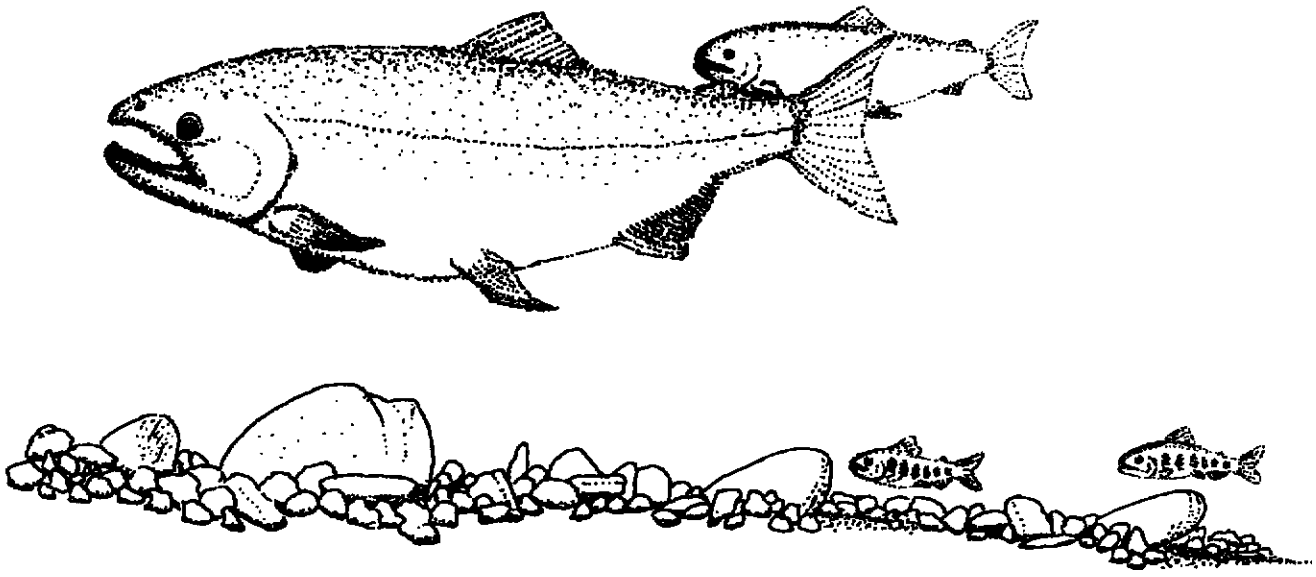
U.S. FISH AND WILDLIFE SERVICE

SUPPLEMENTATION INVESTIGATIONS FOR NATURALLY SPAWNING HOOD CANAL COHO SALMON



WESTERN WASHINGTON FISHERY RESOURCE OFFICE

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Supplementation Investigations

for Naturally Spawning Hood Canal Coho Salmon

(Task 4.1 of Hood Canal Coho MOU)

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ABSTRACT

Spawner and habitat surveys were conducted on selected streams flowing into Hood Canal to determine whether potential coho salmon (*Oncorhynchus kisutch*) habitat is currently underutilized and could be supplemented. Our initial surveys in 1992 revealed many areas that were underutilized by adult spawners. No spawners were found in many areas of the upper Dewatto and upper Tahuya Rivers. However, when we repeated spawner surveys on these streams in 1993, most of them contained adequate numbers of spawners. In 1992, spawners apparently could not migrate past some beaver dams or other obstacles due to unusually low flows. The only area that appeared to be obviously underutilized by coho salmon in both years was the streams above Tahuya Lake. These streams were further evaluated during summer low flow conditions in 1994. Few juvenile coho were found, and the streams appeared to have some good pool habitat for rearing. Based on low spawner counts and apparent availability of habitat, we recommend this area for some type of supplementation effort. We also identified several beaver ponds, marshes, and lakes that appeared to have potential as supplementation sites, however they need to be reexamined during low flows to determine whether adequate rearing habitat exists and whether it is being used by juvenile coho salmon and other fish species. Our results indicate that there are a few small, isolated areas that warrant consideration for supplementation. The best sites appear to be in the upper parts of watersheds where adult spawners may have trouble reaching in some years. Overall, supplementation potential appears to vary greatly from year to year depending on weather and relative seeding.

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INTRODUCTION

In recent years, escapement of adult coho salmon (*Oncorhynchus kisutch*) into Hood Canal streams has declined significantly. Most Hood Canal coho salmon stocks have been listed as depressed in the Salmon and Steelhead Stock Inventory (Washington Department of Fisheries et al. 1993). One possible management strategy for increasing production of wild coho salmon smolts is supplementation. This report describes an initial evaluation to help the Hood Canal Joint Technical Committee (JTC) determine whether supplementation of Hood Canal coho salmon is a positive alternative for increasing production.

Supplementation is as yet an unproved technology because only a small proportion of supplementation efforts have been shown to be successful at increasing natural production (Miller et al. 1990). Past work has indicated that supplementation by planting hatchery-origin stocks can sometimes be counter-productive (Nickelson et al. 1986). Hatchery fish may alter the behavior, growth, and survival of wild fish (Steward and Bjornn 1990). Generally, there is not a high expectation that fry supplementation increases smolt production unless the habitat is underseeded (Lestelle et al. 1993a). Supplementation projects have sometimes been successful at increasing sport, tribal, or commercial harvest but have not been successful at rebuilding runs. However, reestablishing runs or introductions to areas not inhabited by wild populations have shown good successes (Miller et al. 1990).

There is presently no specific information to clearly guide fisheries managers on successfully increasing natural production through supplementation without detrimental side effects. Given the limits to existing knowledge of supplementation, a long-term approach for any supplementation program should be to understand the ecology of the stock and factors limiting present production so that wise decisions can be made. Our main objective was to identify for further evaluation sites that were not utilized or obviously underutilized by coho salmon. We believe an evaluation of Hood Canal streams is a first step in determining supplementation possibilities. To meet this objective we: 1) surveyed a variety of coho salmon habitats for adult spawners; 2) assessed habitat condition with a cursory survey; 3) identified possible brood collection sites; and 4) reexamined selected sites during summer low flow conditions.

METHODS

To assess supplementation potential, we surveyed selected streams on both the east and west sides of Hood Canal (Table 1). Surveys were done primarily on the Dewatto River, Tahuya River above rivermile (RM) 12, Union River above RM 4 (Figure 1), and Duckabush River below RM 6.5 (Figure 2). We also conducted brief surveys on McTaggert Creek and Ripley Creek.

Dewatto, Tahuya, and Union Rivers are located in southeastern Kitsap Peninsula on the east side of Hood Canal. Many of the streams originate from lakes, ground water run-off, or swamp-like basins (Williams et al. 1975) and many have been modified by beavers (*Castor canadensis*). Many eastern Hood Canal streams have a low gradient with few barriers to anadromous salmonids.

Duckabush River, on the west side of Hood Canal, has its headwaters in the Olympic Mountains at an elevation of 6,250 feet. Numerous falls and cascades above RM 7.0 limit anadromous fish migration (Williams et al. 1975). Most Duckabush tributaries are steep and inaccessible to anadromous salmonids.

McTaggert and Ripley creeks are small streams on the west side of Hood Canal. McTaggert Creek is a tributary of the North Fork of the Skokomish River and Ripley Creek is a tributary of the Little Quilcene River.

1992 Surveys

We attempted to walk the main stem and all major tributaries of each stream. On most streams we started at the lowest section and proceeded upstream until the limit of coho access was reached. On some larger streams, such as Tahuya River, we walked downstream due to the difficulty in walking against the current. We did not resurvey WDFW (Washington Department of Fish and Wildlife, formerly WDF) index sites because those stream sections were surveyed weekly by WDFW personnel.

All surveys were done during the November and December adult coho salmon spawning season. We used a hip chain to measure the distance walked along each stream. Stream names, streams numbers, and rivermiles were taken from the WDF Stream Catalog (Williams et al. 1975). We recorded the number and location of live and dead spawners. We also noted the location of coho salmon redds in areas upstream of chum salmon spawning areas. Abundance of other adult salmonids, primarily chum salmon, was also noted. In some upper stream sections where no adult coho salmon were observed, we repeated spawner surveys to determine whether adult fish had moved up later in the year.

In addition to spawner surveys, we conducted habitat surveys on each stream to evaluate spawner distribution relative to available habitat and provide a basis for more detailed habitat surveys in the future. Total distance surveyed and length at individual habitat types were measured with a hip chain. For some inaccessible areas, lengths were estimated from topographic maps (1:24,000). Because our measured distances were generally longer than those estimated from topographic maps or WDF Stream Catalog, we used a correction factor of 1.1 to adjust measurements from maps. The correction factor was estimated by comparing field-measured distances to map distances between references points.

Stream reaches were categorized as confined stream, braided stream, dry streambed, large marsh/beaver pond (> 30 feet wide), and lakes. Small beaver ponds and marshes were usually in confined valleys and were included in the confined stream category. The pool:glide:riffle ratio was calculated from measured lengths of each habitat type. For small streams with numerous small habitat units, the pool:glide:riffle ratio was visually estimated. Within each 1,000 feet or change in stream reach, we visually estimated six parameters: mean width, percent overhead canopy, percent overhanging bank vegetation, gradient (nearest 0.5%), substrate type (percent silt, sand, gravel, cobble, boulder, and bedrock), and abundance of woody debris (low, moderate, or high). In addition to visual estimates of gradient, we also calculated gradient from topographic maps. No habitat information was taken during repeat spawner surveys.

We also identified sites for possible broodstock collection. Sites were evaluated in relation to abundance of spawners and accessibility.

1993-4 Surveys

During 1993, we only surveyed streams that we had identified as potential supplementation sites from the 1992 surveys. In areas where few spawners were observed during 1992 and 1993, we attempted to survey streams on a weekly basis.

After the 1993 spawner surveys, streams that were still identified as good supplementation sites were further evaluated for habitat quality and presence of juvenile coho during summer low flow conditions. We broke each stream into 50-m sections. Depending on time constraints, we systematically sampled 33-50% of the stream length. Habitat measurements were done over the entire 50-m section, while fish were sampled in every other pool or glide within each 50-m section. Juvenile coho salmon and other fish were sampled with a Smith-Root backpack electroshocker. Fish were collected with dip nets and placed in a holding bucket. After each pool or glide was completed, fish were enumerated and returned to the stream. Cutthroat trout (*O. clarki*) were visually broken into four size categories (< 80, 81-110, 111-140, and >140 mm fork length). Habitat units were identified according to Schuett-Hames et al. (1994) and Nickelson et al. (1992a). For each habitat unit, the length was measured along with 2-5 width measurements. Maximum depth and outlet depth were measured for each pool.

Juvenile Coho Observations.-- During 1993 and 1994 summer low-flow conditions, stream habitat surveys were done on eight independent drainages in Hood Canal (R. Tabor, unpublished data). During the habitat surveys, notes were kept on visual observations of juvenile coho. Certainly visual observations say little about the abundance of juvenile coho, but they can be used as the first step in identifying sites that are obviously underutilized by coho. Within each drainage, we attempted to survey all "coho" streams. Drainages surveyed included; Little Anderson (15.0377-85), Stavis (15.0404-6), Boyce (15.0407), Harding (15.0408-11), Anderson (15.0412-6), Union (15.0503-16), Thorndyke (17.0170-4), and Shine (17.0180-1).

RESULTS

Dewatto River

Spawner distribution, 1992-3.-- During 1992, we began adult spawner surveys on November 2, 1992 and ended on December 30, 1992. During the first 3 weeks, adult coho salmon were only observed in the lower sections of Dewatto River. Large numbers of these fish were present in holding pools. No spawning activity was observed. Adult coho salmon were not observed in the WDFW coho salmon index sections until November 25 (Figure 3). Peak counts for WDFW index sections occurred during the middle of December (Figure 3).

No adult coho salmon were observed in Dewatto River above RM 7.5 and in the WDFW index section on Windship Creek in the upper Dewatto River (RM 1.1-1.8), apparently because low flows prevented salmon access past beaver dams. Windship Creek has been used as an index section for the past 12 years and coho salmon have been observed every year except 1992 (Figure 4). In contrast, the peak count of the Dewatto River index section (RM 4.8-5.8) in 1992 was relatively high in comparison to the past 12 years. The greatest difference between the two sites occurred in 1992 (Figure 4).

Although adult coho salmon were not observed in Windship Creek and the upper reaches of the Dewatto River, they were seen immediately below beaver dams in these streams. We repeated surveys of these upper sections in case adult fish were eventually able to pass the beaver dams but even as late as December 30, no coho salmon were present. Both discharge and rainfall data indicate that November and December, 1992 were dry compared to past years (Figure 5).

The only Dewatto River tributaries used extensively by adult coho salmon were Stream 434 and lower Windship Creek (Table 2). Shoe Creek, White Creek, and Stream 422 had no apparent barriers and all were of a size useful to coho salmon, yet few adult coho salmon were present. We observed a few adult coho salmon in the lower section of Shoe Creek but no fish were seen in the upper 1.3 miles. The only coho salmon observed on White Creek and its tributary, Stream 422, were three spawners observed during a spot check near the confluence of the two streams at RM 0.3. We surveyed the upper reaches twice and the lower half mile of White Creek was surveyed weekly by WDFW chum salmon index personnel.

Streams 428, 429, and 437 had adequate water flow and spawning habitat in upstream sections but flows were sub-gravel near the streams' mouth apparently blocking fish migration. Flows at the mouth of Stream 435 were also quite low. Fish access to these streams may require a large fall freshet, which did not appear to occur during our survey period.

Migration of adult salmonids in Stream 426 appeared to be blocked by a culvert 1,045 feet from the mouth of the stream. There is approximately 4,000 feet of good spawning habitat above the culvert. We observed two coho salmon and six redds in the section below the culvert but no redds or fish were seen above the culvert. A culvert on Stream 429 also appears to block access to upper reaches.

Spawner distribution, 1993-4.-- We conducted spawner surveys in Dewatto basin streams from December 3-14. Adult coho salmon were not observed in the WDFW coho salmon index sections until December 3 (Figure 3). Peak counts for WDFW index sections occurred on December 10 (Figure 3).

During 1993-4 surveys, coho salmon spawners were abundant in many upper tributary areas where no spawners were observed during 1992-3 surveys (Table 3). Peak flow conditions in December 1993 were substantially higher than in November-December 1992 (Figure 5). A large rain event occurred from December 7-10 (14.7 cm of rain in Bremerton, Washington). High flows and destruction of several beaver dams apparently allowed coho spawners access to the upper tributaries.

Habitat Survey.-- The lower 3.5 miles of Dewatto River is a low gradient section with good habitat for coho and chum salmon. Above this section, the valley widens with frequent beaver ponds and marshes. The channel is mostly unconfined until RM 8.1.

The upper areas of Stream 437A and Windship Creek appeared to have substantial rearing area for juvenile coho salmon. Approximately 500 ft above the index section on Windship Creek is a large beaver pond (≈9 acres) that appears to be impassable. A series of beaver ponds on Stream 437A also has over 10 acres of available habitat. Additionally, Stream 437B consisted mostly of a series of beaver ponds for 1,750 feet.

Habitat in the lower 1.9 miles of Shoe Creek appeared to be good, the mean width was 9.3 feet and the gradient is ≈2.4%. Some good pool habitat was present, especially from RM 1.5 to 1.9. No barriers were observed, although an impassable cascade is listed at RM 1.2 in the WDF Stream Catalog. Unlike the upper Dewatto River, there were few beaver dams to hinder migration of salmonids in Shoe Creek. The upper section (RM 1.9-2.3) was dry as late as December 3, but some flows were observed at the outlet of Shoe Lake (RM 2.3) on December 14 and January 15. Both Shoe Lake and Larsen Lake could serve as stocking sites for juvenile coho salmon although current fishery management of these lakes is unknown. Shoe Creek tributary 425 is small and is probably not important for coho salmon. Stream 424A begins at the outlet of Larsen Lake at an impassable culvert and flows ≈4,000 feet (3.5% gradient) to Shoe Creek.

White Creek and its tributary, Stream 422, have a moderately steep gradient (3.9% and 5.9%, respectively) which may limit fish migration. A large marsh at RM 1.6 to 1.8 on White Creek could provide a good area for coho salmon rearing. The upper section between Cady Lake (RM 2.0) and RM 1.8 was mostly dry throughout our study period.

Other tributaries were similar to Shoe Creek and White Creek. They tend to have a moderate gradient, 10-30% pool habitat, and moderate level of woody debris.

Broodstock collection.-- The most accessible places for broodstock collection would be along Dewatto Road at Stream 434 or on the mainstem at RM 7.5. Most tributaries' lower sections were accessible but few spawners were observed.

Tahuya River

Spawner Distribution, 1992-3.-- We periodically surveyed Tahuya River from November 24 to December 31. Peak counts for WDFW index sections occurred from December 16 to 23 (Figure 3). We observed coho salmon spawners from RM 12 to RM 15.8. Spawners were particularly abundant on December 15 from RM 15 to RM 15.8. Although spawning habitat was limited in some areas (RM 14.1 to 15.8), spawning was observed on leading edges of old beaver dams and in short stream sections between beaver ponds. No adult coho salmon were observed above a large beaver dam at RM 15.8. Observation of spawners was difficult from RM 15.8 to 17.8 because the habitat was mostly marshes and beaver ponds. The Tahuya River from RM 17.8 to Tahuya Lake (RM 19.4), and streams above Tahuya Lake, appear to have good spawning habitat yet no fish were seen. We repeated surveys of upper Tahuya River area, but even as late as December 30, no coho salmon were present. Similarly to Dewatto River, low flows apparently prevented adult coho salmon access past beaver dams.

Small tributaries, which have been used as spawning areas, may have had unusually few spawners in 1992 due to low flows. For example, of the five index sections in the Tahuya River system, the smallest two streams, Andy's Creek (458) and Erdmann Lake Creek (459), had few spawners. We observed few fish in tributaries 471 and 472.

Spawner Distribution, 1993-4.-- Similarly to the Dewatto River tributaries, we observed coho spawners in many areas of the Tahuya River basin where we did not observe any spawners in 1992-3. The upper extent of coho spawners on the mainstem Tahuya River in 1992-3 was RM 15.8, while in 1993-4 spawners were observed up to the base of the Tahuya Lake Dam at RM 19.6. Additionally, two spawners were observed above the Tahuya Lake Dam in Gold Creek.

Juvenile Coho Survey, 1994.-- Because the tributaries above Tahuya Lake had few spawners, we further evaluated these sites for the presence of juvenile coho salmon. Stream 475 appeared to be mostly dry and was not evaluated. Results from electroshocking collections appeared to be similar to results from spawner counts. No juvenile coho were collected in Tahuya River (RM 20.4 to 20.7). In Gold Creek, where only two coho spawners were observed, juvenile coho were present but not abundant. We sampled a total of 1,908 ft^2 of pool habitat and only 19 juvenile coho were collected (Table 5). If we assume that we were able to collect 65% of the coho in the area sampled (R. Peters, USFWS, personal communication) and then expand to the other areas not sampled, we estimate the entire reach contained 111 juvenile coho. Based on densities of juvenile coho observed in various habitat types in Oregon coastal streams (Nickelson et al. 1992a), we estimated that the reach could support 1,419 juvenile coho. The other site on Tahuya River (RM 20.4 to 20.7) could support 1,407 juvenile coho. Data from Big Beef Creek indicate that 0.3142 smolts are produced per square meter of low-flow habitat. Based on this value, the Gold Creek reach could produce 467 smolts and the Tahuya River section 315 smolts. Because we did not sample the upper stream section (1,132 ft in length) of Gold Creek, the total number of coho smolts and juvenile coho would be somewhat higher. However, this section contains mostly riffles and cascades with few pools. The number of juvenile coho in the Tahuya River site would also be somewhat higher because of some available habitat in stream 477A.

In both streams cutthroat trout were abundant (Table 5). A few adult size cutthroat (> 180 mm) were collected in Gold Creek. Speckled dace (*Rhinichthys osculus*) and sculpin (*Cottus sp.*) were also common in Gold Creek.

Habitat Survey.-- Of the total stream length surveyed on Tahuya River (RM 12.0-21.2), 35% consisted of marshes and beaver ponds. From a physical habitat standpoint, the Tahuya River area above RM 15.8 has a large potential for supplementation. Tahuya Lake could provide a large area for juvenile coho salmon rearing and it has a total of 1.2 miles of spawning and rearing habitat in its two tributaries. Summer low-flow habitat surveys of the tributaries above Tahuya Lake indicated that there was some good available habitat (Table 6). Both contain a high percentage of pool habitat (Table 6). Although we did not measure discharge, flows in Gold Creek visually appeared to be good while flows in Tahuya River RM 20.3-20.8 were low. Both tributaries appear to have potential for supplementation, but the major drawback of supplementation in this area is possible interactions with introduced species. Tahuya Lake contains largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirrus*). However, these species were not collected in the tributaries.

Panther Lake and a marsh below the lake also contain a large amount of rearing habitat. There is no tributary above Panther Lake for spawning but juvenile coho salmon may move upstream for summer or winter habitat. Panther Lake reportedly has had a fish screen at the outlet but we were unable to locate it. The lake is stocked annually with catchable rainbow trout (*O. mykiss*). There is an approximately 1,500 ft stream section below the marsh that appears to have suitable spawning area.

Broodstock Collection.-- In the upper Tahuya River, spawners would best be collected just upriver from Bear Creek Road bridge at RM 15.

Union River

Spawner Distribution.-- In the Union River system, 1992-3 surveys were conducted from RM 4.0 to an impassable barrier (McKenna Falls) at RM 6.6 and were only done on December 22 and 23. We observed few adult coho salmon. The peak WDFW index count (RM 5.3 to 6.0) of 17 fish was recorded the same week we did our surveys. Seventeen fish is the lowest peak count for Union River in the past 12 years. There were a few beaver dams in our survey area but all were relatively small. Counts on index sections of two tributaries were also low. Therefore, few coho salmon apparently returned to spawn in Union River system.

No additional surveys were done in 1993-4. However, peak counts of WDFW index sections returned to more typical levels in 1993-4. The upper reaches appeared to be well seeded with coho spawners.

Juvenile Coho Observations.-- In addition to spawner surveys, we also kept notes on visual observations of juvenile coho during 1994 summer low-flow habitat surveys (R. Tabor, unpublished data). The mainstem and most tributaries were surveyed. Generally, juvenile coho appeared to be well distributed throughout the area surveyed. The only area where no juvenile

coho were observed was an unnamed LB tributary at RM 0.5. Fish may have been difficult to observe due to tannin-colored water. We surveyed the lower 0.5 mile of the stream. Above this is an apparent impassable culvert and a beaver pond which could serve as a good overwintering site. The area above the beaver pond was not surveyed.

Habitat Survey.-- From RM 4.0 to 5.3, the Union River consists of a low gradient stream with occasional beaver ponds. Although rearing habitat was abundant, spawning habitat appeared to be marginal. The substrate consisted mainly of silt, sand and small gravel. The spawning habitat appeared to be somewhat degraded from residential home development and agricultural practices which may be increasing the sediment load. Riparian vegetation had been removed in many places and bank erosion was evident in some areas.

Near McKenna Falls (RM 6.4 to 6.6) the gradient is steep and has a limited amount of coho salmon habitat. From RM 6.0 to 6.4 the gradient moderates and contains good spawning and rearing habitat.

The East Fork Union River has extensive beaver ponds and wetlands in the lower sections but was mostly dry above RM 1.3. Other tributaries appeared to have limited habitat for coho salmon due to impassable barriers or poor flow conditions.

Broodstock Collection.-- Because few coho salmon were observed, we were unable to identify any broodstock collection locations.

Duckabush River

Spawner Distribution.-- In the Duckabush River system, we observed 6 adult coho salmon in the lower section of the main stem, none in the upper section, 13 in Stream 352, and none in Stream 362. A peak count of 49 coho salmon was observed on November 25 by WDFW personnel in the Duckabush River index section (RM 0.1-2.3). Because most of our counts were done over two weeks earlier and only repeated in the tributaries, we probably missed most of the run. No additional surveys were done in 1993-4.

Habitat Survey.-- The upper section contained mostly riffle habitat while the lower section contained an even proportion of pool, riffle, and glide habitat. Woody debris was sparse throughout both river sections which may limit coho salmon production. The accessible section of Stream 362 is short but could provide some spawning habitat. No habitat survey was done on Stream 352.

Broodstock Collection.-- Stream 352 has good access and may be a good site for broodstock collection. On much of Duckabush River, access is difficult, however broodstock collection may be feasible on the lower section.

Other Streams

Spawner Distribution.-- McTaggert Creek and Ripley Creek were each surveyed once, December 7 and 23, respectively. Four adult coho salmon were observed in McTaggert and none were seen in Ripley Creek.

Juvenile Coho Observations.-- In addition to Union River, we kept notes on visual observations of juvenile coho during 1993 and 1994 summer low-flow habitat surveys of several independent drainages. During 1993 surveys, juvenile coho were not observed in the entire Harding Creek and Thorndyke Creek drainages and the upper section of Shine Creek. The lower sections of Thorndyke Creek were resurveyed in 1994 and juvenile coho appeared to be abundant. Beaver dams, located near the estuary, apparently had blocked coho migration in 1992-93. High peak flows and destruction of the lower beaver dam apparently allowed fish passage in 1993-94.

Two adult coho were observed in Harding Creek during spawner surveys in 1993-94 (P. Bahls, Port Gamble Fisheries, personal communication). On August 19, 1994, we also checked for the presence of juvenile coho with a backpack electroshocker. Thirty-two juvenile coho salmon were collected in 12.8 minutes of shocking. However, no juvenile coho were collected to the lower sections of tributaries 409 and 410. Harding Creek and its tributaries appears to be a potential site for supplementation, however further evaluation of juvenile coho density is needed.

Between RM 0.9 and 1.3 of Shine Creek there were several beaver dams which appeared to limit adult passage. The beaver ponds (RM 0.9-1.6) and 1.1 miles of stream habitat above the beaver ponds appeared to have good coho rearing habitat.

Habitat Survey.-- McTaggert Creek appeared to be mostly a steep gradient stream with few pools and few good spawning sites. Ripley Creek appeared to have good spawning habitat. However, recent habitat surveys indicated most of the stream is dry during the summer and has limited rearing habitat (P. Faulds, Point No Point Treaty Council, personal communication).

Summer low-flow habitat surveys of the Harding Creek drainage indicated there are good summer flows. Most of the best rearing habitat is located in a small stretch of Harding Creek from RM 0.3 to 0.8. The other stream sections of Harding Creek and tributaries were composed mostly of riffles and cascades with few pools.

DISCUSSION

The only thing that is clear about coho salmon supplementation is that simply adding more fish to a stream does not necessarily increase production (Miller et al. 1990). There are a number of dynamic and interactive factors determining whether supplementation is effective, as discussed below. Therefore, our evaluation of Hood Canal spawner distribution, stream habitat, and presence of juvenile coho was the first step in determining supplementation possibilities.

Spawner distribution.-- During our 1992 surveys, we revealed many areas that were underutilized by coho spawners. However, in most of these areas spawners were present during 1993-94 surveys. The lack of spawners appears to have been primarily due to unusually low flows during November and December, 1992.

In some years, marshes and beaver ponds on the upper reaches of Dewatto and Tahuya Rivers appear to be inaccessible to coho salmon. In years of normal flows, adult coho salmon may use the upper reaches and small tributaries. Fall freshets may be necessary to breach beaver dams or allow sufficient flow for fish to ascend the dams.

Some accessible streams appeared to have few adult coho salmon present given the amount of available habitat. Before supplementation efforts are undertaken, the streams need to be monitored for a few years to ensure they are consistently underseeded. In upper Tahuya River and Gold Creek, we surveyed 1.3 miles of stream yet only saw two adult coho salmon. Past records indicate these streams are capable of supporting much larger run sizes. For example in 1986 a total of 147 adult spawners were observed between the two streams.

Culverts appeared to block fish passage in two tributaries of the Dewatto River, Streams 426 and 429. Both streams appeared to be similar in size and quality to nearby Stream 434, which had abundant coho salmon spawners present. Supplementation would allow the habitat above the culverts to be utilized. The owner of the road and culvert on Stream 426 agreed to lower the culvert to allow for better fish passage. If the culvert is repaired, spawner surveys should be continued to determine whether the stream becomes seeded on its own.

During low flow years such as 1992-93, access to some tributaries may be blocked by the lack of substantial flow at the creek's mouth. The accumulation of sediments appeared to cause water flow to be mostly sub-gravel. Upper reaches often had good flows and good spawning sites but adult fish apparently did not utilize these areas. Whether past land-use practices have increased the accumulation of sediments is difficult to determine. In Stream 429 a culvert on the Dewatto Bay Road appears to have caused large downcutting of a 1,000 foot section of stream, resulting in the accumulation of sediment at the stream's mouth. Madej (1982) found that land-use changes greatly increased sediment transport rates in Big Beef Creek and caused an increase in channel width and decrease in depth, especially at the creek's mouth.

Time of year.-- Streams also need to be reexamined during summer low flows to determine whether adequate rearing habitat exists, and what proportion of potential habitat is being used by juvenile coho salmon and whether other fish species are present. Surface area should be estimated to determine potential habitat. In lentic habitats such as lakes and marshes, dissolved oxygen and temperature should also be measured. It is important to understand which habitats are limiting production in each season.

Introduced species.-- Exotic species such as largemouth bass and bluegill, both predators and competitors of juvenile coho salmon, have been stocked into many Hood Canal lakes and may occur in other habitats. In the Tenmile Lakes system in Oregon, coho salmon spawners declined dramatically following the introduction of largemouth bass (Reimers 1989). Historically, much of the smolt production in the Tenmile Lakes system occurred in lake environments. Currently, smolt production occurs only in the upper tributaries. Reimers (1989) proposed to trap fry entering the lakes and rear the fish in a hatchery

until November 1 when they could survive well in the lake. Marshes, beaver ponds, and low gradient streams may also be potential habitat for exotic species. Besides exotic species, introductions of hatchery fish may have an adverse effect on coho salmon production. In the Hood Canal area, rainbow trout are stocked into many lakes and cutthroat trout (*O. clarki*) are stocked into some marshes and beaver ponds. Although coho salmon may naturally coexist with these species, artificially high population levels of introduced fish may cause increased predation and competition.

Habitat type.-- An important factor that needs to be considered when supplementing coho salmon is the type of habitat to be stocked. Miller et al. (1990) concluded that supplementation programs have a better chance of success if stocked fish rear in lakes or ponds. Juvenile coho salmon in lakes and ponds can have good survival rates (Peterson 1982) and growth may be faster than in streams (Irvine and Johnston 1992). Nickelson et al. (1992b) concluded that the development of off-channel habitat has the greatest potential to increase production of coho salmon smolts in Oregon coastal streams.

Beaver ponds and other similar habitats are quite abundant in the Dewatto and upper Tahuya drainages. In Oregon coastal streams (Nickelson et al. 1992a) and southeast Alaska streams (Bryant 1984; Murphy et al. 1989) beaver ponds were important rearing areas for coho salmon. Beaver ponds may be particularly important for winter habitat (Nickelson et al. 1992a). Importance of marshes and beaver ponds may also be variable from year to year depending on rainfall and temperature. In the early 1980's, WDFW stocked some of the marshes and beaver ponds in the Tahuya River system, but little evaluation was done after the fish were stocked. The exception was at Long Marsh on upper Little Tahuya Creek which had a smolt trap approximately 2 miles below the stocking site. An estimated 700 hatchery smolts were collected at the trap site which indicated a survival rate of at least 1.3% (Lenzi 1984). The actual survival rate was likely somewhat higher due to fish not counted when the trap washed out, fish that reared below the trap site, and some fish outmigrating as 2+ smolts. The low survival of these hatchery fish was believed to be primarily a function of less than average stream flows in the summer of 1979. No information is known where the fish reared after stocking.

Some beaver ponds and marshes at the headwaters of streams may have little spawning habitat above them and may be historically underseeded unless juvenile coho salmon can migrate upstream past the beaver dams. Management strategies for these areas includes: stocking fish, removal of beaver dams, and the use of small, inexpensive fish ladders to allow juvenile coho salmon passage into beaver ponds (S. Jenks, WDFW, personal communication).

In addition to beaver ponds, western Kitsap Peninsula also has numerous lakes. Recent work in British Columbia indicates lakes are important for juvenile coho salmon, and smolt production may exceed that in adjacent streams (Swales 1988; Irvine and Johnston 1992; Holtby et al. 1993). The ratio of lake perimeter to stream length may be used as an index of the relative potential importance of lake habitat for coho salmon rearing in a watershed (Irvine and Johnston 1992). Within Hood Canal, little is known about the historical

importance of lakes for coho production. Currently though, access to many lakes in the Hood Canal area is blocked by screens. In Haven Lake Creek, adult coho salmon have been able to pass the fish screen at the outlet of Haven Lake in some high flow years and spawn above the lake. The following year, juvenile coho salmon were present in Haven Lake and grew to a large size (D. Collins, WDFW, personal communication). Within the area we surveyed, Panther Lake and Tahuya Lake are accessible by coho salmon. Shoe Lake, Larsen Lake, and Erickson Lake do not appear to be accessible but could serve as stocking sites.

Stocking juvenile coho salmon above natural barriers may also be a viable strategy for supplementation, assuming issues regarding native fish were not an obstacle. In other regions this strategy has been successful (Miller et al. 1990; Hurst 1993). The major natural barrier to anadromous salmonids on Kitsap Peninsula is McKenna Falls on Union River. Above McKenna Falls are 2 miles of stream habitat and Union River Reservoir, a 64-acre (3 miles of shoreline) domestic water supply reservoir for the City of Bremerton. Additionally, there are approximately 0.6 miles of stream habitat and 0.7 miles of marsh/beaver pond habitat above a waterfall on Gold Creek. Many western Hood Canal streams, such as the Duckabush River, Hamma Hamma River, and Lilliwaup River, have large amounts of potential habitat above natural barriers.

Supplementation evaluation.-- Much remains to be learned about the effectiveness of coho salmon fry supplementation before the technique can be widely applied. Early results from extensive studies on small Clearwater River (coastal Washington) tributaries indicate that supplementation may increase production, at least through low summer flow stage but only when tributaries have been underseeded (R. Peters, USFWS, personal communication). However, in cases where streams were naturally fully seeded, adding fry to the streams apparently simply displaced wild fish. It is also important to understand the point in the life history where production is limited. For example, increasing summer production will do little good if that production is lost the following winter. Most likely, each system is different and limits probably vary from year to year depending on weather and relative seeding. Therefore, each system needs careful study of available habitat at each critical stage with consideration for the number of fish available that year to seed the habitat (Lestelle et al. 1993b). Evaluation of current WDFW supplementation efforts in northwest Hood Canal streams (mainly Leland Creek and Tarboo Creek) may also add valuable information. In any case, all future supplementation should be carefully evaluated at every possible step.

RECOMMENDATIONS

1) Based on spawner counts and habitat assessment, the streams above Tahuya Lake appeared to have the best supplementation potential of the streams we examined.

2) A few sites appeared to have some potential for supplementation, however further evaluation during low flow conditions is needed. These sites include:

a) Harding Creek
b) Upper Shine Creek
c) Stream 362 (Duckabush LB tributary)
d) White Creek and tributary 422

3) We believe there are several lakes and beaver ponds that should be considered for supplementation. Further evaluation is needed to determine use by resident and anadromous fish and summer dissolved oxygen and temperature levels. These sites include:

a) Panther Lake
b) Erickson Lake
c) Shoe Lake and Larsen Lake
d) Tahuya Lake
e) Beaver pond on upper Windship Creek
f) Beaver ponds on Dewatto tributary 437A
g) Beaver ponds on East Fork Union River
h) Beaver ponds on Shine Creek

4) Streams above impassable culverts should also be considered as potential supplementation sites. These sites include Dewatto tributaries 426 and 429.

5) Evaluation should include:

a) Continuing spawner counts to assess adult coho salmon abundance and distribution.

b) Examining sites during summer low flow conditions to assess extent of carrying capacity currently being used.

1) Estimate surface area.
2) Determine density of juvenile coho salmon and other species.
3) Assess water quality (temperature and dissolved oxygen) in beaver ponds and marshes.

c) Examining overwintering habitat sites during winter to assess whether juvenile coho salmon migrate there.

d) Requiring extensive evaluation before, during, and after any fish are stocked in a supplementation effort.

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Table 1. -- List of streams surveyed during coho salmon spawning season (November 1992 - January 1993) for supplementation evaluation. Local stream names are given in parentheses. WRIA = Water Resource Inventory Area; RM = rivermile.

Stream Name	WRIA + Stream Number		RM low end	RM upper end
Dewatto River	15	420	0	4.0
Dewatto River	15	420	7.5	8.7
unnamed (White)	15	421	0	2.0
unnamed	15	422	0	0.9
unnamed	15	423	0	0.6
unnamed (Shoe)	15	424	0	1.9
unnamed	15	424A	0	0.7
unnamed	15	425	0	0.2
unnamed	15	426	0	0.8
unnamed	15	429	0	1.0
unnamed	15	434	0	1.3
Ludvick Lake	15	435	0	0.6
unnamed (Windship)	15	436	0	0.5
unnamed	15	437	0	0.8
unnamed	15	437A	0	0.9
unnamed	15	437B	0	0.3
Tahuya River	15	446	12.0	21.8
unnamed (Buffoon)	15	470	1.2	1.5
unnamed	15	471	0	0.3
unnamed	15	472	0	0.3
Gold Creek	15	474	0	0.8
unnamed	15	475	0	0.2
Tin Mine Creek	15	476	0	0.4
unnamed	15	477A	0	0.3
Union River	15	503	4.0	5.3
Union River	15	503	6.0	6.6
East Fork Union R.	15	514	0	0.3
McTaggert Creek	16	105	0	3.0
Duckabush River	16	351	0.2	2.3
Duckabush River	16	351	4.4	6.3
unnamed	16	352	0	0.4
unnamed	16	362	0	0.2
Ripley Creek	17	89	0	0.7

Table 2. -- Number of adult coho and chum salmon spawners and coho salmon redds from November and December 1992 surveys in Hood Canal streams. Redds were not counted in areas that overlapped with chum salmon distribution. WRIA = Water Resource Inventory Area; RM = rivermile.

Stream Name	WRIA + Stream Number	Date	RM low end	RM upper end	Length (miles)	Coho Salmon # Live	# Dead	# Total	#/mile	# seen	# Redds	Chum Salmon # Total	#/mile
Dewatto	15 420	02-Nov	0.0	0.7	0.7	0	0	0	0.0	80		461	658.6
Dewatto	15 420	05-Nov	0.7	1.8	1.1	416	0	416	378.2	85		374	340.0
Dewatto	15 420	16-Nov	1.8	3.2	1.4	96	0	96	68.6	40		354	252.9
Dewatto	15 420	18-Nov	3.2	4.0	0.8	5	0	5	6.3	10		0	0.0
Dewatto	15 420	24-Nov	7.5	7.7	0.2	26	0	26	130.0	80	16	0	0.0
Dewatto	15 420	03-Dec	7.9	8.1	0.2	0	0	0	0.0	80	0	0	0.0
Dewatto	15 420	08-Dec	7.9	8.7	0.8	0	0	0	0.0	60	0	0	0.0
Dewatto	15 420	15-Dec	7.9	8.1	0.2	0	0	0	0.0	90	0	0	0.0
Dewatto	15 420	30-Dec	7.9	8.1	0.2	0	0	0	0.0	90	1	0	0.0
White	15 421	04-Dec	0.0	1.6	1.6	0	0	0	0.0	90		849	530.6
White	15 421	07-Dec	1.6	2.0	0.4	0	0	0	0.0	80	0	0	0.0
White	15 421	14-Dec	0.4	1.6	1.2	3	0	3	0.0	90	1	0	0.0
unnamed	15 422	14-Dec	0.0	0.9	0.9	0	0	0	0.0	95		170	188.9
unnamed	15 423	09-Dec	0.0	0.6	0.6	3	6	9	15.0	80	7	1	1.7
Shoe	15 424	23-Nov	0.0	1.6	1.6	4	0	4	2.5	90		44	27.5
Shoe	15 424	03-Dec	1.6	1.9	0.3	0	0	0	0.0	90	0	0	0.0
Shoe	15 424	14-Dec	0.3	1.6	1.3	1	1	2	1.5	90	6	0	0.0
unnamed	15 424A	14-Dec	0.0	0.7	0.7	0	0	0	0.0	80	0	0	0.0
unnamed	15 425	14-Dec	0.0	0.2	0.2	0	0	0	0.0	90	0	0	0.0
unnamed	15 426	09-Dec	0.0	0.8	0.8	1	1	2	2.5	80	6	0	0.0
unnamed	15 429	07-Dec	0.0	1.0	1.0	0	0	0	0.0	90	0	0	0.0
unnamed	15 429	09-Dec	0.1	0.3	0.2	0	0	0	0.0	90	0	0	0.0
unnamed	15 434	15-Dec	0.0	1.3	1.3	53	4	57	43.8	90	60	0	0.0
Ludvick Lake	15 435	16-Dec	0.0	0.6	0.6	0	0	0	0.0	90	0	0	0.0
Windship	15 436	25-Nov	0.0	0.5	0.5	24	0	24	48.0	80	18	0	0.0
unnamed	15 437	15-Dec	0.0	0.8	0.8	0	0	0	0.0	95	0	0	0.0
unnamed	15 437B	25-Nov	0.0	0.3	0.3	0	0	0	0.0	50	0	0	0.0
unnamed	15 437A	03-Dec	0.0	0.9	0.9	0	0	0	0.0	90	0	0	0.0
unnamed	15 437A	15-Dec	0.0	0.5	0.5	0	0	0	0.0	90	0	0	0.0
unnamed	15 437A	30-Dec	0.0	0.5	0.5	0	0	0	0.0	90	0	0	0.0
Tahuya	15 446	24-Nov	12.0	13.0	1.0	6	0	6	6.0	75	2	0	0.0
Tahuya	15 446	30-Nov	13.0	15.0	2.0	13	1	14	7.0	30	11	0	0.0
Tahuya	15 446	01-Dec	18.2	19.4	1.2	0	0	0	0.0	90	0	0	0.0
Tahuya	15 446	02-Dec	15.0	16.3	1.3	7	0	7	5.4	70	8	0	0.0
Tahuya	15 446	10-Dec	20.5	20.9	0.4	0	0	0	0.0	90	0	0	0.0
Tahuya	15 446	16-Dec	15.0	15.8	0.8	49	2	51	63.7	80	36	0	0.0
Tahuya	15 446	18-Dec	17.8	18.2	0.4	0	0	0	0.0	75	0	0	0.0
Tahuya	15 446	18-Dec	18.2	19.4	1.2	0	0	0	0.0	70	0	0	0.0
Tahuya	15 446	18-Dec	20.6	20.8	0.2	0	0	0	0.0	90	0	0	0.0
Tahuya	15 446	30-Dec	18.2	19.4	1.2	0	0	0	0.0	80	0	0	0.0
Tahuya	15 446	30-Dec	20.6	20.8	0.2	0	0	0	0.0	90	0	0	0.0
Tahuya	15 446	31-Dec	17.4	17.7	0.3	0	0	0	0.0	80	1	0	0.0
Buffoon	15 470	31-Dec	1.2	1.5	0.3	0	0	0	0.0	80	0	0	0.0
unnamed	15 471	16-Dec	0.0	0.3	0.3	3	0	3	10.0	50	2	0	0.0
unnamed	15 472	31-Dec	0.1	0.3	0.2	0	0	0	0.0	90	0	0	0.0

Table 2, continued.

Stream Name	WRIA + Stream Number	Date	RM low end	RM upper end	Length (miles)	Coho Salmon # Live	# Dead	# Total	#/mile	# seen	# Redds	Chum Salmon # Total	#/mile
Gold	15 474	01-Dec	0.0	0.8	0.8	0	0	0	0.0	95	0	0	0.0
Gold	15 474	10-Dec	0.1	0.8	0.7	0	0	0	0.0	60	0	0	0.0
Gold	15 474	18-Dec	0.1	0.5	0.4	0	0	0	0.0	90	0	0	0.0
Gold	15 474	30-Dec	0.1	0.5	0.4	0	0	0	0.0	90	0	0	0.0
Tin Mine	15 476	30-Dec	0.0	0.4	0.4	0	0	0	0.0	90	0	0	0.0
unnamed	15 477A	18-Dec	0.0	0.3	0.3	0	0	0	0.0	90	0	0	0.0
Union	15 503	22-Dec	4.9	5.3	0.4	1	0	1	2.5	80	13	0	0.0
Union	15 503	23-Dec	6.0	6.6	0.6	0	0	0	0.0	80	5	0	0.0
Union	15 503	23-Dec	4.0	4.9	0.9	1	0	1	1.1	70	11	0	0.0
unnamed	15 512		0.2	1.1	0.9	0	0	0	0.0		0	0	0.0
East Fork Union	15 514	21-Dec	0.0	0.3	0.3	0	0	0	0.0	70	0	0	0.0
McTaggert	16 105	07-Dec	0.0	3.0	3.0	3	1	4	1.3	85	8	0	0.0
Duckabush	16 351	06-Nov	0.2	2.3	2.1	5	1	6	2.9	20		525	250.0
Duckabush	16 351	10-Nov	4.4	6.3	1.9	0	0	0	0.0	95		0	0.0
Duckabush	16 351	24-Nov	5.3	5.4	0.1	0	0	0	0.0	95		0	0.0
unnamed	16 352	24-Nov	0.0	0.4	0.4	12	1	13	32.5	95	7	0	0.0
unnamed	16 352	22-Dec	0.0	0.4	0.4	0	2	2	5.0	95	2	0	0.0
unnamed	16 362	12-Nov	0.0	0.2	0.2	0	0	0	0.0	95		0	0.0
unnamed	16 362	24-Nov	0.0	0.2	0.2	0	0	0	0.0	95		0	0.0
unnamed	16 362	22-Dec	0.0	0.2	0.2	0	0	0	0.0	95		0	0.0
Ripley	17 89	23-Dec	0.0	0.7	0.7	0	0	0	0.0		0	0	0.0

Table 3. -- Number of adult coho and chum salmon spawners and coho salmon redds from December 1993 to January 1994 surveys in Hood Canal streams. WRIA = Water Resource Inventory Area; RM = rivermile.

Stream Name	WRIA + Stream Number	Date	RM low end	RM upper end	Length (miles)	Coho Salmon # Live	# Dead	# Total	#/mile	# seen	Chum Salmon # Total	#/mile
Dewatto	15 420	14-Dec	7.9	8.7	0.8	49	0	49	61.3	90	0	0.0
White	15 421	03-Dec	0.0	0.2	0.2	0	0	0	0.0	90	36	180.0
unnamed	15 422	03-Dec	0.0	0.3	0.3	0	0	0	0.0	90	199	663.3
Shoe	15 424	03-Dec	0.1	1.3	1.2	3	0	3	2.5	70	0	0.0
Shoe	15 424	13-Dec	0.1	1.3	1.2	15	0	15	12.5	80	0	0.0
unnamed	15 426	03-Dec	0.0	0.8	0.0	0	0	0	0.0	80	0	0.0
unnamed	15 426	13-Dec	0.0	0.4	0.4	6	0	6	15.0	80	0	0.0
unnamed	15 429	08-Dec	0.0	0.3	0.3	0	0	0	0.0	70	0	0.0
unnamed	15 429	14-Dec	0.0	0.7	0.7	9	0	9	12.9	90	0	0.0
Ludvick Lake	15 435	14-Dec	0.0	0.4	0.4	3	0	3	7.5	90	0	0.0
unnamed	15 437A	14-Dec	0.0	0.9	0.9	27	1	28	31.1	80	0	0.0
Tahuya	15 446	08-Dec	20.6	20.8	0.2	0	0	0	0.0	90	0	0.0
Tahuya	15 446	08-Dec	15.0	15.7	0.7	0	0	0	0.0	40	0	0.0
Tahuya	15 446	13-Dec	18.3	19.4	1.1	9	0	9	8.2	30	0	0.0
Tahuya	15 446	13-Dec	20.3	20.8	0.5	0	0	0	0.0	90	0	0.0
Tahuya	15 446	20-Dec	20.3	20.8	0.5	0	0	0	0.0	90	0	0.0
Tahuya	15 446	29-Dec	20.3	20.8	0.5	0	0	0	0.0	90	0	0.0
Tahuya	15 446	10-Jan	20.3	20.8	0.5	0	0	0	0.0	90	0	0.0
unnamed	15 472	13-Dec	0.1	0.3	0.2	3	0	3	1.5	70	0	0.0
Gold	15 474	08-Dec	0.3	0.5	0.2	0	0	0	0.0	80	0	0.0
Gold	15 474	13-Dec	0.1	0.6	0.6	2	0	2	3.3	80	0	0.0
Gold	15 474	20-Dec	0.1	0.6	0.5	0	0	0	0.0	80	0	0.0
Gold	15 474	29-Dec	0.2	0.6	0.4	0	0	0	0.0	80	0	0.0
unnamed	15 475	20-Dec	0.1	0.3	0.2	0	0	0	0.0	90	0	0.0

Table 4. -- Summary of habitat survey data collected for Hood Canal streams from November 1992 to January 1993. Reach Type: 1 = wetted stream, 2 = dry stream, 3 = large beaver pond/marsh, 4 = lake, 5 = braided stream. Glid = glide; Rif = riffle; Ledg = ledge/bedrock; Bou = boulders; Cobb = cobble; Grav = gravel; Org = Organic debris; % Can = % overhead canopy; % OHBV = % overhanging bank vegetation; WD = abundance of woody debris (1 = few, 2 = medium, 3 = abundant).

Stream Name	WRIA + Stream Number	Dates	RM low end	RM upper end	Distance (ft)	Reach Type	mean Width (ft)	Grade	Percent Habitat type			Percent Substrate							% Can	% OHBV	WD
									Pool	Glid	Rif	Ledg	Bou	Cobb	Grav	Sand	Silt	Org			
Dewatto	15 420	Nov 2,5,16,18	0.0	3.5	21689	1	26.3	0.6	29.8	34.6	35.7	0	0	6.7	73.8	18.2	1.3	0	40.3	5.7	1.3
Dewatto	15 420	Nov 18	3.5	4.3	5400	3	411.6	0.1	98.8	1.2	0	0	0	0	2.7	6.8	90.4	0	7.5	69.2	1.5
Dewatto	15 420	Nov 24	7.5	7.6	608	1	20.0	1.1	51.0	20.0	29.0	0	0	0	30.0	50.0	20.0	0	70.0	30.0	2.0
Dewatto	15 420	Nov 24	7.6	7.9	1893	3	100.0	1.1	100.0	0	0	0	0	0	0	1.0	99.0	0	10.0	90.0	2.0
Dewatto	15 420	Dec 3,8	7.9	8.7	4700	1	7.9	2.9	36.2	34.7	29.1	0	0	0	78.9	10.5	10.5	0	85.7	31.1	3.0
Dewatto	15 420	Dec 8	8.7	8.8	376	5	20.0	0.5	80.0	20.0	0	0	0	0	0.0	50.0	50.0	0	40.0	80.0	2.0
White	15 421	Dec 4	0.0	1.6	10242	1	5.6	3.9	8.4	3.7	87.9	0	0	5.9	82.7	11.5	0.0	0	79.0	46.8	2.6
White	15 421	Dec 7	1.6	1.8	1100	3	85.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	70.0	2.0
White	15 421	Dec 7	1.8	1.9	924	2	0	2.0	0	0	0	0	0	0	0	0	0.0	0	5.0	0.0	1.0
White	15 421	Dec 7	1.9	1.95	203	3	35.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	90.0	1.0
White	15 421	Dec 7	1.95	2.0	177	2	0	1.0	0	0	0	0	0	0	0	0	0.0	0	90.0	40.0	2.0
White	15 421	Dec 7	2.0	2.2	1288	4	612.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	2.0	10.0	1.0
unnamed	15 422	Dec 14	0.0	0.9	4645	1	7.0	6.5	9.0	0	91.0	0	0	8.6	75.8	15.5	0.0	0	56.3	50.6	2.0
unnamed	15 423	Dec 9	0.0	0.6	3080	1	5.3	5.5	24.2	26.2	49.6	0	0	3.2	62.8	25.6	8.4	0	29.2	83.4	2.2
Shoe	15 424	Nov 23, Dec 3	0.0	1.9	11000	1	9.3	2.4	28.9	1.5	69.6	0	0.8	10.3	71.9	15.3	1.7	0	73.9	49.2	2.3
Shoe	15 424	Dec 3	1.9	2.4	3000	2	0.0	2.2	0.0	0	0	0	0	0	0	0	0.0	0	20.0	40.0	1.0
Shoe	15 424	Dec 3	2.4	2.6	1250	4	320.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	20.0	1.0
unnamed	15 424A	Dec 14	0.0	0.7	4017		3.8	3.5	23.5	15.0	61.5	0	0	2.8	69.9	27.1	0.2	0	81.2	65.9	2.4
unnamed	15 424A	Dec 14	0.7	0.8	753	4	542.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	60.0	2.0
unnamed	15 425	Dec 14	0.0	0.2	1000	1	3.0	8.3	20.0	10.0	70.0	0	0	15.0	70.0	15.0	0.0	0	90.0	60.0	3.0
unnamed	15 426	Dec 9	0.0	0.8	5035	1	7.4	3.3	23.9	25.9	50.2	0	0.2	29.1	56.0	14.8	0.0	0	65.3	33.0	2.8
unnamed	15 429	Dec 7	0.0	0.1	422	1	3.0	0.5	50.0	50.0	0	0	0	0	30.0	20.0	50.0	0	60.0	30.0	1.0
unnamed	15 429	Dec 7	0.1	0.3	1312	2	0.0	2.6	0	0	0	0	0	0	0	0	0	0	80.0	5.0	1.0
unnamed	15 429	Dec 7	0.3	1.0	3874	1	6.3	5.1	22.0	10.4	67.6	0	1.3	27.9	47.5	22.4	0.9	0	87.8	39.2	2.0
unnamed	15 434	Dec 15	0.0	1.3	7000	1	5.9	4.8	8.0	0.7	91.3	0	4.8	10.0	70.0	15.2	0.0	0	62.1	20.3	1.7
Ludvick Lk	15 435	Dec 16	0.0	0.6	3360	1	6.2	2.4	13.0	0	87.0	0	0	3.5	78.5	16.5	1.5	0	59.0	41.0	1.0
Windship	15 436	Nov 25	0.0	0.5	2972	1	6.6	1.3	30.1	25.5	44.4	0	0	0.7	61.0	35.1	3.2	0	86.8	52.4	2.0
Windship	15 436	Nov 25	0.5	0.6	428	3	100.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	70.0	2.0
unnamed	15 437	Dec 15	0.0	0.1	400	2	0.0	3.6	0	0	0	0	0	0	0	0	0	0	30.0	20.0	2.0
unnamed	15 437	Dec 15	0.1	0.8	4904	1	4.0	3.6	18.8	11.1	70.1	0	3.1	34.9	54.1	8.0	0.0	0	84.0	54.7	2.4
unnamed	15 437	Dec 15	0.8	1.3	3296	4	188.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	50.0	1.0
unnamed	15 437B	Nov 25	0.0	0.3	111	1	4.0	1.0	41.0	0	59.0	0	0	0	15.0	40.0	45.0	0	20.0	60.0	2.0
unnamed	15 437B	Nov 25	0.0	0.3	1752	3	70.0	1.0	100.0	0	0	0	0	0	0	0	100.0	0	10.0	80.0	2.0

Table 4, continued.

Stream Name	WRIA + Stream Number	Dates	RM low end	RM upper end	Distance (ft)	Reach Type	mean Width (ft)	Grade	Percent Habitat type			Percent Substrate							% Can	% OHBV	WD
									Pool	Glid	Rif	Ledg	Bou	Cobb	Grav	Sand	Silt	Org			
unnamed	15 437A	Dec 3	0.0	0.4	2520	1	6.0	1.4	37.0	40.0	23.0	0	0	1.2	70.0	18.8	10.0	0	83.0	38.0	3.0
unnamed	15 437A	Dec 3	0.4	0.6	1230	3	50.0	0.5	100.0	0	0	0	0	0	0	0	100.0	0	10.0	80.0	1.0
unnamed	15 437A	Dec 3	0.6	0.7	200	1	3.0	1.0	30.0	40.0	30.0	0	0	0	50.0	40.0	10.0	0	20.0	80.0	1.0
unnamed	15 437A	Dec 3	0.7	0.9	1550	3	70.0	0.5	100.0	0	0	0	0	0	0	2.0	98.0	0	10.0	80.0	2.0
Tahuya	15 446	Nov 24, 30	12.0	14.1	13193	1	17.8	0.6	30.7	44.8	24.5	0	0	5.6	74.2	11.4	8.7	0	40.1	61.5	1.7
Tahuya	15 446	Nov 30	14.1	14.9	5421	3	50.0	0.6	100.0	0	0	0	0	0	0	5.0	95.0	0	45.0	90.0	3.0
Tahuya	15 446	Nov 30, Dec 2	14.9	15.7	4986	1	17.6	0.6	35.5	42.8	21.7	0	0	5.4	53.8	9.4	31.4	0	52.8	70.5	2.3
Tahuya	15 446	Dec 2	15.7	16.1	2400	3	40.0	0.2	100.0	0	0	0	0	0	0	0	100.0	0	10.0	80.0	3.0
Tahuya	15 446	Dec 2	16.1	16.3	2056	1	25.0	0.2	97.0	0	3.0	0	0	0	5.0	15.0	80.0	0	60.0	90.0	3.0
Tahuya	15 446	Dec 31	16.3	17.2	6325	3	40.0	0.5	100.0	0	0	0	0	0	0	0	100.0	0	10.0	90.0	2.0
Tahuya	15 446	Dec 31	17.2	17.4	1529	1	20.0	0.5	50.0	50.0	0.0	0	0	0	10.0	25.0	65.0	0	30.0	60.0	2.0
Tahuya	15 446	Dec 18	17.8	18.2	2142	3	70.0	0.5	95.0	5.0	0	0	0	0	0	2.0	98.0	0	10.0	80.0	2.0
Tahuya	15 446	Dec 1	18.2	19.4	9056	1	14.7	1.0	33.1	34.3	32.6	0	1.9	27.6	47.8	15.0	7.8	0	57.8	23.4	1.9
Tahuya	15 446	Dec 1	19.4	20.1	4500	4	1125.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	2.0	10.0	1.0
Tahuya	15 446	Dec 10	20.1	20.3	1580	3	30.0	0.5	100.0	0	0	0	0	0	0	0	100.0	0	2.0	10.0	1.0
Tahuya	15 446	Dec 10	20.3	20.6	1797	1	10.6	1.5	45.7	28.7	25.6	0	0	0	67.9	22.1	10.0	0	75.0	47.1	2.0
Tahuya	15 446	Dec 10	20.6	20.8	1136	3	30.0	1.5	100.0	0	0	0	0	0	0	0	100.0	0	30.0	80.0	2.0
Tahuya	15 446	Dec 10	20.8	21.0	1136	1	10.0	1.5	30.0	40.0	40.0	0	0	0	40.0	40.0	20.0	0	60.0	80.0	2.0
Tahuya	15 446	Jan 15	21.0	21.2	1651	3	30.0	1.5	90.0	10.0	0	0	0	0	2.0	10.0	88.0	0	20.0	90.0	2.0
Buffoon	15 470	Dec 31	1.2	1.5	1530	1	14.0	1.0	48.0	29.0	23.0	0	0	40.0	45.0	10.0	5.0	0	80.0	50.0	2.0
unnamed	15 471	Dec 16	0.0	0.3	1750	1	12.9	0.8	75.7	14.3	10.0	0	0	0	1.0	19.0	80.0	0	40.0	87.1	2.0
unnamed	15 471	Dec 16	0.3	0.4	730	3	50.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	90.0	2.0
unnamed	15 472	Dec 31	0.0	0.2	1100	5	0.0	1.8	50.0	50.0	0	0	0	0	0	10.0	90.0	0	40.0	90.0	2.0
unnamed	15 472	Dec 31	0.2	0.4	1100	1	6.0	1.8	40.0	20.0	40.0	0	0	5.0	60.0	30.0	5.0	0	75.0	40.0	1.0
unnamed	15 472	Dec 31	0.4	0.7	1725	3	45.9	0.0	89.9	10.1	0	0	0	0	2.0	2.0	95.9	0	20.0	95.0	1.0
unnamed	15 472	Dec 31	0.7	1.1	2850	4	1800.0	0.0	100.0	0	0	0	0	0	0	0	100.0	0	5.0	5.0	1.0
Gold	15 474	Dec 1	0.0	0.8	4300	1	9.0	1.9	30.4	29.2	40.4	0	8.6	15.6	30.3	22.2	23.3	0	57.2	41.4	1.5
unnamed	15 475	Jan 15	0.0	0.2	1400	1	5.0	4.5	30.0	20.0	50.0	4.0	0	25.0	36.0	35.0	0.0	0	75.0	20.0	2.0
unnamed	15 477A	Dec 30	0.1	0.3	1175	1	4.0	1.6	40.0	40.0	20.0	0	0	0	40.0	40.0	20.0	0	70.0	60.0	2.0
Union	15 503	Dec 21,22	4.0	5.3	7650	1	13.0	0.5	52.4	21.6	26.0	0	0	0	39.9	44.4	15.7	0	40.4	32.6	2.0
Union	15 503	Dec 22	6.0	6.6	3160	1	8.7	3.2	12.9	22.2	64.9	0.7	38.5	31.5	14.7	8.3	6.3	0	47.8	48.7	1.0
E.F. Union	15 512	Dec 21	0.0	0.3	1435	1	7.2	0.7	24.9	75.1	0	0	0	0	1.4	10.0	88.6	0	30.0	50.0	1.0
McTaggert	16 105	Dec 7	0.0	3.0	16170	1	11.4	-	10.0	20.0	70.0	0	13.1	49.1	27.8	9.9	0	0	62.4	7.0	1.9
Duckabush	16 351	Nov 6	0.2	2.3	12258	1	55.0	0.4	31.1	35.5	33.4	0	0.3	7.7	62.3	20.9	8.9	0	1.1	1.1	1.2
Duckabush	16 351	Nov 10	4.4	6.3	10000	1	42.9	1.0	7.7	20.0	72.3	0	26.6	41.2	20.1	12.0	0	0	30.6	19.5	1.0
unnamed	16 362	Nov 12	0.0	0.2	1148	1	7.1	0.5	62.6	0	37.4	0	0	7.4	54.9	12.6	10.0	15.1	86.3	72.6	3.0
Ripley	17 89	Dec 17	0.0	0.7	3280	1	6.9	1.3	29.0	39.0	32.0	6.0	3.0	18.5	54.5	18.0	0	0	35.0	42.0	1.9

Table 5. -- Number of juvenile coho and other fish collected during electroshocking of several pools in two tributaries of Tahuya Lake in August, 1994. Cutthroat trout were visually divided into four length categories; A = < 80, B = 81-110, C = 111-140, and D = >140 mm fork length. All lamprey collected were ammocoetes. WRIA = Water Resource Inventory Area.

Stream Name	WRIA + Stream Number	Date	Pool #	Pool ft^2	maximum depth (ft)	seconds	# Coho	Cutthroat Trout A	Cutthroat Trout B	Cutthroat Trout C	Cutthroat Trout D	# Dace	# Sculpin	# Lamprey
Tahuya R. (RM 20.4-20.7)	15 446	Aug 18	1	57.0	0.98	65	0	2	0	0	0	0	0	0
		Aug 18	2	123.7	0.79	65	0	1	2	1	0	0	0	0
		Aug 18	3	128.0	1.12	67	0	4	1	1	0	2	0	0
		Aug 18	4	529.3	1.87	238	0	11	2	1	0	4	0	0
		Aug 18	5	267.9	1.31	109	0	0	2	2	0	0	0	1
		Aug 18	6	89.3	0.85	66	0	1	1	0	0	0	0	0
		Aug 18	7	97.9	1.28	118	0	0	4	5	0	0	0	0
		Aug 18	8	206.6	1.64	185	0	2	2	2	0	0	0	0
		Aug 18	9	90.4	0.56	47	0	4	0	3	0	0	0	0
		Aug 18	10	901.6	1.44	498	0	9	12	3	0	1	0	4
		Aug 18	11	471.2	2.95	182	0	7	2	0	0	3	0	0
		Aug 18	12	166.8	0.56	99	0	3	1	0	0	0	0	0
		Aug 18	13	207.6	--	131	0	5	2	0	0	0	0	0
		Aug 18	14	306.6	--	194	0	3	2	3	0	2	0	0
		Aug 18	15	650.9	2.56	194	0	0	3	1	0	0	0	0
	Totals			4294.8		2257	0	52	36	22	0	12	0	5
Gold Cr. (RM 0.1-0.5)	15 474	Aug 18	1	245.3	1.48	152	2	2	3	2	4	29	1	0
		Aug 18	2	109.7	0.75	68	0	10	1	0	0	10	2	0
		Aug 18	3	185.0	--	114	0	9	1	0	0	3	6	0
		Aug 18	4	159.2	0.98	123	1	9	1	0	0	11	8	0
		Aug 18	5	63.5	0.75	86	0	1	1	0	0	6	2	0
		Aug 18	6	118.3	--	91	1	4	3	1	0	10	2	1
		Aug 19	7	190.4	1.38	175	3	2	5	2	1	17	3	2
		Aug 19	8	170.0	--	174	3	10	11	2	0	13	3	0
		Aug 19	9	190.4	1.94	177	2	1	6	4	2	23	0	0
		Aug 19	10	150.6	1.64	202	2	9	6	5	0	19	8	0
		Aug 19	11	324.9	2.07	267	5	13	6	1	1	19	6	0
	Totals			1907.5		1629	19	70	44	17	8	160	41	3

Table 6. -- Summary of summer low-flow habitat survey data collected on two tributaries of Tahuya Lake in August 18-19, 1994.

	Tahuya River (RM 20.4-20.7)	Gold Creek (RM 0.1-0.5)
Total length (ft)	1601	2398
Percent of total length sampled	65.7	45.3
Total area (ft^2)	10818	16007
mean width (ft)	6.76	6.67
Habitat types (%)		
Pool	93.0	48.6
Scour pool	69.0	48.6
Dammed pool	21.6	0.0
Backwater pool	2.4	0.0
Tailout	0.0	4.9
Glide	0.0	5.8
Riffle	6.7	34.7
Cascade	0.3	6.0
Pool data		
Total number of pools	33.3	42.2
mean maximum depth (ft)	1.49	1.1

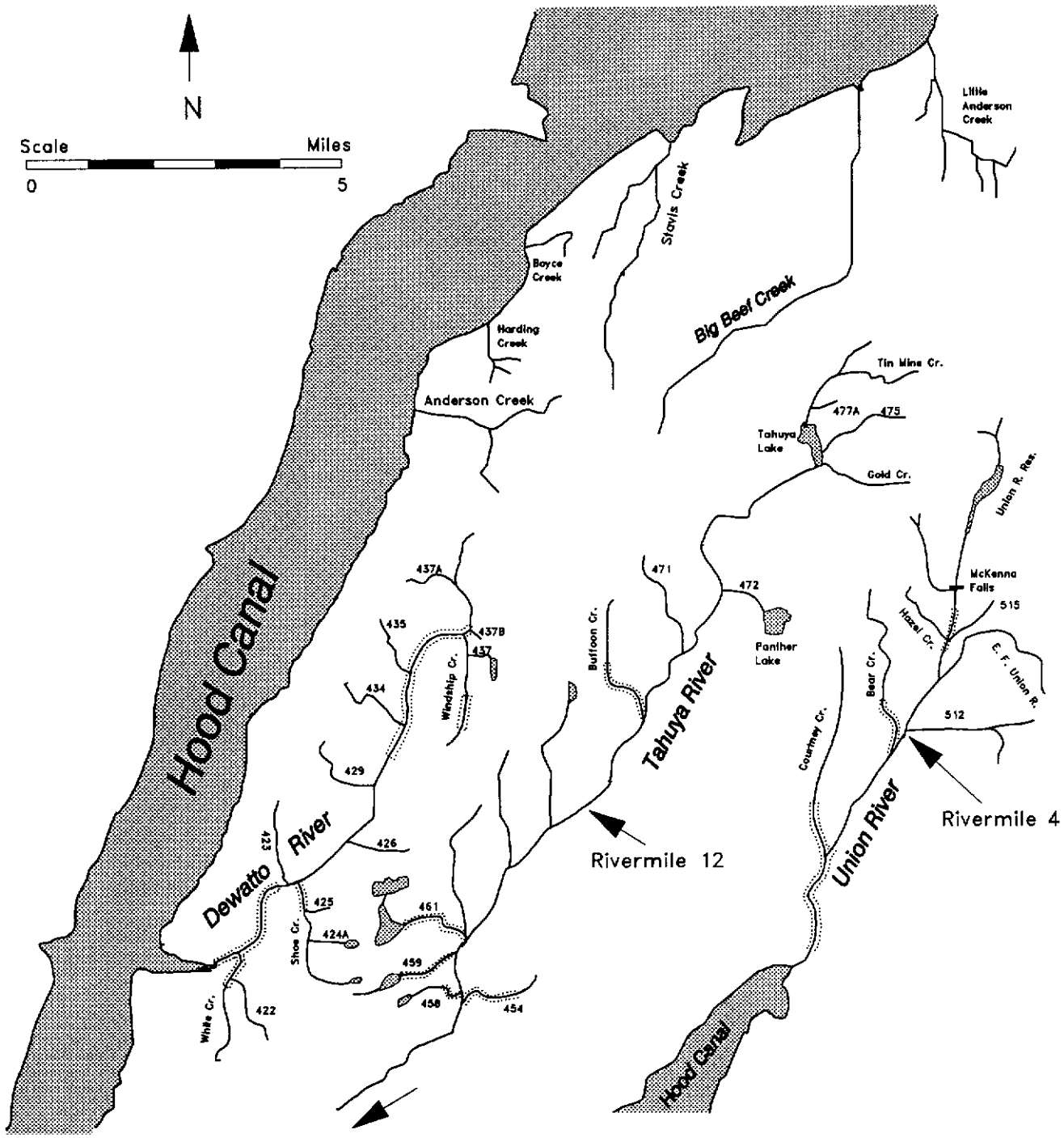

Figure 1.-- Map of southeastern Hood Canal streams surveyed for supplementation evaluation. Surveys were done on the mainstem and tributaries of Dewatto River, Tahuya River above rivermile 12, and Union River above rivermile 4. Preliminary surveys were also done in Little Anderson Cr., Stavis Cr., Boyce Cr., Harding Cr., and Anderson Cr. drainages. Unnamed streams are labeled according to the stream numbers of WDF Stream Catalog. Highlighted stream sections are WDFW chum and coho salmon index sections.

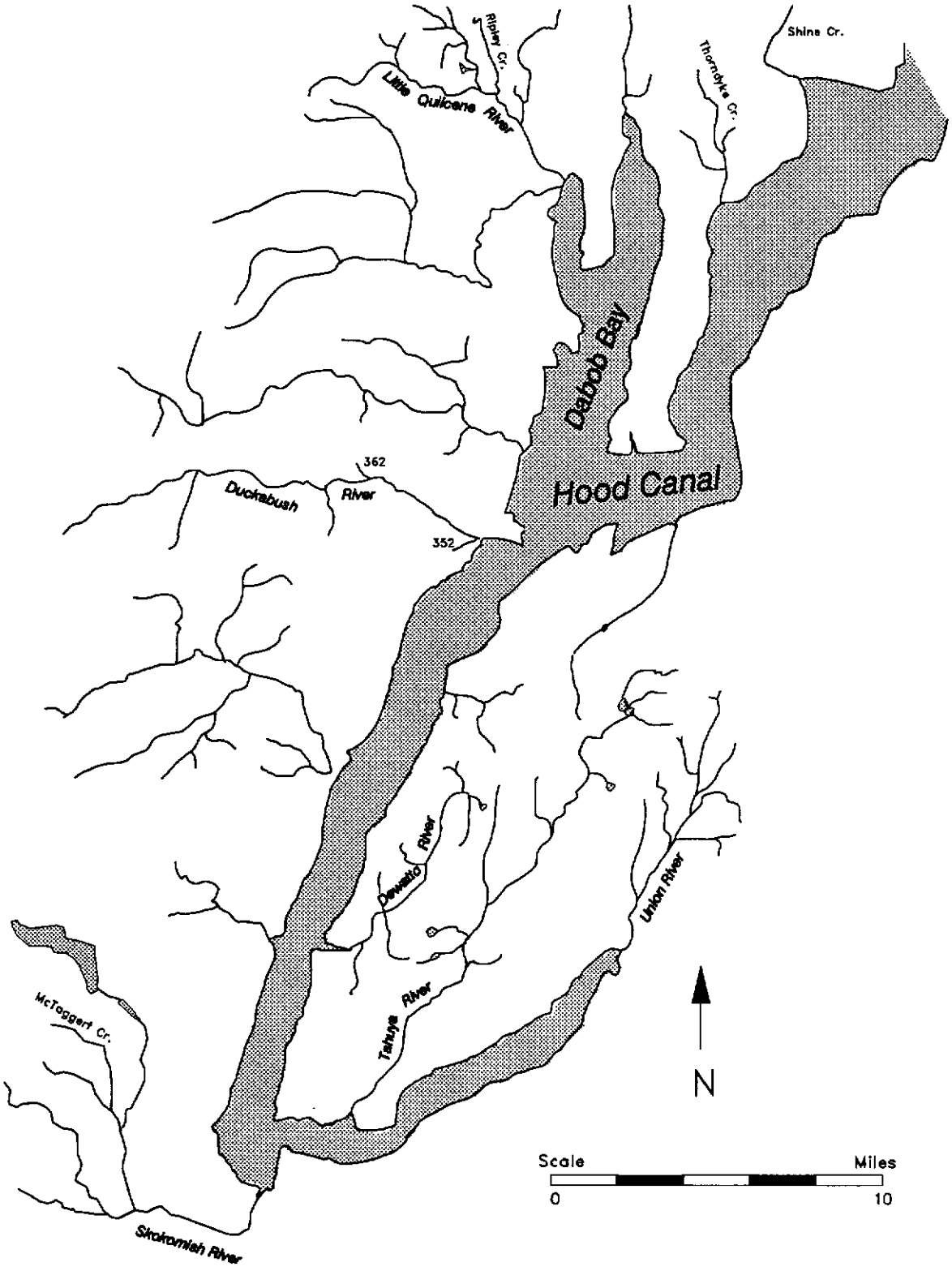

Figure 2.-- Map of other Hood Canal streams surveyed for supplementation evaluation. Study streams in southeastern Hood Canal area are given in Figure 1.

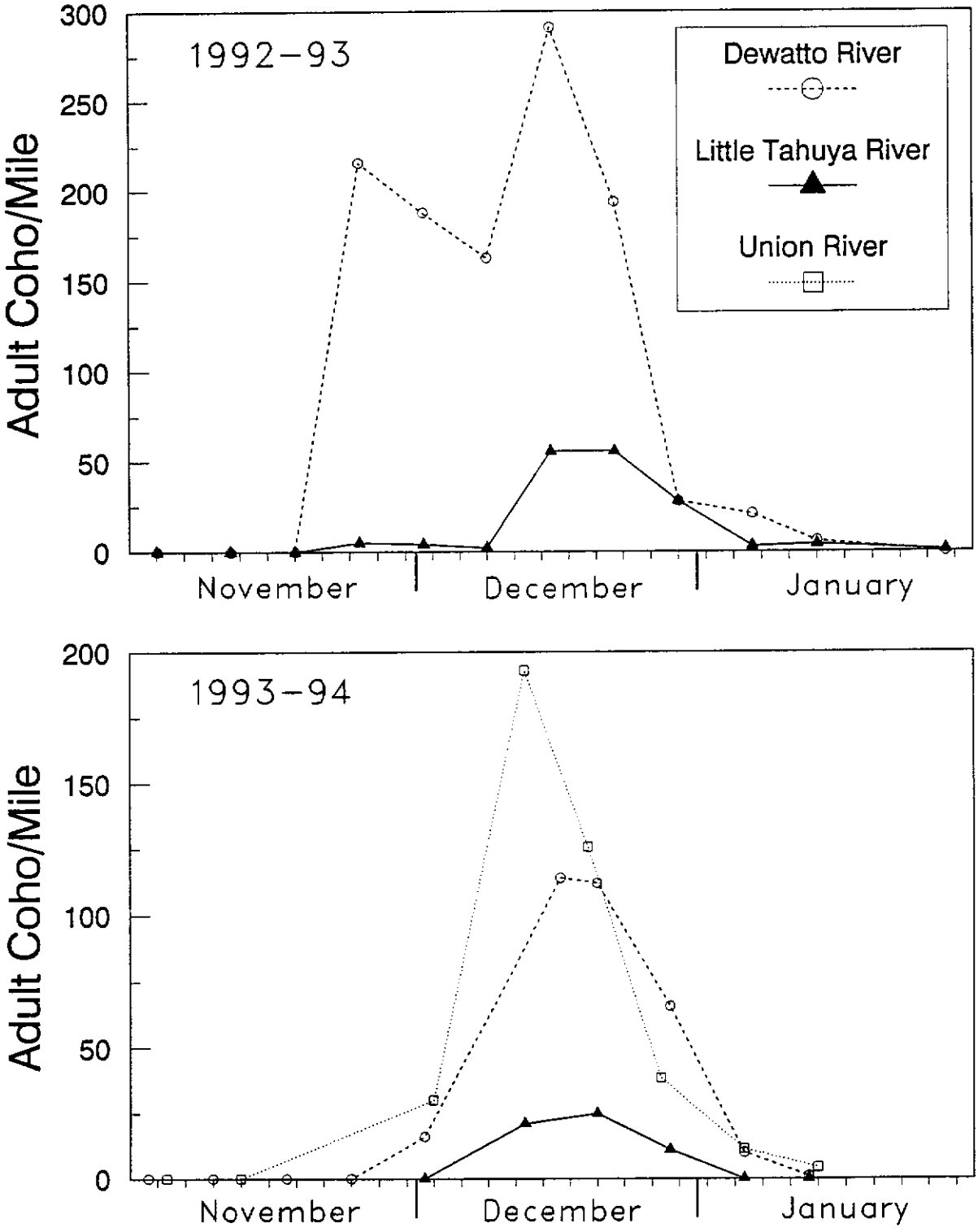

Figure 3.-- 1992-3 and 1993-4 weekly counts of adult coho salmon in WDF stream index sections for Dewatto River, Little Tahuya Creek, and Union River. Few fish were observed in the Union River index section during 1992-3 surveys.

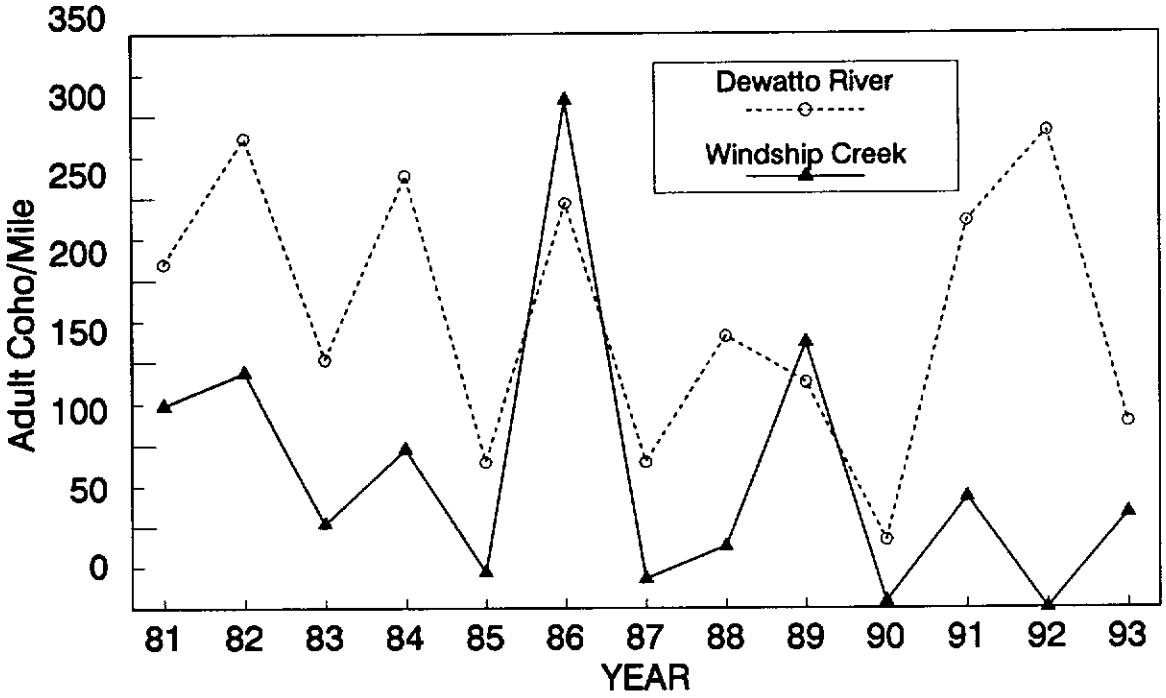

Figure 4.-- Peak adult coho salmon counts of two WDFW stream index sections in the Dewatto River system from 1981-93. Dewatto River (15.0420) index section is at rivermile 4.8-5.8. Windship Creek (15.0436) enters the Dewatto River at rivermile 7.3 and the index section is upstream at rivermile 1.1-1.8.

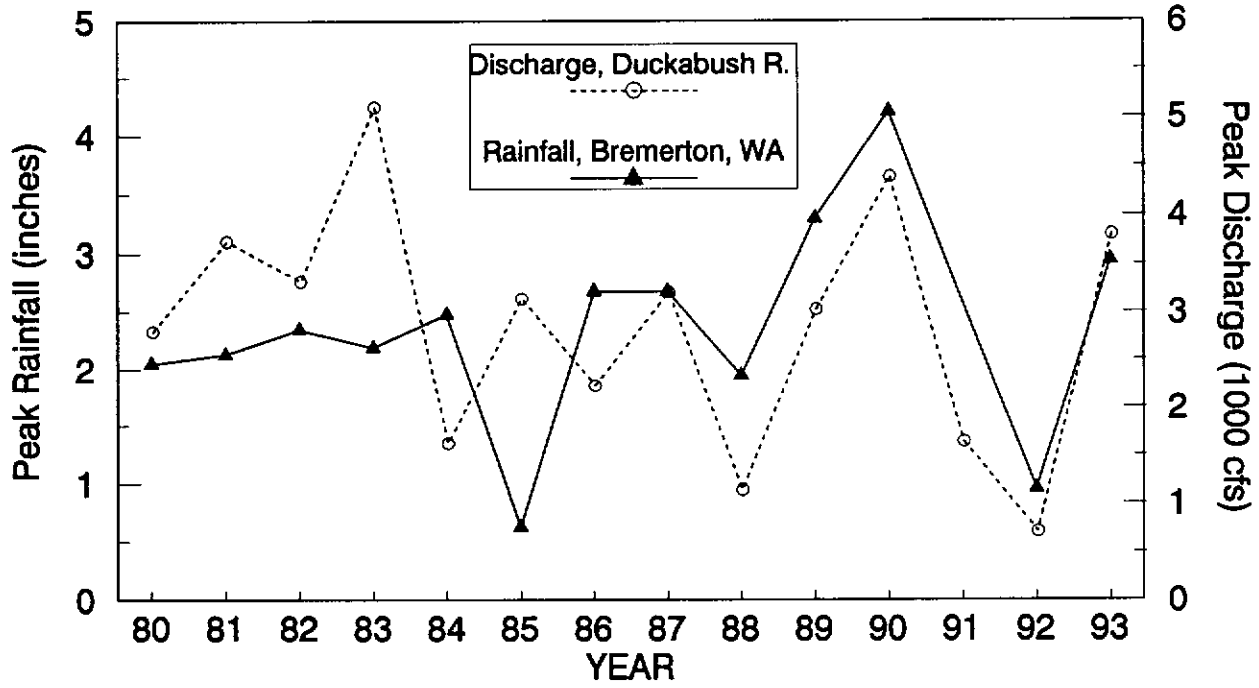

Figure 5.-- Peak rainfall and discharge for November-December of 1980-1993. Rainfall data was collected by U.S. Weather Service at Bremerton, Washington. Discharge data was collected by U.S. Geological Survey at rivermile 4.5 on the Duckabush River.

Appendix A. -- Habitat survey data collected for Hood Canal streams from November 1992 through January 1993. Feet is the distance from the stream's mouth except for Tahuya River which starts at RM 12 and Union River which starts at RM 4. Reach Type: 1 = wetted stream, 2 = dry stream, 3 = large beaver pond/marsh, 4 = lake, 5 = braided stream. Glid = glide; Rif = riffle; Ledg = ledge/bedrock; Bou = boulders; Cobb = cobble; Grav = gravel; Org = Organic debris; % Can = % overhead canopy; % OHBV = % overhanging bank vegetation; WD = woody debris; Grad = gradient.

WRIA + Stream Number	Date	RM low end	RM upper end	Feet	Distance (Ft)	Width	Reach Type	Percent Habitat type			Percent Substrate						% Can	% OHBV	WD	Grade
								Pool	Glid	Rif	Ledg	Bou	Cobb	Grav	Sand	Silt				
Dewatto River																				
15 420	02-Nov	0.0	0.7	500	500	30	1	0	89	11	0	0	5	85	10	0	20	0	LOW	1.0
15 420	02-Nov	0.0	0.7	1000	500	30	1	6	58	36	0	0	5	75	20	0	60	5	MEDIUM	1.0
15 420	02-Nov	0.0	0.7	1552	552	35	1	22	56	22	0	0	5	75	20	0	50	5	LOW	1.0
15 420	02-Nov	0.0	0.7	2108	556	30	1	9	64	27	0	0	12	75	13	0	40	15	MEDIUM	1.0
15 420	02-Nov	0.0	0.7	2450	342	30	1	58	32	10	0	0	5	70	25	0	65	5	MEDIUM	1.0
15 420	02-Nov	0.0	0.7	3155	705	30	1	16	33	51	0	0	5	90	5	0	50	0	LOW	1.0
15 420	02-Nov	0.0	0.7	3601	446	35	1	29	0	71	0	0	2	83	15	0	30	0	MEDIUM	1.0
15 420	02-Nov	0.0	0.7	4028	427	25	1	27	24	49	0	0	0	75	25	0	25	0	HEAVY	1.0
15 420	02-Nov	0.0	0.7	4488	460	30	1	7	38	55	0	0	0	70	30	0	40	5	MEDIUM	1.0
15 420	02-Nov	0.0	0.7	5028	540	30	1	52	0	48	0	0	0	70	30	0	30	3	LOW	1.0
15 420	05-Nov	0.7	1.8	6056	1028	30	1	26	39	35	0	0	2	63	33	2	20	3	LOW	1.0
15 420	05-Nov	0.7	1.8	7057	1001	30	1	45	15	40	0	0	2	63	33	2	35	8	MEDIUM	1.0
15 420	05-Nov	0.7	1.8	7990	933	30	1	38	40	22	1	0	0	65	20	14	40	8	LOW	1.0
15 420	05-Nov	0.7	1.8	9028	1038	32	1	20	45	35	0	0	3	67	25	5	30	8	LOW	1.0
15 420	05-Nov	0.7	1.8	10062	1034	25	1	46	0	54	0	0	5	70	23	2	30	10	HEAVY	1.0
15 420	05-Nov	0.7	1.8	11076	1014	20	1	40	19	41	0	0	5	70	23	2	25	8	MEDIUM	1.0
15 420	05-Nov	0.7	1.8	12086	1010	22	1	22	51	27	0	0	5	70	23	2	30	10	MEDIUM	1.0
15 420	16-Nov	1.8	3.2	13073	987	25	1	23	37	40	0	0	10	80	10	0	20	5	LOW	1.0
15 420	16-Nov	1.8	3.2	14031	958	25	1	38	32	30	0	0	10	80	10	0	20	5	MEDIUM	1.0
15 420	16-Nov	1.8	3.2	15116	1085	25	1	46	24	30	0	0	15	70	15	0	30	5	LOW	1.0
15 420	16-Nov	1.8	3.2	16244	1128	25	1	36	37	27	0	0	10	70	20	0	40	5	LOW	1.0
15 420	16-Nov	1.8	3.2	17284	1040	20	1	35	49	16	0	0	5	90	5	0	50	5	LOW	1.0
15 420	16-Nov	1.8	3.2	18198	914	20	1	40	26	34	0	0	15	70	15	0	60	5	LOW	1.0
15 420	16-Nov	1.8	3.2	19152	954	20	1	21	33	46	0	0	5	70	25	0	50	5	MEDIUM	1.0
15 420	16-Nov	1.8	3.2	19986	834	25	1	9	36	55	0	0	20	75	5	0	60	5	LOW	1.0
15 420	18-Nov	3.2	4.0	21130	1144	25	1	28	42	30	0	0	5	90	5	0	80	5	MEDIUM	1.0
15 420	18-Nov	3.2	4.0	21689	559	25	1	32	34	34	0	0	15	70	15	0	80	5	LOW	1.0
15 420	18-Nov	3.2	4.0	24214	2525	100	3	100	0	0	0	0	0	5	10	85	10	50	MEDIUM	1.0
15 420	18-Nov	3.2	4.0	24436	222	30	1	70	30	0	0	0	0	10	40	50	10	40	LOW	1.0
15 420	18-Nov	3.2	4.0	27089	2653	740	3	100	0	0	0	0	0	0	1	99	5	90	LOW	1.0
	27089 - 45912 not done, WDFW index area																			
15 420	24-Nov	7.5	7.9	46520	608	20	1	51	20	29	0	0	0	30	50	20	70	30	MEDIUM	1.0
15 420	24-Nov	7.5	7.9	48413	1893	100	3	100	0	0	0	0	0	0	1	99	10	90	MEDIUM	1.0

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Percent Habitat type Pool	Glid	Rif	Percent Substrate Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
15 420	03-Dec	7.9	8.1	49343	930	8	1	51	24	25	0	0	0	34	33	33	80	50	HEAVY	1.0
15 420	08-Dec	8.1	8.7	50430	1087	10	1	39	43	18	0	0	0	90	5	5	80	30	HEAVY	1.5
15 420	08-Dec	8.1	8.7	51366	936	8	1	30	35	35	0	0	0	90	5	5	90	25	HEAVY	1.5
15 420	08-Dec	8.1	8.7	52409	1043	7	1	30	35	35	0	0	0	90	5	5	90	25	HEAVY	1.5
15 420	08-Dec	8.1	8.7	53113	704	6	1	30	35	35	0	0	0	90	5	5	90	25	HEAVY	1.5
15 420	08-Dec	8.1	8.7	53489	376	20	5	80	20	0	0	0	0	0	50	50	40	80	MEDIUM	0.5
unnamed LB trib of 420 (White Cr. - local name)																				
15 421	04-Dec	0.0	1.6	1092	1092	10	1	4	7	89	0	0	5	80	15	0	50	20	LOW	2.0
15 421	04-Dec	0.0	1.6	2016	924	7	1	10	10	80	0	0	2	80	18	0	60	35	MEDIUM	2.0
15 421	04-Dec	0.0	1.6	2958	942	6	1	17	1	82	0	0	1	85	14	0	70	50	HEAVY	1.5
15 421	04-Dec	0.0	1.6	4214	1256	6	1	15	0	85	0	0	10	80	10	0	80	50	HEAVY	1.5
15 421	04-Dec	0.0	1.6	5231	1017	5	1	5	6	89	0	0	5	85	10	0	80	50	HEAVY	1.5
15 421	04-Dec	0.0	1.6	6426	1195	5	1	4	1	95	0	0	10	80	10	0	90	50	MEDIUM	1.5
15 421	04-Dec	0.0	1.6	7591	1165	4	1	7	0	93	0	0	2	95	3	0	90	50	HEAVY	2.0
15 421	04-Dec	0.0	1.6	8962	1371	5	1	6	0	94	0	0	0	80	10	0	90	60	HEAVY	2.0
15 421	04-Dec	0.0	1.6	10242	1280	3	1	9	10	81	0	0	5	80	15	0	90	50	HEAVY	1.5
15 421	07-Dec	1.6	2.2	11342	1100	85	3	100	0	0	0	0	0	0	0	100	5	70	MEDIUM	0.0
15 421	07-Dec	1.6	2.2	12266	924	0	2	0	0	0	0	0	0	0	0	0	5	0	LOW	2.0
15 421	07-Dec	1.6	2.2	12469	203	35	3	100	0	0	0	0	0	0	0	100	5	90	LOW	0.0
15 421	07-Dec	1.6	2.2	12646	177	0	2	0	0	0	0	0	0	0	0	0	90	40	MEDIUM	1.0
15 421	07-Dec	1.6	2.2	13934	1288	612	4	100	0	0	0	0	0	0	0	100	2	10	LOW	0.0
unnamed RB trib of 421																				
15 422	14-Dec	0.0	0.9	1155	1155	10	1	10	0	90	0	0	10	80	10	0	50	65	MEDIUM	2.0
15 422	14-Dec	0.0	0.9	2092	937	10	1	11	0	89	0	0	5	80	15	0	50	65	MEDIUM	2.5
15 422	14-Dec	0.0	0.9	3007	915	6	1	11	0	89	0	0	5	80	15	0	65	40	MEDIUM	2.5
15 422	14-Dec	0.0	0.9	4058	1051	4	1	6	0	94	0	0	10	70	20	0	65	40	MEDIUM	2.0
15 422	14-Dec	0.0	0.9	4645	587	3	1	6	0	94	0	0	15	65	20	0	50	35	MEDIUM	2.5
unnamed RB trib of 420																				
15 423	09-Dec	0.0	0.6	1047	1047	6	1	13	9	78	0	0	5	65	30	0	60	90	MEDIUM	1.5
15 423	09-Dec	0.0	0.6	2400	1353	5	1	30	35	35	0	0	1	60	25	14	10	80	MEDIUM	1.5
15 423	09-Dec	0.0	0.6	3080	680	5	1	30	35	35	0	0	5	65	20	10	20	80	HEAVY	1.5
unnamed LB trib to 420 (Shoe Cr. - local name)																				
15 424	23-Nov	0.0	1.6	1008	1008	12	1	21	0	79	0	0	25	65	10	0	90	50	MEDIUM	2.0
15 424	23-Nov	0.0	1.6	2017	1009	12	1	26	0	74	0	0	20	70	10	0	50	70	MEDIUM	2.0
15 424	23-Nov	0.0	1.6	3022	1005	12	1	26	0	74	0	0	15	70	15	0	60	40	MEDIUM	2.0
15 424	23-Nov	0.0	1.6	3966	944	12	1	25	0	75	0	2	10	73	15	0	80	40	MEDIUM	2.0
15 424	23-Nov	0.0	1.6	5011	1045	10	1	14	0	86	0	5	15	70	10	0	80	40	MEDIUM	2.0

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Habitat type Percent Pool	Glid	Rif	Substrate Percent Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
15 424	23-Nov	0.0	1.6	6013	1002	10	1	17	0	83	0	2	10	78	10	0	80	40	MEDIUM	1.5
15 424	23-Nov	0.0	1.6	7028	1015	9	1	27	7	66	0	0	10	80	10	0	80	50	MEDIUM	2.0
15 424	23-Nov	0.0	1.6	8000	972	7	1	25	0	75	0	0	5	85	10	0	80	60	HEAVY	2.0
15 424	23-Nov	0.0	1.6	9110	1110	8	1	47	0	53	0	0	2	78	20	0	90	60	MEDIUM	1.0
15 424	03-Dec	1.6	2.6	11000	1890	5	1	45	5	50	0	0	0	60	30	10	60	45	HEAVY	1.5
15 424	03-Dec	1.6	2.6	14000	3000	0	2	0	0	0	0	0	0	0	0	0	20	40	LOW	1.5
15 424	03-Dec	1.6	2.6	15250	1250	320	4	100	0	0	0	0	0	0	0	100	5	20	LOW	0.0
unnamed RB trib to 424 (no WRIA #, enters at RM 1.1)																				
15 424A	14-Dec	0.0	0.8	1225	1225	4	1	20	10	70	0	0	5	75	20	0	70	70	MEDIUM	2.0
15 424A	14-Dec	0.0	0.8	2000	775	4	1	25	10	65	0	0	5	75	20	0	70	85	HEAVY	2.5
15 424A	14-Dec	0.0	0.8	3084	1084	4	1	25	20	55	0	0	1	69	30	0	90	70	MEDIUM	2.0
15 424A	14-Dec	0.0	0.8	4017	933	3	1	25	20	55	0	0	0	60	39	1	95	40	HEAVY	2.0
15 424A	14-Dec	0.0	0.8	4770	753	542	4	100	0	0	0	0	0	0	0	100	5	60	LOW	0.0
unnamed RB trib. of 424																				
15 425	14-Dec	0.0	0.2	1000	1000	3	1	20	10	70	0	0	15	70	15	0	90	60	HEAVY	2.0
unnamed LB trib. of 420																				
15 426	09-Dec	0.0	0.8	1045	1045	8	1	20	20	60	0	1	30	60	9	0	85	35	MEDIUM	2.5
15 426	09-Dec	0.0	0.8	2050	1005	8	1	30	30	40	0	0	20	60	20	0	70	40	HEAVY	2.0
15 426	09-Dec	0.0	0.8	3000	950	7	1	30	30	40	0	0	25	60	15	0	50	30	HEAVY	2.0
15 426	09-Dec	0.0	0.8	4025	1025	7	1	20	25	55	0	0	35	50	15	0	60	30	HEAVY	2.0
15 426	09-Dec	0.0	0.8	5035	1010	7	1	20	25	55	0	0	35	50	15	0	60	30	HEAVY	2.0
unnamed RB trib. of 420																				
15 429	07-Dec	0.0	1.0	422	422	3	1	50	50	0	0	0	0	30	20	50	60	30	LOW	0.5
15 429	07-Dec	0.0	1.0	1734	1312	0	2	0	0	0	0	0	0	0	0	0	80	5	LOW	1.5
15 429	07-Dec	0.0	1.0	2094	360	4	1	7	27	66	0	0	40	40	10	10	80	5	LOW	1.5
15 429	07-Dec	0.0	1.0	3144	1050	7	1	38	2	60	0	0	35	35	30	0	90	40	MEDIUM	1.5
15 429	07-Dec	0.0	1.0	4135	991	7	1	38	2	60	0	0	35	35	30	0	90	40	MEDIUM	1.5
15 429	07-Dec	0.0	1.0	4135	0	7	1	16	15	69	0	5	35	30	30	0	90	40	MEDIUM	2.0
15 429	07-Dec	0.0	1.0	5144	1009	6	1	19	7	74	0	0	15	70	15	0	85	50	MEDIUM	2.0
15 429	07-Dec	0.0	1.0	5608	464	6	1	17	14	69	0	0	15	70	15	0	90	30	MEDIUM	2.0
unnamed RB trib. of 420																				
15 434	15-Dec	0.0	1.3	1001	1001	6	1	18	5	77	0	0	6	76	18	0	70	20	MEDIUM	2.0
15 434	15-Dec	0.0	1.3	2012	1011	8	1	8	0	92	0	0	6	76	18	0	70	40	LOW	2.0
15 434	15-Dec	0.0	1.3	3000	988	8	1	8	0	92	0	0	5	75	20	0	70	25	MEDIUM	2.0
15 434	15-Dec	0.0	1.3	4000	1000	7	1	10	0	90	0	0	5	80	15	0	70	25	MEDIUM	2.0

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Percent Habitat type Pool	Glid	Rif	Percent Substrate Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
15 434	15-Dec	0.0	1.3	5147	1147	5	1	4	0	96	0	0	5	80	15	0	70	20	MEDIUM	2.0
15 434	15-Dec	0.0	1.3	6000	853	3	1	9	0	91	0	10	20	60	10	0	40	5	MEDIUM	4.0
15 434	15-Dec	0.0	1.3	7000	1000	4	1	0	0	100	0	25	25	40	10	0	40	5	LOW	5.0
Ludvick Lake Creek																				
15 435	16-Dec	0.0	0.6	740	740	0	5	20	0	80	0	0	0	80	15	5	50	30	LOW	1.5
15 435	16-Dec	0.0	0.6	1016	276	8	1	20	0	80	0	0	0	80	15	5	50	30	LOW	1.5
15 435	16-Dec	0.0	0.6	2000	984	6	1	10	0	90	0	0	5	75	20	0	60	40	LOW	2.0
15 435	16-Dec	0.0	0.6	3360	1360	6	1	10	0	90	0	0	5	80	15	0	65	50	LOW	2.0
unnamed LB trib to 420 (Windship Creek - local name)																				
15 436	25-Nov	0.0	0.6	1049	1049	6	1	31	17	52	0	0	2	49	49	0	90	75	MEDIUM	1.5
15 436	25-Nov	0.0	0.6	2033	984	7	1	36	16	48	0	0	0	70	30	0	90	40	MEDIUM	1.5
15 436	25-Nov	0.0	0.6	2972	939	7	1	23	45	32	0	0	0	65	25	10	80	40	MEDIUM	1.5
15 436	25-Nov	0.0	0.6	3400	428	100	3	100	0	0	0	0	0	0	0	100	5	70	MEDIUM	0.0
unnamed RB trib. of 436																				
15 437	15-Dec	0.0	1.3	400	400	0	2	0	0	0	0	0	0	0	0	0	30	20	MEDIUM	1.5
15 437	15-Dec	0.0	1.3	1400	1000	5	1	10	30	60	0	0	5	90	5	0	85	15	LOW	2.0
15 437	15-Dec	0.0	1.3	2400	1000	5	1	5	5	90	0	5	50	40	5	0	85	50	MEDIUM	2.5
15 437	15-Dec	0.0	1.3	3400	1000	4	1	20	10	70	0	10	40	40	10	0	80	70	HEAVY	2.0
15 437	15-Dec	0.0	1.3	5304	1904	3	1	30	5	65	0	0	40	50	10	0	85	70	HEAVY	2.0
15 437	15-Dec	0.0	1.3	8600	3296	188	4	100	0	0	0	0	0	0	0	100	5	50	LOW	0.0
unnamed LB trib. to 420 (no WRIA #, enters at RM 7.4)																				
15 437B	25-Nov	0.0	0.3	111	111	4	1	41	0	59	0	0	0	15	40	45	20	60	MEDIUM	1.0
15 437B	25-Nov	0.0	0.3	1863	1752	70	3	100	0	0	0	0	0	0	0	100	10	80	MEDIUM	1.0
unnamed RB trib. to 420 (no WRIA #, enters at RM 8.05)																				
15 437A	03-Dec	0.0	0.9	1000	1000	6	1	40	40	20	0	0	0	70	20	10	80	35	HEAVY	1.0
15 437A	03-Dec	0.0	0.9	2520	1520	6	1	35	40	25	0	0	2	70	18	10	85	40	HEAVY	1.0
15 437A	03-Dec	0.0	0.9	3750	1230	50	3	100	0	0	0	0	0	0	0	100	10	80	LOW	0.0
15 437A	03-Dec	0.0	0.9	3950	200	3	1	30	40	30	0	0	0	50	40	10	20	80	LOW	1.0
15 437A	03-Dec	0.0	0.9	5500	1550	70	3	100	0	0	0	0	0	0	2	98	10	80	MEDIUM	0.5
Tahuya River																				
15 446	24-Nov	12.0	13.0	787	787	20	1	25	18	57	0	0	10	85	5	0	70	50	LOW	1.5
15 446	24-Nov	12.0	13.0	1748	961	20	1	36	11	53	0	0	10	80	10	0	60	50	MEDIUM	1.5
15 446	24-Nov	12.0	13.0	2727	979	20	1	20	62	18	0	0	5	85	10	0	25	35	LOW	1.5
15 446	24-Nov	12.0	13.0	3777	1050	20	1	28	58	14	0	0	5	85	10	0	15	20	LOW	1.5
15 446	24-Nov	12.0	13.0	4769	992	20	1	33	39	28	0	0	5	85	10	0	15	30	LOW	1.5

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Habitat type Percent Pool	Glid	Rif	Substrate Percent Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
Tahuya River, continued																				
15 446	24-Nov	12.0	13.0	5637	868	20	1	40	26	34	0	0	10	85	5	0	20	45	LOW	1.5
15 446	24-Nov	12.0	13.0	6777	1140	20	1	14	66	20	0	0	10	85	5	0	25	50	LOW	1.5
15 446	30-Nov	13.0	15.0	7373	596	15	1	0	65	35	0	0	5	90	5	0	30	90	MEDIUM	1.5
15 446	30-Nov	13.0	15.0	8448	1075	15	1	15	59	26	0	0	3	90	5	2	50	95	MEDIUM	1.5
15 446	30-Nov	13.0	15.0	9510	1062	15	1	22	54	24	0	0	5	80	10	5	40	80	MEDIUM	1.5
15 446	30-Nov	13.0	15.0	10541	1031	15	1	39	37	24	0	0	10	70	15	5	50	70	MEDIUM	1.5
15 446	30-Nov	13.0	15.0	11574	1033	15	1	18	66	16	0	0	0	80	15	5	60	80	MEDIUM	1.5
15 446	30-Nov	13.0	15.0	12559	985	15	1	76	24	0	0	0	0	5	35	60	70	95	HEAVY	1.0
15 446	30-Nov	13.0	15.0	13193	634	20	1	71	29	0	0	0	0	20	20	60	30	85	HEAVY	0.5
15 446	30-Nov	13.0	15.0	18614	5421	50	3	100	0	0	0	0	0	0	5	95	45	90	HEAVY	0.5
15 446	30-Nov	13.0	15.0	19610	996	12	1	21	54	25	0	0	15	70	15	0	80	80	MEDIUM	1.5
15 446	02-Dec	15.0	16.3	21991	2381	15	1	6	59	35	0	0	5	80	10	5	50	50	MEDIUM	1.0
15 446	02-Dec	15.0	16.3	23600	1609	25	1	88	12	0	0	0	0	5	5	90	40	95	HEAVY	1.0
15 446	02-Dec	15.0	16.3	26000	2400	40	3	100	0	0	0	0	0	0	0	100	10	80	HEAVY	0.5
15 446	02-Dec	15.0	16.3	28056	2056	25	1	97	0	3	0	0	0	5	15	80	60	90	HEAVY	0.5
15 446	31-Dec	16.3	17.4	34381	6325	40	3	100	0	0	0	0	0	0	0	100	10	90	MEDIUM	0.0
15 446	31-Dec	16.3	17.4	35910	1529	20	1	50	50	0	0	0	0	10	25	65	30	60	MEDIUM	1.0
15 446	18-Dec	17.8	18.2	38052	2142	70	3	95	5	0	0	0	0	0	2	98	10	80	MEDIUM	0.5
15 446	18-Dec	17.8	18.2	39308	1256	15	1	39	56	5	0	0	0	60	30	10	60	30	MEDIUM	1.5
15 446	18-Dec	17.8	18.2	40308	1000	15	1	38	39	23	0	0	10	30	20	40	40	30	LOW	1.0
15 446	01-Dec	18.2	19.4	41068	760	17	1	57	19	24	0	0	10	50	30	10	60	25	MEDIUM	1.0
15 446	01-Dec	18.2	19.4	42028	960	14	1	50	32	18	0	0	15	65	15	5	60	25	MEDIUM	1.0
15 446	01-Dec	18.2	19.4	43093	1065	14	1	53	9	38	0	0	25	60	10	5	60	15	MEDIUM	1.5
15 446	01-Dec	18.2	19.4	44073	980	15	1	17	30	53	0	0	30	60	10	0	60	25	MEDIUM	1.5
15 446	01-Dec	18.2	19.4	45073	1000	15	1	27	24	49	0	2	44	44	10	0	60	20	MEDIUM	1.5
15 446	01-Dec	18.2	19.4	46048	975	14	1	22	52	26	0	5	50	40	5	0	60	20	MEDIUM	1.5
15 446	01-Dec	18.2	19.4	47108	1060	14	1	0	40	60	0	10	65	20	5	0	60	20	MEDIUM	2.0
15 446	10-Dec	19.4	20.9	51608	4500	1125	4	100	0	0	0	0	0	0	0	100	2	10	LOW	0.0
15 446	10-Dec	19.4	20.9	53188	1580	30	3	100	0	0	0	0	0	0	0	100	2	10	LOW	0.0
15 446	10-Dec	19.4	20.9	54228	1040	11	1	52	38	10	0	0	0	70	20	10	75	45	MEDIUM	1.0
15 446	10-Dec	19.4	20.9	54985	757	10	1	37	16	47	0	0	0	65	25	10	75	50	MEDIUM	1.0
15 446	10-Dec	19.4	20.9	56121	1136	30	3	100	0	0	0	0	0	0	0	100	30	80	MEDIUM	0.5
15 446	10-Dec	19.4	20.9	57257	1136	10	1	30	40	40	0	0	0	40	40	20	60	80	MEDIUM	1.5
15 446	15-Jan	20.9	21.2	58908	1651	30	3	90	10	0	0	0	0	2	10	88	20	90	MEDIUM	0.5
unnamed RB trib to 446 (Buffoon Creek - local name)																				
15 470	31-Dec	1.2	1.5	1530	1530	14	1	48	29	23	0	0	40	45	10	5	80	50	MEDIUM	1.0

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Percent Habitat type Pool	Glid	Rif	Percent Substrate Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
unnamed RB trib of 446																				
15 471	16-Dec	0.0	0.4	1000	1000	15	1	80	10	10	0	0	0	1	19	80	40	100	MEDIUM	0.5
15 471	16-Dec	0.0	0.4	1750	750	10	1	70	20	10	0	0	0	1	19	80	40	70	MEDIUM	0.5
15 471	16-Dec	0.0	0.4	2480	730	50	3	100	0	0	0	0	0	0	0	100	5	90	MEDIUM	0.0
unnamed LB trib of 446																				
15 472	31-Dec	0.0	1.1	1100	1100	0	5	50	50	0	0	0	0	0	10	90	40	90	MEDIUM	0.5
15 472	31-Dec	0.0	1.1	2200	1100	6	1	40	20	40	0	0	5	60	30	5	75	40	LOW	1.5
15 472	31-Dec	0.0	1.1	3575	1375	50	3	100	0	0	0	0	0	0	0	100	20	95	LOW	0.0
15 472	31-Dec	0.0	1.1	3925	350	30	3	50	50	0	0	0	0	10	10	80	20	95	LOW	0.0
15 472	31-Dec	0.0	1.1	6775	2850	1800	4	100	0	0	0	0	0	0	0	100	5	5	LOW	0.0
Gold Creek																				
15 474	01-Dec	0.0	0.8	1070	1070	12	1	62	34	4	0	0	0	0	10	90	70	70	MEDIUM	0.5
15 474	01-Dec	0.0	0.8	2015	945	8	1	39	27	34	0	0	12	60	24	4	60	50	MEDIUM	1.5
15 474	01-Dec	0.0	0.8	3025	1010	8	1	22	34	44	0	5	30	35	30	0	50	30	LOW	3.0
15 474	01-Dec	0.0	0.8	4300	1275	8	1	4	23	73	0	25	20	30	25	0	50	20	LOW	3.0
unnamed LB trib of 446																				
15 475	15-Jan	0.0	0.2	1400	1400	5	1	30	20	50	4	0	25	36	35	0	75	20	MEDIUM	2.0
Tin Mine Creek																				
15 476	30-Dec	0.1	0.3	2675	1175	4	1	40	40	20	0	0	0	40	40	20	70	60	MEDIUM	1.0
Union River																				
15 503	22-Dec	4.0	4.9	1688	1688	14	1	40	40	20	0	0	0	30	60	10	30	30	MEDIUM	1.5
15 503	22-Dec	4.0	4.9	2688	1000	17	1	95	5	0	0	0	0	0	20	80	30	50	MEDIUM	1.5
15 503	22-Dec	4.0	4.9	5000	2312	14	1	40	40	20	0	0	0	30	60	10	30	30	MEDIUM	1.5
15 503	21-Dec	4.9	5.3	7650	2650	10	1	55	0	45	0	0	0	70	30	0	60	30	MEDIUM	1.5
7650 - 11716 not done, WDFW index section																				
15 503	22-Dec	6.0	6.6	12715	999	7	1	21	34	45	0	10	20	30	20	20	10	80	LOW	1.5
15 503	22-Dec	6.0	6.6	13736	1021	10	1	7	21	72	0	20	60	15	5	0	60	50	LOW	3.0
15 503	22-Dec	6.0	6.6	14876	1140	9	1	11	13	76	2	80	16	1	1	0	70	20	LOW	3.5
East Fork Union River																				
15 512	21-Dec	0.0	0.3	630	630	10	1	44	56	0	0	0	0	2	10	88	30	50	LOW	0.5
15 512	21-Dec	0.0	0.3	1435	805	5	1	10	90	0	0	0	0	1	10	89	30	50	LOW	0.5

Appendix A, continued.

WRIA + Stream Number	Date	RM low end	RM upper end	Distance Feet	Distance (Ft)	Width	Reach Type	Percent Habitat type Pool	Glid	Rif	Percent Substrate Ledg	Bou	Cobb	Grav	Sand	Silt	% Can	% OHBV	WD	Grade
McTaggert Creek																				
16 105	07-Dec	0.0	3.0	984	984	20	1	5	15	80	0	15	60	15	10	0	75	2	LOW	2.0
16 105	07-Dec	0.0	3.0	1968	984	15	1	5	10	85	0	20	55	15	10	0	80	5	LOW	3.0
16 105	07-Dec	0.0	3.0	2952	984	12	1	10	20	70	0	5	35	50	10	0	60	5	LOW	2.0
16 105	07-Dec	0.0	3.0	3936	984	12	1	10	25	65	0	10	45	35	10	0	65	8	LOW	3.0
16 105	07-Dec	0.0	3.0	4920	984	12	1	20	30	50	0	9	50	32	9	0	60	10	LOW	3.0
16 105	07-Dec	0.0	3.0	5904	984	12	1	10	15	75	0	10	45	35	10	0	60	10	LOW	3.0
16 105	07-Dec	0.0	3.0	6888	984	10	1	10	25	65	0	5	45	40	10	0	60	5	LOW	3.0
16 105	07-Dec	0.0	3.0	16170	9282	10	1	10	20	70	0	15	50	25	10	0	60	10	MEDIUM	4.0
Duckabush River																				
16 351	06-Nov	0.2	2.3	999	999	65	1	45	46	9	0	0	5	65	20	10	1	1	LOW	1.5
16 351	06-Nov	0.2	2.3	2066	1067	65	1	52	29	19	0	0	5	65	20	10	1	1	LOW	1.5
16 351	06-Nov	0.2	2.3	3134	1068	55	1	42	17	41	0	0	5	65	20	10	1	1	LOW	1.5
16 351	06-Nov	0.2	2.3	4163	1029	55	1	16	36	48	0	0	8	67	15	10	1	1	LOW	1.0
16 351	06-Nov	0.2	2.3	5067	904	55	1	23	26	51	0	0	8	67	15	10	1	1	LOW	1.0
16 351	06-Nov	0.2	2.3	6096	1029	50	1	21	50	29	0	0	5	75	15	5	2	2	LOW	1.0
16 351	06-Nov	0.2	2.3	7000	904	45	1	21	79	0	0	0	2	70	20	8	1	1	MEDIUM	2.0
16 351	06-Nov	0.2	2.3	8146	1146	50	1	50	27	23	0	0	10	60	25	5	1	1	MEDIUM	1.5
16 351	06-Nov	0.2	2.3	8998	852	85	1	13	17	70	0	0	1	50	40	9	1	1	LOW	1.0
16 351	06-Nov	0.2	2.3	10000	1002	47	1	20	39	41	0	0	8	57	25	10	1	1	LOW	2.0
16 351	06-Nov	0.2	2.3	11000	1000	48	1	28	53	19	0	1	14	55	20	10	1	1	LOW	1.5
16 351	06-Nov	0.2	2.3	12000	1000	43	1	22	13	65	0	2	18	60	10	10	1	1	LOW	2.0
16 351	06-Nov	0.2	2.3	12258	258	60	1	74	26	0	0	1	14	25	50	10	1	1	LOW	0.5
12258 - 24455 not done																				
16 351	10-Nov	4.4	6.3	25455	1000	55	1	0	0	100	0	30	30	20	20	0	50	15	LOW	1.5
16 351	10-Nov	4.4	6.3	26299	844	45	1	8	24	68	0	30	30	20	20	0	50	5	LOW	3.0
16 351	10-Nov	4.4	6.3	27434	1135	45	1	0	34	66	0	30	30	20	20	0	45	25	LOW	2.0
16 351	10-Nov	4.4	6.3	28339	905	50	1	10	0	90	0	20	60	15	5	0	45	10	LOW	2.5
16 351	10-Nov	4.4	6.3	29310	971	30	1	28	18	54	0	15	55	20	10	0	1	1	LOW	2.0
16 351	10-Nov	4.4	6.3	30221	911	40	1	10	27	63	0	15	55	20	10	0	0	1	LOW	2.0
16 351	10-Nov	4.4	6.3	31234	1013	45	1	7	0	93	0	30	30	30	10	0	35	30	LOW	3.0
16 351	10-Nov	4.4	6.3	32355	1121	40	1	0	51	49	0	10	50	25	15	0	20	20	LOW	3.0
16 351	10-Nov	4.4	6.3	33425	1070	40	1	0	23	77	0	40	35	20	5	0	35	35	LOW	3.0
16 351	10-Nov	4.4	6.3	34455	1030	40	1	17	17	66	0	45	40	10	5	0	25	45	LOW	3.0
unnamed LB trib to 351																				
16 362	12-Nov	0.0	0.2	853	853	8	1	60	0	40	0	0	10	60	10	20	85	70	HEAVY	0.5
16 362	12-Nov	0.0	0.2	1148	295	4.5	1	70	0	30	0	0	0	40	20	40	90	80	HEAVY	0.5
Ripley Creek																				
17 89	23-Dec	0.0	0.7	328	328	6	1	20	30	50	60	30	5	5	0	0	80	15	LOW	5.0
17 89	23-Dec	0.0	0.7	3280	2952	7	1	30	40	30	0	0	20	60	20	0	30	45	MEDIUM	1.0