EAST FORK NEHALEM
RAPID BIO-ASSESSMENT 2008

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Upper Nehalem Watershed Council

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INTRODUCTION

The 2008 Rapid Bio-Assessment inventory of the East Fork Nehalem covered 26.6 miles of stream. This included all potential anadromous distribution in the East Fork mainstem (10.2 miles) and its tributaries, Dog, Elk, Jim George, Kenusky, and Tribs. A, B, and C. The intent of the project was to gather information on the status of juvenile salmonid summer rearing distributions and densities. The inventory consisted of extensive snorkel surveys that began at the mouth of each stream and continued to the end of significant salmonid distribution. These surveys will be used to develop a base line and to eventually identify long term trends in the distribution and abundance of juvenile Coho, Steelhead, Cutthroat and Chinook in response to restoration and watershed management issues.

The juvenile survey method was designed to inventory a sub-sample (20%) of rearing habitats using a Rapid Assay technique that could cover large distances and succeed in describing the current distribution of Coho and the relative abundance of Cutthroat, Steelhead, and Chinook in all of the surveyed streams and their tributaries. Beaver dam abundance was also recorded.

METHODS

The sub-basin surveyed was prioritized by the UNWC because of the current data gap existing for salmonid distribution and as part of a sub basin scale assessment process. Snorkel survey crews were concentrated within the basin to complete the sampling activity within a concise window of time. This approach leads to transportation efficiencies and eliminated the possibility of a population shift in response to changes in flow or temperature over time. Land owner contacts were made for all of the private, industrial and public ownerships that existed on both sides of every stream reach surveyed. Developing these contacts involved extensive research in the county tax assessor's office and then a personal contact to describe the survey and request permission for access. The land owner information was recorded (name, contact #, tax lot # and location) and will be available as a byproduct of this contract.

Most surveys were initiated by randomly selecting any one of the first five pools encountered. The protocol however was altered for small tributaries (2^{nd} order) where Coho presence or absence was undetermined. In these tributaries, the first pool above the confluence was selected as unit number one. This alteration in protocol was adopted to identify minor upstream temperature dependant migrations that may not have extended more than a few hundred feet. The identification of this type of migratory pattern in juvenile salmonids is critical for understanding potential limiting factors within the basin (temperature, passage, etc.). Some surveys were initiated at a point above brackish water influence or above agricultural influence where visibility conditions shifted from poor to good. In these surveys the start point of the survey will be indicated separately on the final USGS quads.

The survey continued sampling at a 20% frequency (every fifth pool) until at least two units without Coho were observed. In addition, pools that were perceived by the surveyor as having good rearing potential (beaver ponds, complex pools, and tributary junctions) were selected as supplemental sample units to insure that the best habitat was not excluded with the random 20 percent sample. This method suggests that the data existing in the database could tend to overestimate average rearing density if these non-random units were not removed prior to a data query (the selected units are flagged as non-random in the database).

In sub-basins with low rearing densities, there were situations where Coho were not detected for more than two sampled units. These situations were left to the surveyor's discretion, whether to continue or terminate the survey. There is a possibility that very minor, isolated populations of juvenile Coho could be overlooked in head water reaches of small 2nd order tributaries. This tributary would have to include a strong beaver population that would impound emergent fry and truncate their normal downstream fry distribution patterns.

Pools had to meet a minimum criteria of being at least as long as the average stream width. They also had to exhibit a scour element (this factor eliminates most glide habitats) and a hydraulic control at the downstream end. There were no minimum criteria established for depth. Only main channel pools were sampled. Side channel pools, back waters and alcoves were not incorporated into the surveyed pool habitats. The primary reasons for not including these secondary and off channel pools is that they compromise the consistency of measuring, summarizing and reporting lineal stream distances.

The lineal distances represented in the database were estimated by pacing from the beginning of one sampled unit to the beginning of the next sampled unit. The length of the sampled pool is an independent quantity, which was always measured and not estimated. A minimum of three lineal estimates were also measured with a hip chain for each surveyed stream to develop a calibration factor for each surveyor's estimate of distance. For many reaches, hip chain calibration was not possible in the inventory because of landowner complaints of string being left within the stream corridor. Total distances represented in the database are consistently greater than map wheeled distances using USGS 1:24,000 series maps. This is related to the level of sinuosity within the floodplain that is not incorporated in mapping. If you are attempting to overlay this database on existing stream layer information there would be a need to justify lineal distances with known tributary junctions (these can be found in the comments column).

Pool widths were generally estimated. Because pool widths vary significantly within a single unit, a visual estimate of the average width was considered adequate. Pool widths were typically measured at intervals throughout the survey to calibrate the surveyor's ability to judge distance.

The snorkeler entered the pool from the downstream end and proceeded to the transition from pool to riffle at the head of the pool. In pools with large numbers of juveniles of different species, multiple passes were completed to enumerate by species. (Coho first pass, 0+ trout second pass, etc.). This allowed the surveyor to concentrate on a single species and is important to the collection of an accurate value. In addition, older age class Steelhead and Cutthroat were often easier to enumerate on the second pass because they were concentrating on locating food items stirred up during the surveyor's first pass and appeared to exhibit less of their initial avoidance behavior.

In large order stream corridors two snorkelers surveyed parallel to each other, splitting the difference to the center from each bank.

A cover/complexity rating was attributed to each pool sampled. This rating was an attempt to qualify the habitat sampled within the reach. The 1 - 5 rating is based on the abundance of multiple cover components within a sampled unit (wood, large substrate, undercut bank, overhanging vegetation). Excessive depth (>3 ft) was not considered a significant cover component.

The following criteria were utilized:

1 0 cover present
2 1-25 % of the pool surface area is associated with cover
3 26-50 % of the pool surface area is associated with cover
4 51-75 % of the pool surface area is associated with cover
5 > 75 % of the pool surface area is associated with cover

A point to consider here is that the frequency of higher complexity pools increases with a decrease in stream order. This inverse relationship is primarily a function of average channel width and the resultant ability of narrow channels to retain higher densities of migratory wood. Channel morphology begins to play a much more significant role in this relationship during winter flow regimes where increases in floodplain interaction and the abundance of low velocity habitat may become as significant as wood complexity.

A numerical rating was given to each sampled unit for the surveyor's estimate of visibility. The following criteria were utilized:

Visibility
1 excellent
2 moderate
3 poor

This variable delivers a measure of confidence to the collected data. Survey segments with a measure of 1 can assume normal probabilities of detection (the observed is within 20 percent of the actual for Coho). Segments with a visibility of 2 suggest that less confidence can be applied to the observed number (uncalibrated) and segments with a visibility rating of 3 suggest that the observation can probably be used for only an assessment of presence or absence.

Beaver dam presence was recorded during the 2008 inventory. Beaver dams were simply counted along the survey and given a sum total at the end of each stream. Only intact full spanning dams were counted. This variable may then be sorted in the database for presence, absence and trend within each basin.

There was also commentary recorded within each of the surveyed reaches that included information on temperature, tributary junctions, culvert function, the abundance of other species and adjacent land use. This commentary is included in only the raw Access database under the "comments" field and not in the Excel Pivot Table Summary.

The database contains a field designed to facilitate the development of a GIS data layer. These LLID location numbers are unique for each stream segment. Latitude and longitude values were not collected for start points because these values already exist in the actual LLID number used to initiate a surveyed reach.

GENERAL OBSERVATIONS

Juvenile Coho were found in all of the streams surveyed within the EF Nehalem sub-basin during the 2008 inventory. This included all reaches that were open to anadromous access. Juvenile Coho were, by far, the most abundant fish species present during these surveys, which included only pool habitats. In many pools they were the only fish species present. Juvenile Steelhead were found in very low numbers in only three streams – Jim George, Trib. B of the EF Nehalem (Gunners Lake Fork), and the EF Nehalem mainstem, in order of abundance. The greatest abundance of Cutthroat was observed in Trib. B of the EF Nehalem. The EF Nehalem mainstem and Jim George Cr recorded unusually low abundances of Cutthroat. We attribute these low abundances to the poor visibility (tannins) that limited snorkel accuracy. The results for the lower EF mainstem, Elk, and Trib. B of the EF Nehalem should be considered minimum estimates only for Cutthroat abundance. The impact of this low visibility was less significant for Coho observations because Coho do not exhibit the avoidance behavior displayed by Cutthroat and Steelhead.

A total expanded estimate of 38,495 Coho summer parr were present during the summer inventory of 2008. Adding the standard 20% visual bias for Coho snorkel sampling would raise this estimate to a total of 48,119 summer parr. Back-calculating adult escapement for the 2007 winter brood from this juvenile estimate suggests a total of 385 – 437 adults for the EF Nehalem sub-basin (based on an 8.8% - 10% egg-to-summer parr survival rate and 2,500 eggs). Most juveniles were found summer rearing in the EF mainstem (44%), Jim George (19%), and Kenusky (15%).

The predominantly low gradient, fine sediment stream habitat within the EF Nehalem system favor Coho production. High abundances of fine sandstone gravels were observed in the lower reaches of Jim George, Kenusky, and Tribs. A and B of the EF Nehalem, as well as in the upper EF mainstem. The moderate stream gradients and highly sinuous channels present in these reaches represent the most important anchor habitats in the sub-basin for Coho. Production potential diminished in all of these habitats where stream gradient and substrate size increased.

Average rearing density reached 3.1 Coho/sq.m. in Trib. A of the EF Nehalem (1.2 miles), 2.8 Coho/sq.m. in Trib. A of Dog (0.5 miles), 1.9 Coho/sq.m. in Trib. A of Kenusky (1.3 miles), and 1.6 Coho/sq.m. in Jim George (3 miles). These habitats met and exceeded what are commonly referred to as fully seeded summer densities for Coho in 2008. Significantly higher production potential remains in the Kenusky mainstem, Dog mainstem, Trib. B of the EF Nehalem, and the EF mainstem. Average rearing densities in these reaches in 2008 were between 0.6 - 0.9 Coho/sq.m.. Low adult escapement, high rates of siltation, and elevated water temperatures could all be factors that assist in limiting the production potential of these habitats.

The average density for a surveyed reach is an excellent measure of trend that can be monitored from year to year. However, it tends to portray only a general description of the current status within a reach. Understanding how each reach is functioning is more accurately interpreted in a review of how the rearing density changes within the reach. The pivot table graphics provided in electronic format with this summary are essential for the proper interpretation of this review.

The lower half of the EF mainstem exhibits provides a potentially limitless supply of summer and winter rearing habitat for the prime spawning zones present in most of its tributaries. At present, this stream reach appears to be primarily limited by elevated summer

water temperatures resulting from extreme solar exposure. Riparian tree plantings along the EF mainstem and the preservation of the riparian canopies in the tributaries and headwaters appear to be the best strategies for lowering stream temperatures and arresting downstream cumulative impacts.

(Table 1)
2008 Expanded Estimates

Stream	**Coho**	% Total	**0+**	% Total	**Sthd**	% Total	**Cut**	% Total
East Fork Mainstem	16,830*	43.7	185*	34.3	5*	11.1	210*	29.2
Trib. A	2,935	7.6	20	3.7	-		60	8.3
Trib. B (Gunners Lake Fork)	2,275	5.9	190*	35.2	20*	44.4	245*	34.0
Trib. C	90		-		-		30	4.2
Dog	2,405	6.2	-		-		40	5.6
Elk	680	1.8	10	1.9	-		-	
Jim George	7,485*	19.4	135*	25.0	20*	44.4	110*	15.3
Kenusky	5,795*	15.1	-		-		25	3.5
Total	**38,495**	**100**	**540**	**100**	**45**	**100**	**720**	**100**

* Highlighted estimates represent the top 3 producers by species and age class
- Percent contributions are indicated for only those sub-basins that contributed greater than 1% of the total.
- Visual bias not included

Anadromous adult access was compromised within the basin by both natural and manmade barriers. There were two particularly large portions of the sub-basin where anadromous passage was restricted by natural ephemeral barriers. These were Trib. B1 of the EF Nehalem (leading to Floeter Pond), and Trib. B2 of the EF Nehalem (leading to the Gunners Lakes).

In addition, two culvert barriers to adult passage were noted very near the end of anadromous production potential. The first was encountered in Trib. C of the EF Nehalem (Hawkins Cr), approximately 430 ft. upstream of the mouth, where the main road culvert exhibited a 6 ft. drop. The second was encountered at the end of the EF mainstem survey (RM 10.2) where the main road culvert exhibited a 5 ft. perch. This inventory did not assess the production potential for anadromous salmonids above these two culvert barriers. However, it is likely that limited additional potential exists because the crossings are very high in the basin. There is a distinct need to evaluate the abundance and quality of the habitats above these crossings to determine the cost / benefit and relative importance of including these sites in a restoration proposal. There is likely a significant value to replacing these culverts at these crossings for enhancing resource delivery to the lower mainstem.

There were also two adult and juvenile barrier culverts near the mouth of Elk Cr. These were a cement culvert followed by a steel culvert, each exhibiting a 2 – 2.5 ft. perch, both within the first 1,000 ft of stream. These culverts terminate access to approximately 3 miles of potential salmonid rearing habitat (quality unverified).

3 barriers to juvenile migration were also noted in Trib. A of the EF Nehalem, and the EF Nehalem mainstem. The first two in Trib. A consisted of a 6 inch drop at the main road culvert at the mouth of the stream followed by a 3.5 ft. bedrock step approximately 275 ft. upstream of the

mouth. This culvert barrier received a very low priority rating based on the limited amount of habitat accessible to juveniles between the culvert and the natural bedrock step. What appeared to be the highest priority culvert barrier was found at RM 8.9 in the EF mainstem. The cement box culvert there exhibited a 1 ft. plunge, blocking most upstream temperature dependant migrations of juveniles. Approximately 1.3 miles of productive habitat and potential temperature refugia would be gained by improving passage there. More information on these culverts can be found below in the site specific discussions.

Information on beaver dam locations are detailed in the Access database under their own headings with further description in the comments field. This information is also reviewed below in the Site Specific Observations. Beaver activity was relatively high in the EF Nehalem sub-basin and was present to some degree in almost every stream segment. 21 active dams were encountered. The EF mainstem and Elk Cr. exhibited the strongest legacy of beaver impoundments. Beaver dam building contributes significantly to channel complexity, sinuosity, floodplain connection, primary productivity, and summer and winter rearing capacity for salmonid juveniles. The continued collection of this data could be very revealing as land use patterns, stream gradients, and anadromous fish production change in the future.

Distribution profiles

The distribution of juveniles and their observed rearing densities for each surveyed reach provide a basis for understanding how each reach is functioning in relation to the remainder of the basin or sub-basin. These profiles can help identify spawning locations, identify potential barriers to upstream adult and juvenile migration, identify the end point of Coho distribution and they may also indicate how juvenile salmonid populations are responding to environmental variables such as increased temperature. You will find a review of these distribution profiles within this document for each of the streams surveyed during the 2008 field season.

Location of spawning destinations

The approximate locations of Coho spawning events can usually be found by the presence of a distinct spike in rearing density that trailed off rapidly just upstream. The physical location of a spawning destination has a range of variance plus or minus 4 pools due to the 20 percent sample methodology.

The average densities generated represent a snapshot in time of the current condition that can be compared to known levels of abundance that exist in fully seeded and fully functional habitats. These densities also provide a method for quantifying changes in rearing densities by reach or sub-basin over time. Average densities utilized as a metric in this analysis are calculated for pool surface areas only. Lower levels of juvenile Coho abundance and higher levels of juvenile Steelhead abundance exist in fast water (riffle/rapid) and glide habitats. Replicate surveys conducted in these same reaches in subsequent years will function as an indicator of response to future restoration and enhancement strategies and potential changes in land use. It does not however, provide any indication of actual smolt production because of the distinct relationship between juvenile survival and the abundance of high quality winter habitat.

Adult and Juvenile Barriers

Adult migration barriers are verified by determining that no juvenile production is occurring above a given obstruction (culvert, falls, debris jam, beaver dam, etc.). There are many barriers, both natural and manmade, that impact the migration of salmonids. Some are definitive barriers that are obvious obstructions (such as a bedrock falls). Many barriers however, only impede adult salmonid migrations during low flow regimes. Summer juvenile inventories allow us to definitively quantify whether passage was obtained at any point during the season of adult migration.

Juvenile salmonids typically migrate upstream for a variety of reasons (temperature, winter hydraulic refuge, food resources). Hydraulic refuge and food resources are typically fall, winter and spring migrations that would not be detectable during summer population inventories. Temperature however, is probably the most significant driver of upstream juvenile salmonid migrations during summer flow regimes. Juvenile barriers are subjective to the eye of the observer. The trend in juvenile density can be a method of detecting either partial or full barriers to upstream migration. Each of the surveyed reaches contains a comments section in the Access database to note the presence of culverts, jams and other physical factors that may influence the ability of salmonid populations to make full use of aquatic corridors.

Temperature Dependant Migrations

Potential temperature dependant migrations can be observed in the database by looking for densities that decrease significantly as the lineal distance increases from the mouth of the stream or tributary. This is more likely to be observed in the case of low abundance years where tributary habitats that are seeded to capacity are the exception. During years of high abundance there is a more significant potential for density dependant upstream migrations that would be indistinguishable from the distribution pattern mentioned above. The recognition of this migration pattern allows us, during years of low escapement, to identify important sources of high water quality within the basin that may be traditionally overlooked because of some other morphological condition that suggests to us that there is no significant potential for rearing salmonids (i.e. lack of spawning gravel). These stream reaches typically exhibit declining densities with increased distance from the mouth and no indication of a spawning peak (a point near the upper distribution of the population with significantly higher rearing densities). These tributaries may be functioning as important summer refugia for salmonid juveniles threatened by increasing temperatures in the mainstems.

Precautions

The specific location of spawning sites does not infer that the highest quality spawning gravels were targeted by adult salmonids or that there is any relationship between the location of a redd and the quality of the rearing habitat that exists adjacent to these locations.

The average densities that can be generated as an end product for each stream reach are the result of a 20 percent sample. Consequently, they probably vary significantly around the true average density. There are many sources of potential variation, start point, number of units sampled within the reach, surveyor variability, etc. The range of variability for at least one of these variables (start point), was documented in the final review of the 1998 Rapid

Bio-Assessment conducted by Bio-Surveys for the Midcoast Watershed Council. To facilitate the proper utilization of the data included in this inventory, the 1998 results are included below. The true average density of a stream reach was retrieved by querying the database from an ODFW survey on East Fk. Lobster in the Alsea Basin where every pool was sampled. Comparisons could then be made between the true average density and a randomly selected 20 percent sub sample (every 5th pool). Only mainstem pools were utilized within the range of Coho distribution to match the protocol for the Rapid Bio-Assessment.

(Table 2)

SAMPLE FREQUENCY	AVG. COHO DENSITY	AVG. SH DENSITY	AVG. CUT DENSITY	AVG. 0+ DENSITY
100 %	1.07	.03	.04	.13
50 %	1.10	.04	.03	.14
20 % Start Pool 1	0.87	.04	.03	.13
20 % Start Pool 3	1.01	.03	.03	.13
20 % Start Pool 5	1.13	.05	.04	.12

SITE SPECIFIC OBSERVATIONS

Site specific observations within this document have been organized in an alphabetical format with the exception of the largest stream segment, the EF Nehalem mainstem, which is listed first. Small unnamed tributaries to the EF mainstem are listed last.

These production estimates are based on an expansion of the 20% snorkel sample in pools only and therefore do not constitute an entire production estimate for the basin. These estimates greatly under estimate the standing crop of 0+, Steelhead and Cutthroat because a large component of their standing crop is summer rearing in riffle / rapid and glide habitats that were not inventoried. In addition, there is also production for these three groups that extends upstream beyond the end point of some surveys. The information below can be utilized to establish a baseline for trend monitoring for subsequent survey years on the basin-wide scale and by tributary. It also provides a comparison of the relative production potentials between tributaries that can be utilized as a foundation for prioritizing restoration opportunities.

Mainstem EF Nehalem

(Table 3)
Expanded Estimates of Juvenile Salmonid Production and Percent Contribution to the Sub-basin

Survey Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	16,830	185	5	210
	(44%)	(34%)	(11%)	(29%)

- Visual bias not included

Almost half of all EF Nehalem Coho were found in the EF mainstem. A moderate average rearing density of 0.73 Coho/sq.m. was observed extending 10.2 miles upstream from the mouth. Distribution ended upstream of several log jams at a culvert barrier to adult and

juvenile migration. This steel culvert was perched 5 ft. over boulders with no jump pool. This point was close to the headwaters of the mainstem with relatively little spawning or rearing habitat (about 0.5 miles of steep gradients) remaining upstream of the problem culvert.

Rearing densities for juvenile Coho climbed steadily as the survey progressed upstream toward a strong and even spawning peak of 3.8 Coho/sq.m. at RM 10. Many pools in this zone appeared to be rearing at or above capacity for Coho. Much of the EF mainstems production however, about 42%, was occurring below the upper basin spawning locations in the first 4 miles of stream. This may suggest significant contribution to mainstem rearing from lower basin tributaries. Pools were long, dark, and slow through this reach, with high tannin levels and few riffles. Siltation was high and gravel sorting poor. Solid bedrock exposures were frequent. Water visibility was rated as medium to poor for most of the survey with gradual improvement noted after RM 7. The visibility conditions alone suggest that summer rearing densities were likely higher than reported in this lower Elk mainstem. Reed Canary grass dominated much of the entrenched inner riparian of the EF mainstem channel. Canopy shade was rare. Large wood was intermittently present, deeply embedded in sediment. Spawning conditions appeared to be best in the EF mainstem upstream of RM 7 where gradients increased to facilitate gravel sorting.

Cutthroat abundance was comparatively low in the majority of the EF Nehalem sub-basin and 1+Steelhead were very rare in the sampled pool habitats. Juvenile Coho dominated the aquatic habitats throughout the EF mainstem and its tributaries during the summer inventory of 2008. The moderate average rearing density exhibited by juvenile Coho in the EF mainstem suggests that production potential could be about twice as high in the EF mainstem. Low adult escapement and a lack of spawning gravels appear to currently be the primary limiting factors. Beaver activity was high in the EF mainstem. A total of 15 fresh dams were noted upstream of RM 6. A particularly large dam near RM 9.7 had created a large grassy wetland that was full of summer rearing Coho.

A second culvert barrier (for juveniles only) was encountered at RM 8.9 where a cement box culvert exhibited a 1 ft. plunge. This crossing was just upstream of the confluence of Trib. B. A minor spike in Coho density was observed downstream of this culvert indicating some upstream migration pressure, probably temperature related. Replacement or development of an engineered approach to this culvert appears more important than the culvert at RM 10.2 because of the truncated upstream linkage for temperature dependant juvenile migrations. Connecting the full length and variable habitats of the EF mainstem for the upstream migrations of all adult and juvenile salmonid species would include addressing both of these barriers to migration.

Dog

This small tributary to the EF Nehalem contributed roughly 6% to the sub-basin Coho total, including Trib. A of Dog. No 1+Steelhead were observed and few Cutthroat were present. Good visibility was reported. Coho distribution in Dog extended 1.7 miles and ended in long steep bedrock slides. A moderate rearing density of 0.9 Coho/sq.m. was maintained through this distribution. A peak rearing density of 2.8 Coho/sq.m. was observed in the first pool of the survey which suggests the presence of an upstream migration of juveniles from the EF mainstem, probably temperature dependent. The length of distribution and abundance levels for Coho in Dog indicate that adult spawning also took place in the Dog Cr mainstem and probably even in Trib. A of Dog. The average rearing density for Coho exhibited in Dog Cr. in 2008 suggests that

the full production potential of the habitat had not been met. Low adult escapement appeared to be the primary limitation.

Trib. A of Dog provided 0.5 miles of high quality rearing habitat with an expanded estimate of 625 Coho summer parr. An average rearing density of 2.8 Coho/sq.m. was maintained throughout this distribution with a peak of 4.5 Coho/sq.m. observed at RM 0.3. This population represents either a very strong upstream migration of juveniles from the Dog Cr. mainstem or, more likely, a mix of upstream migration with one to two successful spawning events. Trib. A appeared to have reached its summer rearing capacity for Coho in 2008. No Cutthroat or Steelhead were observed in this stream.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**
2008	2,405	0.9	-	-	40

- Totals include Trib. A, density for mainstem only
- Visual bias not included

Elk

Elk Cr was definitively the least productive of the EF Nehalem tributaries for salmonids. Multiple culvert barriers have truncated access for both adult and juvenile salmonids. Snorkel visibility was poor due to abundant beaver activity and high levels of tannins. A nearly full seeded summer carrying capacity was observed (average rearing density of 1.4 Coho/sq.m) in the 0.1 stream miles surveyed before a concrete culvert with a 2 ft. plunge definitively terminates upstream juvenile migration. Rearing density peaked at 1.9 Coho/sq.m. just downstream of this juvenile barrier. It is likely that this entire population could have been the result of an upstream migration of juveniles from the EF mainstem. A second steel culvert at RM 0.25 exhibited a 2.5 ft. plunge, representing another barrier for juveniles. No Coho were seen upstream of the first culvert barrier.

The short 0.5 mile reach that was surveyed was low gradient with limited summer flow and only minor accumulations of spawning gravel. Fine sediments dominated the habitat. Reed Canary grass was the most abundant riparian vegetation and confined much of the summer channel. A legacy of high beaver abundance was evident in Elk Cr. However, there were currently only 2 active dams noted. Additional salmonid rearing potential was noted by the end of the survey as stream gradient and gravel abundance were just beginning to increase. This stream has the capacity for providing large summer and winter salmonid rearing potential with the recovery of beaver and the provision of unobstructed passage.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**
2008	680	1.4	10	-	-

- Visual bias not included

Jim George

This stream was the most productive tributary for Coho in the EF Nehalem sub-basin during the 2008 inventory. 19% of all summer parr in the sub-basin were observed rearing in the first 3 miles of Jim George in a healthy average rearing density of 1.6 Coho/sq.m.. This level of abundance is probably close to Coho carrying capacity for Jim George. Most adult spawning

activity appears to have taken place in the lower half of the stream. A peak rearing density of 3.6 Coho/sq.m. was observed early on at RM 0.4, coinciding with the zone of highest individual pool counts. 71% of the Coho population was observed downstream of the survey's midpoint, RM 1.5. Pool counts and rearing densities decreased gradually as the survey progressed upstream. Based on the data from 2008, the lower half of Jim George appears to be one of the most significant anchor habitats for Coho in the EF Nehalem sub-basin.

The first mile of Jim George appeared to be ideal Coho habitat with mostly sandstone substrates, fine gravels, and a high level of channel sinuosity. Good water quality and canopy shade was also noted. Stream gradient gradually increased upstream of this reach as larger rock and bedrock exposure became more frequent. Production potential through the upper half of the survey appeared limited due to lack of spawning gravel. Small pockets of fine gravels were intermittently found upstream of any woody debris that was encountered in this reach. Restoration efforts involving in-stream wood placement would benefit salmonid production in Upper Jim George significantly.

Two small log jams with no jump pools ended Coho distribution near RM 3. These were ephemeral barriers to migration. Production potential appeared to continue upstream. Cutthroat production was relatively high also in Jim George compared to other EF Nehalem tributaries. Only Trib. B of EF Nehalem exhibited a larger expanded estimate of 245 Cutthroat. 1+Steelhead production appeared very low in Jim George, as in the rest of the sub-basin (only pool habitats were sampled). Distribution for these two species in Jim George was relatively even throughout the surveyed reach. A total of 2 active beaver dams were noted.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**
2008	7,485	1.6	135	20	110

- Visual bias not included

Kenusky

Coho production among EF Nehalem tributaries was second highest in the Kenusky sub-basin. The expanded estimate of 5,795 juvenile Coho for Kenusky (with Tribs. A, B, and C) represented 15% of the total EF Nehalem population. A total of 6.8 miles of stream habitat in Kenusky was summer rearing Coho juveniles at the time of the 2008 survey, including 4 miles in the mainstem, 1.3 miles in Trib. A, 0.4 miles in Trib. B, and 1.1 miles in Trib. C. This was the second longest lineal distribution of any Coho population within the EF Nehalem system (lineal distribution for Coho within the EF mainstem itself reached 10.2 miles). Kenusky Cr. represents the largest and potentially the most productive tributary habitat within the EF Nehalem.

A relatively low average rearing density of 0.6 Coho/sq.m. was observed in the Kenusky mainstem as well as in Trib. C. This suggests the potential for significantly higher production rates in these habitats with increased adult escapement. Average rearing densities were closer to carrying capacity in Tribs. A and B, reaching 1.9 Coho/sq.m. and 1.5 Coho/sq.m., respectively.

Nearly 70% of all Coho in the Kenusky sub-basin were rearing in the mainstem (4,050 summer parr – expanded). Rearing density for Coho in the mainstem peaked at 2.0 Coho/sq.m. near RM 0.9 and individual pool counts peaked near RM 0.7. The confluence of Trib. A was located just upstream near RM 1. Very high rearing densities for Coho were encountered at the start of Trib. A (peaking over 4 Coho/sq.m.) with a gradually declining profile as the survey progressed upstream and the channel became too steep for good pool formation. This data

strongly suggests that most adult spawning activity in the Kenusky sub-basin, during the 2007 winter brood, took place within the first mile of the Kenusky mainstem and in the lower half of Trib. A. Good water quality, canopy shade, and spawning gravels were present throughout this zone. The moderate stream gradients encountered in these reaches continued along the Kenusky mainstem for another mile leading up to the confluence of Trib. B and then began to increase noticeably. A 3 ft. bedrock falls was present at the survey endpoint which did not appear to be an adult barrier.

Expanded estimates for Coho reached 710 in Trib. A, 260 in Trib. B, and 775 in Trib. C. The density profiles for all three revealed signs of low level adult spawning. These streams all exhibited low flows and ended in steep gradients, boulders, and/or bedrock exposures. The culvert at the mouth of Trib. A was dry at the time of survey, suggesting a subterranean stream flow and a definitive barrier to juvenile migration. No other fish besides juvenile Coho were observed in these three streams. Only 25 (expanded) Cutthroat were estimated for the Kenusky mainstem. Only one active beaver dam was found in the sub-basin, near RM 1.3 on the mainstem.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**
2008	5,795	0.6	-	-	25

- Totals include Tribs. A, B, and C, density for Kenusky mainstem only
- Visual bias not included

Trib. A of EF Nehalem

1.2 miles of high density Coho rearing was observed in Trib. A. 28 out of 30 pools sampled exhibited a rearing density over 1.5 Coho/sq.m. and appeared to be seeded to capacity for Coho. Rearing density exceeded 4.0 Coho/sq.m. in 6 sample pools. The stream-wide average rearing density reached 3.1 fish/sq.m. with a spawning peak of 8.4 Coho/sq.m. located at RM 0.4. These levels are unusually high for the species and describe an important and productive stretch of habitat that was functioning well at the time of survey. Individual pool counts for Coho followed a similar distribution, peaking early in the survey and decreasing gradually upstream.

This profile most likely reflects the location of the heaviest spawning activity within Trib. A. There was evidence of contributions also from an upstream migration of juveniles out of the EF Nehalem in the first two pools of Trib. A. This migration, however, was restricted by a minor 6 inch drop at the culvert above the first pool and then terminated completely another 275 ft. upstream by a 3.5 ft. bedrock step. This step represents a barrier to juvenile, but not adult, passage. Juvenile passage at the culvert looked difficult during low summer flows, which is when upstream migration is most important. Replacement of this culvert, however, seems of low priority considering the bedrock step just upstream and the very short segment of stream where upstream access for juveniles could be restored. Very high Coho rearing densities began just upstream of the bedrock step.

Trib. A maintained the highest average rearing density for Coho within the EF Nehalem system in 2008. This population represented the third largest tributary contribution (8%) to EF Nehalem Coho production behind Jim George (19%) and Kenusky (15%). Coho production in Trib. A was significant considering the relatively short 1.2 mile stream segment. This stream appears to be a main anchor habitat for Coho in the EF Nehalem sub-basin. No 1+Steelhead were found in the pool habitats sampled. No Coho were found in Trib. A1, 0+trout and Cutthroat only.

Year	Coho	Coho/sq.m.	0+	Sthd	Cut
2008	2,935	3.1	20	-	60

- Totals include Trib. A1, density for Trib. A mainstem only
- Visual bias not included

Trib. B of EF Nehalem

Also known as Gunners Lake Fork, this stream contained three main branches – Trib. B mainstem (1.7 miles), Trib. B1 (0.6 miles), and Trib. B2 (0.2 miles). The combined 2008 expanded estimate of 2,275 Coho represented 2.5 total miles of coho distribution and was similar in productivity and size to the rearing estimate from Dog Cr. (each contributed roughly 6% to the EF Nehalem sub-basin population). Cutthroat abundance in the Trib. B sub-basin (245 – expanded) was higher than in any other stream segment in the EF Nehalem, including the EF mainstem (210 – expanded).

Most Coho production (89%) occurred in the mainstem of Trib. B where rearing densities averaged a moderate 0.8 Coho/sq.m.. Evidence of upstream juvenile migrations from the EF Nehalem were present near the mouth of Trib. B. The main spawning peak appeared to be centered on RM 0.9 where rearing densities increased to 1.2 Coho/sq.m. and then began to drop off, along with individual pool abundances. An expanded estimate of 200 Cutthroat were observed in the Trib. B mainstem, mostly in the upper half of the survey. A low expanded estimate of 20 1+Steelhead were also present. This represented 44% of all 1+Steelhead observed during the 2008 EF Nehalem inventory.

Anadromous passage in Trib. B ended at RM 1.7 at a steep log/boulder jam. This may represent only an ephemeral barrier to anadromous passage. The canyon becomes wider again upstream of this narrow pinch. Production potential for Coho and Cutthroat in the Trib. B mainstem appears to be significantly higher than observed in 2008. Low adult escapement is probably currently limiting production.

Coho spawning appears to have occurred in Trib. B1. An expanded estimate of 190 summer parr were observed in an average rearing density of 0.75 Coho/sq.m. over a distribution of 0.6 miles. The survey ended in steep gradients and bedrock slides. No 1+Steelhead were found in Trib. B1. Low levels of Cutthroat and 0+trout were present.

The short 0.2 mile distribution of juvenile Coho (only 70 – expanded) observed in Trib. B2 was probably the result of an upstream juvenile migration. An average rearing density of 2.0 Coho/sq.m. was maintained, although only the first 3 sample pools contained Coho. The survey ended in thin braided channels, steep boulders, and bedrock slides. This appeared to represent the end of anadromous passage. The Gunners Lakes were approximately one mile further upstream. No 1+Steelhead were found in Trib. B2. Low levels of Cutthroat and 0+trout were present.

Year	Coho	Coho/sq.m.	0+	Sthd	Cut
2008	2,275	0.8	190	20	245

- Totals include Tribs. B1 and B2, density for Trib. B mainstem only
- Visual bias not included

Trib. C of EF Nehalem

This steep tributary canyon near the headwaters of the EF Nehalem exhibits low to moderate anadromous spawning potential. At the time of the 2008 summer survey, all adult and juvenile passage was terminated by the main road culvert, about 430 ft. up from the mouth of the stream. A 6 ft. plunge was noted for this culvert. An upstream migration of 90 (expanded) juvenile Coho and 30 (expanded) Cutthroat were observed in the two pools sampled downstream of this culvert. The remaining stream habitat upstream of the culvert appeared relatively steep and the main channel splits in two after approximately one-half mile, leading into two narrow canyons. The benefits of replacing the problem culvert should be evaluated with a rapid assessment of potential habitats (spawning and rearing) existing above the crossing. The 2008 survey in Trib. C below the perched pipe suggests that some level of upstream temperature dependant migration from the mainstem EF Nehalem is occurring. Preservation of water quality (temperature) and upslope forest conditions in this drainage should be established as a high priority.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**
2008	90	1.4	-	-	30

- Visual bias not included

Watershed Recommendations

- Increase riparian tree plantings and log structure placements along the lower EF mainstem to improve juvenile rearing capacity, lower solar exposure, and trap gravel.
- Preserve forest canopies along main tributaries, especially Jim George, Kenusky, Trib. A, and Trib. B, to maintain water quality in the EF mainstem.
- Increase access to spawning habitats for adults and summer refugia for upstream temperature dependant migrations of salmonid juveniles in the EF mainstem, Elk, and Trib. C by replacing culvert barriers.

Distribution and Rearing Density Graphics

An Excel Workbook has been developed from the raw Access data that allows the user to preview distribution, density and abundance graphics by stream and species. This pivot table work book allows managers and users to access information for all of the streams surveyed in 2008. Please contact the Upper Nehalem Watershed Council for an updated version of this tool.

In addition, it is important to note that an extensive amount of supplemental raw data (primarily in the form of surveyor notes and comments) is available in the Access database which can also be obtained through the Upper Nehalem Watershed Council.