

Monitoring Sockeye Salmon Health in the Cedar River and Lake Washington

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The Cedar River sockeye salmon enhancement program began in 1991, with the goals of increasing the number of sockeye salmon returning to the Cedar River and providing biologists with an opportunity to study factors affecting sockeye salmon survival throughout their life history. Washington Department of Fish and Wildlife (WDFW) operates the hatchery with funding provided by Seattle Public Utilities through the Cedar River Habitat Conservation Plan. Since its inception WDFW has provided fish health monitoring for the Cedar River Hatchery located at the Landsburg diversion dam. In July of 2005 SPU also began contributing funding to support the Fish Health component.

Since the origin of this project the majority of the pathogen monitoring at the facility has been screening for the viral pathogen infectious hematopoietic necrosis virus (IHNV). This virus is present in the Lake Washington basin and caused substantial mortalities in sockeye salmon during a previous incubation project on the Cedar River. Sockeye salmon are extremely susceptible to this virus and it causes a high rate of mortality, particularly at the higher densities of artificial culture. Stringent disinfection and isolation procedures are in place at the current hatchery to avoid infection of the juveniles and minimize spread of the virus if disease should occur. Each fall adults are tested for IHNV throughout the spawning season to ascertain the prevalence of the virus. Each release of fry is also sampled for IHNV to assess the condition of the group at release. If the fish in any incubator or rearing unit show unusual behavior, or express above normal mortality prior to release, these fish are examined and tested for viral pathogens. During most years the naturally produced sockeye salmon fry are also tested for viral pathogens throughout the outmigration to monitor the prevalence of IHNV.

METHODS

Adults

Each year during spawning at the hatchery ovarian fluid (OF) from approximately 24 adults is sampled weekly and a total of 61 kidney and spleen (K/S) samples were also taken. Due to low numbers of adult returns in 2007, spawners were also collected from the lower river late in October and November. Additional OF samples were taken from these fish to determine if IHNV prevalence levels was different from the fish collected higher in the river. All samples were tested for IHNV and other regulated viral pathogens, as per requirements of the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State. No pathogen samples were collected from prespawning adults returning to the system in 2007. That summer WDFW staff again collected otoliths from returning adult sockeye salmon captured at the Ballard Locks by Muckleshoot Indian Tribe biologists. No abnormalities were evident in the fish collected at the

locks, environmental conditions were good and no mortalities were seen. There was no evidence of adult mortalities in the lake or unusual prespawning mortalities in the rivers.

OF is generally a more sensitive specimen to test for IHNV so it is emphasized during the hatchery sampling. The following describes the testing methodology. Kidney and spleen tissues collected from adults at the hatchery were combined in 3-5 fish pools to screen for a viral pathogen (infectious pancreatic necrosis virus) that is not detected in the OF. All OF samples were tested individually. These tissues and all juvenile samples were processed fresh using standard virological cell culture procedures. The diluted sample is inoculated onto CHSE 214 and EPC cell lines for a minimum of 14 days at 15°C to monitor for the cytopathic effect from viruses. Confirmation of any viral isolates is done using specific antibody tests. Methodology is used that will detect IHNV, infectious pancreatic necrosis virus or viral hemorrhagic septicemia virus.

Juveniles

In previous years approximately 30 fry have been collected from each incubator or rearing unit at release to test for IHNV. This monitoring assesses the health of the fish at release and is used to evaluate the effectiveness of the IHNV control strategies. To minimize shipping, most weeks some of the fry were held in the incubators and only one shipment was made to the lab each week. The fry were transferred to the Fish Health Laboratory alive, euthanized upon receipt and processed whole with up to five fish per pool. If fish in any of the incubators or rearing containers showed abnormal behavior or excessive mortality, a representative sample was sent to the lab at that time to evaluate the cause and test for virus. In addition to virology, a small number of fish from all of the groups were also examined microscopically to monitor for bacteria, parasites, gill condition, and other abnormalities. The number of adults collected in 2007 was greatly reduced due to the low number of returning adults and high flows damaging the weir. Only 2.69 million fry were released, however, with the small number of fry, the hatchery crew was able to feed all of the fry for approximately a two week period prior to release. This practice has been shown to improve the survival of the fry after release. Fish health sampling was done at the end of the rearing period and sampling levels for virology were increased to approximately 60 fish from each rearing container since some contained fish from more than one incubator. The intensive feeding has the potential cause gill disease so the gill condition was also evaluated.

Most years the WDFW Fish Health Laboratory has also collected periodic samples of approximately 100 sockeye salmon fry from the floating inclined-plane screen trap that is maintained on the lower river to monitor outmigration. These fish are also processed whole, generally in pools of five fish and tested for virus. In 2008 all hatchery produced fry were released below the fry trap so all fry collected in the trap were naturally produced. Although adult returns were poor in 2007, the outmigration was relatively good at 25.1 million fry. Flows remained moderate so there was no scouring or dewatering of redds and was high enough during outmigration to minimize predation. Five samples of naturally produced fry were collected from February 5, 2008 to April 21, 2008.

RESULTS AND DISCUSSION

Adults

During the summer of 2007 the adult return was estimated to be 60,117 sockeye salmon through the Ballard Locks. The fish examined at the locks had light infestations of copepods and

occasional wounds, but no external signs of disease. Returns to the river were lower than anticipated, 45,489 spawners, but there were no reports of moribund or dead adults this year. Mortality levels were normal in the adults that were held at the hatchery for spawning. No signs of disease were evident in these fish, but no pathogen screening was done other than for the viruses. In 2007 IHNV was not detected in the returning adults until mid November (Table 1.). Although initially detected in the fish captured in the lower river the prevalence of virus rapidly increased and was detected in a high percentage of all adults sampled, regardless of collection site, by the following week.

Table 1. Results for adult sockeye salmon virus testing

Sample date	Viral results
10/04/07	0/24 OF virus detected (VD)
10/09/07	0/24 OF VD 0/7 pools K/S (35 fish total in 5 fish pools) VD
10/15/07	0/24 OF VD 0/6 pools from K/S (26 fish total in 3-5 fish pools) VD
10/22/07	0/24 OF VD
10/29/07	0/19 OF VD (fish collected from lower river) 0/24 OF VD
11/05/07	0/20 OF VD (fish collected from lower river) 0/24 OF VD
11/13/07	1/26 OF IHNV detected (fish collected from lower river) 0/9 OF VD
11/19/06	4/4 OF IHNV detected (fish collected from lower river) 13/15 OF IHNV detected

Juveniles

The health of the fry was very good at release (Table 2.). There were only minor impacts on gill condition in some of the fed groups and the majority of the fry were showing some deposition of fat. Abnormal fish were seen in two incubators but IHNV was not detected from fish in those incubators or any of the hatchery releases. Fish in one of these incubators showed premature swim up, but appeared normal upon exam and suffered no mortality. Mortality was seen in another incubator but no pathogens were detected and it was suspected that the loss was due to flow problems. The remaining fish from that incubator were reared and released as normal.

Overall, this was considered a very successful year with the fry released in good condition. The fish accepted feed well and showed good growth. A starter feed of Rangen soft moist feed was used this year and hatchery staff found that it performed very well for the sockeye. Gill condition at release was good even with intensive feeding. As seen in the past, there was some yolk retention on a small portion of the fish, but this is normal for fry that can't emerge volitionally.

Table 2. Results for hatchery produced sockeye salmon fry

Sample date	Vessel	Rearing	Sample type	Virus results	Visual exam
02/06/08	A-6	incubator	diagnostic	0/6 pools VD (30 fish)	fish up and swimming early, but no abnormalities detected
02/06/08	S-11, S12	fed	routine	0/12 pools VD (60 fish)	normal
02/19/08	A-2	fed	routine	0/12 pools VD (60 fish)	normal
02/19/08	A-3	fed	routine	0/12 pools VD (60 fish)	normal
02/27/08	A-4	fed	routine	0/12 pools VD (60 fish)	normal
02/27/08	A-5	fed	routine	0/12 pools VD (60 fish)	normal
02/27/08	A-6	fed	routine	0/12 pools VD (60 fish)	normal, gills slightly swollen
03/05/08	A-7	fed	routine	0/12 pools VD (60 fish)	normal
03/05/08	A-8	fed	routine	0/12 pools VD (60 fish)	normal
03/05/08	A-9	fed	routine	0/12 pools VD (60 fish)	normal
03/10/08	S-13	fed	routine	0/12 pools VD (56 fish)	normal
03/10/08	A-10	fed	routine	0/12 pools VD (59 fish)	normal
03/10/08	A-13	incubator	diagnostic	0/8 pools VD (40 fish)	loss in incubator, fish mostly buttoned up, appeared normal on exam
03/19/08	S-14, A-11	fed	routine	0/14 pools VD (68 fish)	normal
03/19/08	S-15, S-16, A-12	fed	routine	0/13 pools VD (60 fish)	normal
03/25/08	S-17	fed	routine	0/12 pools VD (57 fish)	normal
03/25/08	A-13	fed	routine	0/12 pools VD (60 fish)	normal
03/25/08	S-18, S-19	fed	routine	0/12 pools VD (60 fish)	normal, fish appeared a little smaller than other groups
04/02/08	S-1	fed	routine	0/12 pools VD (55 fish)	normal
04/02/08	S-20, A-14	fed	routine	0/12 pools VD (56 fish)	normal

IHNV was detected in the naturally produced sockeye salmon fry (Table 3.). The virus was detected early in the outmigration in normal appearing fry, which is consistent with what has been seen in the past. The prevalence of virus detected was lower than has been seen in many of the previous years, particularly in years with good fry outmigration.

Table 3. Viral results from naturally produced sockeye salmon fry

Sample date	Virus results	Visual exam
02/05/08	1/21 pools IHNV detected (104 fish)	no microscopic exams, fish appeared normal with small amounts of residual yolk in some fish
02/19/08	1/21 pools IHNV detected (105 fish)	
03/04/08	0/21 pools VD (105 fish)	
03/17/08	0/21 pools VD (101 fish)	
04/21/08	0/20 pools VD (100 fish)	