Big River Basin in the Regional Context

The Big River Basin is a fairly small watershed located on the Mendocino coast, far from major metropolitan areas. The 2000 Census counted just over 500 people in the basin and most of the land is owned by large timber companies or in public ownership. The predominant landuse both historically and currently is timber harvest. Much of the basin has been harvested multiple times. Prior to 1920, 27 splash dams were used across the basin and these impacted all downstream channels. However, historical accounts indicate that the coho salmon and steelhead trout in the Big River Basin appeared to begin declining in the 1950s. This could indicate that the watershed impacts from tractor logging were more related to the salmonid decline than splash damming. Current salmonid populations appear to be limited by poor quality summer rearing and overwintering habitat due to reduced habitat complexity, high water temperatures in the mainstem Big River, low summer stream flows in tributaries in the Inland Subbasin, embedded spawning gravels, and artificial passage barriers. Landowners have shown great interest in recovering the fisheries resources of the basin and restoration projects on both public and private lands hold much promise for the future.

Summary of Basin Conditions and Recommendations

Geology

- The Big River Basin is primarily comprised of Coastal Belt Franciscan Complex, which is relatively stable compared to the mélange terrane of the Central Belt found only in the upper parts of the watershed;
- The Coastal and Middle subbasins have lower relief and longer slopes while the Inland Subbasin has a high percentage of area in higher slope classes;
- Steep slopes, weathered and fractured marine sedimentary rock, tectonic activity, locally thick colluvial soils, a history of timber harvest practices, and the occurrence of high intensity rainfall events combine to make mass wasting a common occurrence in the Big River Basin;
- A study of landslides on MRC ownership within the basin, which comprises 29% of the basin, found that the vast majority of landslides occurred on slopes greater than 60%, and few landslides on lower gradient slopes were not triggered by roads or skid trails.

Land Use Impacts

- Roads, timber harvesting, and grasslands are listed in the Total Maximum Daily Loads as major sources of human-related sediment into streams;
- There has been a significant increase in road building since 1989 across the basin, especially in the Coastal and Middle subbasins. However, new roads have been built to higher standards, on ridge-tops, and are paved; thus creating less of a sediment source;
- Construction of near stream railroads in the Coastal and Middle subbasins and North Fork Big River and roads throughout the basin constricted stream channels and destabilized streambanks;
- Studies in the basin have indicated that over half of the shallow-seated landslides are associated with roads and that these landslides contributed sediment to watercourses in the study period of 1970 to 2000;
- Over 40 years of splash dam logging across the basin before 1920 led to stream channels that are deeply entrenched, cut down to bedrock in many places, lacking functional floodplains, and depleted of LWD;
- As a result of timber harvest, the current landscape is comprised of smaller diameter forest stands than in the past; this limits the recruitment potential of large woody debris to streams and contributes to a lack of instream habitat complexity.

Water Quality

- Water temperatures at monitoring sites in the mainstem of the Big River and larger tributaries in the Inland Subbasin such as the North and South forks Big River were unsuitable for salmonids. Temperatures Coastal and Middle tributaries were generally suitable for salmonids.

Salmonid Populations

- Both historic and current data are limited. Little data are available on population trends, relative health, or diversity. According to NOAA Fisheries listing investigations, the populations of salmonids have likely decreased in the Big River Basin as they have elsewhere along California and the Pacific Coast;
- Based on limited CDFG, USFWS, HTC, MRC, and SONAR presence surveys and surveys documented by NMFS since the 1960s, the distributions of coho salmon and steelhead trout do not appear to have changed;
- More reaches surveyed by CDFG and MRC since 1990 had steelhead trout that coho salmon;
- Thirty tributaries, the mainstem Big River, and the estuary had records of coho salmon and steelhead trout since 1990. Twenty additional tributary also recorded only steelhead trout.

Salmonid Habitat

- Salmonid habitat conditions in the Big River Basin are generally best in the Coastal Subbasin, and mixed in the Middle and Inland subbasins;
- Several reaches where fine sediment data have been collected indicate that levels are high and conditions may be unsuitable for salmonids;
- Cobble embeddedness in spawning gravels in many surveyed tributaries across the basin indicated that conditions were unsuitable for salmonid spawning success. In addition measured permeability in spawning areas in Daugherty and Ramon creeks indicated significant amounts of fine materials;
- Canopy cover was suitable for salmonids on all surveyed reaches within the basin except for James Creek and the mainstem Big River. As a larger order stream, the mainstem Big River is expected to have lower canopy levels;
- In general, a high incidence of shallow pools, and a lack of cover and large woody debris have contributed to a simplification of instream salmonid habitat in surveyed tributary reaches and the estuary;
- Fish passage barriers have been identified in seven surveyed tributaries across the basin and small tributaries along the estuary are blocked to fish passage by perched culverts. Additionally, areas of dry channel in some tributaries in the drier summer months may indicate fish passage problems.

Limiting Factors Analysis Conclusions

Based on available information for the Big River Basin, the team believes that current negative salmonid habitat conditions include:

- Reduced habitat complexity;
- High water temperatures in the mainstem Big River;
- Low summer stream flows in tributaries in the Inland Subbasin;
- Embedded spawning gravels;
- Fish passage barriers.

Refugia Rating

Based on this assessment of watershed processes and conditions, fishery status, and current salmonid habitat, the Big River Basin has medium potential as refugia for salmon and steelhead trout. Salmonid habitat conditions in the Big River Basin are generally best in the Coastal Subbasin, and mixed in the Middle and Inland subbasins.

Recommendations

Flow and Water Quality Improvement Activities

- Protect instream flows in tributaries with cooler water temperatures for thermal refugia from the warmer North and South Forks and mainstem Big River in the summer;
- To minimize and reduce the effects of water diversions, take actions to improve SWRCB coordination with other agencies to address season of diversion, off-stream reservoirs, bypass flows protective of coho

salmon and other anadromous salmonids and natural hydrograph, and avoidance of adverse impacts caused by water diversion;

- Land managers should work to reduce the temperature of water flowing into the Middle and Coastal subbasins. In order to do this, they should maintain and/or establish adequate streamside protection zones to increase shade and reduce heat inputs to Big River and its tributaries throughout the basin;
- Follow the procedures and guidelines outlined by NCRWQCB to protect water quality from ground applications of pesticides.

Erosion and Sediment Delivery Reduction Activities

- To reduce sediment delivery to Big River, land managers should continue their efforts such as road improvements, good maintenance, and decommissioning and other erosion control practices associated with landuse activities throughout the basin. Thirty-six CDFG stream surveys had road sediment inventory and control as a top tier tributary recommendation;
- Support and encourage existing and active road management programs undertaken by landowners throughout the basin;
- Sediment sources from eroding streambanks and adjacent hillslopes should be identified and treated to reduce sediment generation and delivery to creeks;
- Map unstable soils and use soil mapping to guide land-use decisions, road design, THPs, and other activities that can promote erosion;
- Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads;
- Develop erosion control projects similar to the North Fork Ten Mile River erosion control plan (Mendocino Department of Transportation 2001).

Riparian and Habitat Improvement Activities

- Improve instream structure for juvenile ambush escape and cover, including the addition of LWD to develop habitat diversity and to increase shelter complexity, where appropriate/feasible. Thirty-one CDFG stream surveys and the mainstem Big River have increase escape cover as a top tier tributary recommendation. In addition, there is a need to leave large wood on stream banks and in estuarine channels for potential recruitment into stream channels and the estuary;
- Maintain and improve existing riparian cover where needed;
- Ensure that any land management activities include protection and preservation of stream and riparian habitats and maintain or improve ecological integrity within the basin;
- Consider modifying debris accumulations to facilitate fish passage where necessary;
- Adequately fund prioritization and upgrading of culverts to provide coho salmon passage within the range of coho salmon and to pass 100-year flows and the expected debris loads;
- Ensure that high quality habitat is protected from degradation. Salmonid habitat conditions in the Big River Basin are generally best in the Coastal Subbasin, and mixed in the Middle and Inland subbasins;
- Consider the use of management strategies such as conservation easements to maximize potential benefits to aquatic habitats from near-stream forest protection.

Education, Research, and Monitoring Activities

- State Parks, DFG, MRC, and HTC should continue and expand existing monitoring of anadromous salmonid populations to include some winter and spring fish sampling;
- Support stream gage installations and maintenance to establish a long term record of Big River hydrologic conditions;
- Additional investigations of the physical characteristics of Big River are needed to re-evaluate the Sediment Source Analysis. A regional curve of bankfull dimensions vs. drainage area should be developed for Mendocino County and used to validate CGS (2004) bankfull discharge estimates for Big River;

- Hillslope and in-stream monitoring proposed by the MRC in their Watershed Analysis (2003) should be carried out and additional monitoring programs throughout the basin should planned with respect to be comparable to MRC techniques;
- A study examining how sediment plugs moved downstream from historic splash dam locations over time on air photos is recommended;
- Continue water temperature monitoring at current locations and expand these efforts where appropriate;
- Further study of timberland herbicide use is recommended.

Propensity for Improvement

Advantages

The Big River Basin has several advantages for planning and implementing successful salmonid habitat improvement activities that include:

- An expanding group of cooperative landowners that includes both public and private landowners from all thee subbasins in the Big River that are interested in improving watershed and fishery conditions. The effect of this is the ability to choose locations for projects where the best result can be achieved in the shortest time period;
- The recent purchase of a large portion of the estuary and transfer to the State of California for management as a park also will likely improve temperature and sediment conditions in that area of the Big River Basin;
- Much Of the basin is in the ownership of a few large landowners, making the creation and implementation of a coordinated basin-wide watershed program simpler;
- This assessment provides focus on watershed conditions and processes from the basin scale, through the subbasin scale, and down to the level of specific tributaries. This helps focus project design efforts so that local landowners can pursue the development of site specific improvement projects on an adaptive basis;
- Like most river systems, Big River coho salmon and steelhead trout meta-populations have evolved and adapted to the basin's unique conditions. Although these meta-populations are likely below historic levels, there remain local stocks that can take advantage of improved conditions.

Challenges

The Big River Basin also has some challenges confronting efforts to improve watershed and fish habitat conditions, and increase anadromous fish populations:

- Not all landowners are interested in salmonid habitat improvement efforts. Without a watershed wide cooperative land-base, treatment options are limited. In some cases this can remove some key areas from consideration of project development;
- Current levels of coho salmon and steelhead meta-populations could limit the amount of needed straying to rapidly colonize fish into improved or expanded habitat conditions.

Conclusion

The likelihood that any North Coast basin will react in a responsive manner to management improvements and restoration efforts is a function of existing watershed conditions. In addition, the status of processes influencing watershed condition will affect the success of watershed improvement activities. A good knowledge base of these current watershed conditions and processes is essential for successful watershed improvement.

Acquiring this knowledge requires property access. Access is a requirement to design, implement, monitor, and evaluate suitable improvement projects. Thus, systematic improvement project development is dependent upon the cooperative attitude of resource agencies, watershed groups and individuals, and landowners and managers.

The Big River assessment has considered a great deal of available information regarding watershed conditions and processes in the basin. This long assessment process has identified problems and made recommendations to

address them while considering the advantages and challenges of conducting watershed improvement programs in the Big River Basin.

After considering these problems, recommendations, advantages and challenges, the Big River Basin appears to be an excellent candidate for a successful long-term, programmatic watershed improvement effort. According to the current refugia analysis, the Big River has medium potential to become a basin with high quality fishery refugia. Reaching that goal is dependent upon the formation of a well organized and thoughtful improvement program founded on broad based community support for the effort.

Limitations of this Assessment

This watershed assessment provides useful and valuable information and represents a considerable effort of the involved agencies, contractors, and public. It was limited in duration, scope, detail, and analysis level due to constraints in budget, time, access, and overall resources. Specific limitations are presented below to put the assessment in context.

- This assessment only addresses habitat conditions in the Big River Basin. Ocean habitat conditions are not addressed;
- Data collected from individual stream reaches or point locations within them were described in relation to their streams or subbasins. As descriptions and inferences are extrapolated from those data to larger regional and basin scales, the certainty associated with those conclusions and inferences is reduced;
- CGS produced GIS data and maps. Preliminary interpretations based on geologic and geomorphic data are presented herein;
- CDFGs habitat inventory surveys provided instream condition data to the EMDS Stream Reach Model, the Limiting Factors Analysis, and the Restoration Recommendations and Priorities. However, not all subbasin streams were surveyed. Basin wide 34.1% of the stream length was surveyed;
- A lack of information on the suitability and/or use of the estuarine habitat for rearing and over-wintering by juvenile salmonids;
- CDFs land use analysis used aerial photos exclusively;
- Monitoring of two water temperature sites on James Creek in 1994 was conducted by JSF. Although the raw data are not available, summary data such as MWAT and maximum temperature was reported (Valentine 1994). Neither of these sites appeared in the FSP data;
- Many of the water temperature data loggers were set to collect data at 120 or 144 minutes. Previous research (Lewis et al. 2000) suggests that monitoring intervals greater than 96 minutes may result in missing the instantaneous peak temperatures. Therefore, it is possible that the MWMT and overall maximum temperatures may be slightly understate these values;
- It is presumed that all of the monitoring locations, except the MWA sites, are representative of the conditions in their respective stream reaches. For example, for water temperature monitoring sites, it was assumed that the data loggers were placed in a location that was representative of the average summer water temperatures in their respective thermal reach. MWAs stated goal was to monitor thermal refugia for salmonids. Therefore, these temperature monitors were generally placed in deep pools and other areas where you would expect water temperatures to be lower than the average for the thermal reach;
- In many sites throughout the Big River Basin, jumps in water temperatures in excess of 4°F were observed in consecutive measurements. In no case was it determined that a data set should be excluded because of this temperature variation. In absence of any other abnormal data characteristics, it was hypothesized that the observed temperature jump was likely the result of sudden direct exposure to sunlight in the thermal reach. If this were the case, it would be naturally occurring and representative of stream conditions. However, study of these cyclical temperature increases should be undertaken to verify the cause;
- Only surface water quality was assessed. In the instances where the streams are “gaining” (receiving groundwater input), the surface water will be a combination of surface run-off and groundwater. Therefore, surface water quality was assessed under the assumption that any influence from groundwater

would appear in the overall surface water quality. Groundwater water quality data, if it exists, was not incorporated separately into this assessment;

- As mentioned previously, the bulk sediment sampling for both MRC and GMA were collected using a gravimetric technique, which can lead to significantly different results from the volumetric technique that the Big River TMDL target is based on. Furthermore, MRC reported the gravimetric fractions of the entire bulk sediment samples, while GMA only reported the subsurface fractions of the samples. Therefore, even through data from MRC and GMA was reportedly collected in a similar manner, the data may be skewed relative to each other;
- During the review of the raw water temperature data plots, it was noted that there were, in some cases, unusual diurnal fluctuations. Typically, these types of issues were resolved by comparing the periods of unusual fluctuations with the same period of record at other sites in the subbasin. By close inspection of other nearby sites, it was often discovered that while they do not exhibit such dampened diurnal fluctuations, they do show a similar pattern in the fluctuations. Data loggers that exhibited unusual diurnal fluctuations that appeared to be unresponsive to temperature changes in their respective subbasin would be indicative of equipment or battery failure. In the Big River Basin, only one data set was not used for this type of problem. This was the single season recorded at Lower Quail Gulch (MRC 75-20), which did not appear to respond to basin-wide temperature variations and may have malfunctioned. Additional years of data are needed at this site to determine if it is characteristic of the site or if it was indeed a malfunctioning unit. Any file that did not cover the period of June 21 to August 15 or by visual inspection appeared to miss the peak temperatures were flagged. In the Big River Basin, six such temperature files were not used because it was determined that the recorded period likely missed the peak temperatures;
- The EMDS model used is preliminary; not all components of the model are currently in use due to data and modeling issues (i.e., stream temperature, fish passage, stream flow); not all data layers used in the model were fully subjected to quality control review.