

U.S Fish & Wildlife Service

California-Nevada Fish Health Center

National Wild Fish Health Survey Annual Progress Report FY 2013

Prepared by Ken Nichols



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U.S. Fish and Wildlife Service
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California-Nevada Fish Health Center

National Wild Fish Health Survey Annual Progress Report FY 2013

Center staff conducted the National Wild Fish Health Survey (NWFHS) in 2013 by working with partners to collect fish tissue samples and performing laboratory tests for major fish pathogens in accordance with standardized procedures (NWFHS Laboratory Procedures Manual – 2009). This data is entered into a national database and is accessible to the public and resource managers, via the web, and can be viewed at:

<http://www.fws.gov/wildfishsurvey/database/>

Field collection and laboratory work performed by:

Scott Foott, Project leader
Kim True, Assistant Project Leader
Ron Stone, Fish Biologist
Anne Bolick Fish Biologist
Ken Nichols, Fish Biologist

Notice

The mention of trade names or commercial products in this report does not constitute endorsement or recommendation for use by the Federal government. The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the US Fish and Wildlife Service.

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Overview

The National Wild Fish Health Survey (NWFHS) is a program conducted by the U.S. Fish and Wildlife Service’s fish health centers to assess the prevalence and distribution of major fish pathogens in wild fish populations. The CA-NV Fish Health Center (Center) has partnered with numerous federal and state agencies, tribal governments, universities, non-profit and educational organizations, private companies and private landowners to collect fish at over 200 collection sites. Nearly 20,000 fish have been tested for major fish pathogens in the last 17 years (Table 1). The Center’s sampling effort to date comprises a rich diversity of fish species in California, Nevada and Southern Oregon and has provided fish health information that did not exist prior to the NWFHS’s inception in 1997.

Table 1. Total number of fish sampled in each state by fiscal year

Fiscal Year	Arizona	California	Nevada	Oregon	Total
1997		258	6	37	301
1998	20	561	163	255	999
1999		767	308		1075
2000		1158	212		1370
2001		2734			2734
2002		1426	99		1525
2003		1217	191	20	1428
2004		387	179	715	1281
2005		1183	130	105	1418
2006	243	1336	85	16	1680
2007		593	19		612
2008	60	319	22		401
2009		1003	78	127	1208
2010		797		25	822
2011		864			864
2012		866	60	10	936
2013		828	64	86	978
Totals	323	16297	1616	1396	19632

Each year, the center focuses on specific disease issues that are important to our region such as emerging diseases, health issues in species of special concern, or of importance to our partners for managing the fishery resource. Other projects supported by the NWFHS are reoccurring from year to year in order to provide annual trends in disease prevalence for naturally reproducing broodstock populations, and fish health monitoring of wild fish stocks.

In 2014, the NWFHS focused on health screenings of imperiled stocks of fish with surveys conducted for the Central Valley Winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Lost River Sucker (*Deltistes luxatus*) and Lahontan Cutthroat trout (*Oncorhynchus clarki henshawi*). Pathogen surveys were also performed on Fall-run Chinook salmon (*Oncorhynchus tshawytscha*). Pathogens detected included the

bacteria: *Renibacterium salmoninarum* and *Aeromonas salmonicida*; Infectious Hematopoietic Necrosis virus; and parasites: *Tetracapsuloides bryosalmonae*, *Ceratomyxa shasta* and *Parvicapsula minibicornis*.

Our survey work would not be possible without the support of numerous partners including: Yurok Tribal Fisheries, Karuk DNR, Glen-Colusa Irrigation District, California Department of Fish and Wildlife, California Department of Water Resources, Nevada Division of Wildlife, U.S. Bureau of Reclamation, U.S. Geologic Survey, Oregon Department of Fish and Wildlife, FISHBIO, and U.S. Fish and Wildlife Service.

Laboratory Methods

The methods used in the NWFHS to collect, process and test fish tissues are standardized throughout the labs participating in the survey. The detailed procedures and laboratory protocols can be found in [The National Wild Fish Health Survey Procedures Manual](#) (Heil 2009).

Project Summaries:

Natural Origin Late Fall Chinook Adult

Case Numbers: 13-014

Principal Investigator(s): S. Foott

Sample Date(s): 12/17/2013

Estimated funds expended: \$500

Objective: Monitor the disease status of adult salmonid populations in the upper Sacramento basin. Natural origin late-fall Chinook salmon are captured at the base of Keswick Dam and transferred to CNFH for egg collection.

Partners:

Name	Agency	Email	Phone
Scott Hamelberg	USFWS –Coleman NFH	Scott_Hamelberg@fws.gov	(530) 365-8622

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Chinook Salmon	9	Kidney	Virology	3	2	3	IHNV
		OF	Virology	2	1	2	IHNV
		Kidney	Bacteriology	7	1	2	<i>Aeromonas – Pseudomonas</i>
		Kidney	<i>Rs-DFAT</i>	6	1	2	<i>Renibacterium salmoninarum</i>
		OF	<i>Rs-DFAT</i>	2	1	2	<i>Renibacterium salmoninarum</i>

Narrative Summary: Natural origin Late-Fall adults are captured at the base of Keswick Dam and transferred to LSNFH for egg collection. In 2013, 9 naturally produced fish were sampled. IHNV was detected in 100% (3/3) of individual and 3pool male kidney samples (7fish total) and 100% (2/2) of ovarian fluid samples. *Aeromonas-Pseudomonas sp.* was detected in 29% (2/7) of kidney samples. *Renibacterium salmoninarum* was detected in 100% (2/2) of ovarian fluid and 33% (2/6) of male kidney tissue samples tested by direct fluorescent antibody technique.



San Joaquin, Stanislaus, Tuolumne and Merced Rivers Chinook Smolt Quality Assessment (STM2013)

Case Numbers: 13-032, 033, 034, 050, 051, 052, 059

Principal Investigator(s): Ken Nichols

Sample Date(s): 3/27/13-4/30/13

Estimated funds expended: \$5000

Objective:

Health and performance of juvenile salmonid out-migrants (smolts) are major determinants of their survival. Infectious disease will reduce survival both in direct mortality and reduced physical performance (predator avoidance, saltwater adaptation). Contaminants and elevated water temperature are identified as stressors for salmonids in the San Joaquin River and Estuary. Both of these stressors have potential for immunosuppressive effects. Infection with the myxozoan parasite that causes Proliferative Kidney Disease (PKD), *Tetracapsuloides bryosalmonae*, was observed in 90-100% of naturally produced fish in a 2001 survey of Merced out-migrant salmonid health. Methyl mercury, elevated water temperature, nitrogenous input, agricultural runoff, spring irrigation return and their relationship to river flow are other potential issues for juvenile salmonids the San Joaquin River basin. This study examined smolt health during the critical spring outmigration using a suite of assays to detect pathogens (bacteria, virus, and parasites) and biomarkers of contaminate exposure.

Partners:

Name	Agency	Email	Phone
Chris Becker	FISHBIO	chrisbecker@fishbio.com	(209) 847-6300

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Chinook salmon	160	Kidney	Bacteriology	160	1	0	
		Kidney	Rs-DFAT	160	1	0	
		Kidney	Virology	55	3	0	
		Kidney	Histology	144	1	27	<i>Tetracapsuloides bryosalmonae</i>

Narrative Summary:

Juvenile Chinook smolts were sampled in March and April, 2013 in the Stanislaus, Tuolumne, Merced and San Joaquin Rivers. Sampling was intended to monitor smolt health and physiology changes that may affect survival during outmigration. Smolt health sampling and laboratory assays were conducted under protocols established for the USFWS National Wild Fish Health Survey (NWFHS, <http://www.fws.gov/wildfishsurvey/>). No



bacterial or viral pathogens were detected. During April, *Tetracapsuloides bryosalmonae*, the causative agent of proliferative kidney disease (PKD), was detected in 80% of Merced, 7% of Stanislaus and 25% of mainstem San Joaquin River smolts. The majority of *T. bryosalmonae* infections were in the early stages with little or no associated kidney pathology. Smolts captured in April were larger, had higher Fulton condition factors and had higher gill $\text{Na}^+/\text{K}^+-\text{ATPase}$ activity levels compared to fish sampled in March. No brain acetylcholinesterase

inhibition due to pesticide exposure was detected in the fish sampled. The overall condition of smolts appeared good at the time of sampling; however, PKD could have eventually compromised survival and performance of the out-migrants, particularly in fish from the Merced River.

Final Report Reference:

Nichols K, 2013. FY2013 Technical Report: San Joaquin, Stanislaus, Tuolumne and Merced River Chinook Smolt Quality Assessment. US Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, CA. <<http://www.fws.gov/canvfhc/reports.asp>>.

Lower Sacramento River Juvenile Chinook Salmon Pathogen Survey with emphasis on *Ceratomyxa shasta*.

Case Numbers: 13-35,36,39,44,47

Principal Investigator(s): S. Foott

Sample Date(s): 1-11April

Estimated funds expended: \$7000

Objective: Determine prevalence and severity of infection for bacterial, viral, and parasitic infection of natural Chinook juveniles in the Lower Sacramento R.

Partners:

Name	Agency	Email	Phone
Joe Kirsch	USFWS	joseph_kirsch@fws.go	209-334-2968
Josef Loera	GCID	gcidfs@gamil.com	520-865-2055
Bill Poytress	USFWS	bill_poytress@fws.gov	530-527 3043

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Chinook	63	Kd/Spl	Virology	21	3	0	
		Kd	Bacteriology	63	1	17	<i>Aeromonas</i> <i>/Pseudomonas</i>
		Kd	DFAT	55	1	0	
		Intestine	Histology	63	1	17	<i>Ceratomyxa shasta</i>
		Kidney	Histology	57	1	35	<i>Parvicapsula</i> <i>minibicornis</i>

Table 1. Prevalence of infection (virus, *Aeromonas / Pseudomonas* sp.(A/P), *Renibacterium salmoninarum* (Rsal), *Ceratomyxa shasta* and *Parvicapsula minibicornis*) of juvenile Chinook collected from the Sacramento River at Red Bluff Diversion dam (RB), Glenn-Colusa Irrigation District pumps (GC), and various seine sites in the Lower Sacramento (LS) . Viral samples processed as 3 – 5 fish pools.

	4/1RB	4/8RB	4/3GC	4/1LS	4/11LS
Virus pools	0 / 5	0 / 5	0 / 5	0 / 2	0 / 4
No.	14	15	14	7	12
Bacteria					
A/P	2 / 14 (14)	1 / 15 (7)	2 / 14 (14)	4 / 7 (57)	8 / 13 (62)
Staph	0 / 14	0 / 15	1 / 14 (7)	1 / 7 (4)	0 / 13
Rsal (DFAT)	0 / 7	0 / 14	0 / 12 ^a	0 / 13 ^b	0 / 9
Cshasta - 1	0 / 14	1 / 15	9 / 14	0 / 7	7 / 13
Cshasta – 2	0 / 14	0 / 15	0 / 14	0 / 7	0 / 13
POI	0%	7 %	64%	0%	54%
Parvicapsula 1	0 / 8	7 / 15	11 / 14	2 / 7	8 / 13
Parvicapsula 2	0 / 8	1 / 15	3 / 14	0 / 7	3 / 13
POI	0%	53%	100%	29%	85%

a Single suspect bacterial cell observed in 100+ fields from 2 of 12 samples. No PCR confirmation possible.

b Single suspect bacterial cell observed in 100+ fields from 1 of 13 samples. No PCR confirmation possible.

Narrative Summary: A total of 62 juvenile Chinook salmon were collected from the Sacramento R. sites between 1 - 11April (Table 1). None displayed signs of clinical disease. No virus was isolated from the kidney-spleen samples nor was *Renibacterium salmoninarum* confirmed in kidney (Table 1). Asymptomatic infections of common gram-negative bacteria (*Aeromonas – Pseudomonas* sp.) were observed in 7 – 62% of the kidney samples. The highest prevalence of bacterial infection (POI) was seen in salmon captured from the lower Sacramento R. (Table 1).

Both *Ceratomyxa shasta* and *Parvicapsula minibicornis* were seen in histological specimens from all sites however moderate kidney inflammation was only observed in 7 of the 35 infected kidney sections. The *C.shasta* infections were characterized as light and early stage. Mean fork length was similar among the collection groups with the exception of the larger 11April Lower Sacramento fish. Condition factors were considered normal (> 0.800 KFL) and gill Na-K-ATPase activities were within the smolt range (>7 μmole ADP/mg protein/ hr).



Final Report Reference: **Sacramento and Feather River Juvenile Chinook Pathogen Survey Spring 2013** JS Foott, CA-NV Fish Health Center, USFWS, Anderson CA. <<http://www.fws.gov/canvfhc/reports.asp>>. Sent to cooperators July 2013

Virological Examination of adult Lost River Suckers and 0+ Fathead Minnows from Upper Klamath Lake, Oregon 2013.

Case Numbers: 13-042, 13-090

Principal Investigator(s): R. Stone

Sample Date(s): 04April, 2013, 27June, 2013

Estimated funds expended: \$0.00

Objective: Screening for viral pathogens in Lost River Suckers and Fathead Minnows in Upper Klamath Lake, Oregon for the purposes of importation.

Partners:

Name	Agency	Email	Phone
Alex Wilkens	No longer with BOR		
Mark Johnson	USGS	majohnson@usgs.gov	541-273-8689 ext 204

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Lost River Sucker	3	Ovarian Fluid	Virology	3	1	0	
Lost River Sucker	3	Milt	Virology	3	1	0	
Fathead Minnow	80	Whole body	Virology	16	5	0	

Narrative Summary: Lack of recruitment into Lost River Sucker spawning populations in Upper Klamath Lake is a primary factor preventing their recovery. Poor water quality, algal toxins (microcystin), predation and disease have been suggested as causes for high juvenile sicker mortality. The CA-NV Fish Health Center conducted pathogen screening on adult LRS which were spawned lake side to produce juvenile suckers to be used as sentinels both in the lake and laboratory investigations. The FHC partnered with the USGS Klamath Falls Field Station to capture adult sucker. A total of 6 suckers were screened for viral pathogens, no virus was detected. The FHC also partnered with BOR in Klamath Falls to capture and screen Fathead minnows obtained from the A-canal water distribution facility for virus, no virus was detected in the 80 fish examined.



Feather River Juvenile Chinook Salmon Pathogen Survey with emphasis on *Ceratomyxa shasta*.

Case Numbers: 13-49

Principal Investigator(s): S. Foott

Sample Date(s): 12April and 2May (sentinel pickup – no lab case)

Estimated funds expended: \$7000

Objective: Determine prevalence and severity of infection for bacterial, viral, and parasitic infection of natural Chinook juveniles in the Feather R.

Partners:

Name	Agency	Email	Phone
Jason Kindopp, senior env. Scientist DWR	Dept. Water Resources	Jason.Kindopp@water.ca.gov	530-534-2381

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Chinook	77	Kd/Spl	Virology	12	5	0	
		Kd	Bacteriology	39	1	11	<i>Aeromonas /Pseudomonas</i>
		Kd	Rs-DFAT	30	1	0	
		Intestine	Histology	74	1	29	<i>Ceratomyxa shasta</i>
		Kidney	Histology	77	1	32	<i>Parvicapsula minibicornis</i>

Narrative Summary: A total of 77 juvenile Chinook salmon were collected from the two Feather R. sites on 12April and 2May (Table 3). Clinical signs of ceratomyxosis (pale gill, enlarged spleen, hemorrhagic and swollen intestine) were seen in 72% of the 12April Herrington RST sample. These fish had 100%



prevalence of infection for both *C.shasta* and *P. minibicornis* as per histological examination. The population in this reach was considered severely affected by parasitic disease at this time due to hemorrhagic intestines and significant kidney inflammation. Prevalence of *C.shasta* infection at Herrington RST dropped to 40% in the 2May sample and was associated with increased flows. No virus was isolated from the kidney-spleen samples nor was *Renibacterium salmoninarum* confirmed in kidney (Table 1). Asymptomatic infections of common gram-negative bacteria (*Aeromonas – Pseudomonas sp.*) were observed in 20 - 37% of the kidney samples. *Ceratomyxa shasta*

and *Parvicapsula minibicornis* were only seen in histological specimens from the lower river Herrington site (below the thermolito afterbay input). At both sites on 12April, fish size varied considerable and condition factors tended to be < 1.00. Larger fish were selected for gill Na-K-ATPase assays. Gill enzyme activities tended to be in the smolt range. Brain acetylcholinesterase activity can only be viewed as relative data because of a freeze-thaw error. The few samples available for a second assay run were all higher than cohort samples run in the first batch. Our values were much lower than those reported in Wheelock et al. (2005) which will prompt future work on this assay. No obvious trend for depressed brain acetylcholinesterase activity was observed between the sample groups.

Table 2. Prevalence of infection (virus, Aeromonas / Pseudomonas sp.(A/P), Renibacterium salmoninarum (Rsal), Ceratomyxa shasta and Parvicapsula minibicornis) of juvenile Chinook collected from the Feather River at Herrington and Gateway rotary screw traps

	Herrington 4/12	Gateway 4/12	Herrington 5/2	Gateway 5/2
Virus 5p	0 / 6	0 / 6	ND	ND
A/P bacteria	7 / 19 (37)	4 / 20 (20)	ND	ND
Rsal (DFAT)	0 / 15	0 / 15	ND	ND
Cshasta - 1	6 / 25 (24)	0 / 29	4 / 10	0 / 10
Cshasta - 2	19 / 25 (76)	0 / 29	0 / 10	0 / 10
POI	100%	0%	40%	0%
Parvicapsula 1	0 / 28 (0)	0 / 29	0 / 10	0 / 10
Parvicapsula 2	28 / 28 (100)	0 / 29	4 / 10	0 / 10
POI	100%	0 %	40%	0%

Eight of the 12 salmon brought back to the wetlab on 12April died between 4 and 22 days post-return. Intestinal *C.shasta* DNA content indicated clinical ceratomyxosis (C_t values ranged from 21.96 – 33.14). Similarly, *Pavicapsula* DNA was detected in the kidney from 7 of 8 mortalities. No *C.shasta* trophozoites or characteristic lesions were seen in histological sections from the four 30d survivors however one fish had a low level *Pavicapsula* infection. The mortality pattern and high parasite DNA of juvenile Chinook obtained from the Feather R. (particularly the Herrington site) indicates that the dual infections were lethal.

Final Report Reference: **Sacramento and Feather River Juvenile Chinook Pathogen Survey Spring 2013** JS
 Foott, CA-NV Fish Health Center, USFWS, Anderson CA. <<http://www.fws.gov/canvfhc/reports.asp>>. Sent to cooperators July 2013

Disease Screening of Feral Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) Broodstock in Pyramid Lake, NV.

Case Numbers: 13-053

Principal Investigator(s): R. Stone

Sample Date(s): 22April, 2013

Estimated funds expended: \$1500

Objective: Inspection of Feral Lahontan cutthroat trout broodstock for listed pathogens of concern.

Partners:

Name	Agency	Email	Phone
Nancy Vucinich	Pyramid Lake Fisheries	nvucinich@plpt.nsn.us	775-476-0500 ext. 18

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Lahontan cutthroat trout	30	Ovarian Fluid	Virology	6	5	0	
	30	Kidney	Virology	6	5	0	
	30	Ovarian Fluid	FAT	30	1	0	
	30	Kidney	FAT	30	1	0	
	30	Kidney	Bacteriology	30	1	2	<i>Aeromonas salmonicida</i>

Narrative Summary: The Lahontan cutthroat trout is a threatened species native to the drainages once part of Lake Lahontan in Northwestern Nevada, parts of California and Oregon. Pyramid Lake is the largest remnant of Lake Lahontan and is entirely within the Pyramid Lake Indian Reservation governed by the Pyramid Lake Paiute Tribe. The Lahontan cutthroat, extirpated from Pyramid Lake due to water diversions in the early 20th century, has been reintroduced and sustained by tribal hatcheries. The fish health center monitors the health of the feral adult broodstock. A total of 60 fish were sampled at the time of spawn as adult fish return to the egg collection facility near Sutcliffe. No virus or *R. salmoninarum* was detected (0/60). The bacterial pathogen *Aeromonas salmonicida* was detected in 7% (2/30) fish sampled.



Winter Chinook Fish Health Inspection

Case Numbers: 13-066, 068, 069, 071, 073, 075, 077, 078, 079, 081, 082, 083, 086, 088, 092, 093, 096, 097, 099, 101, 104, and 105.

Principal Investigator(s): Anne Bolick

Sample Date(s): 5/21/13 – 7/30/13

Estimated funds expended: \$4500

Objective:



Winter run Chinook salmon were listed as endangered by California Department of Fish and Wildlife (CDFW) in 1989 and the National Marine Fisheries Service (NMFS) in 1994. In 1997, Bureau of Reclamation developed a mainstem Sacramento River rearing facility, Livingston Stone NFH, at the base of Shasta Dam. The facility has been successful in meeting captive production goals; however the propagation of winter Chinook salmon at Livingston Stone NFH is intended to be a temporary measure that will cease when the naturally spawning population has been recovered.

Adult winter Chinook salmon broodstock are collected from the Sacramento River at the Keswick Dam fish trap. The objective of this fish health inspection was to inspect adult broodstock from Keswick Dam for fish health pathogens of concern.

Partners:

Name	Agency	Email	Phone
John Rueth	USFWS	john_rueth@fws.gov	530-275-0549

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Winter Run Chinook salmon	79	Kidney	Virology	36	1	12	IHNV
		Ovarian Fluid	Virology	43	1	12	IHNV
		Kidney	Rs DFAT	31	1	0	
		Ovarian Fluid	Rs DFAT	36	1	0	
		Kidney	Bacteriology	47	1	0	

Narrative Summary:

Adult Winter Chinook salmon were collected from May 21 through July 30, 2013. Laboratory assays were conducted according to the USFWS Standard Procedures for Aquatic Animal Health Inspections. Culturable bacterial pathogens were not detected by direct culture of kidney tissue onto appropriate growth media. Non-culturable or fastidious bacteria (*R. salmoninarum*) was not detected by direct fluorescence antibody testing (DFAT) which detects a specific *R. salmoninarum* antigen located on the cell surface. Infectious hematopoietic necrosis virus (IHNV) was detected in 30% (24/79) of fish collected. Cell culture was observed for cytopathic effects for a 28 day period, and cell culture positive samples for IHNV were confirmed by immunohistochemistry.

Final Report Reference:

2013 WCS Adult Fish Health Inspection Report, 3-226

2013 WCS Adult Sample Summary Report

Klamath River Fish Health Monitoring Project

Case Numbers: N/A

Principal Investigator(s): Kimberly True, Anne Bolick, Scott Foott

Sample Date(s): 3/28/13 – 5/30/13

Estimated funds expended: \$20,000

Objective:

The California- Nevada Fish Health Center, in cooperation with fishery biologists of the USFWS, Yurok and Karuk tribes, has been monitoring juvenile salmon health in the Klamath River since the early 1990s. Present in the Klamath River are two myxozoan parasites, *Ceratomyxa shasta* and *Parvicapsula minibicornis*. *Ceratomyxa shasta* causes ceratomyxosis and is a significant contributor to mortality in juvenile fish that migrate through the region. Typically between 20 and 50% of the out migrating juvenile Fall Chinook salmon are infected with *C. shasta*.



The objectives of this study were to: 1) examine parasite prevalence in Klamath River juvenile Chinook salmon during the spring out-migration period; and 2) compare parasite prevalence in 2013 to previous years. The focus of the study was not on the determination of disease, but instead determining infection.

Partners:

Name	Agency	Email	Phone
Nick Hetrick	USFWS	nick_hetrick@fws.gov	707-822-7201
Dave Hillemeier	Yurok Tribal Fisheries	dhillemeier@yuroktribe.nsn.us	707-482-1350
Mike Polmateer	Karuk DNR	mpolmateer@karuk.us	530-627-3116

Results:

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Chinook salmon	440	Intestine	QPCR	362	1	90	<i>C. shasta</i>
		Kidney	QPCR	250	1	159	<i>P. minibicornis</i>
		Intestine	Histology	77	1	6	<i>C. shasta</i>
		Kidney	Histology	78	1	29	<i>P. minibicornis</i>

Narrative Summary:

A total of 362 natural juvenile Chinook salmon were collected in the Klamath River above the Trinity River confluence from March 28 through May 30 for QPCR. *Ceratomyxa shasta* was detected by QPCR in 25% (90/362) of natural Chinook salmon. *Ceratomyxa shasta* prevalence of infection (POI) was highest in the Scott River to Salmon River reach at 35%. The lowest prevalence was in the Salmon River to Trinity River reach, where 20 fish were collected but the parasite was not detected. Comparatively, *P. minibicornis* was detected by QPCR in 64% (159/250, ci = 57-70%) of natural Chinook salmon. The highest *P. minibicornis* prevalence, 75%, was in the Shasta River to Scott River reach. *Parvicapsula minibicornis* was also undetected in 20 fish collected in the Salmon River to Trinity River reach.



A total of 78 natural juvenile Chinook salmon were collected in the Klamath River for histology. Juvenile salmon had a *C. shasta* POI of 8% (6/77) and *P. minibicornis* POI of 37% (29/78) histologically. All pathology scores were considered negligible.

Final Report Reference:

Bolick, A., True, K., & Foott, J. (2013). Myxosporean Parasite (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) Annual Prevalence of Infection in Klamath River Basin Juvenile Chinook Salmon, April-August 2013. U.S. Fish & Wildlife Service California – Nevada Fish Health Center, Anderson, CA. <<http://www.fws.gov/canvfhc/reports.asp>>.

Appendix 1. NWFHS Summary Table for FY 2013

NWFHS Case#	Collection Date(s)	Location	Species	Partners	Number of Fish	Significant Findings
CN13-14	12/17/2012	Sacramento River, Keswick trap	Chinook salmon	USFWS	9	IHNV, <i>R. salmoninarum</i>
CN13-32	3/27/2013	Tuolumne River, Waterford RST	Chinook salmon	FISHBIO	13	
CN13-33	3/27/2013	Merced River, Hopeton RST	Chinook salmon	FISHBIO	30	
CN13-34	3/28/2013	Stanislaus River, Oakdale RST	Chinook salmon	FISHBIO	23	
CN12-35	4/1/2013 - 4/11/2013	Sacramento River, combined sites	Chinook salmon	USFWS, GCID	63	<i>Ceratomyxa shasta</i> , <i>Parvicapsula minibicornis</i>
CN13-42	4/4/2013	Upper Klamath Lake, Sucker Springs	Lost River Sucker	BOR, USGS	6	
CN13-49	4/12/2013-5/2/2013	Feather River, combined sites	Chinook salmon	CDWR	77	<i>Ceratomyxa shasta</i> , <i>Parvicapsula minibicornis</i>
CN13-50	4/16/2013	Tuolumne River, Waterford RST	Chinook salmon	FISHBIO	30	
CN13-51	4/17/2013	Merced River, Hopeton RST	Chinook salmon	FISHBIO	30	<i>Tetracapsuloides bryosalmonae</i>
CN13-52	4/17/2013	Stanislaus River, Oakdale RST	Chinook salmon	FISHBIO	30	<i>Tetracapsuloides bryosalmonae</i>
CN13-53	4/22/2013	Pyramid Lake, Sutcliffe spawning channel	Lahontan cutthroat trout	Pyramid Lake Paiute Tribe	60	<i>Aeromonas salmonicida</i>
CN13-59	4/30/2013	San Joaquin River, Mossdale trawl	Chinook salmon	CDFW	4	<i>Tetracapsuloides bryosalmonae</i>
CN13-66	5/21/2013-7/30/2013	Sacramento River, Keswick trap	Chinook salmon	USFWS	79	
CN13-85	6/21/2013	Marlette Lake	Lahontan cutthroat trout	NDOW	4	
CN13-90	6/27/2013	Upper Klamath Lake, A-canal	Fathead minnow	BOR	80	
CN13-999	3/28/2013-5/30/2013	Klamath River, combined sites	Chinook salmon	Karuk DNR, Yurok Fisheries, USFWS	440	<i>Ceratomyxa shasta</i> , <i>Parvicapsula minibicornis</i>
Total Fish					978	

