

APPENDIX B

CASE HISTORY: THE FAILURE OF EXISTING PLANS TO PROTECT SALMON HABITAT ON THE CLEARWATER NATIONAL FOREST IN IDAHO

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INTRODUCTION

The large-scale loss of salmon habitat in the Snake River Subbasin and elsewhere in the Pacific Northwest is testimony to the failure of existing stewardship philosophies and their derivative management plans. Sedell and Everest (1990) and others (Pacific Rivers Council, 1992) have documented portions of the loss. In this section, the *failure* of past and existing management plans to protect salmon habitat on the Clearwater National Forest, Idaho, will be examined. Four natal tributaries of the Clearwater River Subbasin supporting salmon production have been selected for close examination of their case histories in terms of watershed and fish habitat impacts. These watersheds typify others in the Snake River Subbasin that have experienced similar histories of timber development. Moreover, the efficacy of past and existing management plans to protect and recover these watersheds will be investigated. The strategies, assumptions, prescriptions, and accountability features of these plans will be scrutinized.

BACKGROUND AND DESCRIPTION

Before 1973 and extending to 1987, management of the Clearwater Forest was guided by a generic document and policy called "Multiple Use Plan--Part I." This plan allocated the Forest landbase into general management zones such as the general forest zone, wild and scenic river zone, and riparian zone. A set of allowable management practices (guidelines) was described for each zone. These guidelines were extremely general in nature and subject to wide interpretation. For example, "*protect the riparian management zone and dependent resources while harvesting timber*" is the type of guidance that would be applied to the riparian zone. Specificity and quantification did not characterize the guidance. Other management policies, practices, guidance and direction available then were similar in nature and content. The Idaho State Forest Practices Act and implementing procedures offered no improvements because they consisted of excessively generalized guidance, escape clauses, and large loopholes.

The concept of "*best management practices*" (BMPs) was introduced as a catchall phrase representing the collection of all standard management practices of the day, which was hardly a guarantee of resource protection but were practices considered conventional, economical, reasonable, and acceptable to practitioners. In practice, resolution of resource conflicts was usually decided in

favor of commodity interests at the expense of aquatic resources. Application of BMPs then became viewed as a justification for proceeding blindly with resource extraction when obviously insufficient attention would be given to assessing BMP effectiveness or monitoring trends of degradation in aquatic resources. Part I of the Multiple Use Plan called for more specific planning in Phase II of the process--unit planning (Clearwater National Forest, 1972). Large parcels of the Forest were stratified into management units incorporating parts of large watershed systems. Stratification was based mostly on timber availability, District administrative and roadless area boundaries rather than an ecosystem or total watershed approach. Extensive inventories of all resources were conducted and an attempt to quantify the resources was made. Resource information was then used to stratify and allocate the landbase into the "best" possible uses and management strategies. Resource outputs and a set of management practices were derived for each management unit within the plan. An attempt to resolve resource conflicts with unit policy statements was made. Unit plans were a definite improvement over Part I. They were based on resource information and did a much better job of allocating the landbase. However, they still lacked specificity, accountability, and failed to adequately deal with cumulative impacts.

Unit planning ended with the arrival of the National Forest Management Act of 1976 (NFMA). Only a few unit plans were completed and carried out. Under NFMA, the entire Forest was subjected to the planning process. More intensive inventories were conducted and an attempt to stratify the Forest landbase into somewhat homogeneous ecologic units was made. The Forest was stratified into management areas and allocated to the "best" use for that segment of the landbase. Goals, objectives, guidelines, standards, and prescriptions were developed for each management area. In addition, similar direction was developed for the Forest as a whole. Timber outputs were quantified for the management areas. Other resources were quantified from District and Forest summaries. Watershed and fish habitat quality standards were derived for most of the watersheds of the Forest. These standards were based on the quantified estimates of sediment yield and its effect on in-stream deposition of sediment--cobble embeddedness (Stowell et al., 1983). This was one of the few attempts in the Columbia River Basin to quantify fish habitat criteria and establish it as an "*accountable*" management standard. The Forest Plan was completed in 1987 and provides direction to the Forest's management efforts to this day. With seven years of implementation, several significant shortcomings have become obvious. Timber outputs were out of synchronization with watershed and fish habitat standards. Projected timber harvests and associated road construction levels were too high to maintain optimum water and fish habitat quality (Clearwater National Forest, Phase I Report, 1992 and Isaacson, 1994). The level of timber activity scheduled by the Forest Plan increased the extent and severity of degradation on the Forest (Clearwater National Forest, Phase I Report, 1992). Degraded watersheds that were projected to recover in the plan have not.

In 1992, the Forest documented the damage in its Phase I Report that listed some 90 developed drainages (71%) that were below Forest Plan standards for water quality. Isaacson (1994) has since corroborated this assessment in his review of Region One and Clearwater National Forest water quality data. These 90 watersheds have since been tentatively listed as *water quality limited waterbodies* by the State of Idaho in their response to the U.S. District Court's decision on Idaho's submitted list of streams for compliance under section 303 (d) of the Clean Water Act (Idaho Sportsmen's Coalition v. Browner, April 14, 1994).

There are many reasons why the Forest Plan failed to adequately protect the watersheds. Some of these are documented in the Forest's Phase I Report (1992). The primary basis of the failure resided in the modeling effort that linked FORPLAN (computer model) timber activities with WATBAL (watershed computer model, Patten, 1989) estimated impacts (sediment yield). The models were not integrated in that sediment modeling was conducted independently of FORPLAN and without a watershed perspective. Timber and associated sediment effects were estimated from broad (gross) management strata and were subjected to broadscale, inappropriate averaging (Clearwater National Forest Plan, 1987). **Many planning assumptions of the modeling effort were simply invalid.** The Plan assumed that degraded watersheds would display a significant recovery pattern within a short period (5 to 10 years). They did not. The pursuit of unattainable timber targets forced the Forest to reenter the damaged watersheds repeatedly. Data from modeling and monitoring efforts were ignored. Consistent funding for extensive watershed restoration did not materialize. Modeled trends in watershed sediment delivery and reduction of sediment delivery to levels approaching assumed **"no impact thresholds"**--relative to dependent in-channel substrate conditions--did not agree with observed trends in substrate sediment conditions. The **"no impact threshold"** is a watershed-specific level of sediment delivery assumed by the Clearwater National Forest to potentially allow recovery in sediment conditions to occur. The observed increases in substrate fine sediments and cobble embeddedness or lack of recovery in these indices indicate that these modeling assumptions are faulty, that lag times for substrate response are very great, or that progress made in substrate recovery is easily reversed by periodic impacts. Existing roads (background sediment yield) were modeled to completely recover in six years. Monitoring and field observations proved this assumption erroneous. Management prescriptions, especially those for the riparian management area, were too generic and offered little protection. The original inventory of riparian areas was underestimated by a margin of some 86,780 acres (Phase I Report, 1992). The **"light"** scheduling of timber harvest in the riparian zones was consistently violated (Phase I Report, 1992). Uneven-age silvicultural treatment of riparian stands (another assumption) was seldom applied (Phase I Report, 1992). Water quality standards for developed watersheds were too obtuse and permissive. Criteria that described optimum fish habitat characteristics were not developed. Landbase allocations for fisheries resources were inadequate (Clearwater Forest Plan, 1987). Only 102,440 acres were allocated to the management of high value fisheries streams. A total of 503,567 acres was allocated to maximum timber development (Clearwater Forest Plan, 1987). Accountability for meeting water and fish habitat standards was not enforced. Although, the Forest Plan was a significant improvement over previous planning efforts, it still contained some **"fatal"** flaws concerning the management of fisheries resources and led to continued decline of anadromous and resident salmonids (Phase I Report, 1992).

The management history of the watersheds for **Lolo, Eldorado, Pete King, and Squaw Creeks**, provide specific examples of failures of past and existing management plans to protect salmon habitat on the Clearwater National Forest. All of these watersheds have had similar histories (25+ years) of timber development and road construction. These watersheds drain portions of the Idaho Batholith, a large and sensitive geologic formation (granite) characterized by highly erosive terrain and rivers that are highly susceptible to sedimentation. Therefore, watershed and fish habitat conditions will be reviewed primarily from the perspectives of sediment delivery to fish habitat and resultant cobble embeddedness and substrate fine sediment levels. Other factors limiting salmonid production in these watersheds are sub-optimal temperatures, loss of riparian shade and potential

large woody debris, low pool frequency and habitat diversity (Rich et al., 1992; Espinosa and Lee, 1991; and Phase I Report, Clearwater National Forest, 1992). Sediment and habitat data were provided by the Clearwater National Forest. Sediment yield data were derived from modeling efforts conducted on the Forest (Patten, 1989). Data on in-stream sediment conditions were obtained from field survey and monitoring programs (Phase I Report, Clearwater National Forest, 1992).

Lolo Creek is a large tributary of the mainstem Clearwater River, and Eldorado Creek is a principal tributary of Lolo Creek. Both watersheds are located on the Pierce Ranger District of the Clearwater National Forest. Pete King Creek is tributary to the lower Lochsa River, whereas, Squaw Creek is tributary to the upper Lochsa River near the Powell Ranger District (Figure B-1).

Lolo Creek

Lolo Creek, a seventh order stream, enters the mainstem of the Clearwater River from the north at river mile 54 and is 42 miles in length. The stream flows primarily in a south/southwesterly direction draining approximately 78.4 miles of existing and potential anadromous fish habitat. Of mainstem Lolo, 18 miles are within the National Forest boundary and drain a watershed of approximately 72,673 acres within the boundaries of the Forest. The remaining 24 miles traverse a mixed ownership pattern of private, state, Nez Perce Tribe, and the Bureau of Land Management interests. Our discussion and analysis will be confined to Clearwater National Forest ownership. The Lolo watershed has a range in elevation of 5238 ft at its headwater sources near Hemlock Butte to 1299 ft at its confluence with the mainstem Clearwater River. The stream displays a wide amplitude in its seasonal flow regime ranging from an average of 500 cfs during spring runoff to an average of 25 cfs during late summer flow (Espinosa and Lee, 1991).

Lolo Creek was once a significant producer of spring/summer chinook salmon in the Clearwater River Subbasin (Fulton, 1968; Chapman, 1981; and Espinosa, 1987). Chapman (1981) estimated that Lolo Creek was capable of producing 84,000 spring chinook smolts in its pristine condition. Today, it produces a mere fraction of this potential because of the combined effects of downstream mortality at hydroelectric facilities and degradation of habitat in the Columbia River ecosystem (Rich et al., 1992). In 1990, it was estimated by Rich et al. (1992) that Lolo Creek was seeded at 11% of its potential carrying capacity.

In concert with other integrated efforts to recover upriver stocks of salmon, massive hatchery supplementation has been conducted in the Lolo system. Despite the heavy stocking, escapement of adult chinook and densities of pre-smolt salmon remain at critically low levels in Lolo Creek (Espinosa and Lee, 1991). In the past few years, adult escapement has probably ranged from 50 to 75 fish (Murphy, pers. comm.).

The Lolo watershed has, over time, sustained manifold impacts from timber harvesting, road construction, mining, and grazing. In comparison to timber management, deleterious effects on fish habitat from placer mining (gold) and grazing remain at minor levels. The Lolo drainage has a lengthy history (30+ years) of timber management on the Forest. During this period, the allowable harvest has ranged from 15 to 30 million board feet. Hundreds of miles of logging roads have been built and thousands of acres have been harvested (primarily clearcut). Road construction and riparian harvesting have generated the most severe impacts on the aquatic habitats of the Lolo

system. Excessive sedimentation, channel impingement, and elimination of large woody debris were the major impacts documented by Espinosa (1975) during his baseline habitat survey.

Management of the Lolo watershed (and the other three tributaries) will be reviewed from two periods--pre-1973 and post-1973. Stratification at 1973 is critical because that is the year that fish habitat monitoring was initiated on the Clearwater National Forest (Espinosa, 1975). The year of 1987 is also critical because that is when the Forest Plan of the Clearwater National Forest was approved for implementation.

Extensive timber development in the Lolo watershed started in 1957 as revealed by a sharp increase in sediment yield produced by logging road construction (Figure B-2). Sediment yield was estimated at 60% over natural in 1957 (WATBAL database, Clearwater National Forest). Before that date, sediment yield was below the Forest's *estimated "impact threshold"* of 35% for Lolo Creek. Figure B-2 displays a histogram of sediment yield before 1973. In concert with an accelerated road building program, sediment yield increased dramatically and sustained high levels through this period. Sediment yield ranged from a minimum of 60% over natural in 1957 to a maximum of 149% over natural during 1965-1969. The mean and median sediment yields were 120% and 122%, respectively. During this period, sediment yield did not exceed the *"geomorphic threshold"* (a level of excessive sediment that induces major channel changes such as braiding, deposition, and bank instability; it is interpreted as an index of watershed instability; Patten, 1989). However, sediment yield did not drop below the *assumed "impact threshold"* during this period. Road construction in Lolo's riparian zone significantly altered the stream's channel and induced instability (Espinosa, 1975). Streamside roads were significant and chronic sources of sediment to Lolo Creek and its tributaries (Espinosa, 1975).

Sediment yields gradually declined from 1969 to 1972. This was short lived as sediment production was accelerated to new highs from 1973 to 1976 by the continuation of logging and road building. Sediment levels exceeded 200% over natural in 1975 and 1976 (Figure B-2). Beginning in 1977 and extending to 1993, sediment production has declined (Figure B-2). From 1973 to 1993, the mean and median sediment yields were 102% and 64%, respectively. Only recently (1990-1993) have sediment yields approached the Clearwater's *assumed "impact threshold"* of 35%. In summary, Lolo Creek has experienced sustained, high sediment impacts from 1957 to 1983 (26 year period). During the last decade, sediment yields have approached 20 to 30% over natural sediment yields, a target considered essential on Lolo Creek before recovery in substrate conditions can commence (Clearwater Forest Plan, 1987).

In 1973 and 1974, fish habitat and population monitoring were initiated in the Lolo watershed (Espinosa, 1975). Before the 1970's, little habitat data were available although Murphy and Metsker (1962) observed and documented sediment problems in the Lolo watershed. In 1974, streambed coring of salmon spawning habitat was initiated in Lolo Creek and extended into 1983. From 1983 to the present day, other sediment and fish habitat variables have been monitored (Espinosa and Lee, 1991). By the late 1970's, feedback information from the monitoring program was starting to influence decisionmakers. The awareness of watershed and habitat degradation problems helped to initiate a moderation of timber and road construction impacts in the early 1980's. The Forest planning process and increased public involvement have further diminished the development

program in the mid-1980's to the present day. Today any project involving extensive timber harvesting and road construction is swiftly challenged by the fisheries entities in the basin.

Substrate coring data collected from Lolo Creek from 1974 to 1983 are displayed in Figure B-3. These sediment levels in chinook spawning substrate far exceed conditions considered optimum (<20%) for chinook production (Bjornn and Reiser, 1991; Stowell et al., 1983). Because of the sustained, high sediment yields (1957-1973), levels of sediment (<6.4mm) in the spawning habitat ranged from 34% in 1975 to 43% in 1976 with a mean and median of 39% (95% confidence interval of +/-2%). There was little variation from year to year and no trend of recovery during this period. Sediment yields remained consistently high before and during the monitoring period. Despite the monitoring feedback and the obvious degraded habitat conditions, management continued to reenter the watershed with timber and roading projects. Although these projects were scaled down in relation to previous activities (less road building), they still generated impacts and stresses to the system. Given the impact history of the Lolo watershed, it may be extremely naive to anticipate recovery back to optimum conditions, especially under a scenario of reduced activity and continual reentry. Madej (1987) has calculated that it will take decades to centuries for excessive sediment to be flushed from some reaches of Redwood Creek, California. She further postulated that it may take centuries for complete mainstem recovery (i.e., removal of flood-deposited sediments; Madej, 1987).

After 1983, the substrate monitoring program was dropped because of timing and budgetary constraints. Fish habitat in Lolo Creek was then monitored periodically with a comprehensive transect methodology that measured channel structural elements plus selected sediment variables like cobble embeddedness and % surface fines (Espinosa et al., 1987; Espinosa and Lee, 1991; and Huntington, 1988 and 1993). In the early 1990's, a monitoring program measuring winter habitat quality and sedimentation was initiated. In 1983, the fish and riparian habitats of Lolo Creek were subjected to extensive rehabilitation efforts funded by the Columbia Basin Fish and Wildlife Program (Espinosa and Lee, 1991).

Espinosa and Lee (1991) have documented the details of the program. Rehabilitation primarily involved riparian restoration (planting of conifers) and in-stream efforts to increase habitat diversity with large woody debris and rock. Cattle were excluded from a critical reach via fencing. Evaluation of fish habitat and population responses to the rehabilitation has been an integral part of this program. Although increases in habitat diversity (pool quantity and quality) and spawning habitat were documented in Lolo Creek, cobble embeddedness remained essentially unchanged (54% in 1974 and 51% in 1988; Espinosa and Lee, 1991). However, statistically significant increases of steelhead and chinook parr in summer rearing habitat were observed for enhanced habitats over control habitats (Espinosa and Lee, 1991; Scully et al., 1990). Espinosa and Lee (1991) concluded that sediment conditions in Lolo's rearing habitat remain unchanged since the baseline survey.

The Clearwater National Forest reported in their Phase I Report (1992) that cobble embeddedness for Lolo was at 49%, a level that equates to roughly 60% habitat capability (the standard assigned to Lolo Creek was 80% habitat capability in terms of smolt production potential as effected by substrate sediment conditions). Huntington (pers. comm.) observed cobble embeddedness to be approximately 45% during his 1993 survey. Other habitat features such as pool

quantity and quality remain well below optimum standards (Espinosa and Lee, 1991; Phase I Report, Clearwater National Forest). Monitoring of winter habitat quality from 1990 to 1993 revealed a decline of 54% in quality ("free winter particle") from baseline (Figure B-4; Espinosa, unpublished data). The quantity and quality of winter habitat in Lolo Creek are likely factors limiting production of anadromous salmonids in the system (Espinosa et al., 1987; Huntington, 1988). According to the Clearwater National Forest, the overall habitat quality of Lolo Creek was assessed at 63%, some 17% below their Forest Plan standard (Phase I Report, 1992).

Based on data for substrate conditions and sediment yield, and habitat capability analyses, it is concluded that essentially little or no recovery in habitat sediment conditions in Lolo Creek has taken place over a period of 19 years despite a substantial decline in sediment yield and extensive rehabilitation during this time.

Eldorado Creek

Eldorado Creek, a fifth order stream, is a principal tributary of Lolo Creek and enters the Lolo mainstem near the Forest Service boundary (Figure 1). The stream flows primarily in a south/south-westerly direction draining approximately 12 miles and 38.3 acres of anadromous fish habitat. The stream drains a watershed of approximately 29630 acres and is 26.5 miles in length. The Eldorado watershed has a range in elevation from 5399 ft near its headwater sources to 2850 ft near its confluence with Lolo. The entire watershed is within National Forest ownership. The stream is capable of providing 0.42 acres of suitable spawning habitat for chinook salmon. In 1984, passage barriers near its mouth were removed to ease upstream migration of chinook salmon (Espinosa and Lee, 1991). In 1985, the rearing habitat of Eldorado was rehabilitated with in-stream structures over an 8-mile reach. In the 1990s, the Clearwater National Forest constructed several sediment traps in small tributaries and initiated a sediment removal program (using a portable dredge). The habitat monitoring program in Eldorado has been restricted to periodic surveys and evaluation of habitat improvement projects. The Nez Perce Tribe has selected Eldorado as one of its production tributaries for its hatchery and supplementation programs. Since the early 1980s, thousands of pre-smolt and smolt chinook salmon have been stocked in Eldorado (Espinosa and Lee, 1991). During the summer of 1993, the first adult salmon was observed in the stream, presumably from these plants (Larson, pers. comm.).

Similar to the Lolo analysis, Eldorado's sediment history will be reviewed from the same time perspective--pre-1973 and post-1973. Extensive timber harvesting in the Eldorado watershed also started in 1957 as shown by a sharp increase in sediment yield produced by logging road construction (Figure B-5). Sediment yield was estimated at 80% over natural in 1957. Figure B-5 displays a histogram of sediment yield for the 20-year period from 1957 to 1993 (WATBAL database, Clearwater National Forest). Like Lolo, Eldorado's sediment production accelerated dramatically and sustained high levels through this period. Eldorado's sediment yields were much higher than Lolo's and exceeded the "**geomorphic threshold**" of **272% over natural** four years during this period. Sediment yield ranged from a minimum of 80% in 1957 to a maximum of 341% in 1961 with a mean and median yield of 219% and 209%, respectively. According to the WATBAL model, when sediment exceeds the "**geomorphic threshold**" major channel changes and long term impacts can be expected. During this period, sediment yield did not drop below the *Clearwater*

N.F.'s assumed "impact threshold" of 45% for this drainage. Similar to its parent stream, logging roads constructed in the riparian zones were significant and chronic sources of sediment to Eldorado Creek.

Starting in 1974, sediment production decreased slightly until 1977 when it again shot upward beyond its *"geomorphic threshold"* in 1978 and 1979 (Figure B-5). A recovery trend started in 1980 and lasted until 1985. Another pulse was observed from 1986 to 1989. Since 1990, sediment yield has gradually decreased but still remains above the *"estimated thresholds"* that must be achieved before recovery can commence in this stream (i.e., 20-30%). From 1973 to 1993, sediment yield ranged from 60% to 306% with a mean and median of 143% and 140% over natural, respectively. Starting in the late 1970s, feedback based on surveys and the forest planning process helped create some awareness and sensitivity to the worsening condition of fish habitat. During the 1990s, this awareness and the public's involvement have helped to moderate the development program in Eldorado. *However, the Clearwater National Forest continues to plan additional timber sales and roading in this below standard watershed that could further contribute to its degraded condition and delay the onset of a recovery trend.*

The fish habitat of Eldorado has been surveyed periodically as part of the Clearwater National Forest's ongoing fisheries program. In the Forest Plan database, Eldorado's level of cobble embeddedness is listed at an average of 37%. The data were collected in the 1970s. In the mid-1980s, Eldorado was resurveyed and cobble embeddedness was measured at a range of 50%-60% in salmon habitat. For the Phase I Report (1992), cobble embeddedness was assessed at an average of 73% for all surveyed reaches. Some critical reaches are in slightly better shape with a range of 45% to 60% cobble embeddedness (Huntington, 1992). In summary, surveys from the 1970's to 1990's have shown an increasing trend in CE, which likely commenced with the large peaks in sediment yield that occurred as the watershed was developed and continued with further development of the watershed.

Other habitat problems have been identified in Eldorado Creek by Vogelsang et al.,(1985). Some of these problems were: low pool frequency, poor pool quality, low levels of large woody debris, poor winter habitat, lack of substrate diversity, low levels of in-stream cover, and high water temperatures during critical rearing periods. Most of these habitat conditions were associated with excessive harvesting of riparian timber and poor road construction.

Obviously, the Eldorado system has been subjected to a long history of severe sediment and riparian impacts. Today its salmon habitat remains in a significantly degraded condition. Its condition is well below its Forest Plan standard of 80%+ habitat capability based on cobble embeddedness alone. A cobble embeddedness <35% is required to achieve habitat capability of 80% for a stream having a C-channel type (Espinosa, 1992). Eldorado Creek has been listed (tentatively) as a *water quality limited waterbody* by the State of Idaho and the Environmental Protection Agency (Martin, pers. comm.; State of Idaho's draft (303) (d) list submitted to EPA, May 13, 1994). Nevertheless, additional timber and roading projects are being planned for the Eldorado watershed. Despite extensive watershed and in-stream rehabilitation plus a relative decrease in sediment yield, there has been no recovery of watershed and habitat conditions.

Pete King Creek

Pete King Creek is a fourth order tributary of the lower Lochsa River near its confluence with the Selway River (Figure 1). The Lochsa River was once a significant producer of steelhead trout and spring chinook salmon (Espinosa and Lee, 1991). Pete King drains a watershed of some 17,526 acres and has a channel length of 12.5 miles. Its headwaters are located near Woodrat Mountain. The stream has a range in elevation of 1476 ft to 5218 ft. Pete King is entirely within National Forest ownership except for a small patented mining claim near its mouth. The stream was surveyed by Huntington (1992) who estimated that it could provide some 17.8 acres of rearing habitat for anadromous fish. Huntington (1992) observed only 0.0077 acres of spawning habitat for chinook salmon, most of which he classified as poor. Because of its steep gradient, chinook spawning would likely be confined to the lower 4.5 miles of mainstem Pete King. Some summer rearing of juvenile chinook does occur in the lower reaches of Pete King. However, because of excessive summer rearing temperatures (>68°F), Pete King is, at best, marginal salmon habitat.

Pete King has a long history of logging, mining, and grazing impacts. For the past 20 years, mining and grazing have had a very minor influence on the watershed. Since the mid-1950s, logging and associated road construction have been the predominant activities in the watershed. During its development history, the headwaters and riparian areas of Pete King have been subjected to heavy impacts. Pete King was also subjected to large, intense fires in the early 1900s. Starting in the 1970s, the watershed and habitats of Pete King have undergone extensive rehabilitation. In the mid-1980s, extensive in-stream restoration of spawning and rearing habitats was initiated under the auspices of the Columbia Basin Fish and Wildlife Program (Espinosa and Lee, 1991). Several in-stream sediment traps were also constructed in mainstem Pete King and its principal tributaries during this period. Sediment is removed annually from these traps and habitat is monitored for recovery in downstream reaches. Habitat and populations have been monitored in Pete King since the late 1970s. Recently, Pete King Creek has been selected as a research stream for chinook salmon supplementation (Bowles and Leitzinger, 1991).

Logging and associated road construction in Pete King Creek were initiated in the mid-1950s and then accelerated in the late 1950s to the mid-1960s (Figure B-6). Sediment yield was estimated at 65% in 1955 and then reached its apogee in 1963 at 347% over natural (Figure B-6). From the period of 1961 to 1974, sediment yields were sustained at levels exceeding the "*geomorphic threshold*" of 174% over natural. A histogram for the two periods of pre-and post-1973 displays drastically different scenarios (Figure B-6). From 1955 to 1972, sediment yield averaged 197% with a median yield of 220% over natural. From 1973 to 1993, the mean and median sediment yields were 77% and 54% over natural, respectively.

Since 1973, sediment yield in Pete King has declined significantly as road construction dropped-off sharply although it still remains elevated. Timber harvesting and roading did not completely stop. To this day timber projects are being carried out and planned for the watershed. In the 1990s, sediment yield has approached levels of <35% over natural, a level considered necessary for recovery to be initiated. Without monitoring and feedback to the management system, it is likely that sediment yields would have remained at levels of 60% to 100% over natural during the decade of 1983 to 1993. The Pete King Creek monitoring program was conducted at a frequency

and intensity great enough to provide feedback to management on impacts to fish habitat so irrefutable that the sustained impacts of an aggressive timber program could no longer be overlooked.

Habitat problems in Pete King have been documented by many investigators (Murphy and Metsker, 1962; Talbert and Espinosa, 1986; Espinosa and Lee, 1991; and Huntington, 1992). Sediment, temperature, and the lack of structural diversity are just a few of the more salient problems. Concerning chinook salmon, sediment in winter habitat and temperature are probably the most critical limiting factors in the system (Espinosa and Lee, 1991 and Huntington, 1992). In the Forest Plan database, Pete King is listed with an average level of cobble embeddedness of 47%. In the early to mid-1980s, observed cobble embeddedness ranged from 50% to 60% (Talbert and Espinosa, 1986). Huntington (1992) recorded an overall average cobble embeddedness of 53% that included the West Fork. The mainstem of Pete King below the confluence of its forks displayed a mean cobble embeddedness of 36% (Huntington, 1992). A considerable amount of sediment still remains in the tributaries to Pete King. The West Fork showed a range in cobble embeddedness of 45% to 87% among its reaches. Three principal tributaries (Nut, Placer, and Walde) displayed a range of 42% to 45% in cobble embeddedness (Huntington, 1992). Old logging roads continue to fail and deliver sediment to the tributaries and mainstem of Pete King Creek (Stotts, pers. comm.). Although there is some evidence that summer and winter rearing habitats in the mainstem are showing some signs of recovery (Huntington, 1992 and Clearwater National Forest Monitoring Report, 1992), regression analysis indicates that there has been no statistically significant recovery trend from 1985 to 1992 despite sediment trapping (See Figure 7 in Appendix A).

Coring of spawning substrate was initiated in the mid-1980s. Figure B-7 displays a histogram of percentage fines (<6.4mm) in spawning substrate of mainstem Pete King during the period from 1985 to 1993. During this period, fines ranged from 30% to 47%, with mean and median levels of 37% and 36%, respectively. These levels are well above those considered optimum for salmonid survival (i.e., <20% fines <6.4 mm) (Stowell et al., 1983; Tappel and Bjornn, 1983). Despite a significant decline in sediment yield from 1973 to 1993, in-stream fines have remained high. The histogram displays two short periods of recovery interrupted by a three-year period of increase from 1989-1991. In-stream fines have declined in 1992 and 1993 (B. Stotts, pers. comm.). The short-term decrease in fines may be attributed to sediment trapping and removal which commenced in 1986. A large sediment trap is located about 0.5 mile above the substrate transects for mainstem Pete King Creek. This brief respite may be short-lived as new projects are being planned for the watershed and old logging roads continue to deliver sediment to the tributaries (B. Stotts, pers. comm.).

Despite a decline in sediment yield and extensive rehabilitation, habitat data indicate that recovery of degraded substrate conditions in fish habitat has not taken place in Pete King Creek (Figure B-7; See also Figure 7 in Appendix A).

Squaw Creek

Squaw Creek is a fourth order tributary of the Upper Lochsa River (Figure 1). This stream was once a significant producer of steelhead trout and spring chinook salmon (Espinosa and Lee, 1991). It drains a watershed of some 17,267 acres and has a mainstem channel length of 4 miles. Squaw Creek is estimated to provide 18.7 acres of rearing habitat and 0.73 acres of spawning habitat for anadromous fish (Espinosa and Lee, 1991). Although Squaw Creek exhibits the same general

pattern of historical timber development, there are some differences between it and the three previously discussed streams. Extensive timber harvesting and roading were initiated in the mid-1950s. In the mid-1980s, extensive in-stream and riparian rehabilitation were conducted in the mainstem and the East Fork. Squaw Creek was also selected as a research test stream for chinook salmon supplementation and is currently being evaluated by the Nez Perce Tribe (Bowles and Leitzinger, 1991).

Road construction associated with logging started in 1956 when sediment yield was estimated to exceed the *assumed "impact threshold"* of 45% over natural and attained a level of 62% over natural. From 1956 to 1963, sediment yield stayed in the range of 60% to 100% over natural (Figure B-8). In 1964, it increased to 125% and reached levels of 293% and 372% over natural in 1969 and 1970, respectively (Figure B-8). During the pre-1973 period, sediment yields exceeded the *"geomorphic threshold"* of 207% over natural for three years and showed a mean and median yield of 148% and 123% over natural, respectively. Starting in 1972, sediment yields declined slightly until 1979 when another increasing trend was initiated (Figure B-8). From 1982 to 1985, sediment yields again decreased slightly. From 1986 to 1988, an increasing trend was again observed. Since then, sediment yields have declined slightly approaching *"assumed recovery thresholds"* (<30% over natural) in the 1990s at which point continued improvement in substrate fine sediment can be expected to commence. From 1973 to 1993, the mean and median sediment yields for Squaw Creek were 86% and 87% over natural, respectively. Sediment did not exceed the *"geomorphic threshold"* during this period. Today additional timber sales are being planned for the Squaw Creek drainage.

In the Forest Plan database, the mean level of cobble embeddedness for Squaw Creek is listed at 50% based on surveys conducted in the 1970's. Kramer et al. (1985) documented a range of 30% to 40% cobble embeddedness before in-stream rehabilitation. The latest habitat assessment by the Clearwater National Forest listed cobble embeddedness at 45% for mainstem Squaw above Doe Creek (Phase I Report, 1992). Other habitat problems in Squaw are associated with poor riparian management (Kramer et al., 1985 and Espinosa and Lee, 1991). Excessive harvesting and riparian road construction have altered and simplified a great deal of the rearing habitat in Squaw and its tributaries. In many areas, the damage is permanent. In-stream restoration associated with the Columbia Basin Fish and Wildlife Program has attempted to alleviate some of these problems by introducing large woody debris and rock. Some riparian habitat was recovered when the parallel riparian roads were rehabilitated and reconstructed. Espinosa and Lee (1991) have documented the habitat and population responses to this effort. Nevertheless, the overall habitat quality of Squaw Creek remains at 63% on the basis solely of cobble embeddedness, some 17% below its Forest Plan standard (Phase I Report, 1992). Squaw Creek has not recovered from its history of development.

Summary Analysis

The history of watershed development and resultant changes in substrate sediment and habitat condition of four salmon watersheds on the Clearwater National Forest have been examined in detail. The analysis has demonstrated very similar patterns of timber development and associated impacts to salmon habitat. Other watersheds on the Clearwater National Forest have a similar history with comparable results including drainages such as Yoosa, Deadman, Papoose, Crooked Fork, and Brushy Fork (Phase I Report, 1992). This is certainly not unique to the Clearwater National Forest.

Without much difficulty, one could document analogous situations elsewhere in the Snake River Subbasin. Available data and analyses consistently indicate that the vast majority of watersheds managed for "**multiple uses**" exhibit degraded conditions in their fish habitats (Sedell and Everest, 1990; Platts and Chapman, 1992; and Isaacson, 1994).

Why have past and existing management plans failed to protect salmon habitat? In the early days (1950s to mid-1970s), the management strategy that was applied can be best characterized as "**management by implied generalization.**" Essentially, the watersheds and habitat will take care of themselves despite practices and impacts.

The axiomatic management assumptions derived from this management perspective are the concepts of "**free lunch**" and "**immaculate recovery.**" Translated, these amount to assumptions that whatever the current status of the watershed or fish habitat, there is a certain amount more impact that can be exacted without serious biological or physical consequences to system integrity. At least the impacts cannot be detected over the background of existing impacts; in addition, despite how serious the historic impacts have been, management today is conducted according to much refined practices that will result in a slow glide path to full recovery, as long as we continue to implement BMPs long enough. Unfortunately, the recovery scenario as practiced does not aim at recovery as a primary target. Rather, recovery is an anticipated spin-off from further development. For example, by harvesting trees in a floodplain, rehabilitation funds for use in the riparian zone can be generated. Or, rather than building a new primitive unsurfaced road, gravel is added to the road surface to lower sediment delivery in a watershed where cumulative sediment delivery is already above impact thresholds. BMPs then are merely means to reduce the level of impact given a decision to proceed with development.

Past management policies and practices led to extensive development and severe impacts that managers are still trying to deal with today. There was no "**free lunch**" or "**immaculate recovery.**" An integral part of that prevailing management effort that has persisted into today's thinking is the idea that BMPs adequately protect aquatic resources. Stanford and Ward (1992) have labeled the **BMP paradigm** as a prime example of the "**illusion of technique**" process that is in vogue today (R. Behnke, Colorado State University, as cited in Stanford and Ward, 1992). The authors describe the process as a mere formalization and synthesis of "**best professional judgment**" with no ecological rationale that is empirically based. Specific sites are visited and subjective judgments are rendered on whether impacts to the resources have occurred. Additionally, inferences as to the significance of the impacts (or lack of impacts) are usually made (Stanford and Ward, 1992). The assessments are strictly subjective, qualitative, and cryptic.

A great deal of the failure to protect salmon habitat can be attributed to this philosophy and **illusion.** It could be more appropriately named "**least management practices.**" BMPs are subject to a wide spectrum of interpretation--frequently by disciplines not qualified to apply measures to protect salmon habitat or that have other resource objectives in mind. Therefore, the least effective practices are frequently applied. BMPs are contingent upon economic considerations and are habitually diluted or dropped because they are not **economically feasible.** BMPs do not deal with cumulative effects and the recovery of impacted watersheds. In fact, they promote cumulative effects

and do not allow recovery because there are no watershed or fish habitat standards (criteria) to regulate or stop the application of practices. As long as BMPs are applied, habitat conditions are assumed to be fine regardless of existing watershed conditions and regardless how much land is subjected to impacts provided that BMPs are employed. Subjective assessments are too easily influenced by managers looking for facile answers to complex problems (*the free lunch syndrome*). Mechanistically, the concept functions like a perpetual motion machine. BMPs cannot protect a watershed from excessive development. This philosophy has unequivocally failed to provide adequate protection for salmon habitat.

There are other examples of reliance on the "*illusion of technique*" process that have led to widespread degradation of watersheds and fish habitats. The FORPLAN debacle is a good example. This simplistic computer model was strictly a timber-producing prototype built on a mountain of invalid assumptions. Because it was a computer model, it was given a *sanctified status* by forest planners that was inviolate. This deified model drove the process of setting timber harvest expectations. The FORPLAN model was not grounded in reality nor had it been validated and calibrated (tested) against real data. Timber volume projections used in the model were not "*ground-truthed*" against actual production and standing volume data by landscape strata (Clearwater National Forest Plan, 1987 and Phase I Report, 1992). Because of its inherent weaknesses and constraints, only gross resource stratifications (land capability units) were possible (Clearwater National Forest Plan, 1987). A watershed or ecosystem perspective was not applied to the process. Therefore, there was no integration of resource capabilities, values, or impacts. An attempt was made to link external watershed modeling efforts to the FORPLAN process; however, it was unverified and still subject to gross stratifications (Clearwater National Forest Plan, 1987). The result was faulty conclusions concerning resource outputs, scheduling of timber sales, impacts, recovery scenarios, and the attainment of water quality standards. Totally unrealistic timber volumes were projected for scheduling and harvest (Clearwater National Forest Plan, 1987). It soon became apparent that the targets were unattainable and that water quality standards for the developed watersheds were not being met (Phase I Report, 1992). The plan was litigated by the Sierra Club and the Wilderness Society in February 1993 and a negotiated settlement was reached in October 1993. The prime issues in the litigation were unrealistic timber harvest projections, uncertainties in the water quality modeling, and incomplete water quality standards (Clearwater National Forest, letter to the public, dated October 8, 1993). The Clearwater National Forest agreed to set a timber volume ceiling of 80 million board feet (MMBF) and to not cause further impacts in its "*below standard*" watersheds (*op.cit.*, 1993).

Other significant manifestations of the illusion of rigorous analysis, promoted by FORPLAN modeling, involved projections of watershed recovery rates under extant levels of watershed impacts, mitigation measures, impact thresholds associated with each watershed, and availability of rehabilitation funding that could be counted on to ameliorate ongoing habitat damage. There was little or no data to support any of these contentions. Recovery of heavily degraded watersheds was a pivotal assumption in the Clearwater National Forest plan. The recovery assumption was based on the premise of receiving funding to abate sediment sources (i.e., road obliteration) and mitigate impacts. The funding did not materialize in a timely, consistent manner or adequate amount. At the same time, the assumption that these "*below standard*" watersheds could still be re-entered with *moderated* logging activities without interrupting recovery was accepted by management.

The Clearwater Forest believed that modeling and mitigating expected sediment yield to levels below "*impact thresholds*" would make it possible. Again, simple answers to complex problems that were not verified by data (e.g., measurement of sediment delivery, in-channel substrate sediment condition) were accepted. The ability of site-specific mitigation measures to reduce erosion and sediment delivery had not been adequately quantified. Modeling of surface sediment erosion on existing road networks was based on assumptions of total extinction of accelerated sedimentation in six years. This did not happen. Extant roads continue to experience accelerated surface erosion. "*Impact thresholds*" were not calibrated or validated with empirical evidence. In dealing with severely degraded watersheds and habitats, it is likely that *zero* sediment delivery over natural is the appropriate threshold for recovery (Heede, 1980). With degraded watersheds, the notion that moderated logging would allow recovery simply did not work (Phase I Report, 1992). Watersheds did not recover or they were further degraded (*op.cit.*, 1992).

The inability of the Forest to promote recovery of damaged watersheds while attempting to achieve timber harvest schedules known to be unjustified considering extant fish habitat conditions was further exacerbated by an "*escape clause*" standard. This particular standard allowed a one-time variance in the "*recovery*" pattern in drainages that were below their respective standards. This allowed many timber sales to survive that otherwise would have been considered a violation of Forest Plan standards and proceed toward implementation. "*Recovery*" was predicted from modeling efforts and not real data. In addition, modeled recovery in the distant future was traded for near-term continued improvement in habitat quality. Monitoring of in-stream sediment conditions soon established that *modeled recovery scenarios* were not accurate (Phase I Report, 1992). The escape standard was used for several years before it was declared illegal by the Regional Office and dropped by the Forest.

Although no documented or consistent standard was established as a replacement in the Forest Plan, management has used and continues to use several variations on the theme of recovery to make their decisions. The latest interpretation is "*no measurable increase in sediment production in drainages currently NOT meeting Forest Plan Standards*" (Clearwater National Forest, letter to the public dated October 8, 1993). In practice, this effort has become a procedure to rationalize timber sales in watersheds where conditions violate Forest Plan standards. Under such a standard continued impacts are allowable provided that they cannot be statistically detected against the existing background of degraded habitat. Road construction and timber harvesting have been moderated; however, impacts have continued to be placed on the drainages. Many projects have been contested and appealed by the public. Most proposals have been significantly modified, delayed, or dropped (Clearwater National Forest monitoring reports, 1990-1992). Without public intervention, it is very likely that the damaged watersheds would have been subject to still greater impacts.

It is only recently that sediment yields in some drainages have approached levels where the initiation of recovery might be expected. The estimated sediment levels have decreased to 20 to 30 % over natural category. However, these sediment delivery levels may still be too high to allow recovery. If more logging occurs within these watersheds, it can be expected that sediment delivery will increase and further degrade habitat and delay recovery. *It is our opinion that sediment yields must remain well below the 20% over natural level until recovery of watersheds and fish habitat*

is documented by "hard data."

Certainly, the advent of the Forest Plan with its quantitative standards for watersheds and fish habitat on the Clearwater National Forest has prevented the continuation of severe resource damage that was observed in the 1950s through the 1970s. Nevertheless, there are major flaws, omissions, and loopholes in this management philosophy and strategy that have prevented salmon watersheds and fish habitat from significant recovery. *In the following list, articulates the "management corrections" that are necessary to adequately protect salmon watersheds.*

Management Corrections

- ! Apply the ESA screening process recommended by this document throughout the Snake River Basin and extend it to the Clearwater, Umatilla, and John Day River Subbasins in order to protect refugia for colonists to and from critical habitat for spring/summer chinook.
- ! Establish Forest Plan standards for salmon watersheds based on our screening criteria for watersheds and fish habitat.
- ! Maintain roadless areas in salmon watersheds roadless until there is documentation that 90% of managed salmon watersheds have recovered to optimum levels (*the roadless reserve concept*).
- ! Take all of the riparian areas out of the allocated timber and grazing landbase. In salmon watersheds, this would mean that fish resources would be the primary, dominant and dependent resources for that management area. No activity would be permitted in this management area that did not enhance or maintain the fish resources. Timber sales and grazing would not be scheduled in this management area as part of the programmed harvest and grazing regimes.
- ! Projects programmed for *degraded or "below standard" watersheds* should not proceed until they can meet the screening criteria for watersheds and habitat.
- ! Continue to monitor watersheds, fish habitat, and populations to provide feedback on recovery progress.
- ! Eliminate roads in landscapes prone to severe surface and mass erosion.
- ! Conduct comprehensive watershed and fish habitat analyses plus inventories of rehabilitation needs with interdisciplinary teams. Establish a basin-wide priority list for watershed and fish habitat restoration projects. Subject the "*need*" for fish habitat restoration to a limiting factor analysis. *Prior to any active restoration activities, remove or reduce anthropogenic perturbations to levels that allow recovery. Emphasize watershed (including riparian) restoration activities as a first priority before considering active in-channel or off-channel treatments.*
- ! Validate BMPs, mitigation, and restoration measures with hard data and science; subject these management techniques to peer review; and develop specific BMPs for salmon watersheds (including private and state land) that feature dramatic reduction of risk to the stocks, rapid habitat recovery, unimpeded recovery, and no grace periods in which one last sediment delivery spike is allowed before recovery proceeds.
- ! In conducting analyses of cumulative effects in large watersheds, do not fragment

watershed systems--i.e., exclude mixed ownership reaches or tributaries that would make the analysis "*look good.*"

- ! Conduct ESA, Section 7 assessments with journeyman-level fisheries biologists.
- ! Develop in-stream flow criteria for salmon watershed systems; provide adequate in-stream flows during critical low flow periods.
- ! ***Hold Resource Managers accountable for their decisions.*** Job performance criteria should include protection of salmon habitat. Replace managers insensitive to the protection of salmon habitat.
- ! In land management plan revisions, allocate salmon watersheds to salmon as the primary resource consideration.

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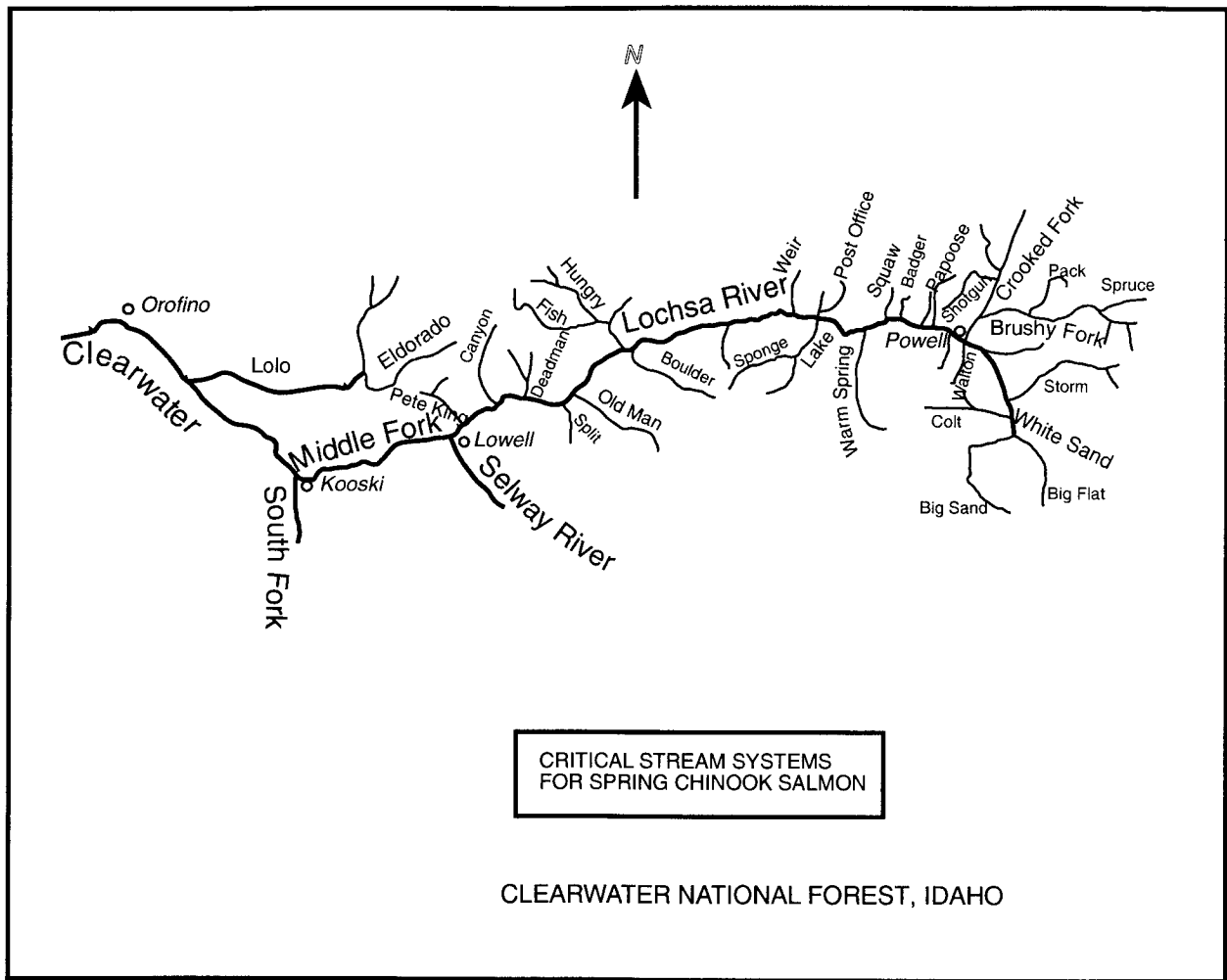


Figure B-1. Middle Fork Clearwater River and tributaries.

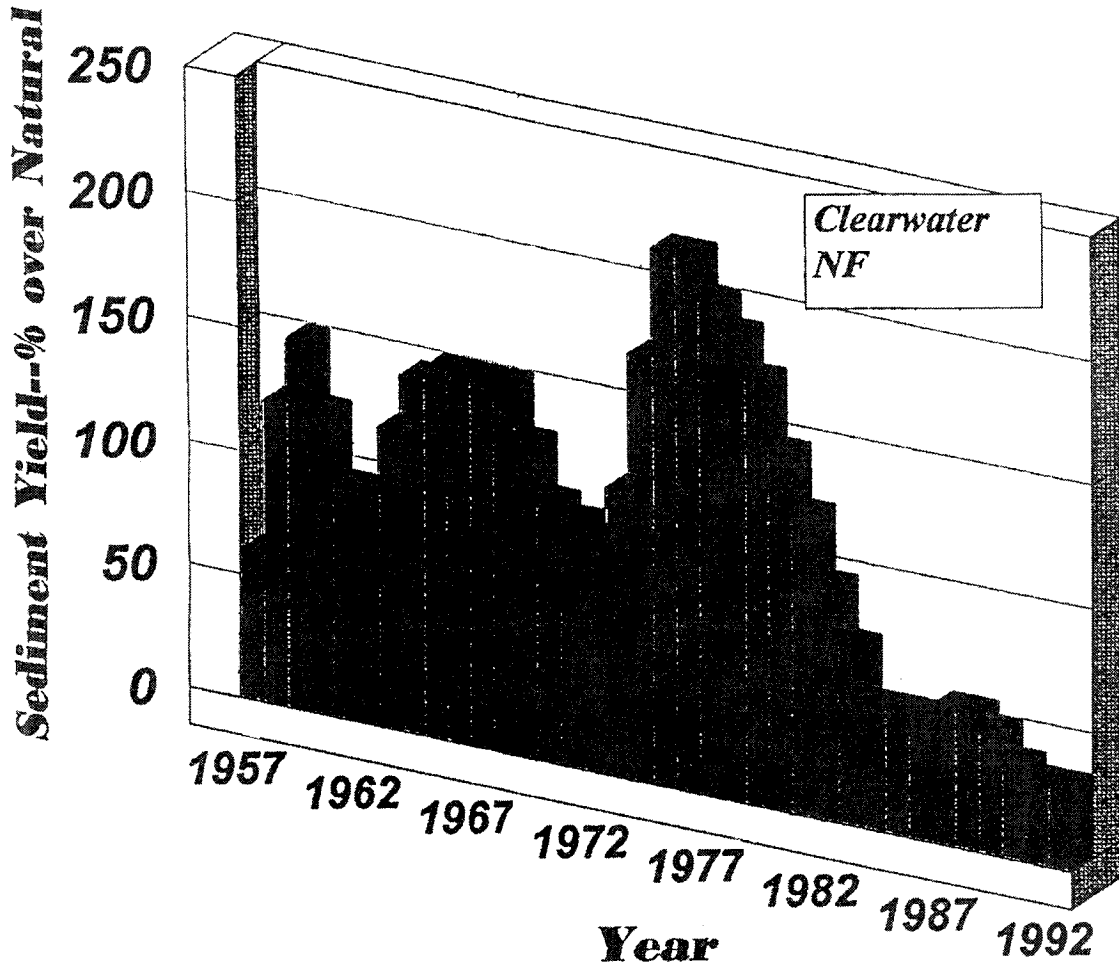


Figure B-2. Estimated sediment delivery from 1957 to 1992 in Lolo Creek on the Clearwater National Forest, Idaho (Clearwater National Forest, unpublished WATBAL runs).

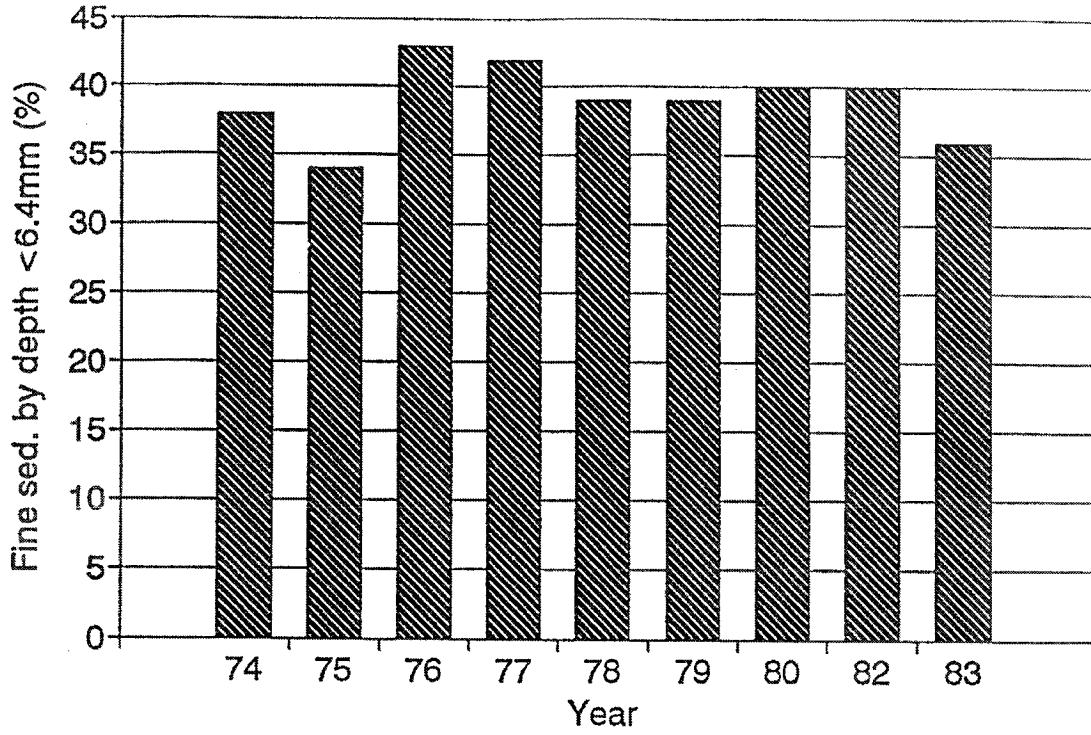


Figure B-3. Fine sediment by depth from coring in spawning substrate in Lolo Creek from 1974 to 1983 (Espinosa, unpublished data). Monitoring ceased in 1983.

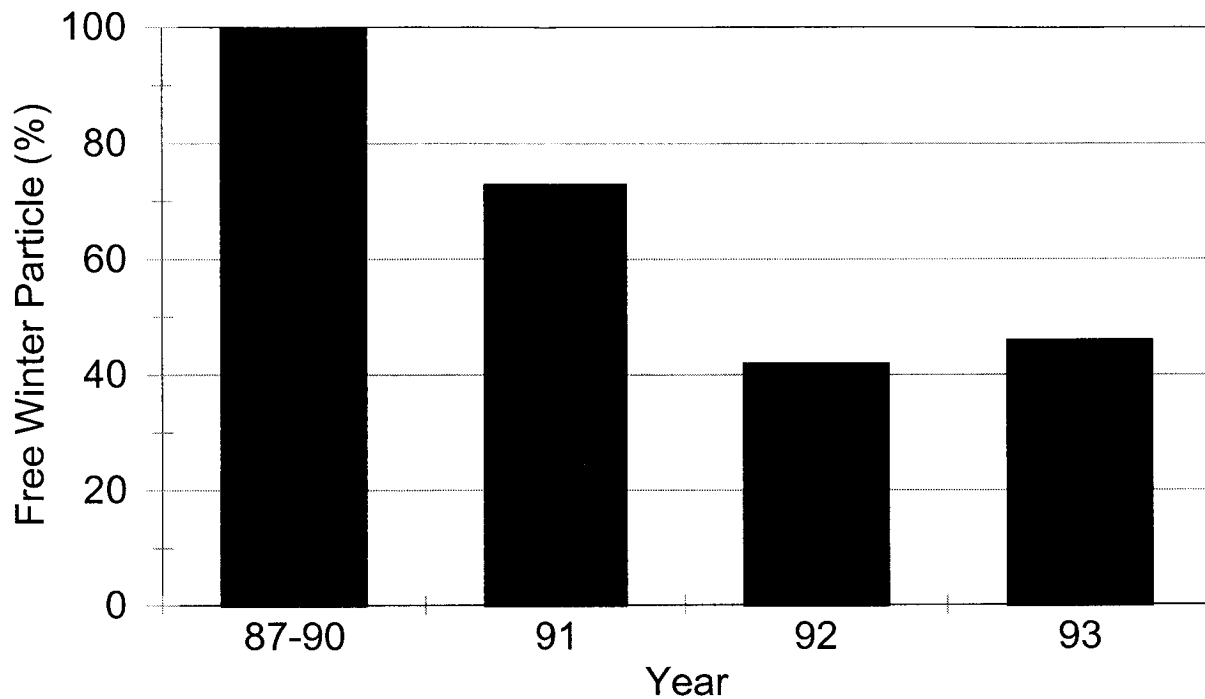


Figure B-4. Trend in "free winter particle" from 1987 to 1993 in Lolo Creek on the Clearwater National Forest (CNF) (Espinosa, unpublished data). Free winter particle is a measure of interstitial rearing space in winter habitat. Decreases in free winter particle also indicate in an increasing trend in cobble embeddedness (CE). Clean cobbles and boulders were added to the sample reach and the percent free winter particle (amount not embedded) was tracked over time. Data indicates that sedimentation continues to occur in winter rearing habitat under existing levels of sediment delivery. Annual differences in free winter particle were statistically significant ($p < 0.01$) (Espinosa, unpublished data).

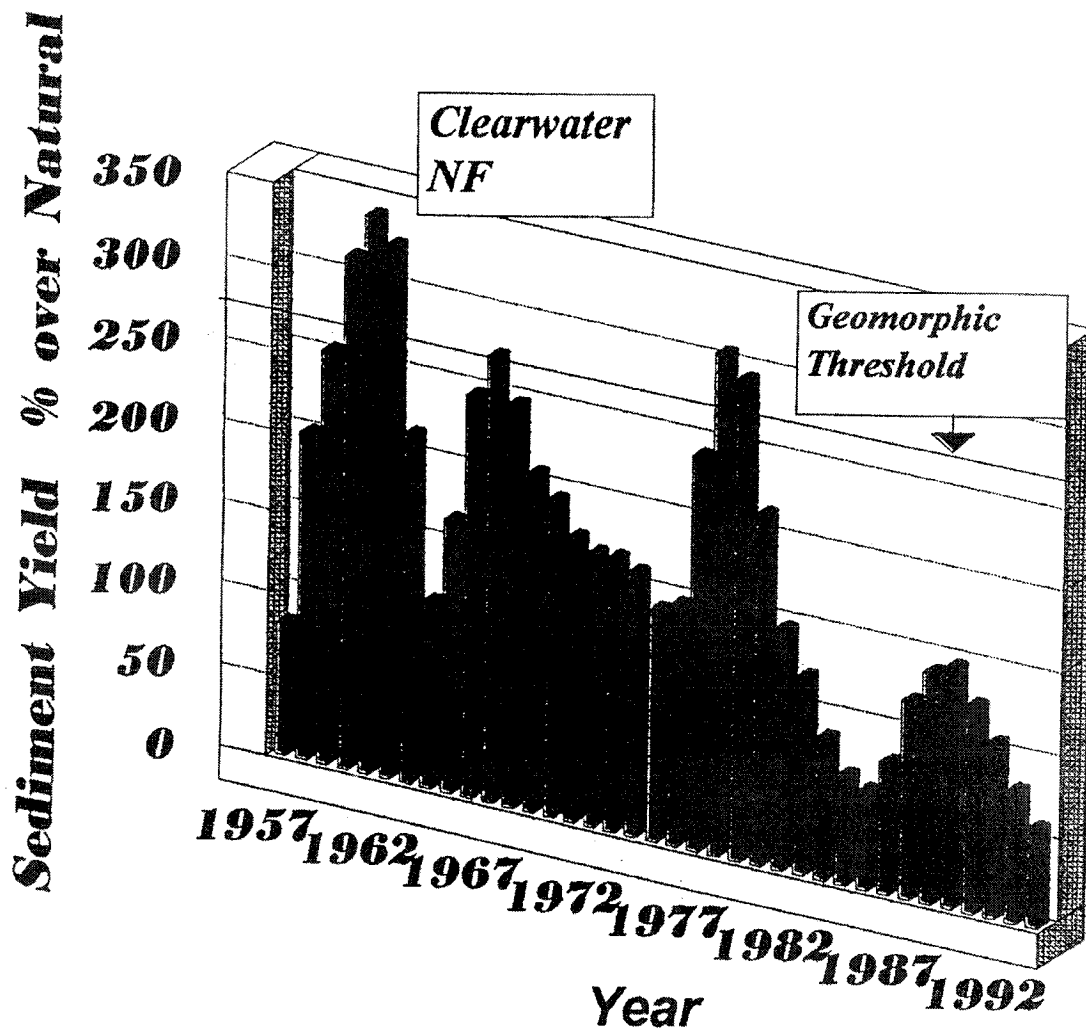


Figure B-5. Estimated sediment delivery from 1957 to 1992 in Eldorado Creek on the Clearwater National Forest, Idaho (Clearwater National Forest, unpublished WATBAL runs).

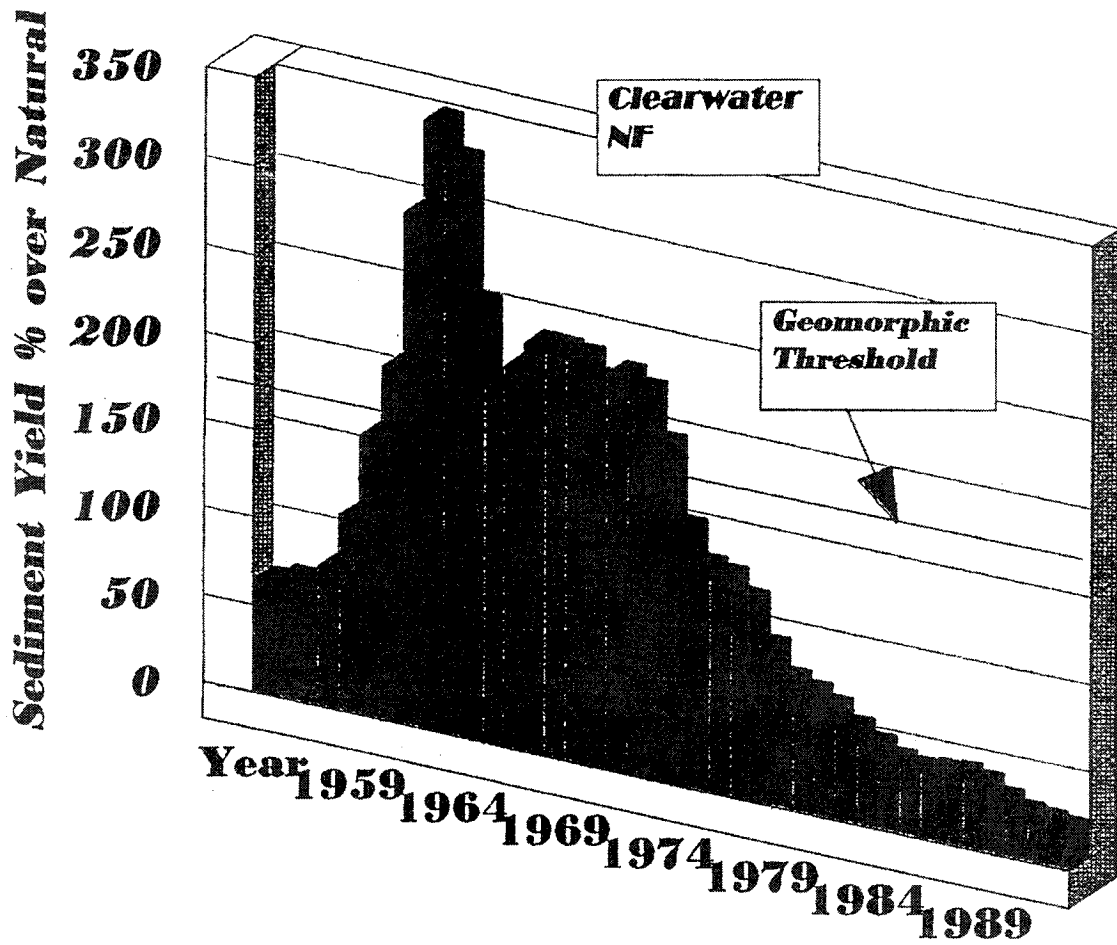


Figure B-6. Estimated sediment delivery from 1957 to 1992 in Pete King Creek on the Clearwater National Forest, Idaho (Clearwater National Forest, unpublished WATBAL runs).

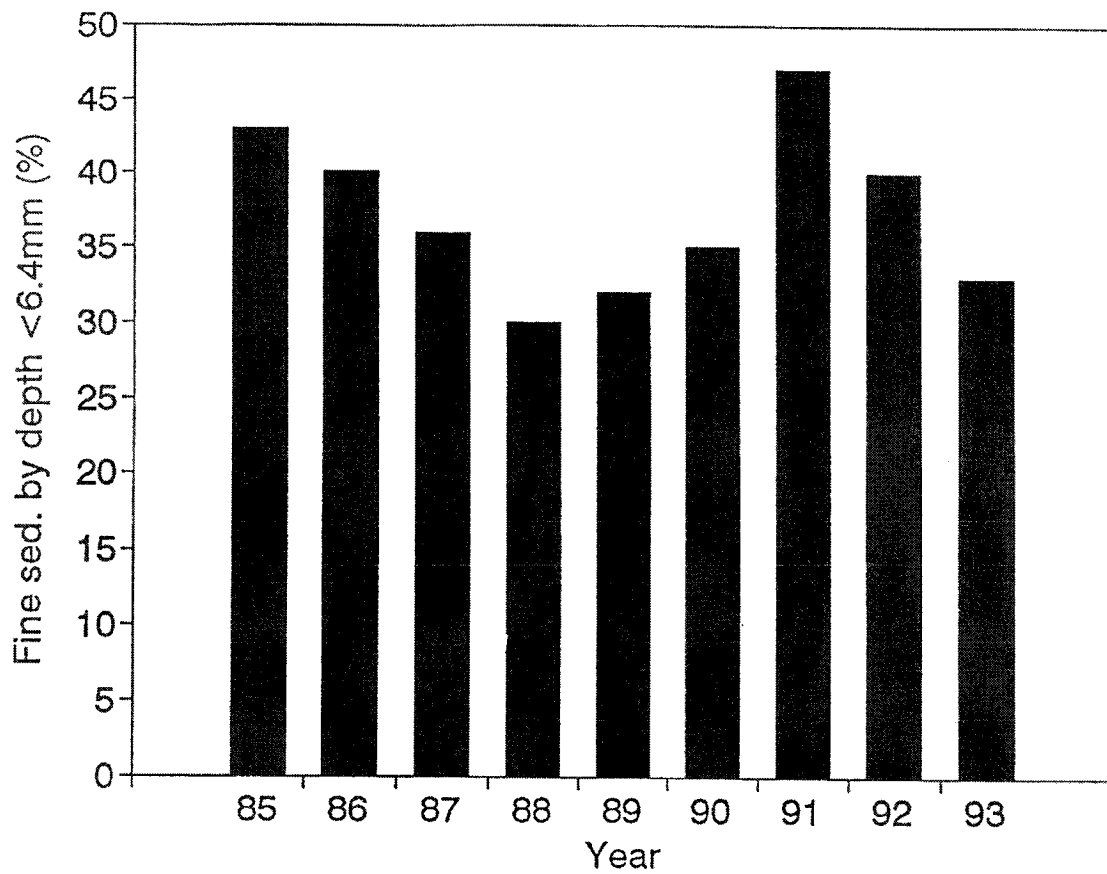


Figure B-7. Percent fine sediment by depth from coring in spawning habitat 1989-1993 in Pete King Creek on the Clearwater National Forest, Idaho. Sediment trapping and removal has occurred within the watershed since 1986.

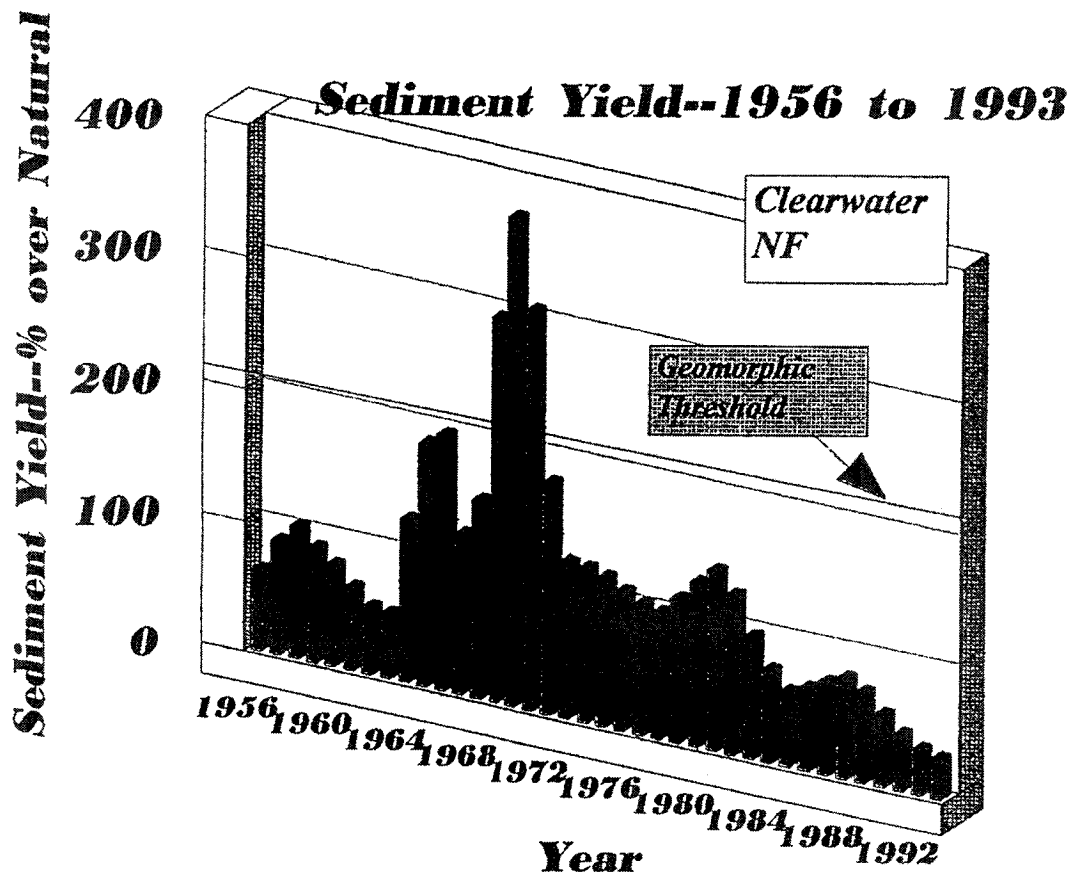


Figure B-8. Estimated sediment delivery from 1956 to 1993 in Squaw Creek on the Clearwater National Forest, Idaho (Clearwater National Forest, unpublished WATBAL runs).