

Chloramine-T Clinical Field Trials - INAD 9321

Year 2006 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
Bozeman National INAD Office
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 2006 (CY06), the efficacy of chloramine-T (CLT) was evaluated in 152 disease trials involving approximately 28.8 million fish to control mortality in a variety of fish species caused by a variety of infectious fish pathogens. Trials were conducted at 47 fish culture facilities, including five U.S. Fish and Wildlife Service National Fish Hatcheries (NFH), 34 state fish hatcheries, five private fish hatcheries, and three 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 CY06 indicated that treatments appeared efficacious in approximately 87% of the trials, ineffective in 3% of the trials, and were characterized as inconclusive in the 9% of the trials. In the remaining 1% 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 2006 (CY06) supplemental chloramine-T field efficacy data. Similar data have been submitted by the Service in previous years. We anticipate that CY06 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 152 field efficacy trials were conducted at 47 fish culture facilities, including five U.S. Fish and Wildlife Service NFH's, 34 state fish hatcheries, five private fish hatcheries, and three 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 36.5 - 80.0 °F, with a mean treatment temperature of 54.2°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. During CY06, a total of 4,053.0 kg of CLT was used in treatment trials conducted under INAD # 9321.

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 CY06, various chloramine-T doses were used. Listed below are the doses and the number of trials conducted with each dose:

1.	10 mg/L:	17 trials
2.	12 mg/L:	4 trials
3.	12;15;20 mg/L:	1 trial
4.	13 mg/L:	1 trial
5.	15 mg/L:	109 trials
6.	20 mg/L:	20 trials

Total	152 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 CY06, 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 CY 2005 Trials

1. Species and size of fish treated

Twenty fish species, including 13 species of salmonids and seven non-salmonids fish species, were treated during CY06. Treated fish ranged in length from 0.5 - 38.0 in. and the mean length of all treated fish was 4.7 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) kokanee salmon *O. nerka*; (12) brook trout *Salvelinus fontinalis*; and (13) lake trout *Salvelinus namaycush*

Non-salmonids: (1) channel catfish *Ictalurus punctatus*; (2) lake sturgeon *Acipenser fulvescens*; (3) largemouth bass *Micropterus salmoides*; (4) smallmouth bass *M. dolomieu*; (5) muskie *Esox masquinongy*; (6) northern pike *E. lucius*; and (7) walleye *Sander vitreus*.

2. Diseases treated

The disease treated most frequently was characterized as BGD (72% of the trials). Other diagnosed diseases included external columnaris, external bacterial coldwater disease, and external flavobacteriosis.

Data Collected

1. Pathologist's report

In CY06 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 Bozeman 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 CY06 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 CY06 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 17 trials (Tables 1 - 3). Included in these 17 trials were 16 trials in which Atlantic, chinook, and kokanee salmon, and brook, rainbow, and steelhead trout, were treated to control mortality associated with BGD; and one trial in which walleye were treated to control mortality associated with columnaris. Treatment resulted in the following:

- 1) Of the 16 trials in which BGD was diagnosed in Atlantic, chinook, and kokanee salmon, and brook, rainbow, and steelhead trout ; treatment in 12 of the trials appeared efficacious; while treatment in one trial (involving Atlantic salmon) did not appear to be efficacious; and treatment in three trials (involving chinook salmon, brook trout, and steelhead trout) were characterized as inconclusive

- 2) The trial in which columnaris was diagnosed in walleye was characterized as inconclusive.

B. Efficacy at 12 - 13 mg/L chloramine-T

Five trials were conducted using 12 - 13 mg/L chloramine-T (Table 1) to control mortality in chinook salmon, and brook and rainbow trout associated with BGD.

All trials appeared efficacious.

C. Efficacy at 12; 15; 20 mg/L chloramine-T

One trial was conducted using 12; 15; 20 mg/L chloramine-T (Table 2) to control mortality in walleye associated with columnaris. Treated fish and control fish followed a similar mortality pattern during the study period. This trial did not appear to be efficacious.

D. Efficacy at 15 mg/L chloramine-T

Fish were treated with 15 mg/L chloramine-T in 109 trials (Tables 1, 3, & 4).

Included in these 109 trials were 91 trials in which treatments were administered to apache, brook, brown trout, cutthroat, lake, rainbow, and steelhead trout, chinook, chum, and coho salmon, musky, and walleye to control mortality associated with BGD; nine trials in which treatments were administered to chinook salmon, steelhead trout, cutthroat trout, lake sturgeon, largemouth bass, musky, and smallmouth bass to control mortality associated with external columnaris; five trials in which treatments were administered to steelhead trout to control mortality associated with external bacterial coldwater disease, and four trials in which treatments were administered to brown trout, chinook and sockeye

salmon to control mortality associated with external flavobacteriosis. Treatment resulted in the following:

1) Of the 91 trials in which BGD was diagnosed in apache, brook, brown trout, cutthroat, lake, rainbow, and steelhead trout, chinook, chum, and coho salmon, musky, and walleye, treatments in 87 of the trials appeared efficacious, while treatment in three trials involving brown, brook, and rainbow trout were characterized as inconclusive, and one study involving rainbow trout did not report efficacy (due to the efficacy packet being complete)

2) Treatments in eight of the trials in which chinook salmon, steelhead trout, lake sturgeon, largemouth bass, musky, and smallmouth bass were diagnosed with external columnaris appeared to be efficacious, while one trial involving cutthroat trout was characterized as inconclusive

3) Treatments in all of the trials in which steelhead trout were diagnosed with external CWD appeared to be efficacious

4) Treatments in one of the trials in which chinook salmon were diagnosed with external flavobacteriosis appeared to be efficacious, while three trials involving brown trout and sockeye salmon were characterized as inconclusive.

E. Efficacy at 20 mg/L chloramine-T

Fish were treated with 20 mg/L chloramine-T in 20 trials (Tables 1 - 3). Included in these 20 trials were 14 trials in which treatments were administered to chinook salmon, brook, rainbow, and steelhead trout, northern pike, and walleye to control mortality associated with BGD; and six trials in which treatments were administered to channel catfish, musky, largemouth bass, and walleye to control mortality associated with external columnaris. Treatment resulted in the following results:

1) Of the 14 trials in which BGD was diagnosed in chinook salmon, brook, rainbow, and steelhead trout, northern pike, and walleye, treatment in 11 of the trials appeared efficacious, while treatment in three of the trials involving chinook salmon were characterized as inconclusive

2) Of the six trials in which external columnaris was diagnosed in channel catfish, musky, largemouth bass, and walleye, treatment in four of the trials appeared to be efficacious, while treatment in the two trials involving channel catfish were characterized as inconclusive.

3. Observed Toxicity

No toxicity or adverse effects relating to CLT treatment were reported in 147 of the 152 trials. However, in two of the trials, the Investigators reported that sockeye salmon appeared agitated during the treatment periods; and in three

trials involving chinook salmon the Investigator noted that there were signs of gill damage after the treatment period. The Investigator, of the chinook trials, also noted that the water is extremely soft and that they have had problems with other chemical treatments in the past.

Summary of Study Results

Chloramine-T was used at doses ranging from 10 - 20 mg/L in 152 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 different species of fish were treated and trials involved approximately 28.8 million fish. Treated fish ranged in size from 0.5 - 38.0 in. Water temperature during treatment ranged from 36.5 - 80.0°F, with a mean treatment temperature of 54.2°F. Overall, results showed that treatment appeared effective in approximately 87% of trials and ineffective in 3% of the trials. Treatment results in 9% of the trials were characterized as inconclusive. In the remaining 1% 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 97% of the trials. Data from the CY06 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 made to improve the quality of data whenever possible, with particular attention paid to the use of untreated control fish, dose verification, and the inclusion of fish pathologist reports.

References

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Table 1. Summary of Year 2006 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)
Ed Weed FCS	1	2.00	ATS	100,000	BGD	3	10	50.0
Roxbury FCS	1	0.50	BKT	120,000	BGD	3	10	45.5
Mackay SFH	2	2.75	KOE	675,000	BGD	3 - 6	10	52.0
Decorah SFH	2	4.9 - 5.1	RBT	34,345	BGD	1 - 3	10	54.0
Erwin SFH	4	6.0 - 10.0	RBT	33,646	BGD	2 - 3	10	59.0 - 63.0
Manchester SFH	2	5.8 - 5.9	RBT	22,800	BGD	1	10	50.0
Marquette SFH	3	4.8 - 15.1	BKT	129,427	BGD	2 - 3	12	46.0 - 50.0
Platte River SFH	1	2.00	CKS	1,147,682	BGD	3	12	44.0
Harrietta SFH	1	0.90	RBT	240,798	BGD	3	13	47.0
Alchesay-Williams Creek NFH	13	3.3 - 7.7	APT	831,035	BGD	3	15	50.0 - 53.0
	2	0.90	BKT	169,200	BGD	3	15	50.0 - 52.0
Bennington FCS	2	4.30	BKT	40,000	BGD	3	15	45.0
Ed Weed FCS	1	3.60	BKT	8,000	BGD	3	15	49.8
Marion FCS	1	5.15	BKT	17,000	BGD	3	15	52.0
Paint Bank FCS	1	7.50	BKT	18,000	BGD	3	15	52.4
Bath SFH	2	6.25	BNT	132,000	BGD	1 - 2	15	48.0

Table 1. Summary of Year 2006 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)
Harrietta SFH	1	1.07	BNT	280,537	BGD	3	15	47.0
Thompson SFH	2	1.8 - 7.2	BNT	222,099	BGD	3	15	48.0 - 58.0
Diru Creek Hatchery	1	1.46	CHS	250,000	BGD	3	15	50.0
Keta Creek Hatchery	5	1.3 - 1.6	CHS	2,111,900	BGD	3	15	44.0 - 47.0
Eastbank SFH	2	38.00	CKS	2,907	Columnaris	3 - 13	15	54.5 - 54.7
Keta Creek Hatchery	1	2.00	CKS	550,000	BGD	3	15	44.0
Lonesome Creek Hatchery	1	37.00	CKS	30	Flavobacteriosis	4	15	47.0
Platte River SFH	1	2.00	CKS	2,595,295	BGD	3 - 5	15	44.0
Solomon Gulch Hatchery	3	1.40	COS	2,089,022	BGD	3	15	42.0 - 43.0
Chelan SFH	1	5.00	CUT	82,500	BGD	3	15	54.0
Omak SFH	1	4.00	CUT	67,000	BGD	3	15	55.0
Jordan River NFH	1	1.85	LAT	3,640,000	BGD	6	15	48.1
Pendills Creek NFH	1	4.32	LAT	966,794	BGD	14	15	53.5
Genoa NFH	1	2.00	LMB	6,800	Columnaris	4	15	70.0
	1	7.00	LST	32,000	Columnaris	7	15	68.0

Table 1. Summary of Year 2006 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)
Kincaid SFH	1	0.50	MUE	25,000	Columnaris	7	15	69.0
London SFH	1	0.75	MUE	35,000	BGD	14	15	69.0
Albert Powell Trout SFH	5	2.0 - 7.0	RBT	475,500	BGD	3 - 14	15	54.0
Alchesay-Williams Creek NFH	7	1.7 - 9.0	RBT	842,053	BGD	3	15	52.0 - 59.0
Bennington FCS	1	3.20	RBT	40,000	BGD	3	15	45.8
Chelan SFH	1	3.20	RBT	36,000	BGD	3	15	55.0
Coursey Springs FCS	2	8.0 - 11.0	RBT	78,000	BGD	3	15	56.0 - 57.0
Darrah Springs SFH	1	5.00	RBT	140,000	BGD	3	15	56.0
Garrison Dam NFH	1	1.00	RBT	164,000	BGD	3	15	56.0
Idaho Trout Company	11	1.0 - 2.7	RBT	776,682	BGD	3	15	59.0 - 60.0
London SFH	2	2.5 - 12.0	RBT	153,000	BGD	3 - 12	15	52.0
Marion FCS	1	10.50	RBT	24,000	BGD	3	15	52.0
Omak SFH	1	4.00	RBT	25,000	BGD	3	15	56.0

Table 1. Summary of Year 2006 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	2	2.0 - 6.3	RBT	420,000	BGD	3	15	49.0 - 51.0
Thompson SFH	1	2.50	RBT	266,161	BGD	3	15	58.0
Genoa NFH	1	2.00	SMB	10,000	Columnaris	1	15	70.0
Bodine SFH	7	1.4 - 3.3	STT	984,814	BGD	3	15	54.0
Cowlitz Trout SFH	1	3.60	STT	867,175	CWD	4 - 9	15	55.0
Lonesome Creek Hatchery	4	1.5 - 2.8	STT	466,780	CWD	3 - 6	15	48.0 - 55.0
Wells SFH	2	24 - 32	STT	715	Columnaris	3	15	52.0 - 53.0
Similkameen Rearing Ponds	2	4.9 - 5.0	SUS	1,213,735	BGD	1	15	39.1 - 50.7
Rathbun SFH	1	2.50	WAE	356,376	BGD	3 - 4	15	73.0
Roxbury FCS	1	1.10	BKT	65,000	BGD	3	20	45.5
Hackettstown SFH	1	3.00	CCF	44,000	Columnaris	3	20	79.0
Fort Peck SFH	1	2.94	CKS	65,000	BGD	3	20	59.0
Whitman Lake Hatchery	1	1.80	CKS	500,000	BGD	3	20	38.7
Genoa NFH	1	4.90	LMB	10,000	Columnaris	2	20	70.0

Table 1. Summary of Year 2006 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)
Hackettstown SFH	1	4.20	MUE	7,500	Columnaris	3	20	68.0
	2	4.0 - 4.5	NOP	32,000	BGD	3	20	68.0
Pequest SFH	1	5.90	RBT	25,000	BGD	1	20	53.0
Alsea SFH	1	5.00	STT	52,000	BGD	3	20	51.0
Rathbun SFH	4	6.4 - 7.0	WAE	85,992	BGD	3 - 6	20	72.0 - 75.7
Rathbun Research (pivotal study)	1	1.80	WAE	868	Columnaris	3	20	72.8

Table 2. Summary of Year 2006 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)
Ed Weed FCS	1	2.00	ATS	100,000	BGD	3	10	50.0
Rathbun Research	1	1.60	WAE	10,500	Columnaris	15 - 17	12;15;20	74.5
Hackettstown SFH	2	2.3 - 17.4	CCF	40,200	Columnaris	3	20	80.0

Table 3. Summary of Year 2006 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)
Decorah SFH	1	3.68	BKT	35,000	BGD	2	10	50.0
Crystal Lake Hatchery	1	1.40	CKS	490,920	BGD	1	10	36.5
Salmon River SFH	1	2.00	STT	1,006,155	BGD	2 - 9	10	63.0
New London SFH	1	0.50	WAE	27,073	Columnaris	2	10	76.5
Roxbury FCS	1	2.70	BKT	46,500	BGD	5	15	43.4
Harrietta SFH	1	1.23	BNT	163,570	Flavobacteriosis	3	15	47.0
London SFH	1	2.50	BNT	62,000	BGD	9	15	52.0
Garrison Dam NFH	1	2.49	CUT	17,000	Columnaris	3	15	60.0
Albert Powell Trout SFH	1	4.00	RBT	350,000	BGD	3	15	54.0
Trail Lakes/Eklutna Hatchery	2	3.00	SOS	221,000	Flavobacteriosis	3	15	39.0
Crystal Lake Hatchery	2	1.40	CKS	953,913	BGD	1	20	36.5
Whitman Lake Hatchery	1	1.80	CKS	386,000	BGD	2	20	38.8

Table 4. Summary of Year 2006 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)
Albert Powell Trout SFH	1	8.0	RBT	15,000	BGD	3	15	54.0

Table 5. Summary Data Regarding Year 2006 Chloramine-T Efficacy Studies

Total Number of Fish Treated: 28,827,999

Number of fish treated in efficacious studies	24,903,168
Number of fish treated in non-efficacious studies	150,700
Number of fish treated in inconclusive studies	3,759,131
Number of fish where efficacy was not needed	15,000

Total Number of Studies: 152

Efficacious Studies	133
Non-efficacious Studies	4
Inconclusive Studies	14
Efficacy was not needed	1

Treatment Regimens and Frequency Used:

10 mg/L; 1 - 9 times	17 trials
12 mg/L; 2 - 3 times	4 trials
12; 15; 20 mg/L; 15 - 17 times	1 trial
13 mg/L; 3 times	2 trials
15 mg/L; 1 - 14 times	109 trials
20 mg/L; 1 - 6 times	20 trials

Treatment Water Temperature (°F):

Temperature Range	36.5 - 80.0
Mean Temperature	54.2

Size of Treated Fish (in.):

Size Range	0.5 - 38.0
Mean Length	4.7

Pivotal Trial:

Study Number: 9321-0-216

Species Treated:

Salmonids:

Atlantic salmon *Salmo salar*
brown trout *S. trutta*
apache trout *Oncorhynchus apache*
chinook salmon *O. tshawytscha*
chum salmon *O. keta*
coho salmon *O. kisutch*
kokanee salmon *O. nerka*
sockeye salmon *O. nerka*
cutthroat trout *O. clarki*
rainbow trout *O. mykiss*
steelhead trout *O. mykiss*
brook trout *Salvelinus fontinalis*
lake trout *S. namaycush*

Non-salmonids:

channel catfish *Ictalurus punctatus*
lake sturgeon *Acipenser fulvescens*
largemouth bass *Micropterus salmoides*
smallmouth bass *M. dolomieu*
muskie *Esox masquinongy*
northern pike *E. lucius*
walleye *Sander vitreus*
