

## **Chloramine-T Clinical Field Trials - INAD 9321**

### **Year 2011 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 2011 (CY11), the efficacy of chloramine-T (CLT) was evaluated in 285 disease trials involving approximately 30.1 million fish to control mortality in a variety of fish species caused by a variety of infectious fish pathogens. Trials were conducted at 57 fish culture facilities, including nine U.S. Fish and Wildlife Service National Fish Hatcheries (NFH), 36 state fish hatcheries, seven private fish hatcheries, and five 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 CY11 indicated that treatments appeared efficacious in approximately 72% of the trials, ineffective in 5% of the trials, and were characterized as inconclusive in 13% of the trials. In the remaining 10% 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 CY11 supplemental chloramine-T field efficacy data. Similar data have been submitted by the Service in previous years. We anticipate that CY11 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 285 field efficacy trials were conducted at 57 fish culture facilities, including nine U.S. Fish and Wildlife Service NFH's, 36 state fish hatcheries, seven private fish hatcheries, and five tribal hatcheries. Water temperature

during treatments at the various testing facilities ranged from 34.0 - 83.3 °F, with a mean treatment temperature of 54.8°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 CY11, various chloramine-T doses were used. Listed below are the doses and the number of trials conducted with each dose:

1.	5 mg/L	2 trials
2.	7.8 mg/L	1 trial
3.	8 mg/L	4 trials
4.	10 mg/L	36 trials
5.	12 mg/L	33 trials
6.	15 mg/L	126 trials
7.	15 & 20 mg/L	1 trial
8.	20 mg/L	82 trials
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	Total	285 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 CY11, 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 CY11 Trials

### 1. Species and size of fish treated

Twenty-seven fish species, including 15 species of salmonids and 12 non-salmonids fish species, were treated during CY11. Treated fish ranged in length from 0.75 - 38.0 in. and the average length of all treated fish was 4.6 in. Species treated included:

**Salmonids:** (1) landlocked Atlantic salmon *Salmo salar*; (2) Atlantic salmon *S. Salar*; (3) brown trout *S. trutta*; (3) arctic grayling *Thymallus arcticus*; (5) apache trout *Oncorhynchus apache*; (6) chinook salmon *O. tshawytscha*; (7) chum salmon *O. keta*; (8) coho salmon *O. kisutch*; (9) sockeye salmon *O. nerka*; (10) kokanee salmon *O. Nerka*; (11) cutthroat trout *O. clarki*; (12) rainbow trout *O. mykiss*; (13) steelhead trout *O. mykiss*; (14) brook trout *Salvelinus fontinalis*; and (15) lake trout *S. namaycush*.

**Non-salmonids:** (1) blue catfish *Ictalurus furcatus*; (2) channel catfish *I. punctatus*; (3) fathead minnow *Pimephales promelas*; (4) hybrid striped bass *Morone saxatilis x M. chrysops*; (5) lake sturgeon *Acipenser fulvescens*; (6) white sturgeon *A. transmontanus*; (7) muskellunge *Esox masquinongy*; (8) northern pike *E. lucius*; (9) tiger muskellunge *Esox*

*lucius x E. masquinongy*; (10) razorback sucker *Xyrauchen texanus*; (11) smallmouth bass *Micropterus dolomieu*; and (12) walleye *Sander vitreus*.

## **2. Diseases treated**

The disease treated most frequently was characterized as BGD (86% of the trials). Other diagnosed diseases included external columnaris, external bacterial coldwater disease, and external flavobacteriosis.

## **Data Collected**

### **1. Pathologist's report**

In CY11 a pathologist's report was submitted for 28% 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 CY11 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 list of all trials in which treatment appeared efficacious; Table 2 provides a list of all trials in which treatment appeared ineffective; Table 3 provides a list of all inconclusive trials; Table 4 provides a list 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 CY11 under INAD #9321).

#### **A. Efficacy at 5 - 8 mg/L chloramine-T**

Atlantic salmon, rainbow trout, and steelhead trout were treated with 5 - 8 mg/L chloramine-T for 3 days in 7 trials (Table 1). Investigators used CLT to control mortality caused by BGD or external flavobacteriosis. CLT treatments appeared effective in all trials.

#### **B. Efficacy at 10 mg/L chloramine-T**

Atlantic salmon, brook trout, brown trout, chinook salmon, coho salmon, lake trout, rainbow trout, muskellunge, razorback suckers, and walleye were treated with 10 mg/L chloramine-T for 1 - 18 days in 36 trials (Tables 1 - 3).

Investigators used CLT to control mortality caused by BGD, external bacterial coldwater disease, or external flavobacteriosis. CLT treatments appeared effective in 28 trials, ineffective in four trials, and were characterized as inconclusive in four trials.

#### **C. Efficacy at 12 mg/L chloramine-T**

Rainbow trout were treated with 12 mg/L chloramine-T for 1 -2 days in 33 trials (Tables 1 & 3). Investigators used CLT to control mortality caused by BGD. CLT treatments appeared effective in 14 trials and was inconclusive in 19 trials.

#### **D. Efficacy at 15 mg/L chloramine-T**

Apache trout, Atlantic salmon, brook trout, chinook salmon, chum salmon, coho salmon, cutthroat trout, kokanee salmon, lake trout, rainbow trout, sockeye salmon, steelhead trout, channel catfish, lake sturgeon, razorback sucker, smallmouth bass, and white sturgeon were treated with 15 mg/L chloramine-T for 1 - 20 days in 126 trials (Tables 1 - 3). Investigators used CLT to control mortality caused by BGD, external coldwater disease, external flavobacteriosis, or external columnaris. CLT treatments appeared effective in 112 trials, ineffective in nine trials, and inconclusive in five trials.

#### **E. Efficacy at 15 & 20 mg/L chloramine-T**

One trial was conducted using 15 & 20 mg/L chloramine-T for 6 days (Table 1). Investigators used CLT to control mortality caused by external columnaris in blue catfish. CLT treatments appeared effective in this trial.

#### **F. Efficacy at 20 mg/L chloramine-T**

Arctic grayling, brook trout, Chinook salmon, cutthroat trout, landlocked Atlantic salmon, rainbow trout, sockeye salmon, steelhead trout, channel catfish, fathead minnow, muskellunge, northern pike, hybrid striped bass, smallmouth bass, tiger muskellunge, and walleye were treated with 20 mg/L chloramine-T for 1 - 3 days in 82 trials (Tables 1 - 4). Investigators used CLT to control mortality caused by

BGD, external columnaris, or external coldwater disease. CLT treatments appeared effective in 42 trials, not reported in 28 trials (due to the efficacy packet being complete), ineffective in three trials, and were characterized as inconclusive in nine trials.

### **3. Observed Toxicity**

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

### **4. Observed Withdrawal Period**

No withdrawal time is needed for fish treated with CLT under the current Food-Use Authorization dated March 14, 2013.

### **Current Study Protocol for CLT INAD #9321**

No changes have occurred to the current study protocol for CLT INAD #9321.

### **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 CY11. Please note all of these facilities are in compliance with their reporting requirements to the NPDES authority. It should also be noted that 276 trials were either 1) in compliance with their reporting requirements to their NPDES authority for a CLT discharge higher

then 0.1 ppm; or 2) met the discharge level set by CVM. In the remaining nine trials the CLT discharge ranged between 0.2 - 5.0 ppm. The investigators were contacted in these trials and reminded of the discharge limit set by CVM.

The following facilities had chloramine-T on-hand during CY11 but never used the drug:

- |                  |                           |
|------------------|---------------------------|
| 1. Whitman Lake  | 8. Salisbury FCS          |
| 2. Marion FCS    | 9. Gallagher SFH          |
| 3. Wray SFH      | 10. Fort Peck SFH         |
| 4. Durango SFH   | 11. Ed Weed FCS           |
| 5. Story SFH     | 12. Crystal Lake Hatchery |
| 6. Solomon Gulch | 13. Bellvue SFH           |
| 7. Bath SFH      |                           |

### **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 CY11.

### **Number of Treated Fish under Treatment Use Authorization**

Total number of fish treated during CY11 was 30,110,212. The total number of treated fish to count against the treatment use authorization dated December 22, 2009 is 55,402,679.

## **Summary of Study Results**

Chloramine-T was used at doses ranging from 5 - 20 mg/L in 285 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-seven different fish species were treated and trials involved approximately 30.1 million fish. Treated fish ranged in size from 0.75 - 38.0 in. Water temperature during treatment ranged from 34.0 - 83.3 °F, with a mean treatment temperature of 54.8°F. Overall, results showed that treatment appeared effective in approximately 72% of trials, ineffective in 5% of the trials, and characterized as inconclusive 13% of the trials. In the remaining 10% 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 CY11 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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**Table 1. Year 2011 Chloramine-T Efficacy Results - Efficacious Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
2	Alchesay-Williams Creek NFH	APT	4.0 - 4.2	93,789	BGD	15	3	51.0
1	Dubois SFH	ARG	6.90	7,900	BGD	20	3	55.0
4	Oquossoc Hatchery	ATS	5.00	877,995	BGD	8	3	70.0
1	Platte River SFH	ATS	4.28	84,992	External Flavobacteriosis	10	3	48.0
1	Genoa NFH	BCF	7.70	1,130	External Columnaris	15 - 20	6	60.0
3	Bennington FCS	BKT	7.0 - 8.5	44,500	BGD	20	3	36.0 - 48.0
3	Coursey Springs SFH	BKT	2.9 - 8.0	432,000	BGD	15	3	54.0 - 57.0
1	Dubois SFH	BKT	1.22	94,000	BGD	20	3	58.0
1	Jordan River NFH	BKT	2.03	3,400	BGD	15	3	46.7
1	Marquette SFH	BKT	6.60	13,552	BGD	10	3	41.0
2	Pain Bank SFH	BKT	6.75	31,000	BGD	15	3	54.0
1	Roxbury FCS	BKT	1.10	60,000	BGD	20	3	50.0
1	Garrison Dam NFH	BNT	1.08	47,000	BGD	15	3	53.0
1	Harrietta SFH	BNT	0.86	78,900	External CWD	10	3	46.4
1	Oden SFH	BNT	1.10	295,105	External Flavobacteriosis	10	3	45.7
1	Rome SFH	BNT	4.50	60,000	BGD	15	1	55.0
2	Genoa NFH	CCF	2.0 - 8.9	1286.00	External Columnaris	15	9 - 14	49.0 - 69.0
1	Milford SFH	CCF	5.00	25,000	BGD	20	3	74.0
1	Milford SFH	CCF	3.00	50,000	BGD & External Columnaris	20	3	58.0

**Table 1. Year 2011 Chloramine-T Efficacy Results - Efficacious Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
1	Rathbun SFH	CCF	4.00	5,265	BGD	15	1	61.5
14	Keta Creek Hatchery	CHS	1.0 - 1.8	3,164,500	BGD	15	2 - 3	46.0 - 50.0
1	Bodine SFH	COS	1.23	90,652	BGD	15	3	54.0
1	Dworshak NFH	COS	5.54	322,325	External CWD	10	3	40.6
3	Mixsawbah SFH	COS	1.3 - 2.9	387,604	BGD	15	3	51.0
1	Eastbank SFH	CSA	38.00	1,113	External Flavobacteriosis	15	5 - 12	54.7
2	Mixsawbah SFH	CSA	2.6 - 3.4	500,462	BGD	15	3	51.0
1	Similkameen Hatchery	CSA	4.27	638,368	External CWD	20	3	37.5
1	Chelan SFH	CUT	4.00	75,000	BGD	15	3	54.0
1	Leadville NFH	CUT	9.50	32,300	External Flavobacteriosis	15	3	40.0
5	Wigwam FRS	CUT	3.6 - 13.0	21,343	BGD	20	3	49.0
2	Nez Perce Tribal Hatchery	FCS	1.50	292,500	BGD	15	3	50.0
1	Genoa NFH	FHM	1.80	85,000	External Columnaris	20	3	52.0
2	Ford SFH	KOE	2.00	145,000	BGD	15	3	49.0
5	Spokane Tribal Hatchery	KOE	5.7 - 6.0	70,500	BGD	15	3	51.0
1	Bald Hill FCS	LAS	4.00	42,000	External Columnaris	20	3	72.0
1	Jordan River NFH	LAT	1.89	3,840,000	BGD	15	3	46.7
1	Marquette SFH	LAT	13.90	840	External Flavobacteriosis	10	3	39.0

**Table 1. Year 2011 Chloramine-T Efficacy Results - Efficacious Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
2	Genoa NFH	LST	3.00	151,200	External Columnaris	15	19 - 20	52.0
1	Hackettstown SFH	MUE	5.20	7,500	BGD	20	3	68.0
1	Wolf Lake SFH	MUE	2.00	28,745	BGD	10	18	70.0
1	Hackettstown SFH	MUH	3.60	7,500	BGD	20	3	68.0
1	Hackettstown SFH	NOP	3.60	30,000	BGD	20	3	68.0
1	Willow Beach NFH	RBS	4.42	10,289	BGD	10	3	60.0
4	Willow Beach NFH	RBS	2.1 - 6.8	60,513	BGD	15	3	56.0 - 72.0
8	Albert Powell Trout SFH	RBT	1.9 - 6.2	450,000	BGD	15	2 - 3	54.0
1	Alchesay-Williams Creek NFH	RBT	3.83	31,922	BGD	15	3	51.0
3	Bennington FCS	RBT	4.0 - 4.3	56,000	BGD	15	3	52.0 - 56.0
1	Bennington FCS	RBT	2.25	54,000	BGD	20	3	43.0
1	Chalk Cliffs SFH	RBT	9.38	38,800	BGD	20	3	58.0
4	Coursey Springs FCS	RBT	4.6 - 11.0	305,500	BGD	15	3	51.0 - 57.0
3	Creston NFH	RBT	2.9 - 3.0	228,000	BGD	20	3	50.2 - 52.5
1	Dan Speas FRS	RBT	7.50	360,700	BGD	15	3	59.0
4	Decorah SFH	RBT	4.6 - 10.4	71,945	BGD	10	3	55.0 - 56.0
5	Dubois SFH	RBT	1.0 - 1.6	255,000	BGD	20	3	53.0 - 64.0
1	Erwin SFH	RBT	7.00	10,385	BGD	10	3	64.0

**Table 1. Year 2011 Chloramine-T Efficacy Results - Efficacious Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
1	Fort Richardson SFH/Ship Creek Processing Facility	RBT	3.00	112,000	External CWD	15	3	35.8
9	Hotchkiss NFH	RBT	1.0 - 6.8	531,897	BGD	10	1	56.0
7	Hotchkiss NFH	RBT	1.4 - 7.3	313,390	BGD	12	1 - 2	56.0
2	Leadville NFH	RBT	6.0 - 10.0	31,786	External Flavobacteriosis	15	3	40.0
1	Liley Fisheries	RBT	3.00	50,000	BGD	20	3	52.0
2	Limestone Springs	RBT	6.0 - 9.0	152,000	BGD	10	2	62.0 - 69.0
13	Limestone Springs	RBT	0.8 - 7.3	1,206,000	BGD	15	2 - 3	45.0 - 69.0
4	Limestone Springs	RBT	0.8 - 10.0	572,000	BGD	20	3	53.0 - 69.0
1	Mt. Shavano SFH	RBT	9.20	30,000	BGD	15	1	50.0
1	Nebraska Waters	RBT	8.00	45,000	BGD	10	3	55.0
2	Paint Bank SFH	RBT	7.5 - 8.0	128,000	BGD	15	3	53.0 - 54.0
7	Rifle Falls SFH	RBT	1.3 - 8.7	508,306	BGD	12	1	55.0 - 59.0
1	Silver Creek SFH	RBT	9.50	12,600	External CWD	15	1	59.0
2	Wigwam FRS	RBT	3.2 - 6.4	61,900	BGD	20	3	49.0
2	Willow Beach NFH	RBT	3.59	34,000	BGD	5	3	55.0
1	Willow Beach NFH	RBT	0.94	74,000	BGD	10	3	54.0
8	Willow Beach NFH	RBT	1.0 - 7.0	432,241	BGD	15	3	54.0 - 59.0
1	Susquehanna Aquaculture/ Brunner Island Fish Farm	RBT	6.00	20,000	BGD	20	3	60.0

**Table 1. Year 2011 Chloramine-T Efficacy Results - Efficacious Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
1	Bonaparte Pond	SCS	6.00	160,000	BGD	15	6	34.0
1	Chiwawa Rearing Ponds	SCS	6.00	349,112	External CWD	20	3	40.0
1	Dworshak NFH	SCS	4.70	36,500	External CWD	10	3	39.6
1	Genoa NFH	SMB	4.50	5,521	External Columnaris	15	5	52.0
2	Genoa NFH	SMB	4.20	4,000	External Columnaris	20	3	52.0
1	Eastbank SFH	SOS	20.00	181	External Flavobacteriosis	15	3	54.7
2	Bald Hill FCS	STT	2.0 - 3.0	80,000	External Columnaris	20	3	60.0
6	Bodine SFH	STT	1.9 - 3.6	410,824	BGD	15	3	54.0
1	Mixsawbaw SFH	STT	3.50	106,725	BGD	15	3	52.0
1	Thompson SFH	STT	5.60	329,700	External Flavobacteriosis	7.8	3	50.0
1	Thompson SFH	STT	6.40	466,000	External Flavobacteriosis	15	3	50.0
2	Bonaparte Pond	SUS	6.0 - 7.0	315,000	BGD	15	2 - 4	44.0
1	Chelan SFH	SUS	5.00	600,000	BGD	15	3	46.0
1	Oneida SFH	WAE	1.00	710,000	External Flavobacteriosis	10	3	67
1	Chelan SFH	WST	8.50	3,796	External Flavobacteriosis	15	1	53.0

**Table 2. Year 2011 Chloramine-T Efficacy Results - Ineffective Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
1	Oquossoc Hatchery	ATS	5.00	173,504	BGD	10	2	70.0
1	Bennington FCS	BKT	1.00	40,000	BGD	20	3	48.0
1	Oden SFH	BNT	1.70	391,000	BGD	15	3	45.7
1	Keta Creek Hatchery Complex	CHS	1.00	250,000	BGD	15	3	46.0
1	Decorah SFH	RBT	7.70	14,000	BGD	10	3	56.0
2	Hotchkiss NFH	RBT	2.6 - 3.6	96,953	BGD	10	1	56.0
6	Limestone Springs	RBT	0.75 - 6.0	563,000	BGD	15	1 - 3	48.0 - 69.0
2	Limestone Springs	RBT	2 - 3	234,000	BGD	20	3	59.0 - 65.0
1	Lyons Ferry SFH	RBT	3.00	60,000	External CWD	15	6 (two 3 day treatments)	53.0

**Table 3. Year 2011 Chloramine-T Efficacy Results - Inconclusive Studies**

# of Studies	Hatchery	Fish Species	Fish Size (in.)	Number of Fish	Disease	Dose (mg/L)	Number of treatment days	Temp. (°F)
1	Platte River SFH	ATS	5.40	26,845	External CWD	15	3	38.0
1	Mason Valley Hatchery	BNT	1.50	54,585	BGD	10	3	51.0
1	Milford SFH	CCF	5.00	25,000	Columnaris & BGD	20	3	58.0
1	Dan Speas FRS	CUT	5.50	43,900	BGD	15	3	59.0
1	Bald Hill FCS	LAS	1.25	150,000	BGD	20	3	53.0
2	Colville Tribal Fish Hatchery	RBT	20.00	4,207	External Flavobacteriosis	15	1 - 3	47.3 - 48.8
1	Fort Richardson SFH/Ship Creek Processing Facility	RBT	3.00	121,000	External CWD	15	3	35.8
3	Hotchkiss NFH	RBT	2.8 - 5.1	83,310	BGD	10	1	56.0
17	Hotchkiss NFH	RBT	2.4 - 8.7	608,799	BGD	12	1 - 2	56.0
1	Liley Fisheries	RBT	1.00	50,000	BGD	20	3	52.0
1	Limestone Springs	RBT	1.50	120,000	BGD	20	3	55.0
2	Rifle Falls SFH	RBT	5.0 - 5.4	276,943	BGD	12	1	59.0
3	Trail Lakes Hatchery	SOS	0.75	2,837,000	External Flavobacteriosis	20	3	38.0
2	Rathbun SFH	WAE	1.1 - 4.6	10,267	BGD	20	1	67.7 - 83.3

**Table 4. Year 2011 Chloramine-T Efficacy Results - Studies where efficacy data was not needed**

<b># of Studies</b>	<b>Hatchery</b>	<b>Fish Species</b>	<b>Fish Size (in.)</b>	<b>Number of Fish</b>	<b>Disease</b>	<b>Dose (mg/L)</b>	<b>Number of treatment days</b>	<b>Temp. (°F)</b>
28	Jones Hatchery	RBT	1.9 - 9.3	1,809,100	BGD	20	3	57.0

**Table 5. Summary Data Regarding Year 2011 Chloramine-T Efficacy Studies**

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<b>Total Number of Fish Treated:</b>	<b>30,110,212</b>
Number of fish treated in efficacious trials	22,066,799
Number of fish treated in non-efficacious trials	1,822,457
Number of fish treated in inconclusive trials	4,411,856
Number of fish where efficacy was not needed	1,809,100

<b>Total Number of Studies:</b>	<b>285</b>
Efficacious trials	204
Non-efficacious trials	16
Inconclusive trials	37
Efficacy was not needed	28

**Treatment Regimens and Frequency Used:**

5 mg/L	2 trials
7.8 mg/L	1 trial
8.0 mg/L	4 trials
10 mg/L	36 trials
12 mg/L	33 trials
15 mg/L	126 trials
15 & 20 mg/L	1 trial
20 mg/L	82 trials

**Treatment Water Temperature (°F):**

Temperature Range	34.0 - 83.3
Mean Temperature	54.8

**Size of Treated Fish (in.):**

Size Range	0.75 - 38.0
Mean Length	4.6

## Species Treated:

**Salmonids:** (1) landlocked Atlantic salmon *Salmo salar*; (2) Atlantic salmon *S. Salar*; (3) brown trout *S. trutta*; (3) arctic grayling *Thymallus arcticus*; (5) apache trout *Oncorhynchus apache*; (6) chinook salmon *O. tshawytscha*; (7) chum salmon *O. keta*; (8) coho salmon *O. kisutch*; (9) sockeye salmon *O. nerka*; (10) kokanee salmon *O. Nerka*; (11) cutthroat trout *O. clarki*; (12) rainbow trout *O. mykiss*; (13) steelhead trout *O. mykiss*; (14) brook trout *Salvelinus fontinalis*; and (15) lake trout *S. namaycush*

**Non-salmonids:** (1) blue catfish *Ictalurus furcatus*; (2) channel catfish *I. punctatus*; (3) fathead minnow *Pimephales promelas*; (4) hybrid striped bass *Morone saxatilis* x *M. chrysops*; (5) lake sturgeon *Acipenser fulvescens*; (6) white sturgeon *A. transmontanus*; (7) muskellunge *Esox masquinongy*; (8) northern pike *E. lucius*; (9) tiger muskellunge *Esox lucius* x *E. masquinongy*; (10) razorback sucker *Xyrauchen texanus*; (11) smallmouth bass *Micropterus dolomieu*; and (12) walleye *Sander vitreus*

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