STREAM INVENTORY REPORT

Unnamed Tributary to Duffy Gulch

WATERSHED OVERVIEW

Elevations range from 500 feet at the mouth of the creek to 1,400 feet in the headwater areas (Figure 1). The unnamed tributary's legal description at the confluence with Duffy Gulch is T18N R16W S12. Its location is 39°26'5"N. latitude and 123°35'14"W. longitude according to the USGS Northspur 7.5 minute quadrangle.

HABITAT INVENTORY RESULTS

The habitat inventory of September 9, 1996 was conducted by Diana Hines. The total length of surveyed stream in the unnamed tributary was 3,138 feet (0.60 miles, 0.95 km) (Table 1). There were no side channels in this creek.

The unnamed tributary consists of one reach; an F3 for the entire 3,138 feet of surveyed stream.

Table 1 summarizes the Level II riffle, flatwater and pool habitat types. By percent occurrence, riffles comprised 16%, flatwater 47% and pools 33% of the habitat types (Graph 1). By percent total length, riffles comprised 9%, flatwater 79% and pools 6% (Graph 2).

Eleven Level IV habitat types were identified and are summarized in Table 2. The most frequently occurring habitat types were step runs, 40%, plunge pools, 19%, and low gradient riffles, 12% (Graph 3). The most prevalent habitat types by percent total length were step runs at 77%, and low gradient riffles and dry units, both at 7% each (Table 2).

Table 3 summarizes main, scour and backwater pools which are Level III pool habitat types. Scour pools were most often encountered at 71% occurrence and comprised 67% of the total length of pools.

Table 4 is a summary of maximum pool depths by Level IV pool habitat types. In first and second order streams, pools with depths of two feet (0.61) or greater are considered optimal for fish habitat. In the unnamed tributary, none had a depth of two feet or greater (Graph 4).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the pool tail-outs measured, 0% had a value of 1, 0% had a value of 2, 0% had a value of 3 and 100% had a value of 4 (Graph 5).

Of the Level II habitat types, pools had the highest mean shelter rating at 36 (Table 1). Of the Level III pool habitat types, scour pools had the highest mean shelter rating at 60 (Table 3).

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Of the 14 pools, 7% were formed by large woody debris (LWD): 0% by logs and 7% by root wads (calculated from Table 4).

Table 6 summarizes dominant substrate by Level IV habitat types. Of the low gradient riffles fully measured, 100% had gravel as the dominant substrate (Graph 6).

Mean percent closed canopy was 93%: 55% coniferous trees and 38% deciduous trees. Mean percent open canopy was 7% (Graph 7, calculated from Table 7).

Table 7 summarizes the mean percent substrate/vegetation types found along the banks of the stream. Mean percent right bank vegetated was 69%, while mean percent left bank vegetated was 75%. Coniferous trees were the dominant bank vegetation type in 58% of the units fully measured. The dominant substrate composing the structure of the stream banks was cobble/gravel, found in 69% of the units fully measured.

DISCUSSION

The information gathered in the process of habitat typing will provide Georgia-Pacific with baseline data on the current condition of this creek and the available habitat for salmonids.

When reviewing the unnamed tributary data, it is important to consider the short distance surveyed. The survey was limited to approximately 3,138 feet with only 43 units; therefore, many of the determinations for the indicated parameters were based on only one or two completely measured units. Determinations based on such a limited sample size may lack statistical validity and therefore are of questionable analytical value.

Level II habitat types by percent occurrence and length

Flatwater habitat types comprised a high percentage of the units by both percent occurrence and length at 47% and 79% respectively (Table 1 and Graph 1). These unit types usually do not provide optimal spawning or rearing habitat for salmonids. Riffle habitat units comprised a low percentage of the stream by both percent occurrence and length at 16% and 9% respectively. Pools comprised a moderate percentage by percent occurrence and low percentage by length at 33% and 6% respectively. Riffles usually provide good spawning habitat while pools provide important rearing habitat. In addition, Mundie (1969) reported that invertebrate food production is maximized in riffles while pools provide an optimum feeding environment for coho. In fact, the most productive streams are those consisting of a pool to riffle ratio of approximately one to one (Ruggles 1966).

Pool Depth

According to Flosi and Reynolds (1994), a stream with at least 50% of its total habitat comprised of primary pools is generally desirable. Primary pools are at least two feet deep in first and second order streams and at least three feet deep in third order streams. The information from

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Graph 4 on maximum depth in pools was used to determine percent of primary pools. The unnamed tributary, a first order stream, is comprised mainly of shallow pools with none of the pools having a maximum depth of two feet or greater.

Instream Shelter

Instream shelter ratings are derived from two measurements: instream shelter complexity and instream shelter percent cover. The first is a value rating which provides a relative measure of the quality and composition of the shelter, and the second is a measure of the area of a habitat unit covered by shelter. The various types of instream shelter include LWD, small woody debris, boulders, rootwads, terrestrial vegetation, aquatic vegetation, bedrock ledges and undercut banks. Of the Level II habitat types, pools had the highest shelter rating at 36. Of the Level III habitat types, scour pools had the highest shelter rating at 60. These values are low as shelter values of 80 or higher are considered optimal for good rearing habitat (Flosi and Reynolds 1994).

Large Woody Debris

The presence of large woody debris in streams is a significant component of fish habitat. Woody debris creates areas of low flow, providing a refuge for fish during periods of high flow (Robison and Beschta, 1990). Woody debris also provides cover for fish, lowering the risk of predation. The percent of pools formed by LWD in the unnamed tributary was 7%. Whether these numbers are high or low, relative to the needs of salmonids is difficult to ascertain since the optimum amount of woody debris in streams has not been specified (Robison and Beschta 1990). However, based on data from Georgia-Pacific's 1995 Aquatic Vertebrate Study, the only coho found in the Ten Mile River Basin were in stream reaches where approximately 50% of pools were formed by large woody debris. Those reaches that did not support coho had a significantly lower percentage of pools formed by large woody debris (Ambrose et al, 1996). This suggests that a low percentage of LWD formed pools could adversely affect juvenile coho populations (C.S. Shirvel 1990).

The above LWD analysis pertains only to pools formed by logs or root wads as described in Flosi and Reynolds (1994)**:** lateral scour pool-log enhanced, lateral scour pool-rootwad enhanced, backwater pool-log formed and backwater pool-rootwad formed. Other pools containing LWD as a component were not included in the calculation. For example, plunge pools may be formed by boulders, bedrock or LWD, but are not described as such by habitat unit types. Therefore, the LWD formed pool calculation is limited to four pool types and does not quantify the total amount of LWD in the unnamed tributary.

Canopy

There are two important benefits of canopy cover in coastal streams. Canopy keeps stream temperatures cool as well as providing nutrients in the form of leaf litter and organic material (Bilby 1988). This leaf litter, organic material, and their associated nutrients are utilized as a food source by benthic macroinvertebrates (aquatic insects). The macroinvertebrates, in turn, are major food sources for most fish species in forested areas (Gregory et al., 1987). Mean percent canopy cover for the unnamed tributary was 93%. This is high since a canopy cover of 80% or higher is considered optimum (Flosi and Reynolds,1994).

Coniferous trees occupied a larger portion of the canopy than did deciduous trees. Coniferous trees comprised 55% and deciduous trees 38% of the canopy. The significance of this is that wood from coniferous species deteriorates less rapidly than wood from alder and most other deciduous species (Sedell, *et al*. 1988). Therefore, more LWD would be available in the future for fish cover and LWD formed pools in this creek and others dominated by coniferous species.

Embeddedness

High embeddedness values (silt levels), such as those found in the unnamed tributary, have been associated with many negative impacts to salmonids. These negative impacts can be observed in important environmental components of salmonid habitat, such as pool habitats, dissolved oxygen levels and water temperatures.

The impact high silt levels have on pool habitat is that they fill in and eventually eliminate pools. As already mentioned, pools provide important habitat for rearing salmonids.

High silt levels also impact oxygen levels in the water. They do so by reducing water circulation within the substrate, thus lowering the oxygen levels needed by salmonid eggs (Sandercock, 1991). This can hinder the survival of the eggs deposited in redds, as well as the survival of juvenile salmonids.

Water temperature is impacted by high silt levels in several ways. Hagans et al (1986) reported the following impacts to water temperatures: 1) the loss of a reflective bottom; 2) darker sediment (as opposed to clean gravels) storing heat from direct solar radiation which is then transferred to the water column; and 3) a reduction in the flow of water through the substrate interstitial spaces thereby exposing more of the water column to direct solar radiation.

Another means by which water temperatures are increased is through the widening of stream channels: over time, high silt levels increase the substrate surface level of the creek, resulting in a wider, shallower stream channel (Flosi and Reynolds, 1994). In shallow streams, more surface area is exposed to the sun relative to the volume of water, leading to an increase in solar heating which in turn leads to higher water temperatures.

Substrates embedded with silt in varying degrees were given corresponding values as follows: 0-25%= value 1, 26 - 50% = value 2, 51 - 75% = value 3 and 76 - 100% = value 4. According to Flosi and Reynolds (1994), creeks with embeddedness values of two or higher are considered to have poor quality fish habitat. In the unnamed tributary, 100% of the pool tail-outs measured had embeddedness values of two or more.

It is important to consider, however, that the above embeddedness values were obtained in the summer during low flow conditions. In winter and spring, flows are usually higher due to the rainy season and the lowered evapotranspiration of the trees. This higher flow can carry away some of the previously deposited silt to sites further downstream. Therefore, embeddedness values may fluctuate throughout the year along different sections of the stream.

Substrate

In the unnamed tributary, 100% of the low gradient riffles had gravel as the dominant substrate. The high concentration of gravel in riffles indicates that there is a sufficient amount of substrate available as potential spawning habitat in this creek. While this creek had sufficient substrate for spawning in the riffles surveyed, the overall percentage of riffles in the surveyed portions of the creek was low at only 16% (Table 1). Subsequently, there may be a lack of sufficient spawning habitat. Another point to consider is that regardless of the amount of substrate or spawning habitat available, this habitat may not be suitable for salmonids if it is highly embedded.

Overall, the unnamed tributary appears to have a relatively low percentage of primary and LWD formed pools, low shelter values and high embeddedness values. In addition, while there was sufficient substrate for spawning, habitat for spawning appeared to be limited. This stream does appear to have sufficient canopy.

RECOMMENDATIONS

1) Due to marginal habitat and small size of this creek, the net results of any expense or effort directed towards creek restoration, other than maintaining good canopy cover, would not be cost effective.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position (ft):	Comments:
254’	No fish observed (NFO), flow is minimal.
382’	Five foot plunge, possible fish barrier.
696’	Left bank failure measures 30' high x 45' long.
714’	Creek full of orange bacteria up to this point.
786’	Large redwood over creek approximately 10 foot diameter at breast height.
812’	NFO.
956’	NFO.

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1075’	Channel type is an F3.
1253’	Dry tributary on right bank.
1514’	Creek has a lot of boulder substrate in this section. NFO.
2233’	Gradient increasing. Left bank failure measures 40' high x 75' long. Tributary enters on left bank; it is not accessible to fish.
2329’	Five foot plunge, possible fish barrier.
2633’	Six foot plunge.
3138’	End of survey, due to lack of suitable habitat. Increasing gradient, lack of suitable substrate for spawning (substrate mostly boulder). No fish observed entire survey, though there were no fish barriers observed for approximately the first 300 feet.

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