NOSC Macroinvertebrate B-IBI Survey Results, 2002-2005

Introduction

The North Olympic Salmon Coalition (NOSC) began conducting surveys on aquatic macroinvertebrates using Benthic Index for Biotic Integrity (B-IBI) scoring standards in October 2002. Four sites were sampled at that time, all on the main stem of Chimacum Creek. The following summer, three more sites were added in the Chimacum watershed and three on Salmon Ck for a total of ten sites sampled in 2003. One additional site was added to Salmon Creek in 2004 and another on Chimacum Ck in 2005, with a total of 12 sites sampled. Specific sampling sites were selected based on three main criteria and a fourth optional criteria:

1. Summer Chum recovery streams
2. Proximity to habitat restoration sites
3. Suitability for maintaining protocol standards
4. Proximity to Jefferson County Conservation District's water quality monitoring sites, or impending project reaches.

Criteria #1, 2, and 3 assist NOSC's project monitoring of changes to the stream's biological integrity. Criteria #4 was not a requirement, but allows NOSC and other interested parties to look at other factors that are being monitored for a more comprehensive look at each site's condition over time.

Dr. James Karr of Univeristy of Washington developed the B-IBI scoring criteria, which is based on Puget Sound lowland streams. Aquatic organisms are indicators of the stream, riparian area, and watershed conditions. These organisms are dependent on aquatic environments for at least one life stage. They are typically insects, but also include freshwater worms, mollusks, crustaceans, and other organisms that do not have an internal skeletal system.

In this report the scores for each site and site descriptions are provided along with information from neighboring water quality surveys stations monitored by Jefferson County Conservation District.

Evidence is showing that the scoring index may need to be calibrated for the Olympic Peninsula steam systems. In order to do this we must sample in the headwaters of streams with minimal human influence. It has also been suggested that for Chimacum Creek, which historically was composed of complex beaver ponds and spruce bogs, we must also investigate how the current scores correlate to historical conditions. This report also provides recommendations to how such analysis could be done and sites that may serve well as future additions to NOSC's B-IBI monitoring.

Sampling Sites

NOSC selected and collected B-IBI samples from twelve different survey sites that are within Chimacum watershed and Salmon Creek between 2002 and 2005. Figure 2 displays the approximate survey locations on Chimaum Ck and Figure 3 shows the approximate survey locations for Salmon Creek sites. Specific sampling sites were selected based on a combination of four criteria:

1. Summer Chum recovery streams
2. Proximity to habitat restoration sites
3. Suitability for maintaining protocol standards
4. Proximity to Jefferson County Conservation District's water quality monitoring sites, or impending project reaches.

Criteria #1, 2, and 3 assist NOSC's project monitoring of changes to the stream's biological integrity. Criteria #4 was not a requirement, but allows NOSC and other interested parties to look at other factors that are being monitored for a more comprehensive look at each site's condition over time.

There are nine sample sites sampled within the Chimacum watershed. Below is a list of these sites and a brief description of their specific location, years they were sampled, and other relevant information. See Figure 2 for their approximate map locations. Site names refer to the first two to three letters of the stream name followed by their location (estimated on maps) in terms of distance (river miles) upstream from the mouth of the stream. Sites with names followed in parenthesis are alternate names that may show up in the original and archived data and files.

CH/0.3 – Below Irondale Road culvert and approximately at river mile 0.3 upstream of Chimacum Creek's estuary on WDFW property. This site corresponds to a Jefferson Conservation District IGDO (Inter-Gravel Dissolved Oxygen) sample area, and is within Summer Chum spawning grounds. The site is moderately undisturbed. There are residential neighborhoods above the riparian corridor. Sampled 2003, 2004, and 2005.

CH/1.25 – Established as a control site for CH/0.3, above the Irondale culvert, at approximately river mile 1.25 from the estuary on a Jefferson Land Trust easement, its location is adjacent to the Shold Business Park in Port Hadlock. This is also within the Summer Chum spawning reach. No IGDO sampling collected there, but it is 0.15 mi upstream of a JCCD water quality monitoring station. Sampled 2003, 2004.

CH/1.26 – upstream of CH/1.25 accessed by property owned by Walt Glyn, and is on an JLT easement. This site was sampled as a replacement for CH/1.25 as it more closely resembles the site conditions at CH/0.3. Sampled in 2005.

CH/3.4 (School) – Located at the Chimacum School and is a site targeted for restoration work in the future for riparian habitat improvement. Monitoring at this site is providing baseline data prior to restoration, as well as educational opportunities for the school's students. This is also a JCCD water quality monitoring station. Sampled 2002, 2003, 2004, and 2005; sampling conducted with 6th grade science classes, supervised by NOSC staff.

CH/6.11 (Gould's #1) – Located downstream of the Gould's restoration site on Chimacum Creek. This site underwent instream restoration in 2002 for Coho habitat and there are JCCD water quality stations 1 mile downstream and 1.2 miles upstream. Sampled 2002, 2003, 2004, and 2005.

CH/6.23 (Gould's #2) – Located within, the Gould's restoration site on Chimacum Creek. This site underwent instream restoration in 2002 for Coho habitat and there are JCCD water quality stations 1 mile downstream and 1.2 miles upstream. Sampled 2002, 2003, 2004, and 2005.

CH/6.52 (Gould's #3) – Located upstream of the Gould's restoration site on Chimacum Creek. This site was established as a "control" site for Ch/6.11 & 6.23. There are JCCD water quality stations 1 mile downstream and 1.2 miles upstream. Sampled in 2002, 2003, 2004, and 2005. This control site should be changed to a site with better riffle habitat as it is no longer suitable for protocol. A more suitable site would be down stream of the double culverts, where the creek crosses Center Road would be a much better site as a "control".

CH/9.45 – Located on a Jefferson Land Trust easement owned by Lee Miller. This site is slated for a habitat improvement project. This is a Coho spawning area, relatively undisturbed/undeveloped, and is upstream of JCCD water quality monitoring station. Sampled in 2005.

ECH/0.53 (Durgan's) – This site is on Jefferson Land Trust Easement on the East Fork of Chimacum Creek between Marshall's, Schmidt's, and Durgan's properties. This site underwent restoration in 2003 and was added to the B-IBI monitoring sites to assess the restoration effects over time. There is no IGDO sampling at this site, but is 0.47 mi downstream and 0.33 mi upstream of two JCCD water quality monitoring stations. This is a Coho Spawning site. Sampled 2003, 2004, and 2005.

Figure 2. Chimacum Watershed sampling sites.

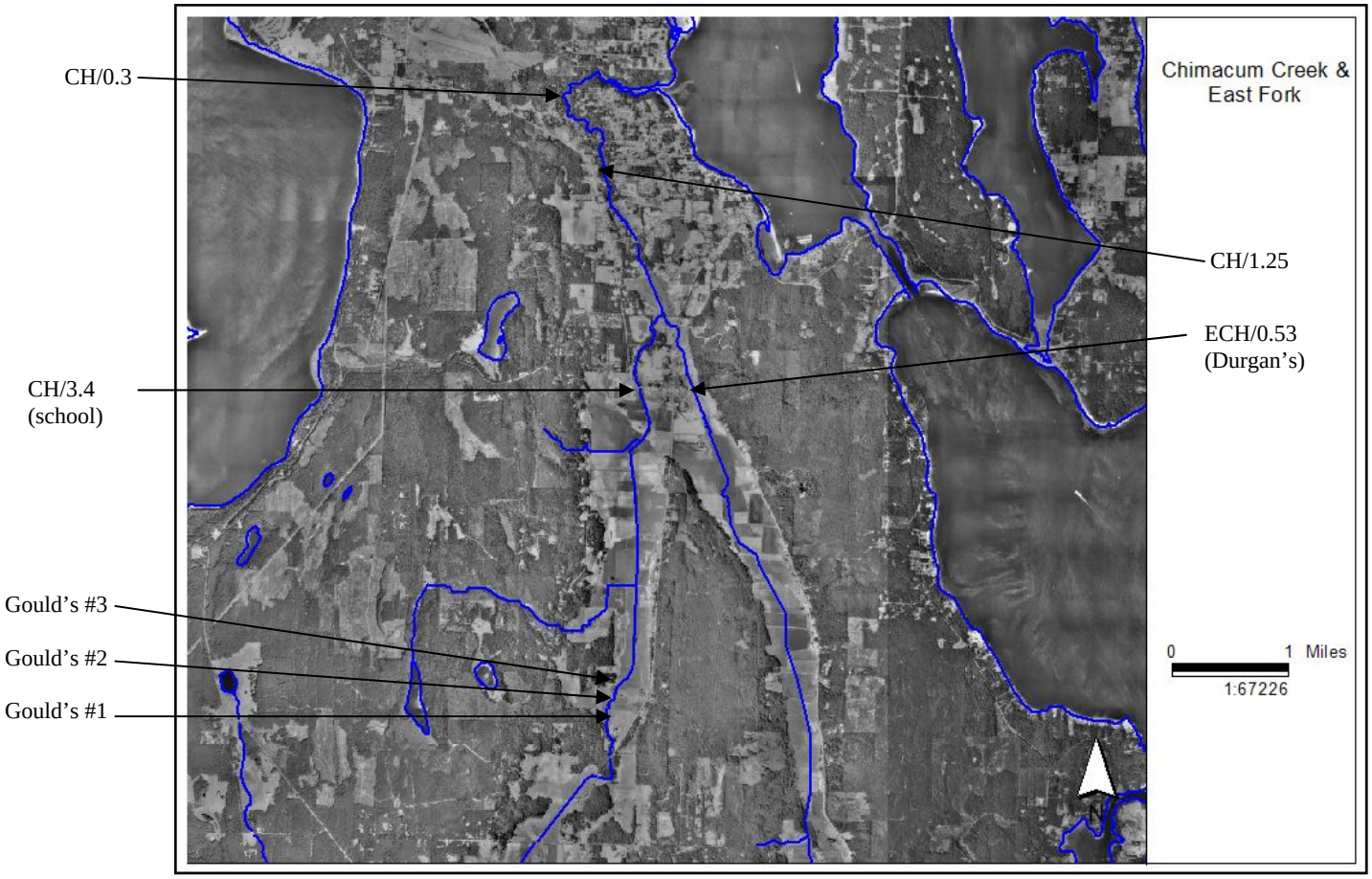


***Figure 2 needs to be updated to show CH/1.26 and the site off of Eaglemount Rd (CH/9.45).

Study sites on Salmon Creek were set up to monitor restoration effectiveness. Below is a list of the sites with a brief description of each site. See Figure 1.3 for relative site location.

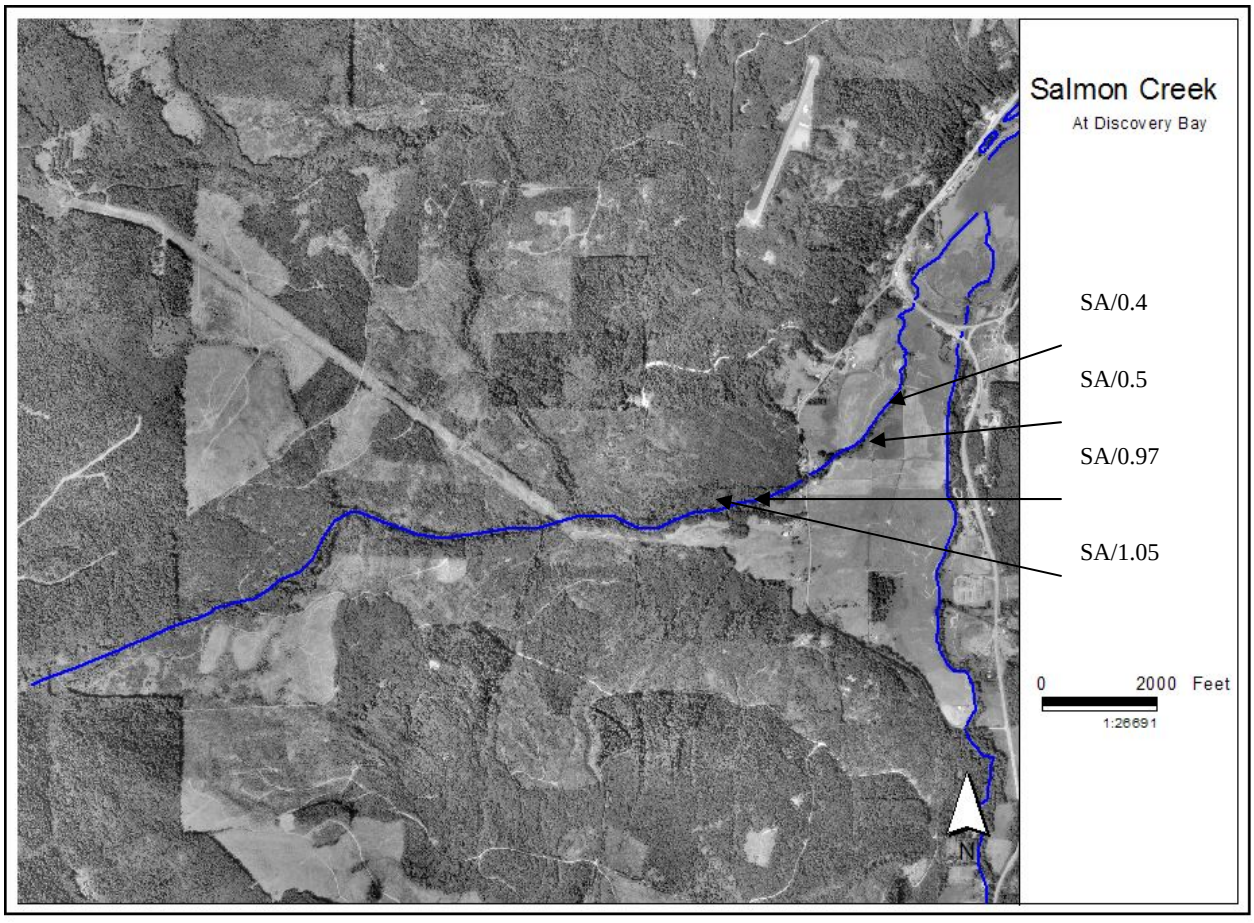
SA/0.4 – Located approximately at river mile 0.4 upstream from the U.S. Highway 101 bridge, this monitoring site was established in 2004 after stream re-construction work was conducted. It is located within Summer Chum spawning habitat and is approximately 0.3 mi upstream and 0.3 mi downstream of two JCCD water quality monitoring stations. JCCD also conducts IGDO monitoring in the reach.

SA/0.5 – This is the "control" site to be paired with SA/0.4. It was established in 2003 outside the channel re-construction reach, upstream of SA/0.4. It is within the Summer Chum spawning reach and is associated with IGDO monitoring.

SA/0.97 – Associated with IGDO sampling sites, this site was established in 2003 downstream from the Houck Creek slope stabilization project to monitor the projects effectiveness in reducing sediment to Salmon Creek. This is within Summer Chum spawning habitat, is associated with JCCD's IGDO monitoring site, and about 0.25 mi upstream of JCCD's water quality station.

SA/1.05 – Also associated with IGDO sampling, this site is the "control" site established in 2003 to be paired with SA/0.97 analysis. It is located above the Houck Creek and Salmon Creek confluence, approximately at river mile 1.05 from the U.S. Highway 101 bridge.

Figure 3. Salmon Creek macroinvertebrate survey sites



Field Methods

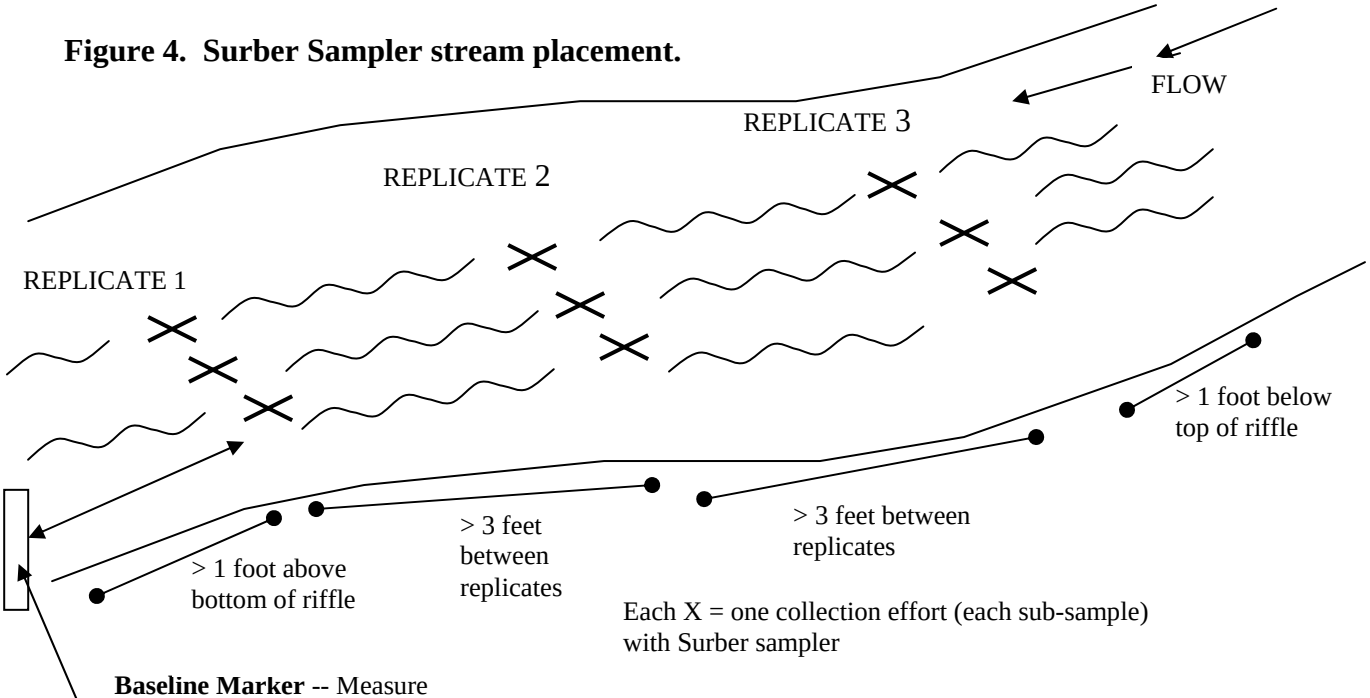
Ideal survey conditions occur in mid September through mid October. This is a time of year when the majority of aquatic macroinvertebrates will reach a stage of development where they are still present in the stream, but large enough to be caught in a 500µm mesh. Samples taken at different times of the year cannot be directly compared accurately due to different life cycle stages for the macroinvertebrates that may affect specific species collected due to seasonal differences in their size (early life cycle stages are often smaller than 500 microns and would pass through the nets and mesh), abundance, and distribution. September – October is also a time when stream flows are typically low, making surveys safer and more sites accessible. However, all samples had to be collected prior to any seasonal salmonid spawning activity resumed at the sample sites. Sampling during any spawning activity had to be avoided because of the alteration to the benthic macroinvertebrate composition and because of the potential for disrupting spawning activity and redds. For sites that are within Summer Chum spawning areas, it is necessary to collect B-IBI samples prior to their arrival in mid to late September. Because of this, Summer Chum sites were sampled in mid August through early September only. Surveys that were repeated from one year to another occurred within ten days of the previous year's collection date to replicate similar conditions.

NOSC followed the 3-Replicate B-IBI Sampling protocol provided by People for Salmon, 2002. In this protocol, each sampling site is comprised of three replicates. Each replicate is comprised of three sub-samples that are combined and labeled singly per replicate. This means that there are a total of nine sub-sample collection efforts at each site monitored to make up the three replicates.

Samples are collect with a 500µm mesh Surber Sampler. They were taken from within a stream riffle, or in the absence of well-defined riffles, the fastest flowing, most turbulent, non-depositional location was chosen. A riffle is defined as a fast-flowing area of a stream where shallow water races over stones and gravel (McCafferty 1998). The site should have sandy, pebbly, gravely or rocky substrate (e.g., no concrete culverts or subsurface flow), a minimum channel width of one foot, and an average water depth from four inches up to one foot. When establishing control sites, riffles were placed upstream and outside the discernible range of influence of the restoration work, but no more than 50 meters away.

When collecting replicate sub-samples, the Surber sampler was placed in the stream adjacent to, or diagonally upstream from that replicate's previous sub-samples, but not overlapping the areas of the stream bottom disturbed by preceding processing. Care was also taken to not step on or upstream of an area that was to be included in the sampling effort before samples were collected in order to avoid sample bias. See Figure 4 for replicate placement.

Figure 4. Surber Sampler stream placement.



Replicates within a site were generally evenly spaced along the length of the riffle with a minimum of three feet in between. The first replicate was placed at least one foot from the downstream end of the riffle; the second was placed in the middle of the riffle, no less than 3 feet between the first and third replicates; and the third was placed a few feet down from the upstream end of the riffle, but no less than one foot from the riffle crest and three feet from replicate two. Sampling always began at the downstream end and proceeded upstream.

The following is a description of how samples were collected and preserved.

The Surber sampler was placed down firmly on top of the surface of the stream bottom with the opening facing upstream. Individuals standing in the water were down stream of the sample area to avoid bias in the sample. Once the frame was secured in place, larger rocks resting within the frame were lifted, held slightly inside the opening of the net and gently brushed crawling or loosely attached organisms off so that they drift into the net. The rocks were then placed in the bucket for a thorough inspection for any remaining organisms. A metal weeding fork was used to disturb the remaining pebbles within the frame for 2 minutes, and digging down to a depth of 4 inches. After 2 minutes, the mouth of the sampler was lifted from the stream and checked for gravel or particles that washed into the net and could block the opening to the collection cup. Any such material was carefully removed from the sampler and placed into a bucket for inspection and cleaning after the replicate sample was finished being collected. Without emptying the cup, the sampling process was repeated twice more at adjacent spots. These three sampling efforts were combined into the collection cup and constitute a single replicate. A flagged marker was then left to mark the upstream end of the replicate location.

When ready to process the sample, the Surber sampler was held vertically with collection cup at the bottom and rinsed with stream water that was filtered through a 500μm sieve to ensure that no organisms were inadvertently added to the sample. Debris and organisms on the inside of the net were then rinsed into the cup at the bottom of the net. The sampler was then carried to the stream bank for processing. Contents of the sampler's cup were emptied into a plastic sorting bucket where pebbles and large debris were removed and inspected for clinging organisms. Remaining material and organisms were rinsed into a 500μm sieve then carefully placed into a storage jar with 70% - 90% ethyl alcohol. Samples with excessive amounts of debris and organisms that would not fit into a single storage jar were separated into as many additional jars as needed. Care was taken to label all jars to identify which replicate and site they belonged to.

The large rocks and debris in the bucket that where removed from the frame area were inspected for any clinging organisms that did not rinse off. Any organisms found were added to the sample's jar. In cases were larger crayfish or muscles were found, a penciled note representing the organism was placed into the sample jar and notes made on the field data sheet. The crayfish or mussel was then returned to the stream. Any vertebrate organisms were also released to the stream and noted on the field data sheet (not in the sample jar).

Samples were labeled with the stream name, date, station number, replicate number, jar series (i.e. "Jar 1 of 2"), and team initials on a small piece of waterproof paper, in pencil. The jar lids were then sealed with electrical tape at the rim and place in a plastic, self-locking bag. The bags were also labeled with the same information as the internal jar label.

All steps described above were repeated for each of the replicates per site. Once samples were collected site parameters were measured and recorded. The following site and physical stream parameters were measured at each site:

- Water and air temperature
- Weather conditions
- Riffle length

- Riffle width, average depth per replicate
- Substrate size and relative abundance per replicate
- Distance from baseline marker to downstream end of restoration site (when applicable) and each of the replicates.

Also included on the data sheet was information about the site, and directions to the exact location of the sample riffle. A baseline marker was also selected and noted on the field sheet. The distance was measured from the first replicate to the baseline marker, and noted as part of the riffle location description. The sampling site was also flagged for future's reference.

In some cases, photographs were taken of upstream and downstream segments, the riffle, baseline marker, substrate (with flagged marker for size reference), and any other useful elements.

Any deviations from the protocol were noted in the field data form as well as any unusual aspects of the stream or riparian condition that may affect the quality of the sample (upstream culverts or erosion, recent evidence of animals in the stream, etc.)

Laboratory Methods

Laboratory work was contracted to professional entomologists and followed the Northwest Biological Assessment Workgroup guidelines for Benthic Index for Biotic Integrity (B-IBI). B-IBI laboratory procedures use Caton sub-sampling devices, divided into 30 grids, each approximately 5 cm by 6 cm, for all sample handling. Samples are sub-sampled to a minimum of 500 organisms, samples are poured into the device, evenly distributed across the grid, grid squares are randomly chosen, and substrate materials lifted out into petri dishes. Using 10x-30x magnification under dissecting microscopes, technicians remove all organisms from the contents of each grid until 500 organisms are collected. The technician then continues to remove all remaining organisms from the final grid, resulting in a sub-sample of more than 500 organisms total. Additionally, the entire sample is inspected for "large and rare" organism that would not otherwise be collected in the subsampling process. They are noted and recorded in the sample's data. Quality assurance procedures are carried out for each sample. Sorted substrate and any remaining material that was unsorted are retained and stored separately until completion of the project.

In order to gauge the accuracy and precision of the taxonomic work that has been performed, a second independent lab was contracted to re-examine 10% of NOSC's annual samples, which were randomly selected by NOSC after receiving all processed samples from the primary taxonomic lab.

Taxonomic Resolution:
Taxonomic identification was provided (at minimum) to the levels outlined in Table 1. The only exception is that early instars of some macroinvertebrates may only be able to be identified to higher taxonomic levels (e.g., genus) because diagnostic features have not fully developed.

Table 1. Level of taxonomic resolution for B-IBI aquatic invertebrate groups.

Group	Taxonomic Resolution
Ephemeroptera	Species (Genus only for Leptophelibidae and some species of Heptageniidae)
Odonata	Genus / Species when possible
Megaloptera	Genus / Species when possible

Plecoptera	Species (Genus only for Capniidae, Taeniopterygidae, Chloroperlidae)
Neuroptera	Genus
Hemiptera	Genus / Species when possible
Trichoptera	Genus / Species when possible
Lepidoptera	Genus
Collembola	Genus
Coleoptera	Genus
Diptera	Genus (Chironomidae to species)
Amphipoda	Genus
Copepoda	Order
Isopoda	Genus
Ostracoda	Order
Cladocera	Family
Decapoda	Genus / Species when possible
Pelecypoda	Family / Genus when possible
Gastropoda	Genus
Tricladida	Class / Family/ Genus when possible
Hirudinea	Genus / Species when possible
Nematoda	Order
Nematomorpha	Order
Nemertea	Genus
Oligochaeta	Genus / Species for mature specimens
Hydrachnidia	Order

B-IBI Calculations

B-IBI scores were calculated by the lab/taxonomist contracted to do the taxa identification. For each replicate, metric values were calculated as described below. The metric values were then averaged across the three replicates. Score were assigned to the averaged metric values using the scoring information provided below. The metric scores were then summed for a total B-IBI score. An example of scoring procedures is provided below, following the metric descriptions and scoring criteria.

B-IBI Species-level Metric Descriptions:

Aquatic insects are identified to the lowest practicable level. Most aquatic insects can be identified to species, with the exception of chironomids, which are identified to the genus level, and rhyacophilids, which are identified to subgroup. Non-insects are identified to the order or family level.
Total Number of Taxa: The total number of unique taxa identified in each replicate.
Number of Ephemeroptera Taxa: The total number of unique mayfly (Ephemeroptera) taxa identified in each replicate.
Number of Plecoptera Taxa: The total number of unique stonefly (Plecoptera) taxa identified in each replicate.
Number of Trichoptera Taxa: The total number of unique caddisfly (Tricoptera) taxa identified in each replicate.
Number of Long-Lived Taxa: The total number of unique long-lived taxa identified in each replicate.
Number of Intolerant Taxa: The total number of unique intolerant taxa identified in each replicate. Chironomids are not included in this metric.
Percent Tolerant Individuals: The total number of tolerant individuals counted in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100*. Chironomids are not included in this metric.
Percent Predator Individuals: The total number of predator individuals counted in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100*.
Number of Clinger Taxa: The total number of unique clinger taxa identified in each replicate.
Percent Dominance (3 Taxa): The sum of individuals in the three (3) most abundant taxa in each replicate, divided by the total number of individuals in that replicate, *multiplied by 100.*

The following are descriptions of the ten metrics used to calculate B-IBI and how conditions affect them, as written for the King County "Greater Lake Washington and Green-Duwamish River Watersheds Wadeable Freshwater Streams Benthic Macroinvertebrate Sampling and Analysis Plan" (2002). Their general descriptions are appropriate for NOSC's B-IBI analysis.

Total taxa richness. The biodiversity of a stream declines as flow regimes are altered, habitat is lost, chemicals are introduced, energy cycles are disrupted, and alien taxa invade. Total taxa richness includes all the different invertebrates collected from a stream site: mayflies, caddisflies, stoneflies, true flies, midges, clams, snails, and worms.
Mayfly (Ephemeroptera) taxa richness. The diversity of mayflies declines in response to most types of human influence. Many mayflies graze on algae and are particularly sensitive to chemical pollution (e.g., from mine tailings) that interferes with their food source. Mayflies may disappear when heavy metal concentrations are high while caddisflies and stoneflies are unaffected. In nutrient-poor streams, livestock feces and fertilizers from agriculture can increase the numbers and types of mayflies present. If many different taxa of mayflies are found while the variety of stoneflies and caddisflies is low, enrichment may be the cause.
Stonefly (Plecoptera) taxa richness. Stoneflies are the first to disappear from a stream as human disturbance increases. Many stoneflies are predators that stalk their prey and hide around and between rocks. Hiding places between rocks are lost as sediment washes into a stream. Many stoneflies are shredders and feed on leaf litter that drops from an overhanging tree canopy. Most stoneflies, like salmonids, require cool water temperatures and high oxygen to complete their life cycles.
Caddisfly (Trichoptera) taxa richness. Different caddisfly species (or taxa) feed in a variety of ways: some spin nets to trap food, others collect or scrape food on top of exposed rocks. Many caddisflies build gravel or wood cases to protect them from predators; others are predators themselves. Even though they are very diverse in habit, taxa richness of caddisflies declines steadily as humans eliminate the variety and complexity of their stream habitat.

Intolerant taxa richness. Animals identified as intolerant are the most sensitive taxa; they represent approximately 5-10% of the taxa present in the region. These animals are the first to disappear as human disturbance increases.

Clinger taxa richness. Taxa defined as clingers have physical adaptations that allow them to hold onto smooth substrates in fast water. These animals typically occupy the open area between rocks and cobble along the bottom of the stream. Thus they are particularly sensitive to fine sediments that fill these spaces and eliminate the variety and complexity of these small habitats. Clingers may use these areas to forage, escape from predators, or lay their eggs. Sediment also prevents clingers from moving down deeper into the streambed, or hyporheos, of the channel.

Long-lived (semi-voltine) taxa richness. These invertebrates require more than one year to complete their life cycles; thus, they are exposed to all the human activities that influence the stream throughout one or more years. If the stream is dry part of the year or subject to flooding, these animals may disappear. Loss of long-lived taxa may also indicate an on-going problem that repeatedly interrupts their life cycles.

Percent tolerant. Tolerant animals are present at most stream sites, but as disturbance increases, they represent an increasingly large percentage of the assemblage. Invertebrates designated as tolerant represent the 5-10% most tolerant taxa in a region. In a sense, they occupy the opposite end of the spectrum from intolerant taxa.

Percent predator. Predator taxa represent the peak of the food web and depend on a reliable source of other invertebrates that they can eat. Predators may have adaptations such as large eyes and long legs for hunting and catching other animals. The percentage of animals that are obligate predators provides a measure of the trophic complexity supported by a site. Less disturbed sites support a greater diversity of prey items and a variety of habitats in which to find them.

Percent dominance (3 taxa). As diversity declines, a few taxa come to dominate the assemblage. Opportunistic species that are less particular about where they live replace species that require special foods or particular types of physical habitat. Dominance is calculated by adding the number of individuals in the three most abundant taxa and dividing by the total number of individuals collected in the sample.

B-IBI 10 Metric Species-level Scoring Criteria

Criteria are for species-level identification of most insects, rhyacophilids to subgroup, and chironomids to genus. Square braces indicate the value next to the brace is included in the range; rounded parenthesis indicates the value is *not* included.

	Scoring criteria		
Metric	**1**	**3**	**5**
Taxa richness and composition			
Total number of taxa	[0, 20)	[20, 40]	> 40
Number of Ephemeroptera taxa	[0, 4]	(4, 8]	> 8
Number of Plecoptera taxa	[0, 3]	(3,7]	> 7
Number of Trichoptera taxa	[0, 5)	[5, 10)	$\geq$ 10
Number of long-lived taxa	[0, 2]	(2, 4]	> 4
Tolerance			

Number of intolerant taxa*	[0, 2]	(2, 3]	> 3
% of individuals in tolerant taxa*	≥ 50	(19, 50)	[0, 19]
Feeding ecology			
% of predator individuals	[0, 10)	[10, 20)	≥ 20
Number of clinger taxa	[0, 10]	(10, 20]	> 20
Population attributes			
% dominance (3 taxa)	≥ 75	[50, 75)	[0, 50)

EXAMPLE: 10 Metric Species-level B-IBI

METRIC	**Rep 1**	**Rep 2**	**Rep 3**	**Replicate Average**	**Metric IBI Score** (1, 3, or 5)
Total number of taxa	25	25	32	27.33	3
Number of Ephemeroptera taxa	6	3	6	5	3
Number of Plecoptera taxa	6	6	5	5.67	3
Number of Tricoptera taxa	6	9	8	7.67	3
Number of long-lived taxa	3	3	3	3	3
Number of intolerant taxa	1	0	1	0.67	1
% of individuals in tolerant taxa	7.6	7.6	6.3	7.16	5
% of predator individuals	26.9	33.8	24.3	28.2	5
Number of clinger taxa	9	12	12	11	3
% dominance (3 taxa)	31.4	34.5	39.3	35.07	5
		Total B-IBI Score (Add Metric IBI scores for Total IBI score)			34

Appendix A

Scoring Biometrics						
Site Chimacum / School			**Date Collected**	9 Oct. 2003		
Replicate	**1**	**2**	**3**			
Metric (No./%)				**Average**	**Score**	**Total**
Total no. of taxa	25	27	26	26	3	18
No. of Ephemeroptera taxa	2	4	4	3.33	1	
No. of Plecoptera taxa	1	0	1	0.66	1	
No. of Trichoptera taxa	1	2	1	1.33	1	
No. of Long-lived taxa	1	0	1	0.66	1	
No. of Intolerant taxa	2	3	3	2.66	3	
% of individuals in tolerant taxa	19.28	37.61	17.9	24.93	3	
% of predator individuals	2.67	5.13	6.19	4.67	1	
Clinger taxa	4	6	5	5	1	

% dominance (3 taxa)	79	79	67	75	3	

	Score per Year			
Site (river miles)	**2002**	**2003**	**2004**	**2005**
Chimacum 0.30	(none)	28	34	34
Chimacum 1.25 +	(none)	32	26	(none)
Chimacum 1.26 +	(none)	(none)	(none)	34
Chimacum 3.40	16	18	22	14
Chimacum 6.11	12	26	24	30
Chimacum 6.23	16 *	26	28	22
Chimacum 6.52 +	18	34	26	24
Chimcacum 9.45	(none)	(none)	(none)	36
E. Chimacum 0.53	(none)	16 *	22	22
Salmon Ck 0.40	(none)	(none)	16 *	22
Salmon Ck 0.50 +	(none)	30	36	30
Salmon Ck 0.97	(none)	36	36	32
Salmon Ck 1.05 +	(none)	38	32	38

"+" indicates control sites
"*" indicates sampling conducted follow instream channel work.