STREAM INVENTORY REPORT
NOYO RIVER

WATERSHED OVERVIEW

Noyo River is a tributary to the Pacific Ocean (Figure 1). Elevations range from 0 feet at the mouth of the creek to 2,400 feet in the headwater areas. Noyo River's legal description at the confluence with the Pacific Ocean is T18N R17W Sec9. Its location is 39°27'36"N. latitude and 123°45'39"W. longitude according to the USGS Fort Bragg 7.5 minute quadrangle. Noyo River drains a watershed of approximately 19,393 acres.

HABITAT INVENTORY RESULTS

The habitat inventory of August 2, 1996 through August 16, 1996, was conducted by Diana Hines, David Lundby, and Dave Wright. The portion of mainstem surveyed includes the area from the end of the tidal zone (first California Western crossing), to the Georgia-Pacific property line (near Alpine Gulch). The total length of surveyed stream in Noyo River was 90,729 feet (17.2 miles, 27.7 KM) (Table 1). Side channels comprised 232 feet of this total. Flow measured at the Hayshed gauging station, by the USGS, from the period between 8/01/96 to 8/07/96, was approximately 22-23 cubic feet per second (cfs).

Noyo River consists of 4 reaches: A B3 for the first 44,831 feet, a C3 for the next 21,580 feet, a B2 for the next 7,011 feet and a B1 for the remaining 17,307 feet.

Table 1 summarizes the Level II Riffle, Flatwater and Pool Habitat Types. By percent occurrence Riffles comprised 13%, Flatwater 38% and Pools 49% of the habitat types (Graph 1). By percent total length, Riffles comprised 5%, Flatwater 41% and Pools 49% (Graph 2).

Sixteen Level IV Habitat Types were identified and are summarized in Table 2. The most frequently occurring habitat types were Glides 19%, Lateral Scour Bedrock Pools 19% and Runs 14% (Graph 3). The most prevalent habitat types by percent total length were Glides at 25%, Lateral Scour Bedrock Pools 22% and Mid Channel Pools 12% (Table 2).

Table 3 summarizes Main, Scour and Backwater pools which are Level III Pool Habitat Types. Scour pools were most often encountered at 75% occurrence and comprised 75% of the total length of pools.

Table 4 is a summary of maximum pool depths by Level IV Pool Habitat Types. In third and fourth order streams, pools with depths of three feet (.91 m) or greater are considered optimal for fish habitat. In the Noyo River, 237 of the 274 pools (86%) had a depth of three 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, 6% had a value of 2, 33% had a value of 3 and 61% had a value of 4 (Graph 5).

Of the Level II Habitat Types, Riffles had the highest mean shelter rating at 86. (Table 1). Of the Level III Pool Habitat Types, Main Channel Pools had the highest mean shelter rating at 69 (Table 3).

Of the 274 pools, 23% were formed by Large Woody Debris: 15% by logs and 8% by root wads (calculated from Table 4).

Table 6 summarizes dominant substrate by Level IV Habitat Types. Of the Low Gradient Riffles fully measured, 22% had gravel and 44% had small cobble as the dominant substrate (Graph 6).

Mean percent closed canopy was 49%: 27% coniferous trees and 22% deciduous trees. Mean percent open canopy was 51% (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 71% while mean percent left bank vegetated was also 71%. Deciduous trees were the dominant bank vegetation type in 85% of the fully measured units. The dominant substrate composing the structure of the stream banks was Sand/Silt/Clay, found in 40% of the fully measured units.

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. These data can be used to identify components of the habitat in need of enhancement so appropriate conditions for Noyo River can be obtained over time.

Level II habitat types by percent occurrence and length

Flatwater habitat types comprised a moderate percentage of the units by both percent occurrence and length at 38% and 41% 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 13% and 5% respectively. Pools comprised a high percentage by both percent occurrence and length at 49% and 54% 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 Graph 4 on maximum depth in pools was used to determine percent of primary pools. Noyo River, a fifth order stream, is comprised mainly of deep pools with 86% of the pools having a maximum depth of three 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 quantity 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, SWD, boulders, root wads, terrestrial vegetation, aquatic vegetation, bedrock ledges and undercut banks. Of the Level II habitat types riffles had the highest shelter rating at 86. Of the Level III habitat types main channel pools had the highest shelter rating at 69. These values are fair to good 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 (LWD) 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, causes spawning gravel to collect behind it, and promotes general watershed stability. The percent of pools formed by LWD in Noyo River was 23%. 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 Root Wad Enhanced, Backwater Pool Log Formed and Backwater Pool Root Wad 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 Noyo River.

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 the associated nutrients are utilized as a food source by benthic macroinvertebrates (aquatic insects). The macroinvertebrates, in turn, are a major food source for most fish species in forested areas (Gregory et al., 1987). Mean percent canopy cover for the Noyo River was 49%. This is low since a canopy cover of 80% or higher is considered optimum, Flosi and Reynolds (1994).

Wood from coniferous trees deteriorates less rapidly than wood from alder and other deciduous species (Sedell, *et al*. 1988). Coniferous trees, at 27%, occupied a larger portion of the canopy than did deciduous trees at 22%. This indicates a greater recruitment potential for high quality logs as fish cover and LWD formed pools.

Embeddedness

High embeddedness values (silt levels), such as those found in Noyo River, 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 the 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.

Substrate 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 Noyo River, 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 Noyo River, 22% of the Low Gradient Riffles had gravel and 44% had small cobble as the dominant substrate. Collectively, the relatively high concentration of both gravel and small cobble in riffles indicates that there is a sufficient amount of substrate available as potential spawning habitat in this river. However, there are two points that are important to consider: First, although there appears to be a suitable amount of substrate, its effectiveness for spawning is degraded as the level of embeddedness increases. Second, while the percentage of gravel and small cobble in riffles was acceptable, the overall percentage of riffles in the river was low at 13% (Table 1) indicating a lack of sufficient spawning habitat.

Overall, the surveyed portions of the Noyo River appear to have insufficient canopy, high embeddedness values, and a relatively low percentage of LWD formed pools. In addition, while there was sufficient substrate for spawning, habitat for spawning appeared to be limited. This river does appear to have a high percentage of primary pools.

Georgia-Pacific recognizes that there are areas of the mainstem Noyo River in need of enhancement, and where feasible will attempt to restore those areas over time as part of its long term management plan. The company will also attempt to facilitate a healthy environment for salmonids in this river through sound management practices.

RECOMMENDATIONS

Noyo River should be managed as an anadromous, natural production watershed.

Sources of stream bank erosion should be mapped and prioritized according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediment entering the stream. In addition, sediment sources related to road systems need to be identified, mapped and treated according to their potential for sediment yield to the watershed.

Increase the canopy in Noyo River by planting willow, alder, redwood and Douglas-fir along the watercourses where shade canopies are not at acceptable levels. Planting efforts need to be coordinated to follow bank stabilization or upslope erosion control projects. Since this is such a wide river planting trees may not be sufficient because of the time it will take for them to grow to adequate heights for providing canopy. A proportion of trees already present along the river should be allowed to grow and left to maintain a functional overstory canopy.

Log debris accumulations retaining large quantities of fine sediment should be modified carefully, over time, to avoid excessive sediment loading in downstream reaches.

SURVEY MEMOS

The following memos were taken in the field at the time of survey. All distances are approximate and measured in feet from the confluence.

52	Begin survey 370' upstream from RR crossing. channel type is an B3
295	One redd (these redds and most of the others noted in this memo were probably created by lamprey)
1080	Tributary entering left bank at 202'
2571	Water tower structure on left bank at end of pool.
3757	Five redds
4284	Young of Year (Yoy) observed
4751	Train crossing over pool at 142'
5634	Tributary entering left bank at 84', possible southern seep salamander (SSS) site.
5854	Tributary entering left bank at 40', possible SSS site
6331	Two redds, tributary entering left bank at 229'
8030	Two yoy observed
9726	Four salmonids approximately 3 inches, 2 salmonids at 2 in
9856	Two redds
10531	Channel type done here
12079	Hayshed Gulch entering left bank at 49'
12202	Gaging station at beginning of unit
13392	Three redds
16547	Confluence pool with South Fork Noyo
18219	Tributary enters right bank at 61'
18926	Third RR crossing here
20122	Six redds
20817	Four redds
23592	Three redds
24060	Five redds
24192	Fourteen redds
24732	Fourth RR crossing
28922	Possible SSS site at 203' on left bank
29251	Tributary enters left bank at 0'
30117	Six redds
30263	Bridge crossing
30631	Green filamentous algae found throughout unit
33281	Bridge crossing at 148'
33795	Four redds observed
34115	Ten yoy observed
34646	Scour is actually created by cement block from bridge. bridge crossing at 131'.
34678	Scour created by cement block from bridge
34866	Eight redds

35554 Large root wad along right bank providing good cover, two STHD observed
35775 Six redds
36005 Two redds
36063 Railroad tracks above
36423 Left bank contains many boulders, appears to be artificial (perhaps erosion control) 25'h x 70'l. no vegetation, many of the boulders appear to be falling into creek. RR tracks above

36687 Three redds observed
36991 Approximately 80 percent exposed substrate in between
38120 Three redds observed
38292 Bridge crossing over unit at 112'. scour caused by cement block from bridge
39102 Road crossing over beginning of unit. bridge crossing at 87'.
39752 RR crossing over unit at 35'. yoy observed
40360 Belted kingfisher
40630 Three redds
41775 Tributary entering left bank at 157'
42099 Unit separated by gravel bar with willows and alders. two redds
42337 P & J ranch along left bank of this unit
42912 One 3" STHD observed
42985 Three redds observed
43347 Two redds
43624 Five redds
43748 Four redds
44162 Two yoy STHD
44303 Bank failure at 96', 15'l x 30'h contributing sand and gravel
44517 Four redds observed
44831 Tributary entering left bank at 161'. possible SSS site
45447 Channel type here, channel is an C3
45641 Three inch STHD
46080 Little Stinker camp above right bank
46411 Tributary entering left bank at 49'. possible SSS site
46539 Bank failure along left bank 30'l x 30'h
46826 Four redds observed. train crossing at 175'. scour created by cement block from bridge

47239 Bank failure along right bank 30'l x 12'h
47780 Seven redds
48886 Tributary entering right bank at beginning of unit
49588 Scour caused by cement block from bridge. RR crossing at 20'
49706 Scour caused by cement block from bridge

50284 Six redds. three red-breasted mergansers. tributary entering left bank at 104'
50804 Three redds
51281 Tributary entering right bank at 22'
51775 Large root wad behind log providing good cover
52078 Tributary entering left bank at 235'
53202 Four redds
53627 Five redds. tributary entering left bank at end of unit
54207 Bank failure along right bank near end of pool 18'h x 20'w. six yoy
54662 Two redds. tributary entering left bank at 192'
55435 Three 40 mm salmonids, two redds
55823 Tributary entering left bank at 104'
55897 Tributary entering left bank at beginning of unit 30'. possible SSS site
56719 One redd
57068 Eight salmonids approximately two in. each
57177 Six salmonids approximately two inches each
57590 Three redds
58055 Two salmonids approximately 2in each
58369 Tributary entering right bank at 87'
58526 Five redds
59409 Three redds
60375 Five redds. tributary entering left bank at 239'
61571 Two redds, two salmonids two inches each
62357 Five inch salmonid
63150 Tributary entering left bank at 47'. possible SSS site
63423 Eight redds
63550 Tributary entering left bank at 120'
64175 Six redds
65130 Three redds. three two inch salmonids
65940 Tributary entering left bank at 29'. possible SSS site
66411 Three redds
66573 Channel type here. channel changes to a B2
66682 Tributary entering right bank at end of unit
67416 One redd. three salmonids at three inches each
67613 Tributary entering left bank at 107'. possible SSS site
67641 RR crossing at end of unit
67953 Tributary entering right bank at 22'
68503 Large madrone fallen over creek at end of unit, approximately 50'l
68634 Four three inch salmonids
68805 Three inch salmonids

69153 Five salmonids approximately three inches each
69456 One redd
69719 Three redds, eight salmonids at three inches each
70095 One 2 inch salmonid, two 3 inch salmonids
70403 About 90% exposed substrate in middle of unit.   four 3 inch salmonids
70805 Three 7 inch salmonids, four 3inch salmonids
71720 Three redds
71861 Five yoy observed
73022 Switchback Gulch entering left bank at 123'.
73727 Substrate has been predominantly bedrock for last three units
74918 Five redds
75654 From May to September temporary wood dam at boy scout camp. during that time dam backs water up to about 3000' essentially creating one long pool. tributary enters left bank at 138'.
79017 Habitat unit number 457 through 477 affected by dam from May to Sept.
80439 American dipper
80922 Tributary entering right bank at end of unit
81040 Six yoy observed
81465 One four inch salmonid. large madrone over creek approximately 50'l
82134 Not as much bedrock substrate
82597 Two redds
84093 Four redds, five yoy
84530 Tributary entering right bank at end of unit
85901 Seven redds, Duffy Gulch enters right bank at 156'
86224 Tributary entering left bank at 34'
86671 Three redds. two juvenile raccoons along bank. tributary entering left bank at 177'
87316 Four inch salmonid
87538 Alpine Gulch enters on right bank at 140'
88965 RR crossing over unit at 201'
89153 Tributary entering right bank at 31'
89265 Seven 2 inch salmonids
90729 Three redds. End of survey, end of G.P. property line

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