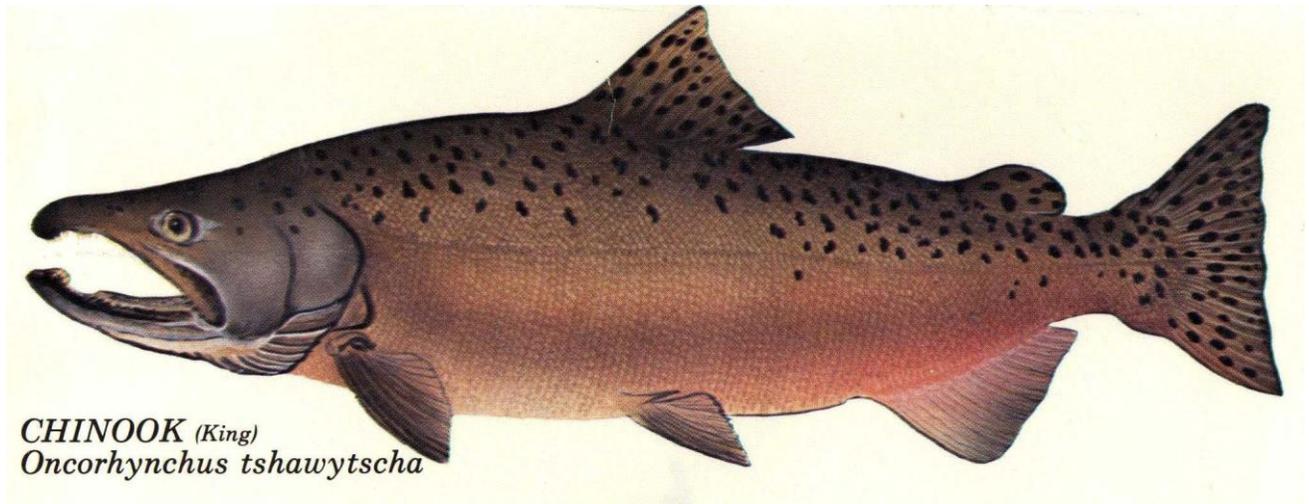


NATIONAL WILD FISH HEALTH SURVEY

California-Nevada
Fish Health Center

ANNUAL REPORT FY 2002-2003



CHINOOK (King)
Oncorhynchus tshawytscha

**National Wild Fish
Health Survey
Annual Progress Report FY 2002-2003**

Prepared by Joshua Reitsma
and Kimberly True

California-Nevada Fish Health Center

California-Nevada Fish Health Center staff conducted the National Wild Fish Health Survey (NWFHS) in fiscal years 2002 and 2003 by collecting and procuring samples, performing laboratory assays, and entering data in the NWFHS Database.

Kimberly True, Assistant Project Leader
Lyn Azar Rosten, Biological Science Technician
Joshua Reitsma, Biological Science Technician

Overview

The National Wild Fish Health Survey (Survey) entered its sixth year in 2002. The work conducted during the past two years continues to assess the distribution and prevalence of significant fish pathogens. In addition, the studies conducted during this period have emphasized work with a variety of partners involved in restoration of important fish species in California, Nevada, and Oregon. As habitat degradation and limited water supplies continue to threaten fisheries throughout the West, the concern for fish health is an ever present aspect of fisheries management and restoration efforts.

Of particular interest in this report is the work conducted in the Yolo Bypass and the Feather River watershed. In the Yolo Bypass, recent research has shown utilization of the floodplain provides several biological benefits for a host of fish species, both salmonid and non-salmonid. The decreased flows and elevated temperatures in this engineered habitat promote accelerated growth in chinook utilizing the floodplain compared to the mainstem Sacramento River. How these environmental factors, as well as native and non-native species interactions, affect fish health is unknown and of interest to fisheries managers studying this seasonal floodplain. The Feather River and its tributary the Yuba River also are of interest in continued restoration efforts for the Sacramento River basin. The Feather River watershed was surveyed to gain a better understanding of the impacts of Infectious Hematopoietic Necrosis Virus (IHNV) on natural fish populations. With Federal Energy Regulatory Commission (FERC) re-licensing occurring for several dam projects in California, fish health information is needed to fully assess the impact these structures, and the fish hatcheries that mitigate for them, have on natural fish production. Juvenile and returning adult fall chinook (*Oncorhynchus tshawytscha*) were sampled during this two-year study to determine the incidence of IHNV during early rearing and adult spawning, two key life history stages for survival and reproduction of these natural fish populations. Of particular interest in the Feather and Yuba River is to determine the prevalence and specific strain of IHNV present in the watershed. Recent IHNV epizootics, and subsequent work conducted by University of California-Davis (UC Davis) and California Department of Fish and

Game (CDFG) have indicated that the strain of IHNV in the Feather River can be more virulent and affect steelhead in hatchery populations; steelhead are not normally as susceptible to disease by IHNV when compared to chinook salmon. In addition, research conducted by United States Geological Survey (USGS) at the Western Fisheries Research Center demonstrates that genetic analysis of viral strains can provide important information about viral “traffic” on a geographical scale, and provide evolutionary information about the rate of virus mutation in specific fish populations.

The Survey continues to provide important fish health information for federally and state listed species such as the threatened Klamath River coho (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*) and Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), and the endangered Lost River sucker (*Deltistes luxatus*), Sacramento winter-run chinook (*O. tshawytscha*) and the unarmored three-spine stickleback (*Gasterosteus aculeatus williamsoni*).

Methods

The methods used to collect, process and test fish tissues are standardized throughout the country for the National Wild Fish Health Survey. The detailed procedures and laboratory protocols can be found in The National Wild Fish Health Survey Procedures Manual (True 2000) at the following websites:

NWFHS <http://fisheries.fws.gov/FHC/FHCNational.htm>.

CANV Fish Health Center <http://www.r1.fws.gov/canvfhc/nwfhsman.htm>

Some studies performed additional tests and/or analysis as requested by partners or as specified in contracted fish health services which overlapped with the Survey.

Organosomatic Indices and Parasitology

Individual fish were weighed (0.1 g) and measured (total length, mm) to determine condition factor ($KTL = W/L^3$). Fish were then examined externally and internally for clinical signs of disease and any abnormalities. Mucus samples (skin scrape) and gill tissues were examined for parasites and general morphology with light microscopy at 40-450x magnification.

Bacteriology

A sample of kidney from each fish was streaked onto 100 mm petri plates, or 20 x 125 mm test tube slants, of Brain Heart Infusion Agar (BHIA) and incubated at room temperature for 72 hours. If growth appeared on the BHIA media, isolated colonies were subcultured onto new BHIA plates to supply bacteria for phenotypic characterization and presumptive identification. Subcultured isolates were screened for bacterial fish pathogens by standard microscopic (Gram characteristics, morphology and motility) and appropriate biochemical tests. Bacterial isolates that were ubiquitous in freshwater and without associated clinical signs were identified to a general group, while those that were potential fish pathogens such as *Aeromonas salmonicida*, *Yersinia ruckeri*, or *Edwardsiella tarda* were examined to a presumptive identity. Corroborative testing for positive results was done by Fluorescent Antibody Testing (FAT).

Renibacterium salmoninarum by ELISA

Kidney tissue from each fish was removed and diluted 1:8 with Phosphate Buffer Saline (PBS) with Tween 20, homogenized, and separated by centrifugation. The samples were then loaded onto 96-well plates to be assayed by Enzyme Linked Immunosorbent Assay (ELISA) for the

presence of *Renibacterium salmoninarum* antigen. The ELISA was run in replicate when the quantity of kidney tissue from individual fish was sufficient. The absorbency values (optical density, OD) were averaged and the distribution of ELISA values for separate groups were evaluated. Individual fish with ELISA OD values greater than 2 standard deviations above the negative reference control OD, and up to 0.499, were defined as low level infections, 0.500-.999 medium level, and values of 1.00 or higher were considered high infection levels. Corroborative testing for positive results was done by Polymerase Chain Reaction (PCR).

Virology

Samples of kidney and spleen, or visceral tissue in the case of smaller fish, were removed from each fish to assay for the prevalence of Infectious Hematopoietic Necrosis Virus (IHNV), Viral Hemorrhagic Septicemia Virus (VHSV), and Infectious Pancreatic Necrosis Virus (IPNV) using accepted cell culture techniques. Kidney and spleen tissues from 3 fish were pooled into one sample, but occasionally 4-5 fish were pooled when the total number of fish was not a multiple of three. For cell culture assay, tissue samples were weighed and diluted to 1:10 in Hank's Balanced Salt Solution (HBSS) and homogenized with a Stomacher 80 Lab Blender®. Samples were centrifuged at 5000 x g for 15 m and then 1.0 mL of the supernatant was combined with 1mL of HBSS supplemented with antibiotics and antimycotic (200 IU mL⁻¹ penicillin G, 200 IU mL⁻¹ streptomycin, 0.5 µg mL⁻¹ amphotericin B and 40 µg mL⁻¹ gentamycin). Final sample dilutions of 1:20 and 1:100 were inoculated onto confluent Chinook Salmon Embryo 214 (CHSE-214), Epithelioma Papillosum Cyprinid (EPC), and Fat Head Minnow (FHM) cell lines in replicate wells of 48-well plates. Samples were incubated on a platform rocker for 30-60 m at 15°C and then 0.5 mL Minimum Essential Media (MEM) or MEM with methycellulose was added to each well. Plates were incubated at 15°C for 21 d and were examined weekly for evidence of cytopathic effects (CPE). Corroborative testing for positive results was done by PCR.

Myxobolus cerebralis (Whirling Disease)

Screening for *Myxobolus cerebralis*, the causative agent of Whirling Disease, was done by Pepsin-Trypsin Digest (PTD) of cranial elements consisting of bone and cartilage. Sampled salmonids were decapitated and the heads grouped into pools of 5 fish, then frozen until laboratory analysis could be performed. The heads were heated in a 60°C water bath for 60 m, so that the cranial elements could be removed from the soft flesh. The cranial elements were then ground in a blender and placed in a pepsin solution of 20 mL g⁻¹ of tissue, and incubated at 37°C for 40 m. The samples were centrifuged, supernatant removed, and digested in a solution of trypsin at 20 mL g⁻¹ of tissue. Samples were incubated at room temperature on a rocker plate for 30 m. The larger remaining particles were filtered through cheesecloth and the samples were centrifuged a final time, prior to discarding the supernatant. A small amount of water was added to the pelleted preparation to provide adequate solution volume in which the samples could be examined by phase contrast microscopy at 200-400x. Corroborative testing for positive results was done by PCR.¹

¹ National Wild Fish Health Survey Laboratory Procedures Manual, 2001

2002 Survey – California and Nevada

California

Contaminants

San Luis – Kesterson NWR, CA

The San Luis Drain (SLD) was conceived as a means to dispose of agricultural drain water generated from irrigating farm fields supplied by the Central Valley Water Project. Farms adjacent to San Luis-Kesterson National Wildlife Refuge discharge their agriculture drain water through wetlands that channel through the refuge. This drain water was found to contain elevated concentrations of selenium, boron, chromium, molybdenum, as well as high concentrations of various salts that disrupt normal ionic balance of affected aquatic ecosystems. In addition, unknown concentrations of agricultural chemical residues (fertilizers and pesticides) may also further contaminate this drain water.²

Beginning in FY 2000, Fish Health Center staff have assisted contaminants monitoring crews by providing fish health assessments at reference and contaminated sites within the refuge. In 2002, a number of sample sites were examined during the month of June, when selenium concentrations are rising in the refuge. Test results were negative for viral and bacterial pathogens despite elevated water temperatures. Previous survey results indicate moderate to heavy parasite loads (*Lernaea*) during summer months, however this was not observed in 2002.

Restoration

Klamath River Basin, CA

Natural populations of coho salmon, a federally-listed threatened species, chinook salmon and steelhead trout have declined significantly in the Klamath River Basin. Restoration efforts have included litigious river flow changes, habitat restoration projects, and hatchery supplementation. In cooperation with biologists from the Yurok tribe, USFWS Arcata FWO, and CDFG, the Fish Health Center performed health monitoring on juvenile salmonid out-migrants in the Klamath River Basin beginning in 2001. The emphasis of the monitoring project was to identify the primary cause of disease in moribund specimens. Fish kills of returning adult salmon in the Klamath River have also increased stakeholder interest in the issue of what pathogens are present in the Basin.

Scott River – Selective diagnostic testing done at a rotary screw trap on the Scott River near Kingsman Creek, resulted in one sample testing positive for *Aeromonas hydrophila*.

Klamath River – Testing at another rotary screw trap at Horse Creek on the Klamath River found six of six (6/6) samples examined for *Ceratomyxa shasta* positive for the parasite. One sample also tested positive for an unidentified myxozoan parasite; later determined to be *Parvocapsula minibicornis* by PCR testing performed by Simon

Scott River rotary screw trap.



² Grassland Bypass Project Annual Report, 1998-1999

Jones of the Pacific Biological Station in Nanaimo, British Columbia.

Klamath Estuary – A moribund top smelt (*Atherinops affinis*) was examined and found to have multiple cysts in the musculature as well as internal necrotic tissues. The exact cause of the cysts was not determined.

Pathogen Surveys

East Bay Regional Parks, (Del Valle Lake, Lake Chabot), San Francisco, CA

In an effort to provide recreational fishing opportunities, many large cities have developed urban fisheries programs. To assess the prevalence and distribution of major fish pathogens in urban environments, fish health assessments were performed at Del Valle Lake and Lake Chabot. These two lakes are managed by East Bay Regional Parks District in the urbanized area surrounding San Francisco. In cooperation with crews from the East Bay Regional Parks District, fish were obtained for health sampling at regular frequencies during the summer of 2002. Five common lake species were sampled and tested for major fish pathogens including largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), redear sunfish (*Lepomis microlophus*), goldfish (*Carassius auratus*) and common carp (*Cyprinus carpio*). The large mouth bass was the only species testing positive for low levels of *Renibacterium salmoninarum* by Enzyme Linked Immunosorbent Assay (ELISA), which was then confirmed by Polymerase Chain Reaction (PCR). No other pathogens were detected.

Sacramento River at Keswick Dam, CA

Infectious Hematopoietic Necrosis Virus (IHNV) infection is common and widespread in fall-run chinook, late-fall chinook, and winter-run chinook salmon in the Sacramento River system. The virus appears to be quite prevalent in both hatchery and natural chinook stocks of the region. In conjunction with the USFWS Livingston Stone Hatchery broodstock program, tissue samples were collected from fish returning to Keswick Dam from April until July, 2002. Approximately 50% of the ovarian fluid, and 25% of the kidney samples tested positive for IHNV. One sample out of 39 (1/39) tested positive for *Aeromonas salmonicida*, the same results occurred for the pathogen *Yersinia ruckeri*. Three out of 47 (3/47) samples tested positive for *Renibacterium salmoninarum* by ELISA, and were confirmed by PCR.

Eiler and Posey Lakes, Lassen County, CA

Whirling Disease is endemic to many waters in California, and the distribution of the disease has been closely followed. To gain more information about the prevalence and distribution of the disease, samples were taken from rainbow (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) in Lassen County, CA. The samples were taken by a Humboldt State University student and submitted to CDF&G Pathology Laboratory. CDF&G requested that the tissues be tested by the Ca-Nv Fish Health Center for Whirling Disease as a component of the NWFHS. The fish tested negative for *Myxobolus cerebralis*.

Nevada

Restoration

Humboldt, County, NV

In the continued effort to restore the Lahontan cutthroat trout (LCT) to this species historic range, the Fish Health Center has systematically sampled several bodies of water in Nevada important to State and Federal fisheries programs. Many of these waters that once contained the native Lahontan cutthroat trout now contain other species of introduced salmonids including rainbow and brown trout. Fish health surveys were conducted on several water bodies in Humboldt County, NV.

North Fork Little Humboldt River – Fish were sampled from the NF of the Little Humboldt and tested positive for the presence of *Renibacterium salmoninarum*. ELISA testing resulted in low positives, which were confirmed by PCR.

Riser Creek – Lahontan cutthroat trout tested negative for all major fish pathogens.

East Fork Quinn River – Positive test results were obtained for *Renibacterium salmoninarum*, at low positive levels by ELISA, and confirmed by PCR.



EF Quinn River brown trout.

2003 Survey – California, Nevada and Oregon

California

Restoration

Palen Reservoir, Sierra County, CA

Lahontan cutthroat trout restoration is a high priority program for the USFWS and our partners in California and Nevada. Palen Reservoir in Northeastern California was surveyed as a possible extended rearing site for LCT. As part of the evaluation process, this reservoir was drained and all fish were sampled for fish pathogens. The population consisted of brown bullheads (*Ameiurus nebulosus*) and 4 large LCT. Fish health information provided from this survey assisted fisheries managers in assessing benefits and risks associated with the site. Fish were sampled in cooperation with CDFG, USFWS Reno Fish and Wildlife Office (FWO), and USFWS Lahontan National Fish



Palen Reservoir Lahontan cutthroat trout.

Hatchery, and a private land owner on Palen Reservoir. The LCT tested negative for all major fish pathogens. The brown bullheads had trematode cysts within the muscle tissue and 40% were positive for the opportunistic bacterial pathogen *Aeromonas hydrophila*.

Sweetwater River, San Diego County, CA

Located in Cuyamaca State Park, a popular recreation area for urbanized San Diego County, the Sweetwater River is an important water resource. The state park holds a number of permanent and intermittent water bodies home to native and introduced species of fish and amphibians. Recent concerns from the USGS have been over the observance of numerous parasites, infecting both native and exotic fish species in the river. Of particular interest is the health status of the unarmored threespine stickleback, a federally-listed Endangered Species.

In August, 2003, a crew from USGS San Diego Field Station collected fish from the Sweetwater River and shipped them live to the Fish Health Center. Goldfish, sticklebacks, and hatchery-reared rainbow trout were examined for fish pathogens. The sticklebacks appeared to be in the most compromised condition upon arrival with several moribund fish in the sample set. Upon external examination, several parasites were identified including the ciliates *Ichthyophthirius* and *Chilodonella*, as well as the monogenean trematode *Gyrodactylus*. *Aeromonas hydrophila* was isolated from the goldfish and the unarmored threespine sticklebacks. Testing for *Renibacterium salmoninarum* antigen by ELISA was positive, and confirmed by PCR in both the goldfish and rainbow trout collected from this site. The bacterial pathogens as well as the severity of the parasitic infections indicate that these fish were in very poor health, most likely due to the stressors associated with the poor water quality described for this site by USGS biologists.

Pathogen Survey

Feather River, Butte County, CA

The Feather River is a major tributary of the Sacramento River and provides essential habitat for outmigrating fall-run chinook and steelhead. Infectious Hematopoietic Necrosis Virus (IHNV) is common in fall-run chinook in the Feather River State Hatchery, however the prevalence of this virus in natural fish populations is not fully known. In an effort to determine whether a Feather River strain of IHNV, or other major fish pathogens are present in the system, juvenile fall-run chinook salmon were sampled. In cooperation with CDFG, fish were collected at two rotary screw traps operated above and below the Thermalito Afterbay in the spring of 2003. The Survey sampled over 370 fish during the out-migration period. Test results were negative for all viral and bacterial pathogens, and juvenile fish appeared normal and healthy in all sample sets.

In the Fall of 2003, returning adults were sampled in cooperation with CDFG, just south of the Feather River State Fish Hatchery. IHNV was found in 18.1% of the 83 fish tested. Viral strain typing will be performed by Ron Hedrick, UC Davis to determine if the IHNV isolated from returning adults is unique to this drainage.

Table 1. Summary of IHNV prevalence in Feather River returning Fall Chinook adults.

Case No.	Coll Date	Description	# Pos / # Sampled	Percent Positive
03-151	10/27/2003	Feather River (near FRSFH)	15/83	18.1

Nevada

Restoration

Truckee River, CA & NV

The Truckee River is important habitat for the Lahontan cutthroat trout as it flows through California and Nevada to Pyramid Lake, the historic site of populations renowned for their large size. In an effort to assist in the restoration of LCT to their native range, pathogen surveys were conducted to assess the presence and distribution of pathogens in co-habiting species including rainbow trout, brown trout and mountain whitefish (*Prosopium williamsoni*). A pathogen of particular interest is Whirling Disease, which historically has been widely distributed throughout the Truckee and other major watersheds in Nevada since the mid 1950s. With the introduction of non-native salmonids into the system for recreational purposes, this pathogen most likely has been maintained, or possibly amplified in numbers and may pose some risk for reintroduction of LCT.



Sampling on the Truckee River in California

Truckee River, CA – Fish were sampled from several sites in California along Highway 89 south of Rt. 80. With the use of an electrofishing raft, crews from USFWS-Reno, Lahontan National Fish Hatchery, CA Dept. of Fish and Game and the Fish Health Center collected fish from 4 sites and performed fish health examinations and collected tissues to test for major fish pathogens. Laboratory test results demonstrated that this stretch of the Truckee River remains positive for both *Myxobolus cerebralis* and *Renibacterium salmoninarum*.



Mountain Whitefish (*Prosopium williamsoni*) with caudal lesions

Truckee River, NV – In cooperation with USGS National Aquatic Water Quality Assessment (NAWQA) program, fish were sampled from the Truckee River at Clark, NV. Previous observations by USGS biologists indicated fish health problems, specifically parasite infections associated with low flows and increasing water temperatures in summer months. Sampling during August 2003 occurred during relatively good water flows, and the majority of fish appeared healthy. Two suckers examined by histology were found to be infected by the parasitic crustacean *Lernaea*. ELISA testing for *Renibacterium salmoninarum* antigen was positive for Tahoe suckers (*Catostomus tahoensis*) and common carp, and test results were confirmed by PCR.

Pathogen Survey

Allerman Canal, NV

The Allerman Canal is a relatively large irrigation channel that utilizes a large proportion of the East Fork of the Carson River. As the canal leaves the Carson River, it flows directly adjacent to Lahontan National Fish Hatchery (LNFH). The hatchery produces Lahontan cutthroat trout as a component of the restoration program for this threatened species. The canal has long been known to be a source of pathogens infecting fish reared at Lahontan NFH. During the early to mid 1960s, the facility was modernized with additional wells to exclude the use of canal water. Pathogens may still enter the facility during high flow events with fish that reside in the canal and enter through the effluent system. It's also possible that canal water applied to adjacent fields by overhead irrigation could propel aerosols onto outdoor raceway. LNFH tested positive for *Myxobolus cerebralis* in 1998 but no clinical signs or disease were associated with this finding. In 1999 and 2000, LNFH underwent epizootics of Furunculosis, the bacterial disease caused by *Aeromonas salmonicida*. To determine what pathogens were present in Allerman Canal, fish were collected and tested in 2003. Laboratory results did not detect viral or bacterial pathogens, however two brown trout collected from the canal tested positive for the Whirling Disease. Considering the small sample size, *Myxobolus cerebralis* was easily detected in fish inhabiting the canal.

Oregon

Pathogen Survey

Upper Klamath Lake, Klamath, OR

In support of USGS monitoring of endangered Lost River sucker and shortnose sucker (*Chasmistes brevirostris*) in Upper Klamath Lake, the fish health center provided training, supplies, initial sample effort, and laboratory services to examine health and physiological indices of adult suckers before, during, and after adverse water quality events caused by blue green algal blooms. These periods were often associated with fish kills and a chronic fish die-off observed in the lake during the summer of 2003. *Aeromonad* and *Pseudomonad* bacteria were detected in 8/20 blood samples (31%). Columnaris (*Flavobacterium columnare*) was associated with 8/20 (42%) of the moribund suckers collected late in the summer. The blood coccidian parasite *Haemogregarini catostomi* was observed in 40% of the bloodsmears collected in April.

Projects overlapping 2002-2003

Pathogen Survey

Yuba River, CA

A vital tributary to the Sacramento River system, the Yuba River provides essential habitat for native runs of chinook salmon and steelhead. Spring-run chinook and steelhead are federally-listed as threatened. Large scale studies are underway to determine the feasibility of removing Daguerra Dam and the effects on naturally reproducing fish populations in this watershed.

Infectious disease can influence survival directly, or compromise physical performance during migration which can subsequently lower ocean survival and successful return of spawning adults. Pathogen surveys have been conducted on the Yuba River system fish to assess possible health concerns which may compromise restoration efforts. Of particular interest is Infectious Hematopoietic Necrosis Virus (IHNV), known to be present in the adjacent Feather River and the Sacramento River basin. Fish Health Center staff sampled sites on the main-stem Yuba, the South



Yuba River juvenile fall chinook salmon.

and the Middle Forks in cooperation with CDFG. Fish were sampled periodically from the rotary screw trap near Marysville in the spring of 2002, and upper tributaries were sampled in 2003. Results indicate that both juvenile fall chinook and steelhead are negative for IHNV, and no other major pathogens were detected in resident fish species sampled (bluegill (*Lepomis macrochirus*), hardhead [*Mylopharodon conocephalus*], Sacramento sucker (*Catostomas occidentalis*), rainbow trout, and smallmouth bass (*Micropterus dolomieu*)).

In the Fall of 2003, returning adults were sampled in cooperation with CDFG carcass surveys. The sample sites included three reaches that span the confluence of the Yuba River with the Feather River, and upstream beyond the Hwy 20 bridge. IHNV was found in 27.8% of the 90 fish tested. Viral strain typing will be performed by Ron Hedrick, UC Davis to determine if the IHNV isolated from returning adults is unique to this drainage.

Table 2 – Summary of IHNV Prevalence in Yuba River Fall Chinook returning adults.

Case No.	Coll Date	Description	# Pos / # Sampled	Percent Positive
03-152	10/28/2003	Yuba River Upper Reach	7/30	23.3
03-155	11/05/2003	Yuba River Middle Reach	6/30	20
03-156	11/06/2003	Yuba River Lower Reach	12/30	40.0
YUBA Summary:		Total Number Positive:	25/90	27.8

Yolo Bypass, CA



Channel catfish tail parasitized by leeches.

The Yolo Bypass, an engineered channel and floodplain of the Sacramento River, provides shallow water habitat and an alternate route of migration for a number of species including chinook salmon. Several other federally-listed fish species occupy the bypass when it is flooded in winter and early spring, as well as a growing number of exotic species. Pathogen surveys have been conducted on the bypass to assist in the management of chinook salmon and to address concerns of native and non-native fish interactions. In cooperation with CDFG, a variety of species have been collected from several sites

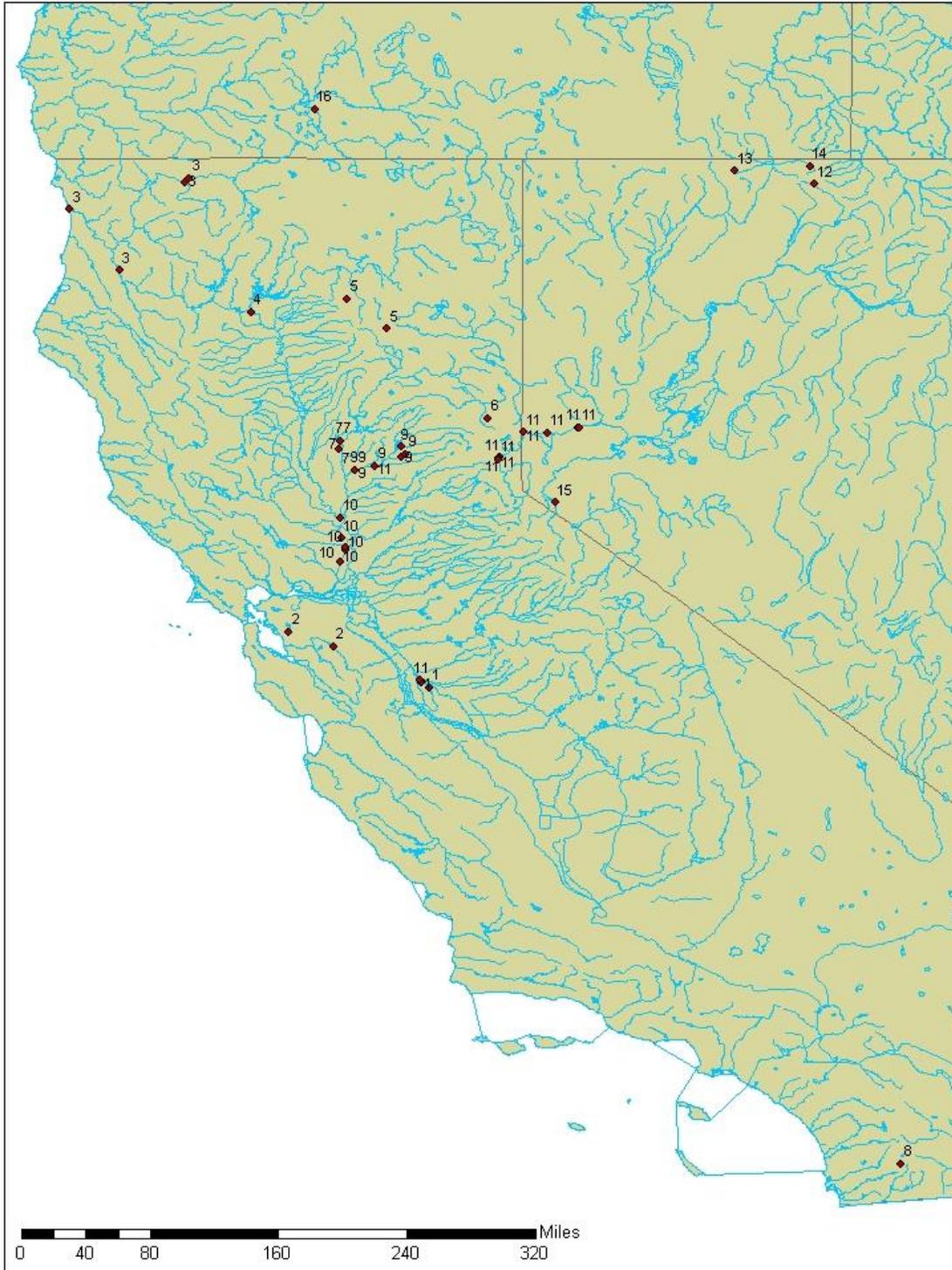
within the bypass during 2002 and 2003. The survey found white catfish (*Ameiurus catus*) parasitized by *Lernaea* and leeches. No other major fish pathogens were found in a diverse sampling of fish species (see summary for location and numbers sampled).

PARTNERSHIPS

List of Partners Corresponds to Sample Sites on Map

Map Site	Partners
1. San Luis–Kesterson NWR, CA	USFWS – Refuges, USFWS – Contaminants, CDFG
2. East Bay Regional Parks, CA	East Bay Regional Parks District
3. Klamath River Basin, CA	USFWS-Arcata FRO, Yurok Tribal Fisheries, CDFG
4. Sacramento River, CA	USFWS - LSNFH
5. Eiler & Posey Lakes, CA	Humboldt St. University, CDFG
6. Palen Reservoir, CA	CDFG, USFWS-Reno FWO, USFWS-LNFH, Private Landowner
7. Feather River, CA	CDFG, DWR
8. Sweetwater River, CA	USGS-San Diego Field Station
9. Yuba River, CA	CDFG
10. Yolo Bypass, CA	CDFG
11. Truckee River, CA&NV	USFWS-Reno FWO, USFWS-LNFH, CDFG (CA), USGS-NAWQA Reno, NDOW, Oregon St. University (NV)
12. NF Little Humboldt River, NV	NDOW, USFWS-Reno FWO
13. Riser Creek, NV	NDOW, USFWS-Reno FWO
14. EF Quinn River, NV	NDOW, USFWS-Reno FWO
15. Allerman Canal, NV	USFWS-LNFH
16. Upper Klamath Lake, OR	USGS

Wild Fish Survey Sample Sites 2002-2003



LITERATURE CITED

Beckon, William N. Biological Effects Section of Grassland Bypass Project Annual Report 1998-1999. USFWS/US Bureau of Reclamation grey literature.

National Wild Fish Health Survey Laboratory Procedures Manual. Kimberly True, editor. June, 2001. United States Fish and Wildlife Service. Division of Fish Hatcheries. Washington, D.C. 321 pp.

Location, Numbers Sampled, & Results for FY 2002 Wild Fish Survey

Collection Sites	Cooperators	Special Concerns or Objectives	Species	# Fish Sampled	Significant Findings
CALIFORNIA					
Yuba River (2 sites)	CDFG SYRCL	Prevalence & distribution of major fish pathogens Important watershed and passage of Endangered Salmon and Steelhead	Fall chinook Steelhead Bluegill Hard head	744 9 2 15	No viral or bacterial pathogens found in fish sampled.
Yolo Bypass (5 sites)	CDFG	Prevalence & distribution of major fish pathogens	Bluegill Largemouth bass Inland silverside Shad Crappie Carp Log perch Shiner Whitefish White catfish Channel catfish Flathead catfish Striped bass White crappie Sacramento pikeminnow	9 1 12 2 6 5 3 1 1 6 1 2 4 3 1	No viral pathogens found in fish sampled. <i>Renibacterium salmoninarum</i> was found in carp using ELISA.
Kesterson/San Luis NWR (4 sites)	USFWS - Refuges USFWS - Contaminants CDFG	Contaminants (selenium)	Common carp Inland silverside Shiner sp.	6 185 125	No viral or bacterial pathogens found in fish sampled.
San Francisco East Bay Parks (Del Valle Lake, Lake Chabot)	East Bay Regional Parks District	Prevalence & distribution of major fish pathogens	Largemouth bass Channel catfish Redear sunfish Goldfish Carp	55 14 5 36 10	Large mouth bass tested positive for the presence of <i>Renibacterium salmoninarum</i> . No other pathogens were found.

Collection Sites	Cooperators	Special Concerns or Objectives	Species	# Fish Sampled	Significant Findings
Klamath River Basin (3 sites)	Arcata FRO Yurok Tribal Fisheries CDFG	Prevalence & distribution of major fish pathogens Important watershed and passage of Endangered Salmon	Fall chinook salmon-juv KR lamprey KR small scale sucker Jack smelt	34 4 4 1	Ceratomyxosis and an unidentified kidney myxosporean parasite caused mortalities in juvenile salmon.
Sacramento River at Keswick Dam	USFWS - LSNFH	Prevalence & distribution of major fish pathogens Important watershed of Salmon	FCS	142	IHNV, <i>Aeromonas salmonicida</i> , <i>Yersinia ruckeri</i> , and <i>Renibacterium salmoninarum</i> was found.
Lassen County Lakes (Eiler Lake, Posey Lake)	CDFG HSU	Prevalence of Whirling Disease	Brook trout Rainbow trout	16 1	No pathogens were found in the heads examined.
NEVADA					
Humboldt County (3 sites – Little Humboldt, Riser Crk., EF Quinn)	NDOW USFWS - NV FWO	Prevalence & distribution of major fish pathogens	Brown trout Lahontan cutthroat trout	40 2	<i>Renibacterium salmoninarum</i> was found in brown trout. No other pathogens were found.
Truckee River (3 sites)	Nevada Division of Wildlife Oregon State University USGS	Whirling Disease Lahontan Cutthroat Trout Recovery	Brown trout Tahoe sucker Rainbow trout	18 30 9	<i>Myxobolus cerebralis</i> continues to be found in the river

Location, Numbers Sampled, & Results for FY 2003 Wild Fish Survey

Collection Sites	Cooperators	Special Concerns or Objectives	Species	# Fish Sampled	Significant Findings
CALIFORNIA					
Palen Reservoir (2002)	CDFG USFWS – Reno FWO LNFH Private Landowner	Lahontan Cutthroat Trout Recovery Prevalence & distribution of major fish pathogens	Brown bullhead Lahontan cutthroat	30 4	Light to moderate infection of <i>Aeromonas hydrophila</i> , trematode cysts were found in bullhead muscle tissue.
Yolo Bypass (3 sites)	CDFG	Prevalence & distribution of major fish pathogens Important watershed and passage of Endangered Salmon and Steelhead	Fall chinook Inland silversides Threadfin shad Fat head minnow Sacramento pikeminnow Largemouth bass Green sunfish Bluegill Channel catfish White catfish	20 34 20 1 1 6 8 24 10 10	White catfish parasitized by <i>Lernaea</i> and leeches, no other major fish pathogens were found.
Yuba River (3 sites)	CDFG	Prevalence & distribution of major fish pathogens Important watershed and passage of Endangered Salmon and Steelhead	Fall chinook (juv) Steelhead (juv) Sacramento sucker Rainbow trout Hardhead Small mouth bass	496 60 24 1 1 5	No major fish pathogens were found in the fish sampled.
Feather River (2 sites)	CDFG DWR	Prevalence & distribution of major fish pathogens Important watershed and passage of Endangered Salmon and Steelhead	Fall chinook	373	No viral or bacterial pathogens found in fish sampled.

Collection Sites	Cooperators	Special Concerns or Objectives	Species	# Fish Sampled	Significant Findings
Truckee River (4 sites)	USFWS, Reno - FWO LNFH CDFG	Whirling Disease Lahontan Cutthroat Trout Recovery Prevalence & distribution of major fish pathogens	Mountain whitefish Mountain sucker Brown trout Rainbow trout Lahontan cutthroat	7 2 13 29 2	<i>Myxobolus cerebralis</i> continues to be found in the river. Test results positive for <i>Renibacterium salmoninarum</i> .
Sweetwater River	USGS – San Diego FS	Disease transfer across aquatic vertebrates. Federally Listed Endangered Species.	Rainbow trout Goldfish Unarmored stickleback	5 6 21	Test results positive for <i>Renibacterium salmoninarum</i> in the trout and the goldfish. Parasites: <i>Ichthyophthirius</i> and <i>Chilodonella</i> (ciliates), <i>Gyrodactylus</i>
NEVADA					
Allerman Canal (Below LNFH)	USFWS - LNFH	Prevalence & distribution of major fish pathogens, in a water body adjacent to LNFH.	Brown trout Speckled dace Lahontan sucker Redside shiner	2 23 1 5	<i>Myxobolus cerebralis</i> was found in the brown trout sampled.
Truckee River At Clark, NV	USGS, Reno – NAWQA	Whirling Disease Lahontan Cutthroat Trout Recovery Prevalence & distribution of major fish pathogens	Rainbow trout Tahoe sucker Carp Redside shiner Mirror carp	3 60 11 25 1	<i>Lernaea</i> was identified on 2 of the suckers. Test results positive for <i>Renibacterium salmoninarum</i> in the carp and the suckers.

OREGON

Upper Klamath Lake	USGS		Lost River sucker Shortnose uckers	20	Light to moderate infection of <i>Haemogregarini catostomi</i> and <i>Flavobacterium columnaris</i> .
--------------------	------	--	---------------------------------------	----	---