Oxytetracycline Medicated Feed Clinical Field Trials - INAD 9332

Year 2001 Annual Summary Report on the Use of Oxytetracycline Medicated Feed in Field Efficacy Trials

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Summary

The efficacy of oxytetracycline medicated feed (OTF) was evaluated in 138 disease control/prevention trials during calendar year (CY) 2001 under compassionate INAD #9332. Trials were conducted at 22 state fish hatcheries, two tribal hatchery, and 11 private hatcheries during CY2001 to control mortality caused by the following diseases: (1) bacterial coldwater disease, (2) systemic columnaris, (3) streptococcus, (4) general systemic bacterial infection, (5) gram negative bacterial enteritis, (6) gram negative septicemia, (7) motile aeromonda disease, (8) external columnaris, (9) edwardsiella infections caused by *edwardsiella tarda*, (10) enteric redmouth, (11) epitheliocystis, and (12) withering syndrom caused by Rickettsia-like prokaryote. Treatments were administered to a variety of salmonid and non-salmonid fish species.

Oxytetracycline-medicated feed efficacy trials conducted during CY2001 involved approximately 24.6 million fish. The current FDA-approved OTF label limits drug use to the control of specific bacterial diseases of specific fish species at water temperatures

not below 48.2^{o} F (9^{o} C). Label guidelines do not permit the use of OTF to control mortality of fish caused by any of the disease conditions described above. To accommodate the needs of aquaculture and to collect pivotal and ancillary clinical field data on OTF for the control of these diseases, the FDA has authorized the use of this compound under Compassionate Investigational New Animal Drug (INAD) Exemption #9332 for the purpose of collecting pivotal and ancillary efficacy data to support a new animal drug approval for OTF. Treatment regimes used by participating aquaculture facilities under INAD #9332 during CY 2001 included the following: (1) 2.5 - 3.75 g/100 lbs fish/day for 2 - 15 days; (2) 10.0 g/100 lbs fish/day for 12 - 15 days; (3) 1.04 - 2.47 g/100 lbs fish/day for 10 - 15 days; (4) 3.80 - 9.10 g/100 lbs fish/day for 10 - 17 days; and (5) 10.7 g/100 lbs fish/day for 15 days. Overall results of OTF used under INAD #9332 during the reporting period indicated that approximately 74% of trials appeared efficacious, 7% appeared ineffective, and 19% were characterized as inconclusive.

Introduction

The current label for OTF use in aquaculture limits use to the control of furunculosis in salmonids caused by *Aeromonas salmonicida*, and the control of bacterial hemorrhagic septicemia in salmonids and catfish caused by *A. hydrophila* or *Pseudomonas sp*. Oxytetracycline medicated feed has been shown to be highly effective in controlling these diseases, especially when predisposing environmental stresses are reduced at the time of treatment (Warren 1991). Furthermore, the current FDA approved label for OTF limits dosage to a range of 2.5 - 3.75 grams of active drug per 100 pounds of fish

per day for 10 days, and limits use to water temperatures "not below 48.2^{o} F (9^{o} C). " These label restrictions severely limit the overall utility of approved OTF use in aquaculture.

Fish culturists have also reported that OTF treatment is a useful tool for the control of bacterial cold water disease (CWD) and columnaris in salmonids. These two diseases, collectively termed "flavobacteriosis" are caused by *Flavobacterium psychrophilus* and *F. columnare*. Enteric redmouth caused by *Yersinia ruckeri*, vibriosis caused by various members of the genus *Vibrio*, and other less common bacterial diseases of fish also have been found to be responsive to OTF therapy. However, none of these latter uses are approved by the FDA.

Purpose of Report

The purpose of this report is to summarize the results of (CY) 2001 supplemental OTF field efficacy studies conducted under INAD #9332. However, it is also expected that data from these studies will be used to enhance the existing OTF database that has been established from previous years studies for the purpose of expanding and/or extending the approved label for OTF.

Facilities, Materials, and Treatment Procedures

1. Facilities

A total of 22 state fish hatcheries, 2 tribal hatchery, and 11 private hatcheries (n = 35 total facilities) used OTF to control mortality caused by a variety of bacterial and other infections.

2. OTF used in trials

The OTF used in these trials was either Terramycin 100 or Terramycin 100D, both of which contained 100 g active oxytetracycline quaternary salt per pound of premix. All Terramycin 100/100D was supplied by Pfizer, Inc., 1107 South 291 Highway, Lee's Summit, MO. Virtually all oxytetracycline medicated feed used in INAD trials was supplied by several commercial fish feed manufacturers.

3. Drug dosages and duration

As described in the Study Protocol for INAD #9332, Investigators were allowed to use OTF either within the current label range of 2.5 - 3.75 grams of active drug per 100 lbs of fish per day for 2 - 15 days (~47% of trials) or at 10.0 grams of active drug per 100 lbs of fish per day for 12 - 15 days (~20% of trials). However, a number of trials (~33%) deviated from the protocol during CY 2001 In these trials, fish were fed at rates of 1.04 - 10.7 grams of active drug per drug/100 lbs fish/day for periods of time ranging from 10 - 17 days.

Fish Species and Fish Diseases Involved in Year 2001 Trials

1. Species of fish treated

Seven salmonid species, seven non-salmonid species, and one species of shellfish were treated during CY 2001. Species treated included:

Salmonids: (1) rainbow trout *Oncorhynchus mykiss*; (2) steelhead trout *O. mykiss*; (3) coho salmon *O. kisutch*; (4) chinook salmon *O. tshawytscha*; (5) sockeye salmon *O. nerka*; (6) kokanee salmon *O. nerka*; and (7) cutthroat trout *O. clarki*.

Non-salmonids: (1) channel catfish *Ictalurus punctatus*; (2) Mozambique tilapia *Tilapia mossambica*; (3) white sturgeon *Acipenser transmontanus*; (4) walleye *Stizostedion vitreum*; (5) white seabass *Atractoscion nobilis*; (6) largemouth bass *Micropterus salmoides*; and (7) hybrid striped bass *Morone chrysops* x *M. saxatilis*.

Shellfish: red abalone *Haliotis rufescens*.

2. Diseases treated

The following diseases were treated during CY2001:

1. Coldwater disease (causative agent *Flavobacterium psychrophilus*)

2. Systemic columnaris (causative agent *F. Columnare*)
3. Streptococcus (causative agent *Streptococcal iniae*)
4. General systemic bacterial infections
5. Gram negative bacterial enteritis
6. Gram negative septicemia
7. Motile aeromonad disease (causative agent *Aeromonas hydrophila*)
8. External columnaris
9. Edwardsiellosis (causative agent *Edwardsiella tarda*)
10. Enteric redmouth (causative agent *Yersina ruckeri*)
11. Epitheliocystis
12. Rickettsia-like prokaryote (RLP)

The diseases most frequently treated during CY 2001 were bacterial coldwater disease (43% of trials) and streptococcus (19% of trials). Treatment of the other 10 diseases listed above accounted for the remaining 38% of the treatment trials.

Data Collected

1. Pathologist's reports

Approximately 41% of the data sets generated under INAD #9332 submitted to the NIO for CY2001trials included pathologist's reports. Fish health pathology reports typically include: (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; and (3) the name and title of the individual performing the diagnosis. Additionally, pathology reports often provide documentation that there were no secondary infections or infestations caused by unrelated disease agents in a population of test fish. As a result, pathology reports provide essential information if efforts are to expand/extend an existing approved label.

2. Mortality data

As stated in the Study Protocol, mortality data were to be collected 5 days prior to treatment, during the treatment period, and for at least 20 days post-treatment. Investigators were strongly encouraged to collect mortality data on a daily basis. However, daily collection of post-treatment mortality data was not always possible due to factors such as fish being moved into other tanks and fish being stocked to rivers and other bodies of water.

Discussion of Study Results:

1. General observations on the efficacy of OTF for the control of bacterial diseases in salmonid and non-salmonid fish (Note: Table 1 provides a summary of all efficacious trials; Table 2 provides a summary of all non-efficacious trials; Table 3 provides a summary of all inconclusive trials; Table 4 provides summary data for all trials; and Table 5 provides a summary of all trials conducted during CY 2001 under INAD #9332.)

A. Efficacy at 1.04 - 2.47 g/100 lbs fish/day for 10 - 15 days at water temperatures above 48.2^{o} F

OTF was used at 1.04 - 2.47 g/100 lbs of fish for 10 - 15 days in 18 trials (Tables 1 & 3). Trials involved abalone and tilapia diagnosed with RLP or streptococcus. OTF treatment appeared efficacious in 16 trials and inconclusive in two trials.

B. Efficacy at 2.5 - 3.75 g/100 lbs fish/day for 2 - 15 days at water temperatures above 48.2^{o} F

OTF was used at 2.5 - 3.75 g/100 lbs of fish for 2 - 15 days in 60 trials (Tables 1 - 3). Trials involved abalone, channel catfish, cutthroat trout, largemouth bass, rainbow trout, tilapia, walleye, white seabass, and white sturgeon diagnosed with CWD, systemic columnaris, external columnaris, epitheliocystis, general systemic bacterial infection, streptococcus, RLP, or motile aeromonad disease. OTF treatment appeared efficacious in 44 (74%) of the trials, ineffective in five (8%) of the trials, and 11 (18%) of the trials were characterized as inconclusive.

C. Efficacy at 2.5 - 3.75 g/100 lbs fish/day for 10 - 14 days at water temperatures below 48.2^{o} F

OTF was used at 2.5 - 3.75 g/100 lbs of fish for 10 - 14 days in 5 trials (Tables 1 - 3). Trials involved coho salmon, rainbow trout, and cutthroat trout diagnosed with CWD. OTF treatment appeared efficacious in three of the trials, ineffective in one of the trials, and one trial was characterized as inconclusive.

D. Efficacy at 3.80 - 9.10 g/100 lbs fish/day for 10 - 17 days at water temperatures above 48.2^{o} F

OTF was used at 3.80 - 9.10 g/100 lbs of fish for 10 - 17 days in 21 trials (Tables 1 & 3). Trials involved abalone, hybrid striped bass, spring chinook salmon, steelhead, and tilapia diagnosed with CWD, edwardsiellosis, enteric redmouth, gram negative bacterial enteritis, gram negative bacterial septicemia, streptococcus, or RLP. OTF treatment appeared efficacious in 15 of the trials while six of the trials were characterized as inconclusive.

E. Efficacy at 3.80 - 9.10 g/100 lbs fish/day for 10 - 14 days at water temperatures below 48.2^{o} F

OTF was used at 3.80 - 9.10 g/100 lbs of fish for 10 - 14 days in five trials (Table 1). Trials involved coho salmon, rainbow trout, and steelhead diagnosed with CWD. OTF treatment appeared efficacious in all trials.

F. Efficacy at 10.0 g/100 lbs fish/day for 12 - 15 days at water temperatures above 48.2^{o}F

OTF was used at 10.0 g/100 lbs fish/day for 12 - 15 days in 20 trials (Tables 1 - 3). Trials involved kokanee salmon, sockeye salmon, spring chinook salmon, rainbow trout, cutthroat trout, and steelhead trout diagnosed with CWD or columnaris. OTF treatment appeared efficacious in 15 (75%) of the trials; ineffective in three (15%) of the trials; and two (10%) of the trials were characterized as inconclusive.

G. Efficacy at 10.0 g/100 lbs fish/day for 14 - 15 days at water temperatures below 48.2^{o}F

OTF was used at 10.0 g/100 lbs fish/day for 14 - 15 days in eight trials (Tables 1 - 3). Trials involved coho salmon, chinook salmon, rainbow trout, sockeye salmon, steelhead, and cutthroat trout diagnosed with CWD. OTF

treatment appeared efficacious in four (50%) of the trials and ineffective in one (13%) of the trials. Three (37%) of the eight trials were characterized as inconclusive.

H. Efficacy at 10.7 g/100 lbs fish/day for 15 days at water temperatures above 48.2° F

OTF was used at 10.7 g/100 lbs of fish for 15 days in one trial (Tables 3). The trial involved abalone diagnosed with RLP. The OTF treatment was characterized as inconclusive.

2. Observed Toxicity

No toxicity or adverse effects relating to OTF treatment were reported.

Summary of Study Results

Oxytetracycline medicated feed was used at dosages ranging from 1.04 - 10.7 g/100 lbs fish/d. Treatment duration ranged from 2 - 17 days. Fourteen different fish species and one species of shellfish (i.e., abalone) were treated with OTF. Treatment trials involved approximately 24.6 million fish/shellfish. Treated fish ranged in length from 0.9 - 13.0 in. Mean length of treated abalone was 3 in. Water temperature during treatment ranged from 35.0 - 84.2 °F, with a mean treatment temperature of 61.5 °F. Approximately 74% of trials appeared efficacious, 7% appeared ineffective, and 19% were characterized as

inconclusive. Thirteen trials involved the use of control fish and ~41% of trials included pathologist's reports. Overall, OTF appeared effective in controlling mortality caused by bacterial coldwater disease. Results of trials indicated that mortality decreased during or following the treatment period, and remained at normal levels throughout the post-treatment period. Furthermore, investigators reported no evidence of toxicity or adverse effects related to OTF treatment. However, based on a general lack of untreated control fish, replication, randomization, etc., it is understood that these data can only be considered as ancillary data. None-the-less, the ancillary data described above should provide useful corroborative data to support a future expanded label claim for OTF. It is anticipated that additional ancillary efficacy data will continue to be collected under INAD #9332. In future trials conducted under INAD #9332, efforts will be directed towards the generation of higher quality data.

References

Warren, J.W. 1991. Diseases of hatchery fish. U.S. Fish and Wildlife Service, Portland, Oregon, 92 p.

Table 1. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Efficacious Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of Treatment Days	Dose (g/100 lbs)	Temp. (°F)
The Abalone Farm, Inc.	1	ABL	3.00	16,500	RLP	10	1.04 - 2.47	55.8
Simaron Fresh Water Fish Inc.	15	TIA	3.0 - 13.0	341,200	streptococcus	12 - 15	1.04 - 2.47	71.6 - 84.2
The Abalone Farm, Inc.	4	TIA	2.8 - 3.0	119,830	RLP	10	2.5 - 3.75	52.5 - 58.8
Rathbun Fish Hatchery	4	CCF	4.4 - 5.1	462,211	columnaris	10	2.5 - 3.75	74.4 & 77.4
SolDuc SFH	1	COS	2.61	676,100	CWD	14	2.5 - 3.75	46.0
McCall SFH	1	CUT	1.40	20,200	CWD	10	2.5 - 3.75	47.0
Washoe Park Trout SFH	2	CUT	2.3 - 2.9	121,800	CWD	10 - 12	2.5 - 3.75	52.0 & 55.0
American Falls SFH	2	RBT	10.0 - 11.0	57,938	CWD	10	2.5 - 3.75	55.0
Bellvue SFH	2	RBT	3.2 - 3.8	194,700	CWD	10	2.5 - 3.75	54.0 & 55.0
Finger Rock Rearing Unit	1	RBT	1.66	40,000	CWD	10	2.5 - 3.75	48.0
Glenwood Springs SFH	1	RBT	2.52	200,000	CWD	10	2.5 - 3.75	49.0
Hagerman SFH	1	RBT	3.43	256,063	CWD	10	2.5 - 3.75	59.0
Mt. Shavano SFH	2	RBT	4.5 - 4.9	69,096	CWD	10 - 11	2.5 - 3.75	49.0 - 50.0
Nampa SFH	1	RBT	4.52	174,370	CWD	10	2.5 - 3.75	59.0
Rifle Falls SFH	5	RBT	1.9 - 4.4	1,528,003	CWD	10	2.5 - 3.75	58.0

Table 1. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Efficacious Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of Treatment Days	Dose (g/100 lbs)	Temp. (°F)
Bellvue SFH	1	RBT	2.04	199,800	Columnaris	10	2.5 - 3.75	53.0
Hagerman SFH	3	RBT	5.1 - 7.2	209,000	Columnaris	10	2.5 - 3.75	59.0
Simaron Fresh Water Fish Inc.	3	TIA	5.5 - 11.4	103,000	streptococcus	12 - 14	2.5 - 3.75	78.8
Hubbs Seaworld Research Institute	4	WSB	2.5 - 7.0	8,550	epitheliocystis	10	2.5 - 3.75	57.1 - 64.4
Stolt Sea Farm California LLC	9	WHS	7.00	3,695	general systemic bacterial infection	10	2.5 - 3.75	68.0
The Abalone Farm Inc	2	ABL	2.80	99,000	RLP	14	3.8 - 9.1	53.3 & 57.6
SolDuc SFH	1	COS	3.06	221,900	CWD	14	3.8 - 9.1	46.0
Solomon Gulch Hatchery	2	COS	3.3 - 3.4	3,223,000	CWD	10	3.8 - 9.1	35.0 - 36.0
Glenwood Springs SFH	1	RBT	2.26	19,680	CWD	10	3.8 - 9.1	46.0
Lookingglass SFH	1	SCS	2.95	219,851	SCS	10	3.8 - 9.1	51.0
Chiwawa Rearing Ponds	1	STT	10.00	91,500	CWD	13	3.8 - 9.1	40.0
Fins Technology, LLC	1	SXW	8.00	98,000	edwardsiella tarda	11	3.8 - 9.1	75.0

Table 1. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Efficacious Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of Treatment Days	Dose (g/100 lbs)	Temp. (°F)
Kent SeaTech Corp.	2	SXW	2.00	2,758,613	gram negative bacterial enteritis	10	3.8 - 9.1	77.0
	4	SXW	6.0 - 9.0	313,014	gram negative bacterial septicemia	10	3.8 - 9.1	71.0 & 78.0
Simaron Fresh Water Fish Inc	5	TIA	5.3 - 7.9	191,000	streptococcus	14 - 15	3.8 - 9.1	73.4 - 78.8
Burnett Inlet Hatchery	1	COS	1.85	31,000	CWD	14	10.0	45.2
Murray Springs Trout SFH	4	CUT	1.1 - 1.8	454,003	CWD	14	10.0	52.0
Washoe Park Trout SFH	2	CUT	1.20	223,000	CWD	14 - 15	10.0	45.0 & 52.0
Murray Springs Trout SFH	1	KOE	1.14	44,000	CWD	14	10.0	52.0
Giant Springs Trout SFH	3	RBT	2.7 - 7.7	351,301	CWD	12 - 14	10.0	54.0
Murray Springs Trout SFH	1	RBT	1.10	50,000	CWD	15	10.0	52.0
Whitman Lake SFH	1	RBT	1.95	1,062,286	CWD	14	10.0	41.2
Dexter Ponds	1	SCS	5.10	222,354	columnaris	14	10.0	64.0

Table 1. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Efficacious Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of Treatment Days	Dose (g/100 lbs)	Temp. (°F)
Burnett Inlet Hatchery	1	SOS	1.23	931,857	CWD	14	10.0	43.7
Eagle SFH	1	SOS	4.60	41,827	columnaris	14	10.0	64.9
Magic Valley Steelhead SFH	3	STT	1.4 - 3.0	765,200	CWD	14 - 15	10.0	58.0

Table 2. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Non-efficacious Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of Treatment Days	Dose (g/100 lbs)	Temp. (°F)
Nez Perce Tribal Hatchery	1	COS	4.40	307,744	CWD	10	2.50 - 3.75	41.6
American Falls SFH	1	RBT	6.00	17,000	CWD	10	2.50 - 3.75	55.0
Bellvue SFH	2	RBT	1.3 - 1.4	397,000	CWD	10	2.50 - 3.75	54.0
Hagerman SFH	1	RBT	1.17	240,000	CWD	11	2.50 - 3.75	59.0
	1	RBT	1.52	80,423	columnaris	10	2.50 - 3.75	59.0
Keta Creek Hatchery	1	COS	1.62	500,000	CWD	14	10.0	47.0
Murray Springs Trout SFH	1	CUT	1.47	144,000	CWD	14	10.0	52.0
Chelan Hatchery	1	RBT	1.75	329,800	CWD	14	10.0	56.0
Magic Valley Steelhead SFH	1	STT	2.00	960,000	CWD	14	10.0	58.0

Table 3. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Inconclusive Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of treatment days	Dose (g/100 lbs)	Temp. (°F)
The Abalone Farm Inc	2	ABL	3.0 - 3.2	48,215	RLP	10 - 15	1.04 - 2.47	54.0 - 55.8
The Abalone Farm Inc	1	ABL	3.00	16,379	RLP	10	2.5 - 3.75	52.2
Rathbun Fish Hatchery	2	CCF	2.9 - 4.0	204,440	columnaris	10	2.5 - 3.75	83.1 - 83.4
Sheep Creek SFH	1	COS	4.00	155,700	CWD	10	2.5 - 3.75	39.2
Jake Wolf Memorial SFH	1	LMB	3.60	3,558	Aeromonas disease	10	2.5 - 3.75	71.0
Bellvue SFH	1	RBT	1.40	65,000	CWD	10	2.5 - 3.75	54.0
Hagerman SFH	1	RBT	5.38	145,000	CWD	11	2.5 - 3.75	59.0
Mt. Shavano SFH	1	RBT	5.20	61,760	CWD	10	2.5 - 3.75	50.0
Hagerman SFH	1	RBT	1.72	327,455	columnaris	10	2.5 - 3.75	59.0
Simaron Fresh Water Fish Inc	2	TIA	7.9 - 9.0	58,000	streptococcus	12 - 15	2.5 - 3.75	77.0 - 80.6
Rathbun Fish Hatchery	1	WAE	4.90	471	external columnaris	2	2.5 - 3.75	75.7
The Abalone Farm Inc	3	ABL	0.9 - 3.2	2,333	RLP	14 - 15	3.8 - 9.1	54.0 - 59.8

Table 3. Summary of CY 2001 Oxytetracycline Medicated Feed Efficacy Results - Inconclusive Trials

Hatchery	Number of Trials	Fish Species	Fish Size (inches)	Number of Fish	Disease	Number of treatment days	Dose (g/100 lbs)	Temp. (°F)
Magic Valley Steelhead SFH	1	STT	5.30	1,946,826	CWD	17	3.8 - 9.1	58.0
Kent SeaTech Corp	1	SXW	6.00	39,580	gram negative bacterial septicemia	10	3.8 - 9.1	71.0
Simaron Fresh Water Fish Inc	1	TIA	7.90	30,000	streptococcus	15	3.8 - 9.1	77.0
Crystal Lake Hatchery	1	CKS	1.80	666,304	CWD	14	10.0	43.5
Nez Perce Tribal Hatchery	1	COS	4.40	307,744	CWD	15	10.0	40.6
Dexter Ponds	1	SCS	5.10	1,084,574	columnaris	14	10.0	64.0
Bonneville SFH	1	STT	2.70	121,400	CWD	14	10.0	43.0
Keta Creek Hatchery	1	STT	1.60	48,000	CWD	14	10.0	50.0
The Abalone Farm Inc	1	ABL	2.00	27,500	RLP	15	10.7	56.4

Table 4. Summary Data Regarding CY 2001 Oxytetracycline Medicated Feed Efficacy Trials

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Total Fish Treated:	**24,550,648**
Number of fish treated in efficacious trials	16,214,442
Number of fish treated in non-efficacious trials	2,975,967
Number of fish treated in inconclusive trials	5,360,239
Total number of trials:	**138**
Efficacious trials	102 (74%)
Non-efficacious trials	10 (7%)
Inconclusive trials	26 (19%)

Trials that Included Control Fish:

Study Numbers: 9332-2K-054; 9332-2K-133; 9332-01-011; 9332-01-054; 9332-01-077; 9332-01-079; 9332-01-080; 9332-01-081; 9332-01-081(2); 9332-01-081(3); 9332-01-094; 9332-01-117; and 9332-01-122

Treatment Regimes Used:

1.04 - 2.47 g/100 lbs fish/day for 10 - 15 days (above 48.2°F)	18 trials
2.5 - 3.75 g/100 lbs fish/day for 2 - 15 days (above 48.2°F)	60 trials
2.5 - 3.75 g/100 lbs fish/day for 10 - 14 days (below 48.2°F)	5 trials
3.80 - 9.10 g/100 lbs fish/day for 10 - 17 days (above 48.2°F)	21 trials
3.80 - 9.10 g/100 lbs fish/day for 10 - 14 days (below 48.2°F)	5 trials
10.0 g/100 lbs fish/day for 12 - 15 days (above 48.2°F)	20 trials
10.0 g/100 lbs fish/day for 14 - 15 days (below 48.2°F)	8 trials
10.7 g/100 lbs fish/day for 15 days (above 48.2°F)	1 trial

Treatment Water Temperature (°F):

Temperature Range	35.0 - 84.2
Mean Temperature	61.5

Size of Treated Fish (in.):

Size Range	0.90 - 13.00

Species Treated:

Salmonids
rainbow trout *Oncorhynchus mykiss*

steelhead trout *O. mykiss*
coho salmon *O. kisutch*
chinook salmon *O. tshawytscha*
cutthroat trout *O. clarki*
sockeye salmon *O. nerka*
kokanee salmon *O. nerka*

Non-salmonids
channel catfish *Ictalurus punctatus*
white sturgeon *Acipenser transmontanus*
white seabass *Atractoscion nobilis*
hybrid striped bass *Morone chrysops* x *M. saxatilis*.
Mozambique tilapia *Tilapia mossambica*
largemouth bass *Micropterus salmoides*
walleye *Stizostedion vitreum*

Shellfish:
red abalone *Haliotis rufescens*