

Chloramine-T Clinical Field Trials - INAD 9321

Year 2007 Annual Summary Report on the Use of Chloramine-T in Clinical Field Efficacy Trials

Prepared by:

Bonnie Johnson, Biologist
U. S. Fish and Wildlife Service
Aquatic Animal Drug Approval Partnership Program
Bozeman, Montana

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 2007 (CY07), the efficacy of chloramine-T (CLT) was evaluated in 234 disease trials involving approximately 31.7 million fish to control mortality in a variety of fish species caused by a variety of infectious fish pathogens. Trials were conducted at 56 fish culture facilities, including six U.S. Fish and Wildlife Service National Fish Hatcheries (NFH), 41 state fish hatcheries, three private fish hatcheries, and six tribal hatcheries. The compassionate study protocol under which treatments were administered allowed the investigator to use chloramine-T on either consecutive or alternate days three times/wk 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 CY07 indicated that treatments appeared efficacious in approximately 70% of the trials, ineffective in 3% of the trials, and were characterized as inconclusive in the 12% of the trials. In the remaining 15% 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 2007 (CY07) supplemental chloramine-T field efficacy data. Similar data have been submitted by the Service in previous years. We anticipate that CY07 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 234 field efficacy trials were conducted at 56 fish culture facilities, including six U.S. Fish and Wildlife Service NFH's, 41 state fish hatcheries, three private fish hatcheries, and six 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 32.0 - 78.0 °F, with a mean treatment temperature of 54.7°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 CY07, various chloramine-T doses were used. Listed below are the doses and the number of trials conducted with each dose:

1.	10 mg/L:	34 trials
2.	10;15 mg/L:	1 trial
3.	10;20 mg/L:	1 trial
4.	12 mg/L:	7 trials
5.	14.6 mg/L:	1 trial
6.	15 mg/L:	118 trials
7.	20 mg/L:	72 trials

Total	234 trials
-------	------------

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 CY07, the most common treatment regimen was to administered CLT on three consecutive days to control mortality in fish caused by BGD.

Fish Species Treated and Fish Diseases Involved in CY07 Trials

1. Species and size of fish treated

Twenty-two fish species, including 12 species of salmonids and 10 non-salmonids fish species, were treated during CY07. Treated fish ranged in length from 0.6 - 38.0 in. and the average length of all treated fish was 4.30 in. Species treated included:

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

Non-salmonids: (1) bluegill *Lepomis macrochirus*; (2) burbot *Lota lota*; (3) channel catfish *Ictalurus punctatus*; (4) lake sturgeon *Acipenser fulvescens*; (5) largemouth bass *Micropterus salmoides*; (6) smallmouth bass *M. dolomieu*; (7) muskie *Esox masquinongy*; (8) northern pike *E. lucius*; (9) tiger Muskellunge *E. lucius x E. masquinongy*; and (10) walleye *Sander vitreus*.

2. Diseases treated

The disease treated most frequently was characterized as BGD (80% of the trials). Other diagnosed diseases included external columnaris, external bacterial coldwater disease, branchiomyces, motile Aeromonas, tail rot, and external flavobacteriosis.

Data Collected

1. Pathologist's report

In CY07 a pathologist's report was submitted for 45% 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 CY07 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 Tables 6a and 6b provide a brief description of all trials conducted during CY07 under INAD #9321; Table 6a lists trials sorted by study number; Table 6b is a list of trials sorted first by disease treated, second by whether treatments were efficacious or not, and lastly by fish species).

A. Efficacy at 10 mg/L chloramine-T

Fish were treated with 10 mg/L chloramine-T in 34 trials (Tables 1 - 3). Included in these 34 trials were 28 trials in which brook trout, rainbow trout, burbot, tiger musky, and walleye were treated to control mortality associated with BGD; two trials in which brown trout were treated to control mortality associated with external bacterial coldwater disease (CWD); two trials in which brown trout were treated to control mortality associated with external flavobacteriosis; one trial in which brook trout were treated to control mortality associated with motile Aeromonas; and one trial in which lake trout were treated to control mortality associated with tail rot. Treatment resulted in the following:

- 1) Of the 28 trials in which BGD was diagnosed in brook trout, rainbow trout, burbot, tiger musky, and walleye; treatment in 24 of the trials appeared efficacious; while treatment in one trial (involving tiger musky) did not appear to be efficacious; and treatment in three trials (involving rainbow trout and burbot) were characterized as inconclusive.

- 2) The two trials in which brown trout were treated to control mortality associated with CWD were characterized as inconclusive.

- 3) In the two trials in which brown trout were treated to control mortality associated with external flavobacteriosis; one trial appeared to be efficacious while the other one was characterized as inconclusive.

- 4) The trial in which brook trout were treated to control mortality associated with motile Aeromonas was characterized as inconclusive.

- 5) The trial in which lake trout were treated to control mortality associated with tail rot appeared to be efficacious.

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

One trial was conducted using 10 and 15 mg/L chloramine-T (Table 2) to control mortality in walleye associated with BGD. This trial did not appear to be efficacious.

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

One trial was conducted using 10 and 20 mg/L chloramine-T (Table 3) to control mortality in northern pike associated with branchiomyces. This trial was characterized as inconclusive.

D. Efficacy at 12 mg/L chloramine-T

Seven trials were conducted using 12 mg/L chloramine-T (Table 1) to control mortality in chinook salmon and rainbow trout associated with BGD. All trials appeared to be efficacious.

E. Efficacy at 14.6 - 15 mg/L chloramine-T

Fish were treated with 14.6 - 15 mg/L chloramine-T in 119 trials (Tables 1 - 4). Included in these 119 trials were 102 trials in which treatments were administered to apache, brook, brown trout, lake, rainbow, and steelhead trout, Atlantic, chinook, chum, coho, and sockeye salmon, musky, and walleye to control mortality associated with BGD; nine trials in which treatments were administered to chinook salmon, steelhead and cutthroat trout to control mortality associated with CWD; seven trials in which treatments were administered to chinook salmon, steelhead trout, lake sturgeon, largemouth bass, smallmouth bass, and walleye to control mortality associated with external columnaris, and one trial in which treatment was administered to sockeye salmon to control mortality associated with external flavobacteriosis. Treatment resulted in the following:

- 1) Of the 102 trials in which BGD was diagnosed in apache, brook, brown trout, lake, rainbow, and steelhead trout, Atlantic, chinook, chum, coho, and sockeye salmon, musky, and walleye, treatments in 97 of the trials appeared efficacious, while treatment in two trials involving rainbow trout did

not appear to be efficacious, and three trials involving rainbow trout and chum salmon did not report efficacy (due to the efficacy packet being complete).

2) Treatments in one trial in which chinook salmon were diagnosed with CWD appeared to be efficacious, while eight trials involving cutthroat and steelhead trout were characterized as inconclusive.

3) Treatments in five of the trials in which steelhead trout, lake sturgeon, largemouth bass, smallmouth bass, and walleye were diagnosed with external columnaris appeared to be efficacious, while one trial involving chinook salmon was not effective, and another trial involving chinook salmon was characterized as inconclusive.

4) Treatment in the trial involving sockeye salmon diagnosed with external flavobacteriosis appeared to be efficacious.

F. Efficacy at 20 mg/L chloramine-T

Fish were treated with 20 mg/L chloramine-T in 72 trials (Tables 1 - 4). Included in these 72 trials were 50 trials in which treatments were administered to Atlantic salmon, cutthroat, rainbow, and steelhead trout, bluegill, and walleye to control mortality associated with BGD; 10 trials in which treatments were administered to Atlantic salmon, channel catfish, largemouth bass, and smallmouth bass to

control mortality associated with external columnaris; 10 trials in which treatments were administered to Atlantic salmon, and cutthroat and rainbow trout to control mortality associated with CWD; and two trials in which treatments were administered to sockeye salmon and rainbow trout to control mortality associated with external flavobacteriosis. Treatment resulted in the following results:

1) Of the 50 trials in which BGD was diagnosed in Atlantic salmon, cutthroat, rainbow, and steelhead trout, bluegill, and walleye, treatment in 15 of the trials appeared efficacious, while treatment in two of the trials involving Atlantic salmon and rainbow trout were characterized as inconclusive, and 33 trials did not report efficacy (due to the efficacy packet being complete).

2) Of the 10 trials in which external columnaris was diagnosed in Atlantic salmon, channel catfish, largemouth bass, and smallmouth bass, treatment in seven of the trials appeared to be efficacious, while treatment in two trials involving largemouth and smallmouth bass were not effective, and one trial involving Atlantic salmon was characterized as inconclusive.

3) Of the 10 trials in which CWD was diagnosed in Atlantic salmon, and cutthroat and rainbow trout, treatment in three of the trials appeared to be efficacious, while treatment in seven trials involving rainbow trout were characterized as inconclusive.

4) Both trials in which external flavobacteriosis were diagnosed in sockeye salmon and rainbow trout appeared to be efficacious.

3. Observed Toxicity

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

Number of Treated Fish under Slaughter Authorization

Total number of treated fish during CY07 was 31,729,167. The total number of treated fish to count against the slaughter authorization dated November 28, 2005 (valid through December 4, 2007) is 59,715,717. The total number of treated fish to count against the current slaughter authorization dated December 5, 2007 is 1,179,258. No changes have occurred to the current CLT INAD #9321 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 CY07. Facilities not listed in Appendix III-a of the current CLT INAD #9321 study protocol have been highlighted.

The following facilities received/carried-over CLT during CY07 but never used the drug:

1. Cassimer Bar Hatchery
2. Chateaugay SFH
3. Coursey Springs FCS
4. Crystal Lake Hatchery
5. Decorah SFH
6. Fort Peck SFH
7. Glenwood Springs SFH
8. Hackettstown SFH
9. Kincaid SFH
10. Mt. Shavano SFH
11. Pendills Creek NFH
12. Pequest SFH
13. Roaring Judy SFH
14. Roxbury FCS
15. Salisbury FCS
16. Uvalde NFH
17. Whitman Lake Hatchery

Summary of Study Results

Chloramine-T was used at doses ranging from 10 - 20 mg/L in 234 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 31.7 million fish. Treated fish ranged in size from 0.6 - 38.0 in. Water temperature during treatment ranged from 32.0 - 78.0°F, with a mean treatment temperature of 54.7°F. Overall, results showed that treatment appeared effective in approximately 70% of trials, ineffective in 3% of the trials, and characterized as inconclusive 12% of the trials. In the remaining 15% 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 CY07 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

- Bills, T.D., L.L. Marking, V.K. Dawson, and J.J. Rach. 1988. Effects of environmental factors on the toxicity of chloramine-T to fish. U.S. Fish and Wildlife Service, Investigations in Fish Control 96, Upper Mississippi Science Center, P.O. Box 818, LaCrosse, Wisconsin.
- Bowker, J. D., L. Telles, B. David, D. Oviedo, and D. Carty. In press. Efficacy studies conducted to support a chloramine-T new animal drug approval claim for freshwater-reared salmonids. *Journal of North American Aquaculture*.
- 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.
- From, J. 1980. Chloramine-T for control of bacterial gill disease. *The Progressive Fish-Culturist* 42:85-86.
- Wakabayashi, H, G.J. Huh and N. Kimura. 1989. Flavobacterium branchiophila sp. nov., a causative agent of bacterial gill disease of freshwater fishes. *International Journal of Systematic Bacteriology* 39:213-216.

Table 1. Summary of Year 2007 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)
Manchester SFH	1	3.20	BKT	45,000	BGD	1	10	50.0
Oden SFH	1	3.00	BNT	115,823	Flavobacteriosis	3	10	45.7
Marquette SFH	1	5.40	LAT	135,285	Tail Rot	3	10	39.2
American Falls SFH	1	2.00	RBT	27,300	BGD	3	10	55.0
Bennington FCS	1	5.00	RBT	63,000	BGD	3	10	65.0
Erwin SFH	1	8.00	RBT	6,570	BGD	2	10	61.0
Hotchkiss NFH	18	2.2 - 8.8	RBT	974,134	BGD	1 - 3	10	56.0
Rifle Falls SFH	1	6.04	RBT	18,000	BGD	1	10	59.0
Oneida SFH	1	0.60	WAE	840,000	BGD	2	10	65.0
Platte River SFH	2	2.40	CKS	693,000	BGD	3	12	43.0
Rifle Falls SFH	5	6.0 - 7.8	RBT	204,000	BGD	1	12	59.0
Similkameen Rearing Unit	1	4.00	SUS	620,000	CWD	3	14.6	39.6
Alchesay-Williams Creek NFH	2	1.0 - 3.9	APT	160,750	BGD	3	15	52.0 - 55.0
Alchesay-Williams Creek NFH	2	2.3 - 3.7	BKT	27,056	BGD	3	15	52.0

Table 1. Summary of Year 2007 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	27,000	BGD	3	15	54.0
Rome SFH	1	2.00	BKT	10,700	BGD	2	15	54.0
Bath SFH	1	7.00	BNT	76,000	BGD	2	15	47.0
Garrison Dam NFH	1	1.32	BNT	46,000	BGD	3	15	53.0
Marion FCS	1	4.04	BNT	18,000	BGD	3	15	58.0
Thompson SFH	1	1.80	BNT	235,368	BGD	3	15	56.0
Diru Creek Hatchery	1	1.33	CHS	405,712	BGD	3	15	50.0
Groover's Creek Hatchery	2	1.40	CHS	70,000	BGD	3	15	50.0
Keta Creek Hatchery	13	1.2 - 2.6	CHS	3,282,350	BGD	3	15	44.0 - 51.0
Groover's Creek Hatchery	2	1.90	CKS	60,000	BGD	3	15	36.0
Keta Creek Hatchery	1	2.20	CKS	330,500	BGD	3	15	46.0
Platte River SFH	1	2.64	CKS	450,000	BGD	3 - 4	15	46.0
Nez Perce Tribal Hatchery	3	3.3 - 4.9	COS	978,848	BGD	3	15	40.6 - 46.9
Platte River SFH	2	4.40	COS	520,000	BGD	3	15	54.0

Table 1. Summary of Year 2007 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)
Solomon Gulch Hatchery	1	1.30	COS	1,871,000	BGD	3	15	43.9
Ed Weed FCS	1	1.07	LAS	110,000	BGD	3	15	50.0
Jordan River NFH	1	1.50	LAT	3,600,000	BGD	7	15	47.0
Genoa NFH	1	3.10	LMB	3,300	Columnaris	3	15	55.0
Genoa NFH	1	1.00	LST	65,000	Columnaris	20	15	68.0
London SFH	1	1.80	MUE	7,500	BGD	4	15	72.0
Albert Powell Trout SFH	10	6.0 - 9.0	RBT	274,000	BGD	3	15	54.0
Alchesay-Williams Creek NFH	13	1.2 - 4.3	RBT	1,507,135	BGD	3	15	52.0
Alsea SFH	1	5.00	RBT	24,000	BGD	3	15	60.0
Buller FCS	1	6.42	RBT	8,000	BGD	3	15	67.0
Darrah Springs SFH	1	4.00	RBT	120,000	BGD	3	15	58.0
Marion FCS	5	2.6 - 5.4	RBT	313,130	BGD	3	15	45.0 - 63.0
Paint Bank FCS	1	6.50	RBT	50,000	BGD	3	15	54.0
Rifle Falls SFH	4	5.8 - 7.3	RBT	198,000	BGD	1	15	59.0

Table 1. Summary of Year 2007 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)
Wolf Lake SFH	5	3.8 - 9.6	RBT	1,399,292	BGD	3	15	52.0
Wytheville FCS	2	6.0 - 7.0	RBT	42,000	BGD	3	15	55.0 - 56.0
Nez Perce Tribal Hatchery	1	2.00	SCS	296,691	BGD	1	15	44.0
Genoa NFH	1	3.50	SMB	1,000	Columnaris	3	15	55.0
Hoko Falls Hatchery	1	1.10	SOS	98,000	BGD	11 - 13	15	47.3
Trail Lakes/Eklutna Hatchery	1	2.00	SOS	137,000	Flavobacteriosis	3	15	40.9
Alea SFH	1	3.00	STT	213,000	BGD	3	15	60.0
Bodine SFH	4	1.5 - 3.2	STT	287,341	BGD	3	15	54.0
Diru Creek Hatchery	1	5.70	STT	25,940	BGD	3	15	50.0
Mixsawbah SFH	5	1.8 - 3.6	STT	517,052	BGD	3	15	50.0 - 51.0
Wells SFH	1	24.00	STT	300	Columnaris	3	15	53.0
Similkameen Rearing Ponds	1	5.00	SUS	280,600	BGD	3	15	32.0
Genoa NFH	1	5.00	WAE	500	Columnaris	3	15	55.0
Rathbun SFH	1	2.80	WAE	295,923	BGD	1 - 3	15	77.4

Table 1. Summary of Year 2007 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)
Roger Reed Salmon SFH	1	1.00	ATS	1,231,007	CWD	3	20	42.3
Wray SFH	1	0.78	BLG	150,133	BGD	5	20	64.0
Rathbun SFH	1	1.00	CCF	4,000	Columnaris	3	20	75.0
Bellvue-Watson SFH	1	1.33	CUT	57,000	CWD	1	20	55.0
Durango SFH	2	1.1 - 1.5	CUT	20,234	BGD	1 - 3	20	50.0
Bald Hill FCS	1	5.00	LAS	36,000	Columnaris	3	20	70.0
Ed Weed FCS	1	1.07	LAS	110,000	BGD	3	20	50.0
Richloam SFH	5	1.7 - 4.3	LMB	196,872	Columnaris	3	20	74.0 - 78.0
Alsea SFH	1	4.90	RBT	54,000	BGD	3	20	60.0
Bellvue-Watson SFH	4	1.1 - 2.1	RBT	538,200	BGD	1 - 3	20	53.0 - 55.0
Chalk Cliffs Rearing Unit	2	5.5 - 7.0	RBT	132,152	BGD	3	20	56.0
Durango SFH	1	2.84	RBT	30,000	BGD	3	20	50.0
Garrison Dam NFH	2	1.00	RBT	135,000	BGD	3	20	53.0
Monte Vista SFH	1	3.50	RBT	50,000	Flavobacteriosis	3	20	67.0
Trail Lakes/Eklutna Hatchery	1	2.00	SOS	272,500	Flavobacteriosis	3	20	40.9

Table 1. Summary of Year 2007 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)
Mixsawbah SFH	1	3.17	STT	65,500	BGD	3	20	52.0
Rathbun SFH	1	7.10	WAE	217,709	BGD	2 - 6	20	77.0

Table 2. Summary of Year 2007 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)
South Otselic SFH	1	3.00	MUH	4,200	BGD	2	10	68.0
Rathbun SFH	1	1.00	WAE	99,000	BGD	2	10 & 15	67.0
Eastbank SFH	1	38.00	CKS	1,200	Columnaris	17 - 24	15	54.5
Albert Powell SFH	2	1.3 - 1.5	RBT	340,000	BGD	3	15	54.0
Genoa NFH	1	1.50	LMB	20,000	Columnaris	3	20	70.0
Genoa NFH	1	1.50	SMB	20,000	Columnaris	3	20	70.0

Table 3. Summary of Year 2007 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	3.30	BKT	72,000	Motile Aeromonad	2	10	46.0
Harrietta SFH	1	2.43	BNT	151,818	CWD	3	10	46.4
Oden SFH	1	4.00	BNT	556,775	Flavobacteriosis	1	10	45.7
Oden SFH	1	1.93	BNT	481,374	CWD	1 - 2	10	45.7
Garrison Dam NFH	1	0.87	BUR	300	BGD	3	10	61.0
Nampa SFH	2	5.6 - 7.6	RBT	242,400	BGD	3 - 5	10	59.0
Wolf Lake SFH	1	1.30	NOP	75,200	Branhiomyces	20	10;20	70.0
Chelan SFH	1	1.49	CUT	292,924	CWD	3	15	58.0
Warm Springs NFH	1	30.00	SCS	600	Columnaris	3	15	55.0
Eastbank SFH	1	8.25	STT	68,176	CWD	3	15	54.5
Lonesome Creek Hatchery	6	1.2 - 3.0	STT	711,848	CWD	3	15	47.0 - 48.0
Bald Hill FCS	1	1.50	LAS	50,000	BGD	3	20	53.0
Bald Hill FCS	1	3.00	LAS	4,000	Columnaris	3	20	70.0
Bellvue-Watson SFH	6	2.0 - 4.3	RBT	528,347	CWD	1 - 3	20	53.0 - 56.0
Durango SFH	1	2.84	RBT	29,000	CWD	3	20	50.0
Jones Hatchery	1	5.20	RBT	82,800	BGD	1	20	59.0

Table 4. Summary of Year 2007 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)
Keta Creek Hatchery	1	1.20	CHS	397,500	BGD	3	15	47.0
Alchesay-Williams Creek NFH	2	1.4 - 3.5	RBT	250,498	BGD	3	15	52.0
Jones Hatchery	31	2.0 - 14.0	RBT	1,552,800	BGD	3	20	59.0
Pueblo SFH	2	2.5 - 3.0	RBT	210,000	BGD	3	20	53.0 - 55.0

Table 5. Summary Data Regarding Year 2007 Chloramine-T Efficacy Studies

Total Number of Fish Treated:	31,720,167
Number of fish treated in efficacious studies	25,486,407
Number of fish treated in non-efficacious studies	484,400
Number of fish treated in inconclusive studies	3,347,562
Number of fish where efficacy was not needed	2,410,798

Total Number of Studies:	234
Efficacious Studies	164
Non-efficacious Studies	7
Inconclusive Studies	27
Efficacy was not needed	36

Treatment Regimens and Frequency Used:

10 mg/L; 1 - 5 times	34 trials
10;15 mg/L; 2 times	1 trial
10;20 mg/L; 20 times	1 trial
12 mg/L; 1 - 3 times	7 trials
14.6 - 15 mg/L; 1 - 24 times	119 trials
20 mg/L; 1 - 6 times	72 trials

Treatment Water Temperature (°F):

Temperature Range	32.0 - 78.0
Mean Temperature	54.7

Size of Treated Fish (in.):

Size Range	0.6 - 38.0
Mean Length	4.30

Species Treated:

Salmonids:

- (1) Atlantic salmon *Salmo salar*
- (2) brown trout *S. trutta*
- (3) apache trout *Oncorhynchus apache*
- (4) chinook salmon *O. tshawytscha*

- (5) chum salmon *O. keta*
- (6) coho salmon *O. kisutch*
- (7) sockeye salmon *O. nerka*
- (8) cutthroat trout *O. clarki*
- (9) rainbow trout *O. mykiss*
- (10) steelhead trout *O. mykiss*
- (11) brook trout *Salvelinus fontinalis*
- (12) lake trout *Salvelinus namaycush*

Non-salmonids:

- (1) bluegill *Lepomis macrochirus*
 - (2) burbot *Lota lota*
 - (3) channel catfish *Ictalurus punctatus*
 - (4) lake sturgeon *Acipenser fulvescens*
 - (5) largemouth bass *Micropterus salmoides*
 - (6) smallmouth bass *M. dolomieu*
 - (7) muskie *Esox masquinongy*
 - (8) northern pike *E. lucius*
 - (9) tiger Muskellunge *E. lucius x E. masquinongy*
 - (10) walleye *Sander vitreus*
-