's aquatic resources. The Statewide Fish Management Policy was approved by the Wildlife Commission on November 14, 1997. This Policy established direction regarding the stocking of fish exposed to disease pathogens and may provide some additional insight into historic fish management practices. This Policy provides, "[T]he use of stocked fish will not compromise the health of Colorado's aquatic resources, nor will the use of stocked fish threaten the status of any population of native fishes. Decisions on stocking fish where the impacts of the stocking are unknown will require rigorous analysis of the assumptions used to suggest stocking, to ensure that faulty assumptions will not lead to damage of the fishery resource. Fish exposed to pathogens that are determined not to present a threat to the resource may be used in waters determined annually by the Division of Wildlife Director."

INTRODUCTION

At the March 10, 2000 Colorado Wildlife Commission meeting, the Commission requested that the Division begin a review of the Policy D-9 entitled 'The Stocking and Use of Fish Tested Positive for or Exposed to the Whirling Disease Parasite *Myxobolus Cerebralis*.' This review was deemed necessary because of new information on the effects of stocking fish exposed to whirling disease.

The Division has prepared this Decision Document for the purpose of providing the scope and factual information surrounding the problem created by Whirling Disease in Colorado. The Decision Document also provides policy alternatives that may be appropriate for adoption by the Commission.

There are three questions that should be addressed in the policy review.

1. Does the Commission wish to specify a more stringent method of testing hatchery reared fish both at state owned and private units to quantify the number of whirling disease spores at positive fish production facilities?
2. Does the Commission wish to change the policy guidance to the Division of Wildlife and private aquaculturists about the appropriate use of whirling disease exposed fish?
3. Under what circumstances should the policy be reviewed in the future?

The Division of Wildlife proposes that the following alternatives be discussed at the Commission workshop, and moved forward for detailed analysis, which would include: assessment of biological impacts and scientific basis, analysis of impacts on the numbers of fish stocked, the number of lakes and acreages impacted by changes, the number of stream sections and miles affected by changes, recreational impacts, social and economic considerations and the determination of a preferred alternative.

A policy alternative will be selected at the July Commission meeting and the regulatory process will follow from the selected policy.

AN OVERVIEW OF WD IN COLORADO

Whirling Disease (WD) affects salmonid fishes, especially rainbow and cutthroat trout, and to a lesser degree, brown and brook trout, and is caused by a microscopic parasite. When the parasite heavily infects young fish during the period when cartilage is forming into bone, the spinal column can be deformed enough to cause nerve damage resulting in severe whirling. Hence the name "whirling disease." As fish mature and bone forms, the fish are much less susceptible to showing disease symptoms. It should also be recognized that the "disease" has varying effects ranging from low exposure with no clinical signs of WD to high exposure and with possibly severe nerve damage. The majority of fish in the Division's hatchery system has low exposure and is stocked in many of the state's waters. Once established, the parasite is very difficult to eradicate, since the life cycle involves both fish and small worms that inhabit mud in stream bottoms. One method being used in hatcheries is to place water in underground pipelines. In open waterways, this is not practical and therefore, the parasite will continue to exist for many years.

HISTORY OF WD

WD originated in Europe and was documented in the United States in 1956. In the late 1980's, it was found in Colorado and it is now known to exist in about 15% of the state's streams and 25% of the state's lake habitats. While stocking infected fish has contributed to its spread, there are also other possible methods of spreading the disease to additional waters, including birds and humans. The parasite can pass through the digestive tract of birds that consume WD infected fish and humans can transport the parasite on wading boots and through the use of boats between infected and non-infected waters. It is not felt that humans are a significant factor in spreading the parasite. The impact from birds, however, is believed to be significant and responsible for the recent introduction of WD into Yellowstone Lake since no documented stocking of fish occurred. It is evident that the parasite is continuing to spread, not only in Colorado, but also throughout the United States. Whether this spread can be controlled is still the subject of great disagreement.

The impact of WD to stream fisheries in Colorado has ranged from severe to minor. The best example of a severe impact is the Colorado River below Granby where natural reproduction of rainbows has all but been destroyed. This is due to the heavy concentration of the parasite and worms contributing to the life cycle, in an upstream water impoundment. In contrast, the Arkansas River brown trout fishery has shown little, if any, impact. The magnitude of the impact is likely determined by the condition of the habitat. The more degraded the habitat, including heavy siltation, the greater the impact. The majority of Colorado streams and lakes remain unaffected by whirling disease.

Many recent news articles have incorrectly portrayed every stream in Colorado as having been decimated by whirling disease. This portrayal is not true and misconstrues the actual impact of the disease. To date, the impact to fish availability, and thus indirectly economic impact, has been on the Western slope. The Western slope is home to many of the historically protected "AAA" and "A" waters and therefore fewer stocking opportunities exist in those areas. The predictable result has been lowered angler success, license sales and satisfaction on the Western slope.

The Colorado Division of Wildlife is addressing whirling disease on multiple fronts and dedicating substantial resources, both financial and personnel, to this problem. To date the Division's goal has been to prevent the further spread of the disease and to avoid increasing the level of infectivity in waters that are already WD positive. The Division's program is guided by the existing Colorado Wildlife Commission Policy (established in 1996) on the use and stocking of exposed fish. This policy includes fish stocked by the Division as well as private producers. The activities addressing the management of whirling disease and its impacts are grouped into fish health, fish production, fish research, regulations and resource management. The Division's fish health lab at Brush conducts numerous tests on fish to be stocked to ensure clean fish are used in protected waters and exposed fish comply with regulations. Recent scientific advancements have increased the sensitivity of WD testing procedures. Colorado is at the forefront of WD testing and research and is the only known state in the nation to have established DNA testing as a means to determine the presence of the WD parasite in stocked fish. The current research involves testing on virtually all aspects of the disease, including infectivity levels, resistance, population effects and habitats among others. Fishing regulations on the Western slope have been modified to reduce the daily bag limit because fewer catchable trout are available for stocking in the protected waters. The actual results of these regulations are being monitored to determine impacts. In addition to the lab research, fieldwork is ongoing to identify any waters that may have been exposed to the parasite. This field research is

important to identify what methods of spread are hazardous to the resource as well as to evaluate management implications. The fieldwork has shown, for example, that re-stocking of fingerling fish (average 5" in length) into streams is a viable management technique used to increase salmonid populations without increasing the WD threat to the resource. Some evidence from the hatcheries suggests that negative fish, once exposed, will have higher spore levels and more clinical signs of WD than fish reared in positive water.

DIVISION'S ACTIONS IN RESPONSE TO WD

The Division received Legislative approval for the expenditure of up to \$12 million to clean up and modernize a significant portion of Colorado's fish production system. The majority of hatcheries in the state are WD positive and the impact to fisheries in Colorado has been dramatic. The Division's goal is to produce the necessary WD negative trout for re-stocking waters that have had reduced numbers of fish in recent years. In addition, fish with low exposure of the parasite will also be raised and stocked into WD positive waters. Stocked fish continue to be an important component in the recreational fishing opportunities sought by anglers and it is imperative that the Division increases the production capacity of clean fish in Colorado.

The Division is also increasing its efforts in the public information arena to make sure that anglers are aware of the steps they can take to help prevent the inadvertent spread of the parasite from water to water. Information now includes advice on when and where to clean and dispose of fish entrails, as well as advice on cleaning waders, boots and other equipment that may be used in waters where the parasite exists.

The Division takes its mandate to protect fish and their habitats seriously while at the same time trying to provide maximized recreational fishing opportunities. The Division acknowledges the support and cooperation of the Colorado Fish Health Board and recognizes that their continued support will be critical in managing WD. The whirling disease issue is likely to exist for many years and the division will continue to dedicate resources, as appropriate, to managing the problem.

HATCHERY CLEAN-UP

The Division of Wildlife's coldwater fish production has been severely impacted by the WD parasite. Currently seven of 16 facilities are certified "negative." Two of those seven are warm water fish units. Two other units have revealed positive results using a controversial research test called PCR. Another unit has been classified "suspect" because the water supply from Pueblo Reservoir is known to be positive. This has reduced CDOW's ability to produce the numbers of sub-catchable fingerlings and catchable fish requested by the Division's aquatic biologists.

The Division's biologists request small fish to supplement the natural reproduction of trout. Larger "catchable" fish are required to provide recreational fishing opportunities. "Clean" catchable production has also suffered as a result of WD impacts. The extent of this impact is now being fully realized as the aquatic unit identifies facilities where important native Cutthroat restoration can be accomplished.

In 1997, several modernization projects were undertaken in the Fish Production Section. Elimination of the WD parasite is one of the projects main goals. Units selected for these projects were Bellvue, Buena Vista, Durango, Finger Rock, Rifle, Roaring Judy and Mount Shavano. Funding was also provided to increase production at the existing WD negative hatcheries. Beginning in 1998, extensive work was begun at Finger Rock and Mount Shavano and design work was begun at Rifle and Roaring Judy to secure ground water sources and protect facilities from exposure to WD. The Division's goal is to produce up to two million clean, catchable trout and up to 14 million clean sub-catchable trout per year.

Other facilities with potential to be declared WD negative or to increase production of WD negative fish are also currently being modernized. These facilities include Bellvue, Durango, Mount Ouray and Buena Vista. Seven point nine million dollars (\$7.9 million) were funded for Phase 1 projects in 1997. Most Fish Unit Maintenance Funds for FY 1997 were also targeted toward these projects. An additional \$5 million was requested in 1998 for FY 1999-2000 projects. Some hatchery personnel have expressed concern over shifting the direction of the WD policy prior to completion of the hatchery modernization effort and analysis of the production capabilities at that time. Also, some hatchery managers argue that the short term proposal to purchase WD negative fish from private hatcheries or state hatcheries from adjoining states could result in the importation of viral or bacterial diseases that could have far greater detrimental impacts to Colorado's aquatic resources.

Other methods to control WD at positive facilities are being actively pursued. These include: research into the use of antibiotics to prevent spore formation; development of Snake River Native Cutthroat trout brood stocks (a fish that has shown some resistance to the WD parasite); chemical or biological control of the intermediate host worm; manipulation of fish hatchery management to reduce exposure, including secondary treatments such as U.V. light. Development of a vaccine is unlikely but research by entities outside of the division is also continuing in this area.

RECENT RESEARCH AND THE IMPLICATIONS

The original impetus for a review of the WD policy was driven by the findings of Barry Nehring's recent research however, some of the conclusions reached by Nehring remain a major focus for debate. Nehring, in a recent presentation to the Sportsman's Advisory Group, stated that the landscape of knowledge is changing at an extremely rapid pace. This shifting landscape is argued as a primary reason for thoughtful and deliberate analysis when considering adopting a new WD policy. Scientific professionals know far more today than even one year ago and may know exponentially more in the next few years. Given the status of collective knowledge on the subject, a number of concerns have been raised as to whether now is the right time to make a major policy shift in light of the evolving knowledge base. The preliminary but critical questions then become: Is now the correct time to promulgate a new policy or would it be more prudent to wait until more definitive information is available? If the attempt to resolve this complicated issue is premature will ballot initiatives or litigation result? Or is it imperative that the Commission acts now to provide long-term protection for the state's fishery resource?

Transportation and distribution of wildlife, including fish, has been recognized by the Division of Wildlife, to carry some level of responsibility in the transmission of various diseases: viral, bacterial, and parasitic pathogens or other unwanted problems to resident wildlife populations. The Division has recognized that some risk is involved when stocking fish and has worked to

limit the risk of spreading pathogens, especially whirling disease (*Myxobolus cerebralis*), through policy and regulation.

In the late 1980's and early 1990's, decisions were made that allowed the stocking of whirling disease exposed fish in habitats known to be positive for the parasite. One of the primary risk considerations used to determine the suitability of WD positive hatchery reared fish being stocked into positive waters, was a comparison of the background level of infection (WD spores) in resident fish, against the spore levels in the fish considered for placement in those waters.

In low elevation waters (seasonal salmonid habitats) where trout are stocked in spring and fall to provide angling opportunities, the risk of spreading WD is not considered a threat. These low risk "C" class waters often do not support year-round trout populations, or are considered to be dead-end waters that do not have an outflow into other trout habitat. In a few large standing "C" waters where year-round survival of trout does occur, natural reproduction is minimal or non-existent. In either case, stocking of WD positive fish into "C" waters, regardless of spore load, continues to be considered an acceptable use, under current Wildlife Commission Policy, of these hatchery reared fish because there are no known WD impacts to the fishery resource.

In higher elevation waters where WD was known to exist or where exposed fish had been stocked for many years, waters were classified as restricted, or "B" class waters. In these waters the risk to adjacent wild trout populations was taken into consideration, and the only WD positive fish that could be stocked were required to test at a "low" level of spores per head. At that time the Division based decisions on available information but recognized the limitations of the information with continuing research rapidly adding to the WD knowledge base. This prompted additional research that focused on identifying actual or potential impacts that stocking of exposed fish into these "B" class WD positive waters might have.

Initial results from on-going research have identified risk factors, and some specific waters, where the stocking of fish with high levels of infectivity has apparently increased the number of Triactinomyxons (TAMS) released into the environment, mostly in running waters downstream from the stocking sites (Nehring, 1999). The risk factors include size of the lake, depth, gradient of outlet stream, downstream beaver ponds and the location of the outlet. The research has also made the Division more aware of actual and potential risks associated with previous decisions. In addition, laboratory-testing procedures have been analyzed and modified to yield much more accurate estimations of the number of spores hatchery reared fish were actually carrying to receiving waters.

For these reasons, the Division has been prompted to review the risk of continuing to place WD exposed trout in some of the restricted "B" class waters, both lakes and streams. This evaluation will discuss the magnitude of differences between the laboratory testing procedures and will provide information related to the appropriate classification of waters currently in the restricted stocking habitat "B" category. It will include other known information on previous stocking, fish availability for year 2000 and implications of decisions on Kokanee. For example, the restriction on stocking rainbows into Blue Mesa and Granby has resulted in increased Mackinaw predation on Kokanee populations. The Commission will also need to consider potential shifts and impacts to recreational fishing and matters related to the Federal hatcheries that produce fish for placement in Colorado waters. There are no guarantees that the Federal hatcheries will continue to provide a significant number of the fish stocked into Colorado waters. This information should be considered prior to any additional WD positive fish stocking into the "B" waters of concern.

As is often the case, new biological information triggers new questions and analysis in response to the additional data. Nehring's research is no exception and has generated at least as many questions as answers. Because of the limited geographical scope of Nehring's research some biologists have expressed concern that extrapolation of that information to all waters of the state (through policy) would not be prudent. Additionally, some biologists would like to see Nehring's research subjected to more intense peer review. Nehring's research is ongoing and will provide more definitive information with each new data set. While most biologists recognize the importance of the research, some question if a direct correlation between stocking and levels of infectivity has not been shown on a large scale (statewide basis) and is therefore inconclusive at this point. Further, some argue that increased TAM levels below stocked reservoirs do not necessarily correlate to increased spore loads in fish or negative impacts to existing fish populations. Additional questions then arise: Is the intent to manage spore levels or fish populations? Can fish populations be managed without managing spore levels? At what level of infectivity do fish populations suffer?

Rainbow trout are not native to the state and were brought to Colorado for the express purpose of providing recreation. Many biologists (and non-biologists) argue that these 'exotic' species should be managed for maximum recreational opportunity, including stocking these species in abundance where native species will not be impacted. These individuals point out that referring to 'wild rainbow trout' may be misleading. It may be more appropriate to focus on areas where significant natural rainbow production occurs and restrict stocking of WD positive fish in those select waters.

ADDITIONAL RESEARCH AND ITS IMPLICATIONS

Research is continuing on many fronts and additional questions need to be answered regardless of whether the Commission adopts a new WD policy. For example, some evidence exists that WD negative fish stocked into WD positive waters results in these previously negative fish having a much higher spore load than lightly infected fish stocked into the same WD positive water. In addition, some evidence exists that the age and size at which rainbows are exposed to WD has some impact on their ability to withstand the parasite. Further research is necessary to confirm or contradict this information.

Brown trout are thriving in many of the same waters that have seen a dramatic decline in rainbow populations. Additional research may be needed to evaluate whether brown trout are part of the cause (in conjunction with WD) in rainbow declines or whether they have simply moved into the available habitat after the rainbows have died. Laboratory research conducted in 1999 indicated that brown trout might be able to expel WD spores. This research will continue in 2000 and if confirmed, would suggest that brown trout are capable of reducing levels of infectivity if stocking of infected fish was discontinued. Also, preliminary evidence suggests that Snake River Cutthroat may be less susceptible to WD. More information regarding Snake River Cutthroats (and other salmonid species) is forthcoming. If other species show resistance, the Commission may choose to emphasize the stocking of a species other than rainbow trout.

Nehring's research is based on, among other elements, counting TAMS to determine infectivity of the water. Both 'alive' and 'dead' TAMS are counted in this calculation. One biologist believes additional research needs to be provided on whether viable and dead TAMS should be treated the same in this calculation.

TESTING METHODOLOGY OF FISH

The regulation defining a "low level" of spore burden in hatchery produced fish was initially developed in 1996, based on the rationale that fish stocked at or below this "low" level, into known positive waters, would not present an unreasonable risk to the resident populations. This was based on the best scientific evidence and professional opinion at that time. Fish produced at the hatcheries were tested prior to the stocking season to determine the average number of WD spores per fish head. The procedure allowed for the heads to be frozen and processed with Pepsin, trypsin digestion, in a method similar to another lab that had been contacted when the protocol for the Division's lab was being established. At this time the spores were considered extremely durable and the procedure was thought to have a high recovery rate of the actual number of spores in each head.

Over time, as the Fish Health Laboratory ran thousands of these tests, it became apparent that many spores were being damaged by freezing and digested by the procedure so that recovery rates were low. Laboratory technicians re-wrote the procedure based on the original research that described a much more complicated and time consuming protocol of the test. In addition, the Division's protocol has refined the procedure and it now yields much more accurate quantification of the number of spores these hatchery fish actually have in their heads. Although it is not possible to give an exact estimate of the magnitude of difference between the two procedures, it is not uncommon to see differences of 5 to 40 times as many spores than were previously recovered. On average a 15 to 20 fold increase in recovery rates is generally accepted as the best comparison range we can currently offer. In addition, there are inherent problems with testing fish prior to the stocking season and actually knowing what the spore levels may be in the different age groups of fish as the stocking season progresses. It is however, a workable estimate of the differences between facilities and their ability to produce fish with the lowest possible spore burden on each of the water supplies available to these units. It is not an exact science but a way to guide fish placement into waters that can minimize risks to resident fish populations. It is also not unusual to observe significant differences among individual fish, different groups of fish, or even different species of fish, all on the same facility. As the fish age they appear to reach their peak spore burden around one/two year post exposure.

Continued stocking with fish testing less than (<)10,000 spores per head as determined by the original "less accurate" procedure therefore carries with it an additional risk factor of actually having 15 to 20 times the spore burden than was originally thought to be acceptable. Research indicates that in some of the "B" class waters, continued stocking of fish with spore levels currently calculated in the range of < 150,000 to 200,000 per fish head, has apparently increased the number of TAMs being released by the intermediate worm host. Elevated levels of TAMs specifically in downstream waters may have had, or could have, population impacts on resident fish. At the very least, it should be recognized that these TAMs do pose an additional risk to those fish populations living in habitats identified as being conducive to significant biological-magnification (lots of worms etc.) and/or comprised of very sensitive fish species.

But, as with most issues involving WD, the use of the (<) 10,000 (or any absolute number) spore level as a criteria for stocking is hotly debated. Most biologists would agree that the 10,000 level was somewhat arbitrary and some aquatic and hatchery biologists believe that any absolute spore load level impedes the ability to manage based on considerations of the unique characteristics of each water and each species available for stocking. In support of this

argument biologists cite, among other arguments, the escalating sensitivity of spore testing procedures and the fact that Kokanee are not the threat to the resource that rainbows appear to be with the same relative spore load. In addition, the current 10,000-spore limit has resulted in restricted stocking of some rivers with little or no naturally reproducing trout populations. Some aquatic biologists and hatchery managers argue that flexibility should be maintained to account for individual waters' particular spore load, species susceptibility and habitat.

POLICY IMPLICATIONS OF "SHIFTING" WATERS

All of the policy alternatives presented involve the opportunity to change the existing classification of waters. The impact of shifting the waters from their current classification will either result in more waters receiving WD positive fish or fewer waters receiving WD positive fish. Even Policy Alternative 1 (Retain current policy with modifications on testing) will result in a different categorization of waters throughout the state; e.g. If the Commission requires the more stringent test, more waters will be effectively precluded from stocking notwithstanding retention of the 10,000 spore level.

The analysis that follows, therefore, will not address each particular alternative but rather set forth the likely results if more waters are included or precluded from stocking either through designation of the individual waters or modification of the spore load criteria (including modifications in testing requirements).

A. Shifting more waters to the 'A' category

It is generally believed that moving additional waters to the 'A' category will result in further detrimental impact to local economies. This impact to local economies directly results from lost recreational opportunity in areas that have traditionally provided the majority of the salmonid habitat. Of particular concern are small communities on the Western Slope. To date the Western Slope has born the majority of the burden both to local economies and decreased opportunity for recreation. The areas around Gunnison and Granby were cited as examples of local communities that were severely impacted by stocking restrictions. Others believe that the 'hit' has already been absorbed and that additional decreased stocking in Western Slope waters won't have a significant additional detrimental impact. Eastern Slope waters and economies may benefit from the increased stocking of fish that cannot be stocked into newly created 'restricted habitat.' Most of the excess would be available for stocking in non-salmonid habitat primarily along the Front Range. This increase would likely decline over time as additional hatcheries are updated and become capable of producing WD negative fish.

The argument for further reduction in stocking WD positive fish is based on the fundamental goal of resource protection. Many argue that any decrease will have a positive impact on the division's ability to ultimately control WD. Many others, however, argue that the existing policy, regulations and biological review provides the necessary level of resource protection while continuing to allow flexibility in management of the state's aquatic resources.

Moving additional waters to the 'A' category will also increase hatchery inefficiency and transportation costs. For example, rainbows from the Roaring Judy Hatchery near Gunnison must be trucked hundreds of miles for stocking in Eastern Slope waters because the hatchery exceeds the 10,000-spore load level. This type of inefficiency will increase if more waters are restricted. Impacts to division revenue are less clear. Undoubtedly there will be some

detrimental impact in license revenue but the extent of that decrease is difficult to predict and tied largely to the speed with which hatchery modernization occurs. Private hatcheries generally oppose an increase in restricted waters. WD negative hatcheries, however, would benefit if the division chooses to purchase fish to supplement the state's production.

Summary of shifting more waters to 'A'

- Loss of recreational opportunity
- Increased economic impact, especially on Western Slope
- More fish stocked into urban waters on Eastern Slope
- Provides more resource protection
- Increases production and transportation costs

B. Shifting more waters to the 'C' category

Moving additional waters to the 'C' category is the preferred alternative for those who wish to maximize recreational opportunity with the division's existing stocking capabilities. The magnitude of that impact is difficult to quantify. Advocates of this alternative argue that the increase in recreational opportunity (and diversity of opportunity) is important and the risk to the resource is minimal. Advocates of this position point out that none of the alternatives presented would allow for stocking WD positive fish into existing 'A' or 'AAA' waters. The local economies on the Western Slope would likely benefit from a renewed stocking program that would occur in waters that have experienced dramatic declines over the last five years. These waters are primarily in the mountain areas and on the Western Slope. Those opposed to moving more waters to the 'C' category argue that this would provide less protection to the state's resources and less protection to T&E species.

By moving more waters to the 'C' category the division could increase hatchery efficiency and minimize transportation costs from their hatcheries. The increased recreational opportunity would likely result in either maintenance of existing revenue or additional revenue to the division through license sales. Again, this increase is very difficult to quantify. Private hatcheries would have more flexibility and generally support this alternative. It is unlikely that the division would need to purchase any trout from private hatcheries if more waters were moved to the 'C' category.

Summary of shifting more waters to 'C'

- Increased recreational opportunity and diversity of opportunity
- Provides for less resource protection
- Decreases production and transportation costs
- Decreases adverse impacts to local economies on the Western Slope

C. Maintaining the status quo

It should be acknowledged that maintaining the status quo is not set out as a policy alternative in the section below. Analysis of the status quo is, however, relevant as a baseline for assessing impacts of proposed alternatives. Notwithstanding the fact that a true status quo option is not delineated, it is certainly within the purview of the Commission to adopt the status quo as a viable policy for managing WD in Colorado.

By maintaining the status quo the detrimental impact to the Western Slope economies would likely continue but not increase in magnitude. A continued decline in recreational days and diversity of opportunity would likely occur on the Western Slope and in the San Luis Valley. The Western Slope is experiencing a 75% decline in stocking below its historical stocking levels. No detrimental impact would result to the economies of the Eastern Slope and metro areas along the Front Range. Advocates of maintaining the status quo argue that little or no degradation of the state's aquatic resource has occurred since the Commission adopted the WD policy in 1996. Others argue that the status quo will further expose the state to the negative impacts of WD by spreading the parasite and increasing spore levels in waters already infected.

Advocates of the status quo state that the existing policy has resulted in a decrease in spore loads to a fraction of their pre-1996 levels and that more time would result in a further reduction in WD contamination. Little or no impact would result to division revenue by maintaining the status quo. Additionally, production and transportation costs at the state's hatcheries would remain unchanged. Predictability is a key component of private hatchery production and therefore private hatcheries are generally not opposed to maintaining the status quo.

Summary of maintaining the status quo

- No further decrease in recreational opportunity
- No further detrimental impact to Western Slope economies
- No further increase in production or transportation costs
- Maintains current level of resource protection

CONCLUSION

Recent research has brought the issue of WD impacts to the forefront and compelled the Division to seek further guidance in light of new knowledge regarding the transmission and impact of whirling disease. Ultimately the Wildlife Commission must provide direction to the Division over whether WD positive fish should continue to be stocked in Colorado. If the Commission concludes that WD positive fish should be stocked, further guidance over the location, testing method and criteria for stocking must be established through policy and ultimately regulations.

PROPOSED ALTERNATIVES

Alternative No. 1 – Retain the existing Policy D-9 with modifications concerning testing of fish

This alternative would allow the continued stocking of whirling disease exposed fish in two classes of waters, the restricted "B" waters and the low-risk "C" waters. The designation of waters to the various classes would continue to be the responsibility of the Director of the Division of Wildlife, based on the criteria outlined in the Policy, which basically use the best current science and information on risk associated with possible spread of the parasite or increasing the level of severity. Annual recommendations on what waters could be stocked are based on a continual review of new research and field survey information.

As a result of this action the following categories of waters would be maintained, but the number of waters in each category would be dynamic and changing:

***"AAA" "A" "B" "C"

(**"AAA" = negative fish by PCR testing, "A" = negative fish by PTD testing, "B" = exposed fish with average spore level of less than 10,000, "C" = exposed fish with no spore limit)

There are several considerations that need to be addressed in retaining this option:

- 1) The regulation that defines "lightly-infected fish" as being fish with less than 10,000 spores per head average could be left as is, or modified, based on the latest information and sensitivity of testing. The number could go higher or lower based on research findings.
- 2) A decision on testing methodology needs to be made. The method of testing fish prior to stocking could be left as currently conducted; or the method could be explicitly re-defined as "using the best science available" both in regulation and the policy. The method of testing, of course, could change over time as research and development of standards continues. For the year 2000, the Division is applying the best science (new method) in the testing of its production units.
- 3) The portion of the regulation that defines "restricted habitat" would need to be addressed. The Commission could place greater emphasis on defining what risk factors need to be taken into account when restricted "B" habitats are designated by the Division. This could be either in the Policy, or in the regulation.

Alternative No. 2 – Change the Policy to restrict the stocking of fish exposed to whirling disease to only those waters currently determined to be "low-risk" habitats

This alternative would allow the continued stocking of whirling disease exposed fish in one class of waters, the low-risk "C" waters, as they are currently designated by the Director. The designation of waters to this class would continue to be the responsibility of the Director of the Division of Wildlife, based on the criteria outlined in the Policy. Changes on what waters could be stocked are based on a continual review of new research and field survey information.

This option eliminates the restricted "B" habitats, and all such waters would be shifted to "A".

"AAA" "A" "B" (eliminated, waters shifted to "A") "C"

There are several considerations that need to be addressed in retaining this option:

- 1) The regulations that define "lightly-infected fish" as being fish with less than 10,000 spores per head average, and what constitutes "restricted habitat" could be determined to be no longer needed, if the current Policy as it applies to "low-risk" is retained. The regulation would have to be changed.
- 2) A decision on testing methodology needs to be made. The method of testing fish prior to stocking could be left as currently conducted; or the method could be explicitly re-defined as "using the best science available" both in regulation and the policy. The method of testing, of course, could change over time as research and development of standards continues. For the year 2000, the Division is applying the best science in the testing of its production units.

- 3) Criteria on what constitutes "low-risk" habitat are currently fairly narrow, meaning water that often exceeds 68 degrees F, water that has no salmonid reproduction, are dead-end waters not connected to flowing coldwater habitats. These criteria would essentially remain as is.

Alternative No. 3 – Change the Policy to restrict the stocking of fish exposed to whirling disease to only those waters determined to be "low-risk" habitats based on a new definition of what is low-risk habitat.

This alternative would allow the continued stocking of whirling disease exposed fish in one class of waters, the low-risk "C" waters, as they would be re-defined and designated by the Director. This option eliminates the "restricted "B" habitats, but would allow the stocking of exposed fish into some coldwater habitats that would be moved from the defunct restricted "B" category into a new low-risk "C" category if they meet certain criteria. Changes on what waters could be stocked would be based on a continual review of research and field survey information.

This option eliminates the restricted "B" habitats

The category of "C" waters would be expanded to include coldwater habitats that are deemed to be of low risk based on an annual application of the risk factors that address resource protection, spread of the parasite, or increases in severity.

"AAA" "A" "B" (eliminated, waters shifted to redefined "C") "C"

There are several considerations that need to be addressed in retaining this option:

- 1) The regulations that define "lightly-infected fish" as being fish with less than 10,000 spores per head average may need to be retained if some coldwater habitats fit new "low risk" criteria.
- 2) A decision on testing methodology needs to be made. The method of testing fish prior to stocking could be left as currently conducted; or the method could be explicitly re-defined as "using the best science available" both in regulation and the policy. The method of testing, of course, could change over time as research and development of standards continues.
- 3) Criteria on what constitutes "low-risk" habitat would need to be redefined if some coldwater habitats are to continue to be stocked, and could be included in the Policy, or left to the discretion of the Director. Criteria for what is a low-risk habitat would be re-defined and include for example, an elevational break point in a watershed or outflow location.

Alternative No. 4 – The Commission should develop a new Policy allowing the continued stocking of fish exposed to whirling disease in all exposed habitats.

This alternative would actually be a liberalization of the current Policy. It is based on the thinking that all the actions to date have not resulted in any diminishing level of infectivity in streams and lakes already considered to be WD +, and more restrictive policies and regulations are too damaging to the recreational and economic interests in the state.

Under this alternative, the categories "B" and "C" are combined, with some "B" waters likely to move to "A" status.

Positive waters could be stocked with exposed fish of varying spore loads, as long as they meet the Policy direction of not spreading the parasite or increasing severity of the parasite.

"AAA" "A" "B & C" (eliminated and consolidated to accept exposed fish)

There are several considerations that need to be addressed in retaining this option:

- 1) The regulations that define "lightly-infected fish" as being fish with less than 10,000 spores per head average, and what constitutes "restricted habitat" could be determined to be no longer needed, or could be continued for waters that are currently listed as restricted "B" habitats. That category itself could be discontinued, or continued under this option.
- 2) If a spore-loading criteria is maintained, a decision on testing methodology needs to be made. The method of testing fish prior to stocking could be left as currently conducted; or the method could be explicitly re-defined as "using the best science available" both in regulation and the policy. The method of testing, of course, could change over time as research and development of standards continues.
- 3) If spore testing is maintained, criteria on what constitutes "low-risk" habitat for the stocking of fish with high spore loads would need to be defined if the criteria of not spreading the disease or increasing the severity are to be maintained.

In the introduction to this discussion paper, it was mentioned that all of these alternatives would be evaluated from the Division's perspective of possible biological impacts of changes in stocking, scientific basis of changes, analysis of impacts on the numbers of fish stocked, the number of lakes and acreage impacted by changes, the number of stream sections and miles affected by changes, recreational impacts, social and economic considerations,

Alternative No. 5 – Retain the current classification but increase the spore level for "B" waters using the new PTD testing method.

This alternative would allow continued stocking of whirling disease exposed fish in two classes of waters, the restricted "B" and the low-risk "C" waters. The designation of the waters to the various classes would continue to be the responsibility of the Director of the Division of Wildlife, based on the criteria outlined in the Policy, which basically uses the best available and accepted science. The spore level available for stocking fish into the "B" category would be increased and require the use of the new PTD method (fresh head). Annual recommendations on what waters could be stocked are based on a continual review of new research and field survey information.

As a result of adopting this policy the following categories of waters would be maintained, but the number of waters in each category would be dynamic and changing:

"AAA", "A", "B", and "C."

(**"AAA" = negative fish by PCR testing, "A" = negative fish by PTD testing, "B" = exposed fish with average spore level of less than a level determined to be biologically acceptable using the best available science, "C" = exposed fish with no spore limit)

All "AAA" waters would continue to require PCR testing before stocking (Protecting Native Resources) and the PTD method of testing(Fresh Heads) would be used for the remaining waters.

The Hatchery Section would continue with the Modernization Projects to produce 1)as many negative fish as possible; and 2) strive to reduce spore loads at the positive Units.

All hatcheries (State and Private) must have testing done at the Brush Lab. If another lab is used, the Brush Lab must approve the method and location.

The Commission should consider the following in determining whether to adopt this Policy Alternative:

- 1) This Alternative would give researchers time to concentrate their efforts toward managing the fishery resource in the presence of WD before this issue is addressed again. To date efforts have been to reduce the spore infectivity levels and understanding the basic information of how the organism reacts in the wild.
- 2) If spore count criteria are maintained a decision on testing methodology needs to be made. The method of testing fish prior to stocking could be left as currently conducted; or the method could be explicitly redefined as "using the best ACCEPTED science available" both in regulation and policy. The method of testing, of course, will change over time as research and development of standards continues. These methods MUST be applied across the board to State and Private Hatcheries that are stocking fish in the State.
- 3) Does the Wildlife Commission want to use a "Broad Brush" in managing the Whirling Disease situation in the State? Or does the WC want to allow the biologists the ability to manage a specific body of water on a population/ecosystem level. Not all environments have the same conditions and each fishery biologist should be allowed to manage those individuals systems in the proper manner. This Alternative would allow for that flexibility.

These changes would still allow for protection of waters that are currently negative while giving the Hatchery Section time to complete the modernization of the positive hatcheries while maintaining the current level of resource protection and recreation.

BACKGROUND INFORMATION

A listing of current categories of waters, a Glossary of Terms, a map of current WD-positive waters, a research overview, a list of current fish availability, and a list of upcoming angler roundtable meetings are attached to further assist in understanding the issues.

CURRENT CATEGORIES OF WATERS UNDER POLICY D-9

The current breakdown of waters and acreage or miles by "A", "B", or "C" categories, including the Division's administratively directed "AAA" category for cutthroat management waters.

LAKES			STREAMS	
WATER CLASS	SURFACE ACRES	NUMBER OF WATERS	MILES OF STREAM	SEGMENTS
AAA	7,157	582	1,698	193
A	69,393	1,033	11,095	1,253
B	37,785	119	480	42
C	86,325	2,149	13,933	25
Totals	200,660	3,883	27,206	1,513

From this table, the "B" and "C" waters contribute 58% of the total area where exposed WD fish can be stocked. This table reflects the statewide designation in 1999 and will very likely change in 2000.

GLOSSARY – 2000 WHIRLING DISEASE POLICY

D-9 Wildlife Commission Policy – Approved by the Wildlife Commission, May 1996, and directs the stocking of salmonid fish testing positive for whirling disease. Establishes three classes of water as designated by the Director: A – negative fish, B – low exposed with average spore level of 10,000 / fish, C – exposed with no spore limit.

Clean Fish – Fish that have been sampled and determined to be 100% free of the whirling disease organism.

Positive Fish – Fish that have been sampled and determined to contain the organism, or have been reared on fish units that have tested positive.

Low Positive or Exposed Fish – Fish that have been sampled and determined to contain the organism at a very low level. Current regulation defines this level at 10,000 spores or less for each fish.

Positive Fish Hatchery – A hatchery that has been determined to have the whirling disease organism.

Negative Fish Hatchery – A hatchery that has been determined to not have the whirling disease organism.

“AAA” – The highest level of water class. Require 100% clean fish as determined by DNA testing. Usually contain native cutthroat trout.

“A” Water Class – Requires 100% clean fish as determined by pepsin-trypsin testing method. This method is less sensitive than DNA testing for “AAA” waters.

“B” Water Class – Allows stocking of low positive or exposed fish with less than 10,000 spores per lot of fish.

“C” Water Class – Allows stocking of positive fish with no limitations on spore level.

Polymerase Chain Reaction (PCR or DNA) – Technology that allows testing for the DNA presence of the whirling disease organism.

Pepsin-Trypsin Digestion (PTD) – Used on fish age one and older to determine the presence of the whirling disease organism. Refinements in the method at the Brush Aquatic Health Laboratory have created a more sensitive “New” method. This “New” method will be used in the future at all Division of Wildlife fish production facilities. **(Note: Read attachment of 1/25/00 by Pete Walker)**

Fish Stocking Request – Annual biologists’ request for fish to be stocked into lakes and streams. Request broken up now by negative and positive fish.

Hatchery Production Availability – Annual numbers of fish available from either positive or negative Division of Wildlife hatcheries.

■ ETATS

Bill Owens, Governor

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WILDLIFE

AN EQUAL OPPORTUNITY EMPLOYER

Bruce L. McCloskey, Acting Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192



*For Wildlife-
For People*

September 8, 2000

To Whom It May Concern:

Enclosed you will find copies of three research reports on whirling disease. Information contained in Barry Nehring's report continues to support previous conclusions. Stocking of *Myxobolous cerebralis*-infected trout increases the level of infection in resident wild trout especially rainbow, brook and cutthroat trout. Levels of infection in brown trout also increase in some but not all instances. It appears the extent of *T. tubifex* habitat along with stocking history (number of years stocked), elevation and distance to known positive waters contribute to the establishment and degree of impact on brown trout and other resident wild trout populations. He reports data from five reservoirs/lakes/ponds stocked for a number of years with *M.c.* positive trout and the high levels of triactinomyxons (TAMs) produced and the resulting high parasite burdens in resident wild trout. These results are compared to five waters where positive trout stocking ceased or never was started. He states: "We do not believe it is a statistical accident or a fluke of nature that high levels of TAM spores are regularly detected in effluent from ponds, lakes or reservoirs where *Mc*-exposed trout are reared or stocked, while TAM spore levels are low or absent in other bodies of water of similar size, shape, and ecological condition but have not been stocked with *Mc*-exposed trout."

In the report written by Dr. George Schisler of the Colorado Cooperative Fish and Wildlife Research Unit at Colorado State University he states: "The effect of distance to known positive waters on *M. cerebralis* status of the waters tested in this study suggests that transport by fishermen, fish-eating birds, or fish migration may be a contributing factor in the spread of the pathogen in Colorado." He also stated: "The results of this study indicate that *M. cerebralis* has become established in many high elevation waters. Availability of *T. tubifex* habitat and proximity to other *M. cerebralis* -positive sites has a significant effect on the *M. cerebralis* status of a water. Higher elevations do provide some refuge from the parasite due to the longer distances to heavily infected waters and reduced *T. tubifex* habitat in these locations."

Obviously the continued stocking of *M.c.* positive trout will increase the risk of the parasite spreading, eventually infecting waters in closer proximity to native cutthroat trout habitats. As with most field investigations, empirical data never provides absolute proof of a cause and effect relationship. Other researchers working on the IPN virus among brook and rainbow trout in lakes in Banff and Jasper National Parks, however, have also reported significant declines in the incidence of the disease once the stocking of infected fish stopped. Natural resource managers must determine if sufficient evidence exists to make decisions. I believe the evidence presented is sufficient to conclude there is a cause and effect relationship between stocking *Mc*-infected fish and the incidence and degree of infection in resident wild trout.

Respectfully submitted,

Eddie Kochman,
State Wildlife Manager, Aquatic Wildlife Section

Encl. 3

C: Walt Graul
Bruce McCloskey

DEPARTMENT OF NATURAL RESOURCES, Greg E. Walcher, Executive Director
WILDLIFE COMMISSION, Bernard L. Black, Jr., Chairman • Rick Enstrom, Vice-Chairman • Philip James, Secretary
Members, Tom Burke • Mark LeValley • Marianna Raftopoulos • Robert Shoemaker • Olive Valdez
Ex-Officio Members, Greg E. Walcher and Don Ament

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A Simple Technique Used to Filter and Quantify the Actinospore of *Myxobolus cerebralis* and Determine Its Seasonal Abundance in the Colorado River

KEVIN G. THOMPSON

Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University,
201 Wagar Building, Fort Collins, Colorado 80523, USA

R. BARRY NEHRING*

Colorado Division of Wildlife,
2300 South Townsend, Montrose, Colorado 81401, USA

Abstract.—We used a simple technique for filtering the actinospores of *Myxobolus cerebralis* from natural waters to observe seasonal periodicity at eight sites in the upper Colorado River drainage. We used a tub lined with 20- μ m-mesh Pecap screen to concentrate actinospores from 1,900-L samples and estimate density by microscope count. Identity of the observed actinospores as those of *M. cerebralis* was confirmed in 86 samples by the use of a polymerase chain reaction test. The 42-ha Windy Gap Reservoir appeared to be a point source of actinospores; the highest densities observed were consistently from samples taken at sites just below the reservoir. Both densities and the frequency of detection were much lower 26 km below the reservoir. The actinospores first appeared in abundance after the runoff in both years of the study. Actinospore densities tended to be greatest during summer and early fall and lowest during spring. In August 1997, a series of significant flow fluctuations and attendant water temperature swings appeared to alternately inhibit and stimulate the release of actinospores. Populations of rainbow trout *Oncorhynchus mykiss* continue to suffer recruitment failures throughout the study reach, apparently because of the effects of whirling disease in age-0 fish. This suggests that the detection of low numbers of actinospores by this technique at some sampling locations may indicate a level of infectivity that is destructive for the susceptible rainbow trout.

Wolf and Markiw (1984) first demonstrated that *Myxobolus cerebralis*, the salmonid parasite that can cause whirling disease, has a two-host life cycle that alternates between salmonid fishes and oligochaete worms and produces spores in each host that can only infect the other host. (Hereafter, we refer to the spore of *M. cerebralis* as myxospore and the triactinomyxon spore as actinospore [Lom et al. 1997]). This life cycle was independently confirmed by El-Matbouli and Hoffmann (1989). Recently, Andree et al. (1997) used DNA-based techniques to further demonstrate that the alternating myxospore and actinospore stages are the same organism. El-Matbouli and Hoffmann (1998) detailed the development of the organism in the worm host from the myxospore stage to the actinospore stage by the use of light and electron microscopes. These studies firmly established that the actinospore is *M. cerebralis*; consequently, detecting this actinosporean in a natural water indicates that *M. cerebralis* is enzootic in that water.

Although *M. cerebralis* was once considered a

threat only in cultured fish environments, recent studies and observations in Colorado, Utah, and Montana have shown that whirling disease can affect wild salmonid populations. The presence of whirling disease and the concomitant collapse of recruitment of rainbow trout *Oncorhynchus mykiss* have been documented in several streams in the intermountain west (Walker and Nehring 1995; Nehring and Walker 1996; Vincent 1996; Nehring et al. 1998). The parasite was first detected in the upper Colorado River drainage in 1988 among hatchery rainbow trout stocked in the fall of 1987 on private property at two separate locations (Walker and Nehring 1995). Wild adult rainbow trout in the Colorado River first tested positive for the parasite at the annual disease inspection during egg-taking operations in April 1992 (Walker and Nehring 1995).

Unfortunately, little is understood about the ecology of the parasite in the wild. Do localized areas of infectivity influence wider areas of some streams? What densities of the actinospores of *M. cerebralis* are sufficient to cause the impacts on salmonid populations observed in the Colorado River? Are there seasonal patterns to the release

* Corresponding author: barry.nehring@state.co.us

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SOAPBOX

Snake River fish not the answer to disease

By Harold K. Hagen

The Colorado Division of Wildlife is advertising another new program to eliminate whirling disease in Colorado trout waters. The plan is to supplant the "disease prone" rainbow with Snake River Cutthroat. After spending millions on hatchery renovations and other uncompleted projects, they suddenly have discovered a "miracle" fish they claim will "negate" stream infections and become the perfect substitute for the rainbow.

With few outside opinions, the DOW has embarked on replacement. According to the *Denver Post* (Dec. 5), they began a major effort three years ago to develop a broodstock at the same time they were starting a field study to evaluate resistance. One could be suspicious of research that anticipates results before data are gathered. DOW stated that "an initial 2 million eggs are expected this year from 3-year old females and that they expect a crescendo in 2001." Is there any doubt that the plan to scuttle the rainbow was determined several years ago?

The Colorado field studies are in no sense basic research showing resistance to whirling disease is an established fact. The results are reported in the *Denver Post* in such a way that a layman would draw that conclusion. Less spore burden, lower morality rates from the disease, less threat of passing the infection, probable greater success in natural spawning, etc. are all asserted attributes of the Snake River Cutthroat. None of this was provided in the field studies.

Dolphins

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largest in playoff history. The 62 points were the most the Dolphins have allowed — ever.

It may have been the most embarrassing loss for Johnson and Marino in their storied careers. It was punctuated by a cold blast of water from the sprinkler system in the south end zone soon after a Jaguars touchdown made it 55-7.

“I’ve never experienced a game like this in my life,” said Marino, 38, who deflected questions about his retirement. “Even as a kid, I’ve never had a game like this.”

Marino was 11 of 25 for 95 yards before Johnson pulled him early in the third quarter. More telling: By the time gimpy Jaguars quarterback Mark Brunell was lifted with a 38-0 lead, Marino had thrown two interceptions, no

See JAGS, Page D6

of Wyo



The DOW asserts that the Snake River Cutthroat somehow acquired resistance to whirling disease. Since resistance is well recognized as heritable, there must be a traceable lineage. In this case, it would be in the Snake River. The clear implication is both the DOW and Wyoming had solid information on resistance at the time of an initial egg contribution from Wyoming. The DOW expects these imported trout to show that resistance. If the states did have information, where are the data published? Why have we been subjected to countless schemes and millions of dollars in costs to combat the disease in the rainbow if this Snake River Cutthroat resistance was known?

The Snake River Cutthroat is a good fish in its place, but it has many limitations. I know the Snake River Cutthroat very well. I was a member of a research team that evaluated its potentials for widespread culture. I have reared thousands of SRC and its hybrid rainbow/cutthroat cross.

The DOW has been substituting assertion for scientific research and fact so consistently, in the whirling disease conundrum, that DOW personnel are willing to believe the Snake River Cutthroat is a final answer to whirling disease. It is dishonest to ask the people of Colorado to go along with another costly program that has little evidence to support its claims and no real chance of eliminating whirling disease. Whirling disease devastation has been exaggerated far beyond its documented impact.

It is time the director of the Natural Resources Department asks for full accounting of the CDOW and its never-ending whirling disease programs.

Harold K. Hagen lives in Fort Collins.



V. Richard Haro/The Colorado
each of Wyoming's Carrie Bacon during the
half of Saturday's game at Moby Arena.

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Table 53. Trout population biostatistics for the 3.2 km reach of the Colorado River on the Kemp/Breeze ranches, fall 1981-1986 versus fall 1993-1998.

Year	Brown Trout					Rainbow Trout				
	N	95% CI	Kg/ha	N/ha	N/ha \geq 35 cm	N	95% CI	Kg/ha	N/ha	N/ha \geq 35 cm
1981	3,415	\pm 1335	82	294	36	10,300	\pm 1,635	231	889	185
1982	2,031	\pm 588	48	175	53	4,756	\pm 739	124	410	173
1983	1,476	\pm 710	42	127	25	2,341	\pm 452	81	202	86
1984	1,735	\pm 408	35	150	11	2,410	\pm 410	78	210	78
1985	1,651	\pm 613	55	142	34	1,976	\pm 329	94	170	115
1986	1,230	\pm 389	44	106	33	3,214	\pm 538	109	277	111
Mean 81/86	1,923	-----	51	166	32	4,166	----	120	360	125
1993	3,280	\pm 1,244	91	283	51	1,881	\pm 396	128	162	154
1994	4,965	\pm 1,817	119	428	49	774	\pm 232	53.1	67	65
1995	9,707	\pm 2,084	224	837	138	610	\pm 219	41.2	53	50
1996	5,857	\pm 1,274	190	505	164	288	\pm 126	19.9	25	24
1997	4,330	\pm 926	162	373	149	293	\pm 199	17.0	25	23
1998	7,333	\pm 1,300	224	632	142	359	\pm 168	15.3	31	13

<u>Station Name</u>	<u>Distance Below Windy Gap Dam</u>	<u>n/ha (11-22 cm)</u>
Hitching Post Bridge	1.6 kilometers	118
Chimney Rock Ranch	4.8 kilometers	185
Sheriff Ranch	8.5 kilometers	300
Thompson/Doucette Ranch	10.5 kilometers	302
Paul Gilbert Wildlife Area	19.4 kilometers	442
Lone Buck Wildlife Area	20.5 kilometers	199
Parshall (Kemp/Breeze Wildlife Area)	25.8 kilometers	237