

Chloramine-T Clinical Field Trials - INAD 9321

Year 2008 Annual Summary Report on the Use of Chloramine-T in Clinical Field Efficacy Trials

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Summary

Chloramine-T has been used effectively in the U. S. under compassionate INAD Exemption #9321 to control mortality in a variety of fish caused by common fish bacterial pathogens. In calendar year 2008 (CY08), the efficacy of chloramine-T (CLT) was evaluated in 257 disease trials involving approximately 34.8 million fish to control mortality in a variety of fish species caused by a variety of infectious fish pathogens. Trials were conducted at 53 fish culture facilities, including nine U.S. Fish and Wildlife Service National Fish Hatcheries (NFH), 35 state fish hatcheries, five private fish hatcheries, and four tribal hatcheries. The compassionate study protocol under which treatments were administered allowed the investigator to use chloramine-T on either three consecutive or alternate days for 1h at dosages ranging from 10 - 20 mg/L; or one day a week for 1 h at 15mg/L. Overall, results of trials conducted in CY08 indicated that treatments appeared efficacious in approximately 60% of the trials, ineffective in 6% of the trials, and were characterized as inconclusive in 15% of the trials. In the remaining 19% of the trials, the Investigators were not required to report efficacy data because the

effectiveness technical section for the specific claim has been completed and accepted by CVM.

Introduction

Bacterial gill disease (BGD) is one of the most common diseases of hatchery reared salmonids (Bullock 1990) and causes more fish losses than any other bacterial disease (Bills et al. 1988). Fish mortality is generally not a direct result of the infection, but is a consequence of the infection. Mortality is most likely the result of asphyxiation from lack of adequate oxygen exchange in severely congested gills. Stressors associated with intense fish culture may predispose fish to infection. Although *Flavobacterium branchiophilum* is the bacteria responsible for causing most outbreaks of BGD (Wakabayashi, et al., 1989; Ferguson et al., 1991), other gram-negative bacteria have also been implicated. These "other" bacteria include *F. aquatile*, *F. psychrophilus*, *F. columnaris*, as well as other flavobacters and aeromonads and pseudomonads. Clinical signs of BGD have been well documented, and it is widely known that this disease can cause the rapid proliferation of gill epithelium and the production of excess mucus as the host responds defensively to the infection. This response can "smother" gills and cause severe losses if prompt measures are not taken. If BGD, which is horizontally transmitted, is not diagnosed and treated early, an epizootic may occur within a 24-h period (Bullock et al. 1990).

Historically, several chemicals including benzalkonium chloride (available as Hyamine 1622 and 3500), diquat, and chloramine-T have been used to control mortality

caused by BGD (Bullock et al. 1990). However, none of these chemicals have been approved by the FDA to control mortality in freshwater fish caused by BGD. Because chloramine-T appears to be the most effective therapeutant when salmonids have BGD (From 1980; Bullock et al. 1990; Bowker et al, in press) it has become the prime candidate for approval with the U.S. Food and Drug Administration (FDA) as a bath treatment. Chl-T has been characterized as a non-selective sanitizing agent and has been shown to clean up gills infested with bacteria and coated with excess mucus.

Purpose of Report

The purpose of this report is to summarize the results of calendar year 2008 (CY08) supplemental chloramine-T field efficacy data. Similar data have been submitted by the Service in previous years. We anticipate that CY08 data will be used to enhance the existing chloramine-T database established from previous years, and will be considered in the “body of evidence” for the purpose of developing an appropriate label claim for the use of chloramine-T in aquaculture.

Facilities, Materials, Treatment Procedures

1. Facilities

A total of 257 field efficacy trials were conducted at 53 fish culture facilities, including nine U.S. Fish and Wildlife Service NFH's, 35 state fish hatcheries, five private fish hatcheries, and four tribal hatcheries. Treatments were used to control/prevent mortality in a variety of fish species caused by various fish

pathogens. Water temperature during treatments at the various testing facilities ranged from 33.7 - 78.0 °F, with a mean treatment temperature of 55.0°F.

2. Chemical material

Chloramine-T (CAS No. 127-65-1) is a pure white crystal powder. All facilities used designated lots of chloramine-T provided by one of the following two manufactures: (1) Axcentive SARL/International Specialty Chemicals, Inc., Tarrytown, NY; or (2) B.L. Mitchell, Inc., Greenville, MS.

3. Treatment Methods

Chloramine-T treatments were administered using either a flow-through or standing bath treatment method. Both procedures called for accurately weighed amounts of dry chemical dissolved in an appropriate amount of non-chlorinated water. When using a flow-through system, dissolved chemical was metered into rearing units at a rate to achieve the desired treatment concentration during a 1 h period. When using a standing bath method, water flow to the rearing unit was turned off and dissolved chemical added to the rearing unit and mixed thoroughly to ensure uniform chloramine-T concentration throughout the tank. Thorough mixing was essential to ensure there were no chloramine-T "hot spots." After the 1 h treatment, water flow was turned on again to flush the chemical out of the rearing unit.

4. Drug dosages

During CY08, various chloramine-T doses were used. Listed below are the doses and the number of trials conducted with each dose:

1.	10 mg/L	55 trials
2.	10;15;20 mg/L	1 trial
3.	12 mg/L	27 trials
4.	12 & 15 mg/L	1 trial
5.	15 - 16.6 mg/L	66 trials
6.	15 & 20 mg/L	2 trials
7.	20 mg/L	105 trials

Total	257 trials
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5. Number of treatments per disease outbreak

According to the Study Protocol, Investigators were allowed to administer chloramine-T on three consecutive/alternate days when used to control mortality caused by BGD or once/week when used to prevent mortality. During CY08, the most common treatment regimen was to administered CLT on three consecutive days to control mortality in fish caused by BGD.

Study Protocol Deviation: Treatment regimen administered in 80 trials (approximately 31% of trials) deviated from the protocol. In these trials, fish were treated with CLT at 10; 12; or 20 mg/L for 1 - 33 days. In most cases the fish were treated at 10; 12; or 20 mg/L for 1 to 2 days (66 trials). This was mostly due to the Investigators treating at a lower CLT dose in order to meet the CLT discharge limit of <0.1 ppm. Investigators that deviated from the CLT protocol (when the discharge limit was not the reason for the deviation) were contacted and reminded that following the protocol is required.

Fish Species Treated and Fish Diseases Involved in CY08 Trials

1. Species and size of fish treated

Twenty-two fish species, including 14 species of salmonids and eight non-salmonids fish species, were treated during CY08. Treated fish ranged in length from 0.5 - 38.0 in. and the average length of all treated fish was 4.70 in. Species treated included:

Salmonids: (1) Atlantic salmon *Salmo salar*; (2) landlocked Atlantic salmon *Salmo salar*; (3) brown trout *S. trutta*; (4) apache trout *Oncorhynchus apache*; (5) chinook salmon *O. tshawytscha*; (6) chum salmon *O. keta*; (7) coho salmon *O. kisutch*; (8) sockeye salmon *O. nerka*; (9) kokanee salmon *O. nerka*; (10) cutthroat trout *O. clarki*; (11) rainbow

trout *O. mykiss*; (12) steelhead trout *O. mykiss*; (13) brook trout *Salvelinus fontinalis*; and (14) lake trout *Salvelinus namaycush*.

Non-salmonids: (1) bluegill *Lepomis macrochirus*; (2) burbot *Lota lota*; (3) lake sturgeon *Acipenser fulvescens*; (4) largemouth bass *Micropterus salmoides*; (5) muskellunge *Esox masquinongy*; (6) tiger Muskellunge *E. lucius x E. masquinongy*; (7) striped bass *Morone saxatilis*; and (8) walleye *Sander vitreus*.

2. Diseases treated

The disease treated most frequently was characterized as BGD (84% of the trials). Other diagnosed diseases included external columnaris, external bacterial coldwater disease, external flavobacteriosis, *Nucleospora salmonis* (misdiagnosed as BGD), unidentified bacteria (misdiagnosed as BGD), and a target animal safety study.

Data Collected

1. Pathologist's report

In CY08 a pathologist's report was submitted for 36% of the studies. Pathology reports are important for accurate interpretation of study results because they typically contain the following information:

1. A description of how the identity of disease agent(s) was verified,
2. Disease identification records that confirm the presence of the disease agent,
3. The name and title of the individual performing the diagnosis.

Additionally, evidence would typically be provided to document that there were no secondary infections or infestations caused by unrelated disease agents in the population of test fish.

2. Treatment response and drug accountability data

Drug receipt reports, drug use reports, diagnosis, treatment, and mortality reports (including adverse effects/toxicity observations), and fish disposition reports were prepared by study Investigators. Such reports were routed through the Study Monitor for review, and then sent to the AADAP Office for review, data analysis and report writing, entering data into a database, and archiving in permanent files.

Based on correspondence with FDA, the following efficacy and safety technical sections have been completed:

1. Effectiveness of chloramine-T at a concentration of 12 ppm administered as a 60 min bath once per day every other day for a total of three treatments to control mortality associated with bacterial gill disease in

freshwater-reared salmonids (we refer to your file number INAD 4000 H-0071 dated July 11, 2000).

2. Safety of chloramine-T at a concentration of 20 ppm administered as a 60 min bath on three consecutive or alternate days for the control of mortality associated with bacterial gill disease in freshwater-reared salmonids (we refer to your file number INAD 4000 P-0093 dated September 13, 2002).

As a result of the completed technical sections, mortality data are no longer required when Investigators administer chloramine-T at a dosage of 12 - 20 ppm on three alternate or consecutive days for 60 min to control mortality associated with bacterial gill disease in freshwater-reared salmonids. In all other cases, collection of mortality data is still required and efforts were made to collect all such data. However, for a variety of reasons, mortality data were not always collected for the entire required data collection period. Reasons for incomplete mortality data included: splitting fish into additional rearing units and stocking early life stage fish shortly after final treatment.

Discussion of Study Results

1. Relevance of study to a proposed label claim for chloramine-T

Results of CY08 trials conducted under Compassionate INAD exemption #9321 are similar to results detailed in reports previously submitted to FDA under INAD's #9321 and #4000.

2. General observations on the efficacy of CLT for the control of bacterial diseases in salmonid and non-salmonid fish (Note: Table 1 provides a summary of all trials in which treatment appeared efficacious; Table 2 provides a summary of all trials in which treatment appeared ineffective; Table 3 provides a summary of all inconclusive trials; Table 4 provides a summary of all trials where efficacy data was not required; Table 5 provides summary data for all trials; and Table 6 provides a brief description of all trials conducted during CY08 under INAD #9321).

A. Efficacy at 10 mg/L chloramine-T

Brook trout, chinook salmon, coho salmon, lake trout, rainbow trout, muskellunge, and striped bass were treated with 10 mg/L chloramine-T for 1 - 33 days in 55 trials (Tables 1 - 3). Investigators used CLT to control mortality caused by BGD or external bacterial coldwater disease. CLT treatments appeared effective in 27 trials, ineffective in six trials, and were characterized as inconclusive in 22 trials.

B. Efficacy at 10; 15; 20 mg/L chloramine-T

One trial was conducted using 10; 15; and 20 mg/L chloramine-T for 1 - 3 days (Table 1) to control mortality in rainbow trout associated with external coldwater disease. This trial appeared to be efficacious.

C. Efficacy at 12 mg/L chloramine-T

Rainbow trout, kokanee salmon, and sockeye salmon were treated with 12 mg/L chloramine-T for 1 - 3 days in 27 trials (Tables 1 & 3). Investigators used CLT to control mortality caused by BGD. CLT treatments appeared effective in 26 trials and were characterized as inconclusive in one trial.

D. Efficacy at 12 & 15 mg/L chloramine-T

One trial was conducted using 12 & 15 mg/L chloramine-T for 4 - 8 days (Table 2) to control mortality in walleye associated with BGD. This trial was not efficacious.

E. Efficacy at 15 - 16.6 mg/L chloramine-T

Apache trout, brook trout, brown trout, chinook salmon, chum salmon, coho salmon, kokanee salmon, sockeye salmon, lake trout, rainbow trout, steelhead trout, tiger muskellunge, and lake sturgeon were treated with 15 - 16.6 mg/L chloramine-T for 1 - 17 days in 66 trials (Tables 1 - 3). Investigators used CLT to control mortality caused by BGD, external bacterial coldwater disease, external flavobacteriosis, external columnaris, or as a target animal safety study. CLT treatments appeared effective in 55 trials, ineffective in one trial, and were characterized as inconclusive in 10 trials.

F. Efficacy at 15 & 20 mg/L chloramine-T

Two trials were conducted using 15 & 20 mg/L chloramine-T for 3 - 4 days (Tables 2 & 3). Investigators used CLT to control mortality caused by external flavobacteriosis and *Nucleospora salmonis* (misdiagnosed as BGD) in rainbow trout and lake trout. CLT treatments were not effective in one trial and were characterized as inconclusive in the other trial.

G. Efficacy at 20 mg/L chloramine-T

Atlantic salmon, land-locked Atlantic salmon, brook trout, brown trout, cutthroat trout, kokanee salmon, rainbow trout, steelhead trout, bluegill, burbot, largemouth bass, and walleye were treated with 20 mg/L chloramine-T for 1 - 14 days in 105 trials (Tables 1 - 4). Investigators used CLT to control mortality caused by BGD, external flavobacteriosis, external columnaris, or on an unknown disease (misdiagnosed as BGD). CLT treatments appeared effective in 45 trials, not report in 49 trials (due to the efficacy packet being complete), ineffective in six trials, and were characterized as inconclusive in five trials.

3. Observed Toxicity

No toxicity or adverse effects relating to CLT treatment were reported in any of the trials.

Current Study Protocol for CLT INAD #9321

Please see the attached current study protocol for CLT INAD #9321 . Please note no changes have occurred to this study protocol.

Facility Sign-up List

Please see “Table 7. Facilities and Names of Investigators” for facilities that signed-up to participate in the CLT INAD #9321 during CY08. Facilities not listed in Appendix III-a of the current CLT INAD #9321 during CY08 study protocol have been highlighted.

The following facilities had chloramine-T on-hand during CY08 but never used the drug:

- | | |
|---|---------------------------------------|
| 1. American Falls SFH | 2. Coursey Springs FCS |
| 3. Crystal Lake Hatchery | 4. Darrah Springs SFH |
| 5. Ed Weed FCS | 6. Fort Peck SFH |
| 7. Glenwood Springs SFH | 8. Hackettstown SFH |
| 9. Harrietta SFH | 10. Monte Vista SFH |
| 11. Mt. Shavano SFH | 12. Pequest SFH |
| 13. Pueblo SFH | 14. Roaring Judy SFH |
| 15. Roger Reed Salmon SFH | 16. South Otsellic SFH |
| 17. Whitman Lake Hatchery | 18. Texas Freshwater Fisheries Center |
| 19. Susquehanna Aquaculture/ Brunner Island Fish Farm | |

Correspondence sent to CLT INAD #9321 Participants

Please see the attached correspondence that was sent to all chloramine-T participants after the AADAP Office received their sign-up form for calendar year 2008.

Number of Treated Fish under Treatment Use Authorization

Total number of fish treated during CY08 was 34,789,272. The total number of treated fish to count against the current treatment use authorization dated December 5, 2007 is 35,968,530.

Summary of Study Results

Chloramine-T was used at doses ranging from 10 - 20 mg/L in 257 treatment trials in which fish were treated one, two, or three times to control mortality, or once per week when used to prevent mortality. Twenty-two different fish species were treated and trials involved approximately 34.8 million fish. Treated fish ranged in size from 0.5 - 38.0 in. Water temperature during treatment ranged from 33.7 - 78.0°F, with a mean treatment temperature of 55.0°F. Overall, results showed that treatment appeared effective in approximately 60% of trials, ineffective in 6% of the trials, and characterized as inconclusive 15% of the trials. In the remaining 19% of the trials, mortality data collection and reporting were not required. There was no evidence of toxicity or adverse effects related to CLT treatment reported in any of the trials. Data from the

CY08 trials support the results of previous Annual Report submissions under INAD #9321 and INAD #4000 that indicate that the chloramine-T treatment regimen recommended in INAD Protocol #9321 is safe and effective to control/prevent mortality in a variety of fish species caused by external bacterial infections such as BGD. As a result of the lack of quality criteria, such as dose verification, use of controls, replicates, and randomization, it is understood that these data will be considered as ancillary data, and that pivotal efficacy studies are needed to definitively demonstrate chloramine-T efficacy for the treatment of BGD. However, the ancillary data described above should provide useful, corroborative data to help support a label claim for the use of chloramine-T to control mortality associated with BGD in a variety of fish species. Although it is anticipated that the majority of future efficacy data collected under INAD #9321 will also be ancillary data, efforts will be directed towards the continued generation of high quality data.

References

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- Bullock, G.L. 1990, Bacterial gill disease of freshwater fishes, Fish Disease Leaflet 84, U.S. Dept. of the Interior, Fish and Wildlife Service, Washington DC.
- Ferguson, H.W., V.E. Ostland, P. Byrne, and J.S. Lumsden. 1991. Experimental production of bacterial gill disease in trout by horizontal transmission and bath challenge. *Journal of Aquatic Animal Health* 3:118-123.
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Table 1. Summary of Year 2008 Chloramine-T Efficacy Results - Efficacious Studies

Hatchery	Number of efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Oden SFH	1	4.00	BNT	411,052	External Flavobacteriosis	3	10	46.0
Lyons Ferry SFH	3	2.2 - 3.1	FCS	848,000	BGD	3	10	53.0
Wolf Lake SFH	1	0.75	MUE	456,952	BGD	33	10	70.0
Decorah SFH	4	4.1 - 6.1	RBT	63,979	BGD	3	10	55.0
Erwin SFH	2	5.00	RBT	16,625	BGD	2	10	60.0
Hotchkiss NFH	12	1.3 - 7.0	RBT	629,385	BGD	1	10	56.0
Leadville NFH	1	6.00	RBT	14,000	BGD	3	10	46.0
Wolf Lake SFH	2	1.1 - 4.8	RBT	1,956,765	BGD	3	10	52.0
Inks Dam NFH	1	1.05	STB	24,000	External Flavobacteriosis	3	10	69.9
Canyon Creek SFH	1	4.80	RBT	534,100	External CWD	1 - 3	10;15;20	50.0
Ford SFH	2	1.80	KOE	230,000	BGD	3	12	51.0
Rifle Falls SFH	23	5.2 - 9.4	RBT	926,418	BGD	1 - 2	12	59.0
Pillar Creek Hatchery	1	1.00	SOS	879,000	BGD	3	12	33.7
Alchesay-Williams Creek NFH	2	5.2 - 5.4	APT	81,878	BGD	3	15	52.0
Jordan River NFH	1	1.40	BKT	5,000	BGD	5	15	47.1

Table 1. Summary of Year 2008 Chloramine-T Efficacy Results - Efficacious Studies - continued

Hatchery	Number of efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Paint Bank FCS	1	7.50	BKT	30,000	BGD	3	15	56.0
Rome SFH	1	2.00	BKT	216,000	External Flavobacteriosis	1	15	52.0
Alchesay-Williams Creek NFH	1	3.21	BNT	70,853	BGD	3	15	67.0
Grover's Creek Hatchery	3	1.40	CHS	73,000	BGD	3 - 6	15	50.3
Keta Creek Hatchery	1	1.00	CHS	3,000,000	BGD	3 - 13	15	48.0
Eastbank SFH	1	38.00	CKS	1,256	External Flavobacteriosis	7 - 13	15	54.7
Grover's Creek Hatchery	1	1.70	CKS	33,000	BGD	3	15	50.3
Mixsawbah SFH	1	2.68	CKS	260,100	BGD	3	15	50.0
	1	2.51	COS	139,000	BGD	3	15	50.0
Solomon Gulch Hatchery	2	1.80	COS	787,358	External Flavobacteriosis	3	15	42.0 - 43.0
Ford SFH	4	1.80	KOE	346,000	BGD	3	15	49.0 - 51.0
Jordan River NFH	1	1.40	LAT	3,385,048	BGD	5	15	46.2
Genoa NFH	1	1.00	LST	81,206	External Columnaris	17	15	66.4
Wray SFH	1	2.05	MUH	11,576	BGD	16	15	64.0
Albert Powell Trout SFH	6	2.3 - 7.0	RBT	473,000	BGD	3	15	54.0

Table 1. Summary of Year 2008 Chloramine-T Efficacy Results - Efficacious Studies - continued

Hatchery	Number of efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Alchesay-Williams Creek NFH	2	0.8 - 1.4	RBT	385,068	BGD	3	15	52.0
Bellvue-Watson SFH	1	3.00	RBT	150,214	External CWD	2	15	53.0
	1	1.25	RBT	83,280	External Flavobacteriosis	3	15	54.0
	1	1.00	RBT	78,000	BGD	3	15	53.0
Chateaugay SFH	1	3.75	RBT	109,000	BGD	3	15	46.0
Fillmore SFH	1	3.00	RBT	539,000	BGD	3	15	60.0
Paint Bank FCS	1	9.00	RBT	70,000	BGD	3	15	55.0
Willow Beach NFH	6	1.0 - 2.3	RBT	270,767	BGD	3	15	55.9 - 62.0
Wolf Lake SFH	2	4.7 - 4.8	RBT	333,314	BGD	3	15	52.0
Wytheville FCS	1	5.50	RBT	68,400	BGD	3	15	56.0
Dworshak NFH	2	5.10	SCS	1,917,100	BGD	3	15	40.1 - 40.7
Hoko Falls Hatchery	1	0.50	SOS	60,000	BGD	12 - 13	15	42.0
Bodine SFH	3	3.0 - 3.5	STT	301,890	BGD	3	15	57.0
Hoko Falls Hatchery	1	0.50	STT	23,000	TAS	1	15	41.0
Mixsawbah SFH	1	3.37	STT	122,743	BGD	3	15	50.0

Table 1. Summary of Year 2008 Chloramine-T Efficacy Results - Efficacious Studies - continued

Hatchery	Number of efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Similkameen Rearing Pond	1	4.50	SUS	521,347	External CWD	3	16.6	37.7
Bald Hill FCS	2	3.50	ATS	82,000	External Columnaris	3	20	70.0
Bennington FCS	2	8.0 - 8.5	BKT	40,500	BGD	3	20	35.0 - 51.0
New Hampton SFH	2	1.10	BKT	243,903	BGD	3	20	47.1 - 47.4
Roxbury FCS	1	2.04	BKT	125,000	BGD	3	20	44.8
Richloam SFH	1	3.50	BLG	732	External Columnaris	3	20	70.6
Bennington FCS	1	8.00	BNT	35,000	BGD	3	20	51.0
New Hampton SFH	1	1.12	BNT	141,475	BGD	3	20	47.4
Leadville NFH	1	9.50	CUT	38,900	BGD	3	20	37.0
Durango SFH	6	1.79	KOE	464,395	BGD	1 - 3	20	49.0
Genoa NFH	1	4.90	LMB	4,000	External Columnaris	3	20	53.0
Richloam SFH	1	4.90	LMB	1,066	External Columnaris	3	20	76.6
Alsea SFH	1	5.00	RBT	258,511	BGD	1	20	55.0
Bellvue-Watson SFH	2	1.3 - 2.1	RBT	161,280	External Flavobacteriosis	3	20	53.0 - 54.0
Bennington FCS	3	4.0 - 4.5	RBT	77,000	BGD	3	20	54.0 - 66.0

Table 1. Summary of Year 2008 Chloramine-T Efficacy Results - Efficacious Studies - continued

Hatchery	Number of efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Chalk Cliffs SFH	1	5.00	RBT	23,000	External Flavobacteriosis	3	20	57.0
	2	6.7 - 9.0	RBT	69,531	BGD	3	20	52.0 - 60.0
Durango SFH	1	2.65	RBT	75,400	BGD	3	20	50.0
Leadville NFH	1	10.00	RBT	32,500	BGD	3	20	37.0
Limestone Springs	6	1.3 - 3.5	RBT	800,000	BGD	3	20	51.0 - 62.0
Marion FCS	1	2.62	RBT	200,000	BGD	3	20	48.0
Salisbury FCS	1	1.32	RBT	5,000	BGD	3	20	46.0
Alsea SFH	2	3.50	STT	171,000	BGD	2	20	55.0
Rathbun SFH/Research	5	2.9 - 4.5	WAE	289,149	BGD	1 - 2	20	72.5 - 77.4

Table 2. Summary of Year 2008 Chloramine-T Efficacy Results - Ineffective Studies

Hatchery	Number of non-efficacious trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Thompson SFH	1	2.05	BNT	257,800	BGD	3	10	56.0
Platte River SFH	1	1.30	COS	785,687	External Flavobacteriosis	1	10	48.0
Hotchkiss NFH	4	0.8 - 2.6	RBT	436,310	BGD	1 - 2	10	56.0
Rathbun SFH/Research	1	1.00	WAE	54,003	BGD	4 - 8	12 & 15	65.0
Trail Lakes/Eklutna Hatchery	1	3.00	SOS	511,000	External Flavobacteriosis	3	15	39.0
Jordan River NFH	1	1.40	LAT	153,739	<i>Nucleospora salmonis</i>	4	15 & 20	46.2
Garrison Dam NFH	1	4.70	BUR	126	BGD	3	20	50.0
	1	1.03	CUT	34,000	Unknown (Misdiagnosed)	3	20	55.8
Durango SFH	1	1.79	KOE	75,862	BGD	1	20	49.0
Limestone Springs	2	1.0 - 1.3	RBT	200,000	BGD	1 - 2	20	44.0 - 45.0
Salisbury FCS	1	1.32	RBT	5,000	BGD	3	20	46.0

Table 3. Summary of Year 2008 Chloramine-T Efficacy Results - Inconclusive Studies

Hatchery	Number of inconclusive trials	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Marquette SFH	1	9.80	BKT	59,524	External Flavobacteriosis	3	10	46.0
Oden SFH	2	2.4 - 21.6	BNT	419,018	External Flavobacteriosis	1 - 3	10	46.0
Marquette SFH	1	5.40	LAT	205,283	External Flavobacteriosis	3	10	39.2
Hotchkiss NFH	18	1.4 - 7.0	RBT	1,116,679	BGD	1 - 6	10	56.0
Hotchkiss NFH	1	3.23	RBT	168,596	BGD	1	12	56.0
Solomon Gulch Hatchery	2	1.3 - 1.4	COS	2,475,472	External Flavobacteriosis	1 - 3	15	40.0 - 73.0
Bellue-Watson SFH	2	2.8 - 3.1	RBT	125,100	External Flavobacteriosis	2 - 3	15	53.0 - 54.0
Lonesome Creek Hatchery	6	1.2 - 3.0	STT	550,571	External CWD	3	15	47.0 - 48.0
Bellue-Watson SFH	1	2.81	RBT	57,528	External Flavobacteriosis	3	15 & 20	53.0
Wray SFH	1	6.00	BLG	1,188	External Columnaris	6	20	68.0
Durango SFH	1	1.10	KOE	225,485	External Flavobacteriosis	3	20	48.2
Chalk Cliffs SFH	1	2.00	RBT	80,000	BGD	1	20	57.0
Fort Richardson SFH	1	3.40	RBT	180,057	BGD	3	20	35.2
Rathbun SFH/Research	1	3.00	WAE	218,928	BGD	8 - 14	20	78.0

Table 4. Summary of Year 2008 Chloramine-T Efficacy Results - Studies where efficacy data was not needed

Hatchery	Number of trials where mortality was not needed	Fish Size (in.)	Fish Species	Number of Fish	Disease	Number of treatment days	Dose (mg/L)	Temp. (°F)
Bald Hill Fish Culture Station	1	1.5	LAS	50,000	BGD	3	20	53.0
Jones Hatchery	48	1.7 - 12.1	RBT	1,985,300	BGD	3	20	57.0 - 59.0

Table 5. Summary Data Regarding Year 2008 Chloramine-T Efficacy Studies

Total Number of Fish Treated:	34,789,272
Number of fish treated in efficacious studies	24,357,016
Number of fish treated in non-efficacious studies	2,513,527
Number of fish treated in inconclusive studies	5,883,429
Number of fish where efficacy was not needed	2,035,300

Total Number of Studies:	257
Efficacious Studies	154
Non-efficacious Studies	15
Inconclusive Studies	39
Efficacy was not needed	49

Treatment Regimens and Frequency Used:

10 mg/L; 1 - 33 times	55 trials
10;15;20 mg/L; 1 - 3 times	1 trial
12 mg/L; 1 - 3 times	27 trials
12 &15 mg/L; 4 - 8 times	1 trial
15 - 16.6 mg/L; 1 - 17 times	66 trials
15 & 20 mg/L; 3 - 4times	2 trials
20 mg/L; 1 - 14 times	105 trials

Treatment Water Temperature (°F):

Temperature Range	33.7 - 78.0
Mean Temperature	55.0

Size of Treated Fish (in.):

Size Range	0.50 - 38.0
Mean Length	4.70

Species Treated:

Salmonids:

- (1) Atlantic salmon *Salmo salar*
- (2) landlocked Atlantic salmon *Salmo salar*
- (3) brown trout *S. trutta*
- (4) apache trout *Oncorhynchus apache*
- (5) chinook salmon *O. tshawytscha*
- (6) chum salmon *O. keta*
- (7) coho salmon *O. kisutch*
- (8) sockeye salmon *O. nerka*
- (9) kokanee salmon *O. nerka*
- (10) cutthroat trout *O. clarki*
- (11) rainbow trout *O. mykiss*
- (12) steelhead trout *O. mykiss*
- (13) brook trout *Salvelinus fontinalis*
- (14) lake trout *Salvelinus namaycush*.

Non-salmonids:

- (1) bluegill *Lepomis macrochirus*
 - (2) burbot *Lota lota*
 - (3) lake sturgeon *Acipenser fulvescens*
 - (4) largemouth bass *Micropterus salmoides*
 - (5) muskellunge *Esox masquinongy*
 - (6) tiger Muskellunge *E. lucius* x *E. masquinongy*
 - (7) striped bass *Morone saxatilis*
 - (8) walleye *Sander vitreus*.
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