DEPOSITION OF FINE SEDIMENT IN THE SALMON RIVER WATERSHED, PAYETTE AND BOISE NATIONAL FORESTS, IDAHO

STATISTICAL SUMMARY OF INTRAGRAVEL MONITORING, 1975-2003, AND PHOTOGRAPHIC SUMMARY OF SOUTH FORK SALMON RIVER CHANGES SINCE 1966

Krassel Hole, South Fork Salmon River, 2003

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Abstract

This report represents a departure from the reporting formats used in the past. Statistical analysis of core sampling data collected by the Boise and Payette National Forests from 1975 through 2003 is presented with minimal discussion. In addition, a variety of images from photomonitoring that includes time series sequences and snapshot comparisons are also presented to provide visual support for the conclusions derived from statistical analyses of sediment data. While this is a stand-alone document, it is intended to be part of a more thorough interactive reporting application that can be obtained from the authors. This new approach has been taken to expedite reporting and to ensure that required analysis and reporting can be accomplished given current budget and time constraints. Information provided here is intended to update the normal Payette National Forest sediment monitoring reports and to provide baseline information for modification of watershed condition indicators for sediment and substrate in the South Fork Salmon River watershed.

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INTRODUCTION

Sediment monitoring on the Payette National Forest began after severe flooding caused by rain on snow in the winter of 1964-65 inundated important habitat for anadromous fish in the South Fork Salmon River (SFSR) (Nelson *et al*. 2002; Platts *et al.* 1989). Monitoring was begun with core sampling using techniques modified from McNeil (1964), and Platts *et al.* (1989) present trend analyses dating to 1966. Formal sediment monitoring by the Boise National Forest, however, began in 1975 (Corley 1976) using a 12-in core sampler at 5 permanent locations in known spawning areas on the SFSR and in one such location on Johnson Creek, a major tributary to the East Fork South Fork Salmon River (EFSFSR) and in a parallel watershed located one drainage to the east of the SFSR; the Johnson Creek sampling was used as control (*i.e.*, largely unaffected by the floods) data. At that time, Corley also established several permanent photopoints for photographic monitoring of streambed changes over time. This monitoring has continued continuously (with some interruption) up to the present time.

The Payette National Forest (PNF) began additional sediment monitoring with core sampling in 1981 in the Secesh River watershed, which is a major tributary to the SFSR but of generally somewhat lower relief, and in the Chamberlain Creek watershed[1] in the Frank Church River Of No Return Wilderness (FCRONRW), a largely undisturbed area of granitic geology and topography similar to that of the Secesh River watershed, in 1989. For the past decade, the PNF has reported approximately annually on the results of this monitoring and the SFSR monitoring. This monitoring and reporting has served to satisfy requirements of the 1988 PNF Land and Resource Management Plan (LRMP) (USFS 1988) and terms and conditions of ongoing action and individual project consultations pursuant to the listing of Snake River Spring/Summer and Fall Chinook salmon (*Oncorhynchus tshawytscha*), Snake River steelhead (*O. mykiss*) and Columbia River bull trout (*Salvelinus confluentus*) as *threatened* under the Endangered Species Act of 1973 (ESA) as amended (16 USC 1531 *et seq*.). In addition, the original LRMP specified certain conditions pertaining to streambed sediment levels in the SFSR prior to initiation of certain new projects and anticipated establishment of standards and guidelines based partly on this monitoring related for management actions in the SFSR. More recently, the PNF's revised LRMP (USFS 2003) specifies watershed condition indicators based on intragravel sediment conditions that must be reevaluated pursuant to the Biological Opinion provided by the National Marine Fisheries Service (NMFS, now generally referred to as NOAA Fisheries) as a result of formal ESA consultation on the revised plan (NOAA Fisheries 2003).

The purpose of this report is to summarize the sediment core data collected in the SFSR watershed (after 1975 only), the Secesh River watershed, and the Chamberlain Creek watershed, and to present the images obtained from photographic monitoring in the SFSR. We believe that the best way to interpret the condition and trend of sediment conditions in the SFSR and to determine appropriate standards for habitat condition is to look objectively at multiple lines of evidence, that include numeric habitat attribute data and statistical methods for making comparisons among sites and modeling trends, current and historical photographs, and historical documentation of conditions where available. To this end, this report contains the most comprehensive presentation of information of various type so far assembled in one document.

We have formatted this report differently than previous reports in order to gain efficiency in consolidating a large amount of information. We have not fully analyzed the sampling data as we have in the past, though some limited interpretations of intragravel conditions are presented; however, statistical information herein is chiefly a summary of our long-term sampling effort. Photographs, particularly those comprising the photographic monitoring record of the SFSR, generally do not require interpretation other than to point out singularly interesting items; however, they

[1] Although a core sample was taken in Chamberlain Creek in 1981, additional sampling was discontinued until 1989.

provide powerful supporting evidence for conclusions drawn from habitat data analysis. Information in this report will also be part of the suite of supporting materials, which include previous reports, used to develop and propose refined sediment criteria for Forest management.

This report also introduces a new way of reporting on our sediment monitoring efforts in the SFSR and Chamberlain Basin. It is part of an interactive multimedia presentation of results that includes both documents, screen displays, links to other resources, and archived information. While we hope this report can stand alone as the most comprehensive discussion of condition and trend in the SFSR, including how they compare with other spawning streams in granitic watersheds, the interactive presentation will likely be more effective[2].

We have also altered the presentation of information in this report as befits more of a summary document than an in-depth report. Some results of the most recent statistical analyses were included in the body of the document with some discussion, but most information, including photographs and graphs, was moved to appendices unless especially useful in illustrating a point made in the text.

[2] Contact Rodger L. Nelson or Karen L. Ketchu for the interactive report on CD-ROM.

METHODS

CORE SAMPLING

Methods are thoroughly described in Nelson *et al.* (2002) and are not included in detail here. It is important, however, to reiterate The core sampling on the upper SFSR and Johnson Creek is performed by the Boise National Forest (BNF) and uses a slightly different sampling protocol than the PNF sampling in the other two watersheds; the precise methods and the differences between the PNF and BNF protocols are well described in several other reports in this series; they have been shown to produce the same results.

One important change that we have made in this report is that we have added coefficients of variation (CV) have been added to the statistical tables in Appendix 1. Coefficient of variation reflects the ratio of the standard deviation of the sample to its mean and was calculated as:

$$CV = \sqrt{s^2}/\text{mean} \qquad (1)$$

where s^2 is the sample variance.

We have also slightly altered the presentation of summary data in this report for clarity. Regression coefficients are now presented with one additional decimal place in this report to better display the modeled trend. Previous presentations occasionally led to the confusing situation where significant trends were shown with a slope that appeared to be zero because of the numeric format used and did not adequately show differences between models; one additional decimal place solves these problems.

PHOTOGRAPHIC MONITORING

Photographic monitoring of the SFSR was to be performed using a 35mm camera and polarizing filter from the established locations (see above). In addition to the formally established photographic monitoring sites, we have located some older photographs of the SFSR from the PNF archives and have attempted to update them with recent images for comparison and have included them in this summary report. Photographs in this report dated prior to 1975 are not part of the established photopoints, but the existence of these older photos may have been influential in determining the established suite of photopoints.

STUDY AREAS

A brief description of study area locations is presented here; refer Nelson *et al.* (2002) and to previous reports listed therein for additional information.

SOUTH FORK SALMON RIVER

Study areas for sediment monitoring are located in important Chinook and steelhead spawning areas of the SFSR at Stolle Meadows (UTM not determined), immediately upstream of the mouth of Dollar Creek (UTM 4,952,650N 603,486E)[3], Poverty Flat (UTM 4,964,162N 60,2467E), immediately upstream of the Oxbow breach (UTM 4,971,562N 615,600E), and immediately downstream of the Glory Hole near Krassel Guard Station (UTM 4,978,865N 60,2467E); the Johnson Creek site is at the spawning area located upstream of the Ice Hole Campground (UTM 4,971,040N 618,379E).

Photographic monitoring sites were established in 1975 and are located at several locations between the mouth of Fitsum Creek to the north and the mouth of Camp Creek to the south. Photopoint 4 (PP-04)[4] is the southernmost site and is located upstream of the Darling spawning area at the roadcut stabilization area known as the "binwall"; PP-04A, which comprises two photos (left and right panorama) is somewhat downstream (north) of PP-04. Four photographic views comprise the photopoint 5 series, one from about 75 yds upstream of Miner's Peak bridge looking south toward the Oxbow breach (PP-05), one from the same location looking north (PP-05A), one on the hillside looking down on an adult holding pool historically known as the "Swimming Hole" (PP-05B), and one from the hillside looking downstream below the Swimming Hole (PP-05C). The two photopoints in the photopoint 6 series are near Krassel Hole, one from just downstream of Krassel Hole looking upstream (PP-06), and one about 1.3 mi downstream of that location looking downstream from an elevated position of the eastern hillside above the road (PP-06A). At this time, UTM coordinates have not been determined.

SECESH RIVER

Study areas are located in important Chinook spawning areas of Lake Creek upstream of Corduroy Junction (UTM 5,021,358N 582,627E), near the mouth of Threemile Creek (UTM 5,016,783N 583,577E), and downstream of Burgdorf, Idaho (UTM 5,013,400N 585,331E) and of the Secesh River in the Secesh Meadows subdivision (UTM 5,009,270N 593,387E) and at Chinook Campground (UTM 5,007,590N 593,638E).

CHAMBERLAIN CREEK

Study areas are located at one known Chinook spawning area upstream of the mouth of Flossie Creek (UTM 5,025,572N 640,801E) and one on West Fork Chamberlain Creek downstream of the mouth of Game Creek (UTM 5,028,540N 641498E)

[3] UTM coordinates estimated from 1:100,000 stream hydrography overlaid on digital raster graphic representations of 7.5° topographic maps (except for some that were refined with a GPS receiver), presented as northing (N) and easting (E), respectively; not suitable for navigation to the exact sampling location.
[4] Nomenclature differs slightly from that established by Corley (1976).

RESULTS

CORE SAMPLING

SOUTH FORK SALMON RIVER

All size classes of fine particles have generally increased at all SFSR sites since 2000 (Table 1), and geometric mean particle diameters have correspondingly declined; at the Ice Hole site, however, all size classes of fines have decreased since 2000. With the exception of the Ice Hole site, the volume of fines in cores equaled or exceeded the long-term average value for all sites in 2003. With just two exceptions, however, the levels of fines and the geometric mean particle diameters in 2003 were within the ranges observed in previous years. These exceptions included small fine particles (particle diameter ≤ 0.85mm) at the Stolle Meadows site and coarse fines (particle diameter ≤ 4.75mm) at Poverty Flat.

Table 1.—Mean annual levels[a] of subsurface fines (in percent) and geometric mean particle diameters from core sampling in monitoring sites in the South Fork Salmon River watershed above the confluence with the Secesh River, 1977-2003 (table continued on next page).

	Stolle Meadows (B081)				***Dollar Creek (B082)***				***Poverty Flat (E084)***			
Year	***LF***	***CF***	***SF***	***GM***	***LF***	***CF***	***SF***	***GM***	***LF***	***CF***	***SF***	***GM***
1977	22.2	18.5	4.5	19.2	29.0	25.6	5.5	15.8	35.9	31.3	13.2	11.9
1978	19.9	17.1	5.8	20.3	31.1	27.8	6.7	14.7	33.7	29.2	11.1	12.5
1979	23.0	19.2	6.4	19.1	28.1	25.3	8.5	16.0	32.4	28.9	11.8	13.6
1980	20.7	16.2	3.6	44.8	27.7	24.3	4.9	28.3	29.3	26.4	6.0	23.2
1981	22.7	18.0	5.3	38.1	26.2	22.6	7.0	30.9	30.1	26.6	8.7	23.7
1982	17.5	14.0	4.5	48.4	27.5	23.8	6.3	29.2	30.4	26.7	7.5	23.1
1983	22.4	18.8	4.7	35.9	27.8	24.5	4.1	30.3	35.5	31.5	5.5	17.8
1984	25.0	20.8	4.4	29.9	26.5	23.0	3.6	29.1	28.9	25.3	4.7	25.2
1985	22.7	18.8	4.5	33.6	29.7	26.1	4.3	25.0	36.0	32.3	5.5	17.9
1986	26.3	21.5	5.4	31.3	28.7	24.4	4.5	28.2	34.1	29.4	6.0	22.0
1987	27.0	21.5	5.1	35.1	28.6	24.3	4.1	30.0	33.8	28.6	7.5	18.4
1988	20.4	16.3	4.1	45.1	26.8	22.3	4.2	29.6	30.2	25.2	4.7	26.6
1989	22.7	17.9	4.6	39.0	30.9	26.7	4.0	25.5	28.3	24.3	4.4	27.3
1990	25.8	20.7	5.5	32.6	30.2	24.7	4.7	23.2	29.8	25.5	5.4	25.2
1991	26.2	21.0	5.0	35.1	26.6	21.8	3.3	29.2	31.2	26.9	4.8	23.6
1992	24.5	20.4	5.1	37.9	26.4	22.8	4.0	31.0	31.2	27.1	7.4	22.1
1993	23.4	19.0	4.6	36.5	29.5	24.6	4.1	26.9	35.1	30.7	5.5	18.6
1994	18.9	13.4	2.7	54.1	26.0	19.9	2.5	39.6	33.4	26.2	4.3	25.5
1995	26.7	21.8	5.9	28.2	25.6	21.5	4.6	29.6	29.8	25.5	5.9	25.0
1996	32.8	28.1	6.0	25.8	27.8	23.9	5.3	28.3	35.3	29.7	5.9	18.2
1997	25.5	20.4	5.6	35.6	28.9	23.8	4.6	26.3	36.8	31.7	9.0	18.3
1998	24.3	19.7	5.4	36.7	42.7	37.2	9.6	15.6	28.0	23.4	4.2	26.6
1999	28.6	24.3	5.3	30.0	26.3	22.0	3.7	28.6	37.8	31.6	7.8	17.7
2000	26.9	21.2	6.3	30.7	30.5	25.8	4.1	33.8	31.5	27.7	4.5	33.0
2001	28.9	23.0	6.4	20.9	29.3	23.9	5.7	22.3	30.4	24.4	4.3	28.0
2002	30.4	25.4	6.8	25.0	27.8	23.5	4.7	28.9	37.6	32.3	7.1	16.4
2003	31.2	25.6	7.5	23.4	30.2	25.7	5.6	24.5	37.4	32.6	6.6	18.9
Mean	***24.7***	***20.1***	***5.2***	***33.0***	***28.8***	***24.5***	***5.0***	***26.7***	***32.7***	***28.2***	***6.6***	***21.5***

[a] LF = large fines; CF = coarse fines; SF = small fines; GM = geometric mean particle diameter. (NOTE: This table in Nelson *et al.* [1998] the Oxbow had coarse fines as 32.6 in 1997 and for Dollar had large fines as 21.6 in 1995; these were apparently typographic errors). In addition, all values for 2000 and 2001 were misreported in Nelson *et al.* (2002); the errors resulted from a database error for the very smallest size classes and is explained in the *errata* attachment to Nelson *et al.* (2002).

Table 1 (continued).—Mean annual levels[a] of subsurface fines (in percent) and geometric mean particle diameters from core sampling in monitoring sites in the South Fork Salmon River watershed above the confluence with the Secesh River, 1977-2003.

	Glory Hole (E085)				Oxbow (E083)				Ice Hole (B152)			
Year	**LF**	**CF**	**SF**	**GM**	**LF**	**CF**	**SF**	**GM**	**LF**	**CF**	**SF**	**GM**
1977	31.8	28.0	7.0	13.6	35.0	31.4	7.3	12.7	24.4	21.8	4.8	17.2
1978	31.7	28.4	11.0	13.2	36.4	32.7	11.6	11.8	25.5	23.1	6.5	16.4
1979	32.8	28.8	6.1	14.1	34.9	31.2	10.1	12.7	23.1	19.5	6.0	18.3
1980	30.6	25.0	6.1	23.9	32.0	27.7	7.2	22.0	25.4	22.3	5.5	29.5
1981	27.2	24.1	5.0	25.2	31.4	27.5	8.3	22.0	25.9	22.8	4.6	26.3
1982	24.5	20.7	5.2	28.5	30.5	26.8	6.8	24.1	27.3	24.4	4.7	25.4
1983	24.5	21.4	4.2	30.1	36.2	31.9	6.3	19.0	27.9	24.9	4.2	25.5
1984	22.1	19.1	3.1	33.7	33.5	29.4	5.0	20.0	27.9	25.0	3.3	23.7
1985	28.9	25.8	4.0	25.8	36.6	32.4	5.4	17.0	32.3	29.4	3.6	20.7
1986	22.5	19.1	3.2	34.0	35.6	29.8	5.7	18.3	31.6	28.4	4.2	21.5
1987	28.8	24.2	5.2	25.6	35.5	30.3	6.6	18.8	27.9	24.6	5.2	26.7
1988	25.2	21.7	3.8	31.1	29.7	24.6	4.4	25.4	26.1	22.7	4.8	31.7
1989	24.1	19.6	3.7	30.0	30.0	24.9	5.2	25.6	25.7	21.9	4.2	28.5
1990	28.6	24.9	3.5	25.9	31.7	26.2	5.5	23.2	23.7	20.9	3.4	29.9
1991	23.6	19.9	3.8	31.8	27.1	21.9	4.6	26.6	28.3	25.1	4.3	26.9
1992	27.4	24.0	5.2	28.1	28.3	23.7	5.9	27.8	26.2	23.4	3.5	32.5
1993	22.8	18.8	3.8	32.4	21.8	16.7	3.4	38.0	30.4	26.2	4.2	23.4
1994	22.5	17.2	1.5	41.8	33.2	24.3	3.0	26.4	30.7	26.8	2.9	28.0
1995	34.9	30.7	5.1	17.5	34.1	27.4	6.1	19.5	33.3	29.2	5.4	18.8
1996	34.3	30.3	5.8	20.0	32.2	26.7	5.9	22.2	28.5	24.3	3.7	29.5
1997	34.2	29.2	5.9	19.6	36.3	31.6	7.6	17.1	27.8	23.6	5.3	26.1
1998	38.7	33.4	7.2	16.8	29.2	23.2	5.9	23.6	26.9	22.9	5.6	27.5
1999	35.2	30.7	6.5	18.9	31.3	25.6	6.8	22.2	26.9	23.0	4.6	27.4
2000	30.7	26.3	4.7	24.1	29.4	23.4	5.7	23.2	24.5	20.8	5.3	37.8
2001	23.1	19.3	3.4	32.5	27.6	21.4	4.6	22.8	30.5	26.5	3.8	25.8
2002	27.7	23.9	5.4	25.1	29.5	25.0	6.4	26.0	30.1	26.5	4.3	26.4
2003	31.8	28.9	5.4	24.6	33.5	28.5	7.1	20.0	24.4	20.5	5.2	34.1
Mean	**28.5**	**24.6**	**5.0**	**25.5**	**31.9**	**26.9**	**6.2**	**21.8**	**27.5**	**24.1**	**4.6**	**26.1**

[a] LF – large fines; CF – coarse fines; SF – small fines; GM – geometric mean particle diameter. (NOTE: This table in Nelson *et al.* [1998] the Oxbow had coarse fines as 32.6 in 1997 and for Dollar had large fines as 21.6 in 1995; these were apparently typographic errors). In addition, all values for 2000 and 2001 were misreported in Nelson *et al.* (2002); the errors resulted from a database error for the very smallest size classes and is explained in the *errata* attachment to Nelson *et al.* (2002).

Ordinary least squares (OLS) regression suggested many trends in substrate condition, most indicating gradual increases in fine sediments (Table 2, next page). However, the ubiquitous presence of serial autocorrelation indicates that OLS regression is not the best choice for modeling trends. Autoregressive regression (AR) detected far fewer significant trends, with only the Stolle Meadows and Oxbow spawning areas showing trends in most sediment metrics. The substrate at the Oxbow spawning area is clearly coarsening over time, which is hardly surprising given the extensive channel adjustments that are still occurring as a result of the breach that occurred in 1974; in fact, the change in channel slope upstream of the breach (where the spawning area is located) can be seen with careful inspection of the images in Images 208 and 209 (Appendix 4). At the Stolle Meadows site, fines in all size classes were seen to be increasing over time (Figures 1-4, Appendix 2), though it is not clear why this should be so. Despite relatively high levels of fines at the Poverty Flat spawning area in 2002 and 2003, coarsening of the streambed, as reported previously (*e.g.*, Nelson *et al*. 2002) was still apparent with a significant downward trend in small fine particles and a corresponding upward trend in geometric mean particle diameter.

Table 2.—Regression parameter estimates for fine sediments and geometric mean particle diameter, SFSR spawning areas, 2003 (linear models expressed as y = bx + a).

Substrate Class[a]	Ordinary Least Squares				Autoregression		
	a	b	r^2	Dw[b]	a	b	r^2
Stolle Meadows (B081)							
LF	-633.5	0.33**	0.08	1.18**	-633.9	0.33**	0.26
CF	-503.6	0.26**	0.06	1.12**	-506.5	0.26**	0.28
SF	-116.1	0.06**	0.03	1.17**	-117.5	0.06**	0.22
GM	229.4	-0.10**	0.00	0.88**	243.9	-0.11	0.35
Dollar Creek (B082)							
LF	-118.3	0.07†	0.01	1.28**	-123.3	0.08	0.16
CF	12.5	0.01	0.00	1.26**	9.3	0.01	0.17
SF	77.7	-0.04**	0.01	0.91**	79.9	-0.04*	0.34
GM	-197.9	0.11**	0.01	1.05	-182.6	0.10	2.07
Poverty Flat (E084)							
LF	-134.3	0.08*	0.01	1.19**	-131.8	0.08	0.19
CF	-8.5	0.02	0.00	1.17**	-7.4	0.02	0.19
SF	298.6	-0.15**	0.09	0.86**	296.5	-0.15**	0.43
GM	-425.1	0.22**	0.87**	0.03	-419.9	0.22*	0.38
Glory Hole (E085)							
LF	-199.9	0.11**	0.01	1.05**	-188.7	0.11	0.28
CF	-152.7	0.09**	0.01	1.04**	-142.5	0.08	0.28
SF	98.1	-0.05**	0.02	0.85**	94.1	-0.04	0.41
GM	-202.5	0.11**	0.01	0.88**	-230.8	0.13	0.36
Oxbow (E083)							
LF	373.1	-0.17**	0.03	1.29**	367.1	-0.17**	0.18
CF	542.5	-0.26**	0.07	1.19**	535.8	-0.26**	0.26
SF	195.6	-0.10**	0.06	1.08**	193.0	-0.10**	0.30
GM	-552.8	0.29**	0.06	0.98**	-550.8	0.29**	0.33
Ice Hole (B152)							
LF	-149.9	0.09**	0.01	2.09**	-134.1	0.08	0.31
CF	-55.5	0.04	0.00	0.95**	-42.1	0.03	0.32
SF	42.1	-0.02*	0.00	1.46**	43.1	-0.02	0.09
GM	-674.7	0.35**	0.06	0.79**	-728.8	0.38**	0.43

[a] LF – Large Fines (≤6.3mm).
CF – Coarse Fines (≤4.75mm).
SF – Small Fines (≤0.85mm).
GM – Geometric Mean Particle Diameter.
[b] DW - First order Durbin-Watson statistic.

Significance:
†Moderately significant (P≤0.10).
*Significant (P≤0.05).
**Highly significant (P≤0.01).

Secesh River

As with the SFSR spawning areas, fine sediments were generally higher in the Lake Creek and Secesh River spawning areas in the most recent sampling (Table 3, next page). In most cases, fine sediments were higher (and geometric mean diameters were lower) in the 2001 to 2003 sampling than the long-term average, though all were within the range of variation observed during the entire monitoring period. As always, the Threemile Creek site (E033) had the highest levels of fines of all size classes and the lowest geometric mean diameters; this situation is thoroughly discussed in Nelson *et al.* (2002). The Burgdorf site (E048) had the "cleanest" streambed, as it has for several years, and the other three sites were similar.

Time series analysis of conditions in the Lake Creek and Secesh River spawning areas shows that, except for the site at Burgdorf, sediment conditions are generally deteriorating (Table 3, next page). This is a disturbing result because we had thought, prior to 2001, that a declining trend that was evident in the 1980s had reversed following aggressive watershed improvements undertaken subsequent to passage of the 1988 Land and Resource Management Plan (LRMP or Forest Plan). Results presented in Nelson *et al.* (2002) began to suggest that things might not be so

Table 3.—Mean annual levels[a] of subsurface fines (in percent) and geometric mean particle diameters from core sampling in monitoring sites in Lake Creek and the Secesh River, 1981-2003 .

	Corduroy Junction (E034)				Burgdorf (E048)				Threemile Creek (E033)			
Year	**LF**	**CF**	**SF**	**GM**	**LF**	**CF**	**SF**	**GM**	**LF**	**CF**	**SF**	**GM**
1981	16.3	9.4	5.4	48.0	19.4	12.8	4.5	39.5	25.8	13.8	9.4	22.9
1982	14.1	9.2	2.9	47.2	20.4	13.4	4.9	38.3	24.7	13.1	9.0	23.0
1983	16.8	11.0	3.9	47.7	20.8	13.4	5.4	41.1	28.9	17.1	9.1	19.8
1984	19.5	12.9	4.3	37.6	19.2	12.3	4.4	38.0	28.8	15.7	9.7	17.7
1985	22.2	14.4	5.7	32.8	22.0	13.9	5.6	33.3	28.0	15.0	10.0	19.7
1986	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	22.3	14.9	5.2	37.7	21.6	14.2	4.7	39.1	29.2	16.7	9.3	19.4
1988	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1989	33.1	21.9	8.5	19.4	29.0	22.8	3.4	23.0	31.7	19.4	9.1	18.0
1990	23.7	16.1	5.1	28.6	19.6	12.7	4.3	39.4	27.2	14.8	9.6	18.0
1991	28.2	19.6	6.2	25.0	20.4	13.5	4.5	40.1	30.8	17.1	10.8	15.8
1992	28.5	18.1	7.4	24.4	19.8	13.6	4.4	41.5	34.9	21.6	10.1	13.8
1993	26.8	18.5	6.5	26.8	21.5	15.7	3.6	38.3	32.6	20.0	10.2	15.8
1994	NA	NA	NA	NA	21.0	14.4	3.7	37.9	57.5	43.9	11.1	7.3
1995	17.7	12.6	3.2	43.2	14.2	9.3	3.0	55.3	23.2	12.4	8.6	30.7
1996	21.9	13.9	5.6	34.3	16.8	10.3	3.8	40.7	30.0	13.6	12.8	18.9
1997	23.9	16.8	4.8	30.2	18.5	12.3	3.8	36.1	35.9	19.1	13.1	16.1
1998	20.9	14.0	4.7	35.7	16.9	11.2	3.3	54.1	31.4	17.3	10.9	18.2
1999	19.4	13.8	3.6	39.6	18.5	12.7	3.8	47.4	28.8	17.7	7.8	20.8
2000	23.1	16.1	5.0	35.0	19.6	13.0	4.2	40.1	30.4	19.8	7.9	18.9
2001	26.5	18.3	5.8	25.4	21.1	14.4	4.0	39.1	31.9	18.5	10.8	18.4
2002	23.2	15.3	5.6	28.7	20.2	14.0	3.9	41.5	34.3	19.5	12.0	16.2
2003	25.8	17.0	6.2	27.7	21.1	13.8	5.3	42.7	32.3	19.9	9.4	16.8
Mean	**22.7**	**15.2**	**5.3**	**33.8**	**20.1**	**13.5**	**4.2**	**40.3**	**31.3**	**18.4**	**10.0**	**18.4**

	Secesh Meadows (E096)				Chinook Campground (E046)			
Year	**LF**	**CF**	**SF**	**GM**	**LF**	**CF**	**SF**	**GM**
1981	14.2	8.6	4.1	48.9	15.5	10.0	3.7	40.3
1982	17.9	11.8	4.4	38.2	15.1	9.8	3.6	46.4
1983	18.9	12.6	4.4	40.7	18.4	12.6	4.1	40.9
1984	18.6	12.6	4.0	36.4	19.8	13.7	4.1	36.8
1985	21.2	14.3	4.8	36.5	19.7	13.5	4.1	37.7
1986	20.6	13.8	4.9	38.6	NA	NA	NA	NA
1987	21.2	14.4	4.9	40.4	21.2	15.2	3.9	38.5
1988	NA	NA	NA	NA	NA	NA	NA	NA
1989	27.2	19.3	5.6	26.8	31.1	21.5	6.9	21.6
1990	22.7	15.7	4.9	33.7	24.7	19.1	3.6	29.6
1991	23.0	16.4	4.8	32.5	20.8	14.1	4.4	36.3
1992	25.2	17.0	4.6	29.3	19.4	12.9	4.4	44.5
1993	24.0	17.1	4.6	30.5	21.0	15.0	3.5	35.9
1994	24.2	17.6	3.9	32.8	23.2	16.2	4.3	34.2
1995	16.8	11.4	3.4	43.7	18.6	13.3	3.6	50.6
1996	28.0	19.5	6.4	25.7	23.1	17.7	3.2	37.2
1997	15.5	11.1	2.7	47.2	20.5	14.2	3.8	40.6
1998	19.3	13.0	4.5	43.3	20.6	13.9	4.4	44.0
1999	NA	NA	NA	NA	19.2	13.7	3.7	45.8
2000	18.3	13.1	3.9	42.5	19.2	13.3	4.1	43.4
2001	20.6	13.3	5.3	36.3	22.6	15.3	4.7	34.9
2002	25.1	17.5	5.5	29.3	21.6	15.8	3.8	39.1
2003	20.6	13.3	5.9	32.6	23.9	16.7	5.0	31.7
Mean	**21.1**	**14.4**	**4.6**	**36.5**	**20.9**	**14.6**	**4.1**	**38.6**

[a] LF = large fines; CF = coarse fines; SF = small fines; GM = geometric mean particle diameter.

Table 4.—Regression parameter estimates for fine sediments and geometric mean particle diameter, Lake Creek and Secesh River spawning areas, 2003 (linear models expressed as y = bx + a).

Substrate Class[a]	Ordinary Least Squares				Autoregression		
	a	b	r^2	Dw[b]	a	b	r^2
Corduroy Junction (E034)							
LF	-478.6	0.25**	0.03	1.26**	-524.7	0.27**	0.18
CF	-403.0	0.21**	0.04	1.33**	-433.4	0.23**	0.16
SF	-45.7	0.03	0.00	1.44**	-39.9	0.02	0.10
GM	1138.0	-0.55**	0.04	1.06**	1359.0	-0.66**	0.27
Burgdorf (E048)							
LF	211.4	-0.10*	0.01	1.04**	151.5	-0.01	0.27
CF	114.2	-0.05	0.00	0.97**	43.2	-0.01	0.32
SF	95.0	-0.05**	0.02	1.22**	88.2	-0.04*	0.19
GM	-639.0	0.34**	0.01	1.09**	-651.5	0.35	0.24
Threemile Creek (E033)							
LF	-464.8	0.25*	0.03	1.11**	-514.2	0.27**	0.28
CF	-358.4	0.19**	0.04	1.23**	-485.9	0.23**	0.25
SF	-93.2	0.05†	0.00	1.33**	-67.5	0.04	0.16
GM	250.0	-0.12*	0.01	0.99**	419.3	-0.20†	0.29
Secesh Meadows (E096)							
LF	-301.2	0.16**	0.02	1.32**	-372.4	0.20**	0.19
CF	-255.1	0.14**	0.03	1.31**	-310.9	0.16**	0.19
SF	-32.1	0.02†	0.00	1.47**	-37.6	0.02	0.10
GM	552.4	-0.26**	0.01	1.03**	1024.0	-0.50**	0.29
Chinook Campground (E046)							
LF	-296.4	0.16**	0.02	0.87**	-521.0	0.27**	0.37
CF	-259.8	0.14**	0.02	0.80**	-481.2	0.25**	0.41
SF	-11.3	0.01	0.00	1.19**	-23.3	0.01	0.19
GM	-2.9	0.02	0.00	0.97**	415.5	-0.09	0.31

[a] LF – Large Fines (≤6.3mm).
CF – Coarse Fines (≤4.75mm).
SF – Small Fines (≤0.85mm).
GM – Geometric Mean Particle Diameter.
[b] DW - First order Durbin-Watson statistic.

Significance:
†Moderately significant (P≤0.10).
*Significant (P≤0.05).
**Highly significant (P≤0.01).

favorable, and these results confirm that. In most cases, the trends are similar to those reported in Nelson *et al.* (2002), but are more clearly defined. The statistically detectable upward trends in fine sediments at the Corduroy Junction (E034), Threemile Creek (E033), and Chinook Campground (E046) monitoring sites were all similar, whereas the upward trends at the Secesh Meadows site were somewhat weaker. The trends were most evident for the larger size classes (large and coarse fines), and typically not significant for small fines; however, the downward trend in small fines at the Burgdorf site was statistically significant (P≤0.05).

CHAMBERLAIN CREEK

Unlike the upper SFSR and Lake Creek–Secesh River sites, fine sediments were not necessarily higher in the past few years (Table 5, next page). In fact, although the West Fork Chamberlain Creek site (E136) showed all classes of fines to be higher than the long-term average in 2002 and 2003, all classes of fine sediments were much lower than the long-term average at the Chamberlain Creek site (E032). Reasons for this disparity are unknown.

Time series analysis revealed strongly downward trends in all sizes classes of fine sediments at the Chamberlain Creek site (Table 6) and a corresponding upward trend in geometric mean particle diameter. On the other hand, however, sediment trends were largely upward at the West Fork Chamberlain Creek site, though there was no statistically detectable trend for either small fine particles (diameter ≤ 0.85mm) or geometric mean particle diameter. These trends are visually displayed in Appendix 2.

Table 5.—Mean annual levels[a] of subsurface fines (in percent) and geometric mean particle diameters from core sampling in monitoring sites in the Chamberlain Basin, 1989-2003[a].

	Chamberlain Creek (E032)				WF Chamberlain Creek (E136)			
Year	LF	CF	SF	GM	LF	CF	SF	GM
1989	31.8	22.7	5.8	23.3	NA	NA	NA	NA
1990	28.6	20.8	4.7	28.4	NA	NA	NA	NA
1991	26.4	18.4	5.1	33.5	29.0	17.9	8.4	23.2
1992	28.5	19.9	5.7	28.7	31.9	21.0	8.3	19.5
1993	21.9	17.1	2.8	42.2	31.4	21.3	6.9	20.9
1994	22.4	15.5	4.4	41.3	26.0	18.1	5.4	23.3
1995	16.9	12.8	2.3	61.5	25.1	16.5	6.0	26.0
1996	23.9	18.5	3.0	39.6	34.2	24.6	6.6	18.4
1997	15.7	11.3	2.3	55.6	28.7	19.3	6.3	22.6
1998	13.9	9.6	2.6	68.8	30.6	21.9	5.4	20.4
1999	17.2	12.4	2.7	60.0	31.5	22.5	6.1	20.3
2000	19.8	15.0	3.1	52.4	33.4	23.1	7.4	18.6
2001	24.0	17.8	4.0	41.4	28.0	20.5	4.9	23.2
2002	15.0	11.5	2.3	80.9	34.9	23.6	8.3	18.8
2003	15.3	10.8	3.0	75.1	33.0	21.3	8.9	21.8
Mean	21.4	15.6	3.6	48.8	30.6	20.9	6.8	21.3

[a] Data were collected at E032 in 1981 but results are not shown here, and data for E136 from 1989 and 1990 were eliminated due to sampling errors.
[b] LF = large fines; CF = coarse fines; SF = small fines; GM = geometric mean particle diameter.

Table 6.—Regression parameter estimates for fine sediments and geometric mean particle diameter, Chamberlain Basin spawning areas, 2003 (linear models expressed as y = bx + a).

Substrate Class[a]	Ordinary Least Squares				Autoregression		
	a	b	r^2	Dw[b]	a	b	r^2
Chamberlain Creek (E032)							
LF	1978	-0.98**	0.20	1.27**	1891	-0.94**	0.35
CF	1352	-0.67**	0.16	1.28**	1299	-0.64**	0.32
SF	383.9	-0.19**	0.16	1.34**	365.6	-0.18**	0.27
GM	-6464	3.26**	0.22	1.44	-6371	3.22**	0.31
West Fork Chamberlain Creek (E136)							
LF	-579.4	0.30**	0.02	1.39**	-601.9	0.32*	0.15
CF	-613.0	0.32**	0.04	1.47**	-650.9	0.34**	0.13
SF	63.4	-0.03	0.00	1.24**	109.9	-0.05	0.21
GM	309.6	-0.14	0.00	1.49**	324.2	-0.15	0.08

[a] LF – Large Fines (≤6.3mm).
CF – Coarse Fines (≤4.75mm).
SF – Small Fines (≤0.85mm).
GM – Geometric Mean Particle Diameter.
[b] DW - First order Durbin-Watson statistic.

Significance:
†Moderately significant (P≤0.10).
*Significant (P≤0.05).
**Highly significant (P≤0.01).

INTERBASIN COMPARISON

The Chamberlain Basin spawning areas were intended to serve as control sites for geologically similar watersheds regularly or formerly managed for more development. Although such activities have declined in both the SFSR and Secesh River watersheds in recent years, both do have a legacy of effects from land disturbance.

This comparison shows that there were few consistent differences among basins from 1989 through 1994, but that, beginning in 1995 and through 2000, the SFSR sites consistently had a lower average geometric mean particle diameter than the sites in the other two basins. Furthermore, from 1997 to 1999 and again from 2001 to 2003, all three basins differed significantly, with the Chamberlain Basin having the largest average geometric mean particle diameter, the SFSR the lowest, and the Secesh River in between. In 2000, however, all three basins have had statistically undetectable differences in geometric mean particle diameter, whereas the SFSR spawning areas had significantly lower geometric mean particle diameter than the Chamberlain Basin sites. This shows that the SFSR and Secesh River spawning areas, particularly the latter, have generally been similar to the wilderness sites, though year-to-year variations in conditions can result in apparent differences manifested as lower geometric mean particle diameters in the developed areas. Nelson et al (2002) suggested that with the SFSR spawning areas generally exhibiting steadily increasing trends in geometric mean particle diameter, differences among basins seem to be getting less pronounced overall. This no longer appears to be the case, as the SFSR sites have seen declines in geometric mean particle size over the past three years whereas the Chamberlain Creek sites had higher average geometric mean particle diameters than previously observed. Comparisons of watersheds by sediment size class paint a similar picture (Appendix 1).

Table 7.—Multiple comparison[a] of mean geometric mean particle diameters among basins by year.

Year	*SFSR*	*Secesh*	*Chamberlain*
1989	29.3 A	21.8 B	23.3 B
1990	26.7 A	29.8 A	28.4 A
1991	28.9 A	30.0 A	28.5 A
1992	29.7 A	30.7 A	24.1 B
1993	27.7 B	29.0 AB	31.6 B
1994	35.9 A	32.4 A	32.3 A
1995	23.1 B	44.8 A	43.7 A
1996	24.0 B	32.0 A	29.0 A
1997	23.8 C	34.1 B	39.1 A
1998	24.4 C	38.6 B	44.6 A
1999	24.2 B	38.4 A	40.2 A
2000	31.1 A	35.3 A	35.5 A
2001	27.5 B	30.8 AB	32.3 A
2002	24.2 C	31.0 B	49.8 A
2003	24.2 C	30.3 B	48.5 A

[a]Mean values in a row with different letters are significantly different ($P \leq 0.10$) by Tukey's HSD test.

Photographic Monitoring

The time series sequences and snapshot comparisons are displayed in Appendix 4. Both types of display show dramatic changes over the past several decades. While the flooding of 1964-65, 1974, and 1997 left their marks on the landscape, the time series images show that the severity of the changes caused by these events has generally decreased. Some of this decrease is undoubtedly due to the rehabilitation efforts, from bank stabilizations to pavings to actual road decommissionings have reduced the vulnerability of the watershed and the potential for anthropogenic actions to exacerbate the effects of natural disturbances.

Several specific issues deserve some detailed discussion. First, there have been substantial changes in the river reach upstream of Miner's Peak bridge since diversion of water by the Oxbow cutoff created in 1974. These changes are also reflected in our sediment monitoring, which has shown a coarsening trend in the Oxbow spawning area as the river continues to headcut. Simultaneously, the walls of the breach are continuing to erode (Images 212, 213, and 214) and deposit fine sediments downstream (Figure 1) including near the mouths of Camp and Phoebe Creeks as the river migrates to the west (Images 215 and 216). By 1991, Barta *et al*. (1992) estimated that the breach had widened some 10m over it's initial width with headcutting toward the spawning reach south of the breach and increased deposition to the north. The reach-level adjustments to cutting off the oxbow can be clearly seen in the aerial photos beginning with Image 205.

Figure 1.—Sandbar immediately downstream of the Oxbow breach in 2001.

Another interesting set of images is that showing the changes over time at the Swimming Hole (PP-05B). This significant adult holding pool was virtually filled with fine sediment by the 1964-65 floods (Image 109) but showed substantial improvement by 1972 (Image 110). However, a large slug of sand appeared here later in 1972 (Figure 2) that may have continued to develop until 1977 (Image 112), after which it starts to recede again (Image 113). This pool is not far downstream from

Figure 2.—The Swimming Hole late in 1972 showing deposition of additional fine sediments (from Mickelson et al. [1973]).

the Oxbow breach, which was created in 1974; it may be affected by erosion occurring in that area, and may have been particularly affected during the 1974 to 1977 period.

Finally, a key comparison showing improvements related to rehabilitation work is at the binwall stabilization near the Darling spawning area (Images 219 and 220). This open cutslope, which is immediately upstream of steelhead and salmon spawning reach, was very difficult to stabilize, but is now mostly vegetated.

DISCUSSION

Various lines of evidence confirm continued recovery of the SFSR with respect to the inundation of the river with fine sediment after flooding in the winter of 1964 and spring of 1965. Several publications stemming from research after the floods have documented improvements over time, including studies of fine sediment trends in spawning areas (*e.g.*, Platts *et al.* 1989) and changes in pool sediment volume (*e.g.*, Bohn and Megahan 1991). In addition, previous reports in this series have documented far less severe depositional responses to severe flooding in recent years (Nelson *et al*. 1998). Of all these lines of evidence, the photographic presentation of changes is probably most compelling. These studies and this monitoring effort suggest that the rehabilitation efforts initiated following the 1964-65 floods, which have included road closures and obliterations, hillslope stabilizations, paving of the main road and campgrounds, and restricted timber harvest have been largely successful in reducing sediment inputs and restoring resilience to the river ecosystem. In addition, although apparently not achieved purposely, streambars in the river are being stabilized by reed canarygrass (*Phalaris arundinacea*), into which willows and presumably other native species are invading (personal observation of the authors).

The SFSR is a high-relief area dominated by unstable hillsides, which undoubtedly contributed large amounts of fine sediment before any anthropogenic alterations occurred in the watershed. Concerns over increasing fine sediment in the river arose quickly as resource development began, but there are virtually no quantitative data from before the 1964-65 floods. It would certainly be reckless to conclude that conditions in the SFSR are approaching "pristine," though we can't objectively define that condition. There continues to be considerable fine sediment in the river and there seem to be short-term increases in certain areas at various times, but intragravel quality generally appears to be adequate for salmon and steelhead spawning, while information such as provided by Bohn and Megahan (1991) and the photographic series herein suggest that rearing areas are improving as well.

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APPENDIX 1. STATISTICAL TABLES

SOUTH FORK SALMON RIVER

Table 8.—Mean annual percentages of fine sediments from core sampling in the Stolle Meadows spawning area, South Fork Salmon River, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	22.2	1.1	30.0	18.5	0.9	32.2	4.5	0.3	44.8	19.2	0.6	20.1
1978	40	19.9	0.9	28.5	17.1	0.8	28.5	5.8	0.3	34.1	20.3	0.5	17.0
1979	40	23.0	1.1	30.2	19.2	0.9	29.2	6.4	0.4	41.5	19.1	0.6	19.3
1980	40	20.7	1.4	43.9	16.2	1.2	46.0	3.6	0.2	43.0	44.8	3.3	46.8
1981	40	22.7	1.0	28.2	18.0	0.9	31.9	5.3	0.4	46.1	38.1	2.0	32.7
1982	40	17.5	1.0	37.0	14.0	0.9	41.4	4.5	0.4	53.7	48.4	2.7	35.6
1983	40	22.4	1.3	36.0	18.8	1.1	37.4	4.7	0.4	48.7	35.9	2.6	46.1
1984	40	25.0	1.0	25.5	20.8	0.9	28.2	4.4	0.2	35.4	29.9	1.4	28.7
1985	40	22.7	0.7	20.5	18.8	0.7	22.9	4.5	0.3	37.2	33.6	1.2	21.9
1986	40	26.3	1.1	27.6	21.5	1.1	32.3	5.4	0.3	36.9	31.3	2.2	43.5
1987	40	27.0	1.6	37.7	21.5	1.3	39.1	5.1	0.4	55.0	35.1	2.3	42.2
1988	40	20.4	1.3	39.1	16.3	1.1	43.2	4.1	0.3	40.7	45.1	3.7	52.3
1989	40	22.7	1.1	30.7	17.9	0.9	31.5	4.6	0.2	33.8	39.0	1.9	31.3
1990	40	25.8	1.4	35.1	20.7	1.3	39.7	5.5	0.4	45.2	32.6	1.8	35.3
1991	40	26.2	1.8	43.9	21.0	1.7	51.4	5.0	0.4	53.1	35.1	2.4	43.1
1992	35	24.5	1.2	28.1	20.4	1.2	34.9	5.1	0.3	36.3	37.9	2.4	37.0
1993	20	23.4	1.3	24.7	19.0	1.2	28.0	4.6	0.4	35.5	36.5	2.1	25.4
1994	40	18.9	1.2	40.2	13.4	1.1	49.8	2.7	0.5	112.0	54.1	3.9	45.7
1995	40	26.7	1.1	25.7	21.8	0.9	26.9	5.9	0.5	55.0	28.2	1.5	32.8
1996	40	32.8	2.2	41.9	28.1	2.1	47.6	6.0	0.5	52.9	25.8	2.7	65.3
1997	40	25.5	1.7	41.8	20.4	1.5	47.8	5.6	0.5	53.3	35.6	2.8	49.6
1998	40	24.3	1.4	37	19.7	1.2	38.2	5.4	0.4	49	36.7	3	50.9
1999	40	28.6	1.5	33.4	24.3	1.5	38.3	5.3	0.3	41.9	30	2.7	57.8
2000	40	26.9	1.3	29.7	21.2	1.2	35.7	6.3	0.4	43.3	30.7	1.9	38.6
2001	40	28.9	1.4	29.9	23	1	28.8	6.4	0.4	41.5	20.9	1.2	35.8
2002	40	30.4	1.4	29.7	25.4	1.4	33.7	6.8	0.5	44.8	25	1.8	44.4
2003	40	31.2	1.4	27.7	25.6	1.3	32	7.5	0.4	36.3	23.4	2	54.9
Average	**39**	**24.7**	**1.3**	**32.7**	**20.1**	**1.2**	**36.2**	**5.2**	**0.4**	**46.3**	**33.0**	**2.1**	**39.0**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

Table 9.—Mean annual percentages of fine sediments from core sampling in the Dollar Creek spawning area, South Fork Salmon River, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	29.0	1.0	22.5	25.6	1.0	24.8	5.5	0.3	34.4	15.8	0.5	19.9
1978	40	31.1	1.0	20.5	27.8	1.0	21.6	6.7	0.3	32.5	14.7	0.4	19.1
1979	40	28.1	1.1	24.3	25.3	1.0	25.7	8.5	0.4	26.7	16.0	0.5	20.4
1980	40	27.7	1.2	27.4	24.3	1.1	29.7	4.9	0.3	38.5	28.3	1.4	30.9
1981	40	26.2	1.0	23.3	22.6	0.9	24.3	7.0	0.4	33.4	30.9	1.7	35.1
1982	40	27.5	1.0	23.6	23.8	0.9	24.2	6.3	0.3	30.6	29.2	1.3	27.3
1983	40	27.8	1.0	23.6	24.5	1.0	24.8	4.1	0.1	20.9	30.3	2.1	44.6
1984	40	26.5	1.1	25.4	23.0	1.0	26.5	3.6	0.2	41.1	29.1	1.4	31.4
1985	40	29.7	0.8	16.4	26.1	0.7	17.7	4.3	0.1	20.4	25.0	0.9	22.9
1986	40	28.7	0.9	20.4	24.4	0.9	22.5	4.5	0.2	29.1	28.2	1.3	28.9
1987	40	28.6	0.8	17.4	24.3	0.7	19.3	4.1	0.2	31.1	30.0	1.5	31.7
1988	40	26.8	1.1	25.2	22.3	0.9	26.0	4.2	0.2	34.0	29.6	1.4	29.7
1989	40	30.9	1.2	24.6	26.7	1.2	27.3	4.0	0.2	35.8	25.5	1.3	31.6
1990	40	30.2	1.0	21.5	24.7	0.8	19.8	4.7	0.3	38.7	23.2	1.0	27.9
1991	40	26.6	0.8	17.9	21.8	0.7	19.9	3.3	0.2	32.0	29.2	1.1	23.2
1992	40	26.4	1.0	25.0	22.8	0.9	25.4	4.0	0.2	37.2	31.0	2.0	40.7
1993	40	29.5	1.5	31.4	24.6	1.4	35.6	4.1	0.2	34.3	26.9	1.5	35.5
1994	40	26.0	1.4	35.2	19.9	1.5	47.0	2.5	0.4	108.2	39.6	3.0	47.5
1995	40	25.6	1.2	29.2	21.5	1.0	30.0	4.6	0.3	34.2	29.6	1.9	40.5
1996	40	27.8	0.7	16.6	23.9	0.7	17.7	5.3	0.2	27.6	28.3	1.1	25.2
1997	40	28.9	0.9	18.9	23.8	0.8	20.5	4.6	0.2	28.5	26.3	1.2	29.5
1998	40	42.7	1.8	26.0	37.2	1.8	30.6	9.6	0.5	31.0	15.6	1.0	40.2
1999	40	26.3	1.3	31.8	22.0	1.2	34.6	3.7	0.2	40.9	28.6	1.4	30.5
2000	40	30.5	1.2	24.0	25.8	1.2	29.3	4.1	0.2	33.8	24.1	1.0	26.8
2001	40	29.3	1.3	28.2	23.9	1.2	31.1	5.7	0.9	101.1	22.3	1.5	42.9
2002	40	27.8	1.3	28.5	23.5	1.1	30.6	4.7	0.2	28.9	26.4	1.8	44.2
2003	40	30.2	1.3	26.9	25.7	1.1	27.4	5.6	0.3	31.4	24.5	1.8	45.4
Average	**40**	**28.8**	**1.1**	**24.3**	**24.5**	**1.0**	**26.4**	**5.0**	**0.3**	**37.6**	**26.2**	**1.4**	**32.4**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

Table 10.—Mean annual percentages of fine sediments from core sampling in the Poverty Flat spawning area, South Fork Salmon River, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	35.9	1.1	19.4	31.3	1.1	21.7	13.2	0.9	45.4	11.9	0.4	19.9
1978	40	33.7	1.2	22.1	29.2	1.1	24.8	11.1	0.8	47.6	12.5	0.4	21.4
1979	40	32.4	0.9	17.4	28.9	0.8	17.8	11.8	0.7	35.7	13.6	0.4	17.2
1980	40	29.3	0.9	18.4	26.4	0.8	19.7	6.0	0.4	41.3	23.2	1.1	29.7
1981	40	30.1	1.1	23.9	26.6	1.1	26.3	8.7	0.6	42.1	23.7	1.3	35.6
1982	40	30.4	1.3	26.1	26.7	1.2	28.5	7.5	0.4	37.1	23.1	1.8	49.7
1983	40	35.5	0.8	14.0	31.5	0.8	15.7	5.5	0.3	31.2	17.8	0.7	25.6
1984	40	28.9	1.0	22.2	25.3	1.0	24.2	4.7	0.4	49.9	25.2	1.4	35.8
1985	40	36.0	1.3	23.5	32.3	1.3	26.3	5.5	0.3	39.5	17.9	1.1	38.4
1986	40	34.1	0.9	17.0	29.4	0.9	19.5	6.0	0.4	46.7	22.0	1.6	46.6
1987	40	33.8	1.0	19.4	28.6	1.1	24.9	7.5	0.4	29.7	18.4	1.1	37.0
1988	40	30.2	1.1	23.2	25.2	1.0	25.2	4.7	0.3	39.2	26.6	2.0	47.0
1989	40	28.3	1.3	28.4	24.3	1.2	32.4	4.4	0.3	39.0	27.3	1.6	37.7
1990	40	29.8	1.1	24.2	25.5	1.2	28.7	5.4	0.3	37.7	25.2	1.5	38.0
1991	40	31.2	1.2	24.2	26.9	1.1	27.1	4.8	0.4	56.7	23.6	1.4	38.4
1992	40	31.2	0.9	18.6	27.1	0.9	21.5	7.4	0.4	38.1	22.1	1.4	40.5
1993	40	35.1	1.3	23.4	30.7	1.3	26.4	5.5	0.4	41.3	18.6	1.1	37.7
1994	40	33.4	1.3	25.2	26.2	1.7	40.3	4.3	0.8	113.0	25.5	2.1	52.7
1995	40	29.8	1.6	34.7	25.5	1.5	36.5	5.9	0.5	50.4	25.0	1.5	37.8
1996	40	35.3	1.5	26.9	29.7	1.5	32.9	5.9	0.5	47.9	18.2	1.2	40.1
1997	40	36.8	1.2	20.5	31.7	1.2	23.1	9.0	0.4	28.7	18.3	1.3	43.2
1998	40	28.0	1.1	25.3	23.4	1.0	26.9	4.2	0.2	33.1	26.6	1.4	34.4
1999	38	37.8	1.3	21.4	31.6	1.3	26.0	7.8	0.5	38.9	17.7	1.2	41.4
2000	40	31.5	2.3	45.8	27.7	2.1	47.9	4.5	0.3	41.3	33.0	3.4	65.4
2001	40	30.4	1.8	37.7	24.4	1.6	40.6	4.3	0.5	68.8	28.0	3.0	68.2
2002	40	37.6	1.6	26.4	32.3	1.7	33.6	7.1	0.5	47.4	16.4	0.8	31.2
2003	40	37.4	1.6	27.4	32.6	1.6	31.6	6.6	0.6	58.1	18.9	1.4	46.3
Average	**40**	**32.7**	**1.2**	**24.3**	**28.2**	**1.2**	**27.8**	**6.6**	**0.5**	**45.4**	**21.5**	**1.4**	**39.1**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

Table 11.—Mean annual percentages of fine sediments from core sampling in the Glory Hole spawning area, South Fork Salmon River, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	31.8	1.0	19.1	28.0	1.0	21.5	7.0	0.5	42.8	13.6	0.3	15.9
1978	40	31.7	1.2	24.6	28.4	1.1	23.8	11.0	0.3	19.9	13.2	0.6	27.3
1979	40	32.8	1.2	23.1	28.8	1.1	23.4	6.1	0.2	22.9	14.1	0.5	21.4
1980	40	30.6	1.1	23.6	25.0	0.9	24.0	6.1	0.4	39.4	23.9	1.4	36.5
1981	40	27.2	0.9	21.4	24.1	0.9	23.4	5.0	0.4	51.3	25.2	1.3	33.5
1982	40	24.5	1.3	34.1	20.7	1.2	36.6	5.2	0.3	33.9	28.5	1.6	34.8
1983	40	24.5	1.0	25.7	21.4	0.9	26.5	4.2	0.2	26.9	30.1	1.5	30.9
1984	40	22.1	1.1	30.6	19.1	1.0	32.8	3.1	0.2	41.7	33.7	1.5	28.5
1985	40	28.9	1.3	29.0	25.8	1.3	31.1	4.0	0.2	37.7	25.8	1.4	33.9
1986	40	22.5	1.1	30.4	19.1	1.1	35.3	3.2	0.2	38.2	34.0	1.5	27.5
1987	40	28.8	1.1	23.2	24.2	0.9	23.6	5.2	0.5	57.4	25.6	1.2	30.8
1988	40	25.2	1.0	25.8	21.7	0.9	27.3	3.8	0.1	24.6	31.1	1.5	30.9
1989	40	24.1	1.1	29.3	19.6	1.0	32.9	3.7	0.2	30.6	30.0	1.5	30.7
1990	40	28.6	1.1	24.3	24.9	1.1	27.5	3.5	0.2	32.5	25.9	1.3	32.5
1991	40	23.6	1.0	27.7	19.9	0.9	27.3	3.8	0.4	60.1	31.8	1.3	26.9
1992	40	27.4	1.0	23.9	24.0	1.0	25.9	5.2	0.3	35.0	28.1	1.6	35.6
1993	40	22.8	1.1	30.2	18.8	1.0	32.0	3.8	0.2	39.0	32.4	2.0	40.0
1994	39	22.5	1.2	34.6	17.2	1.1	38.9	1.5	0.2	100.1	41.8	3.2	47.6
1995	40	34.9	1.7	30.8	30.7	1.7	34.5	5.1	0.3	43.3	17.5	1.2	42.3
1996	40	34.3	1.0	17.8	30.3	1.0	20.2	5.8	0.6	63.7	20.0	0.9	28.9
1997	40	34.2	1.0	18.5	29.2	1.0	21.9	5.9	0.3	32.8	19.6	0.9	29.9
1998	40	38.7	1.2	20.1	33.4	1.1	21.7	7.2	0.4	39.3	16.8	1.0	35.9
1999	40	35.2	1.5	27.7	30.7	1.6	32.4	6.5	0.7	64.1	18.9	1.0	34.4
2000	40	30.7	1.4	28.7	26.3	1.4	33.1	4.7	0.5	61.7	24.1	1.4	36.2
2001	40	23.1	0.9	24.1	19.3	0.8	26.5	3.4	0.3	52.9	32.5	1.4	27.4
2002	40	27.7	1.1	24.8	23.9	1.1	27.8	5.4	0.4	47.7	25.1	1.0	25.1
2003	40	31.8	2.0	40.5	28.2	2.0	44.5	5.4	0.6	72.6	24.6	1.7	44.4
Average	**40**	**28.5**	**1.2**	**26.4**	**24.5**	**1.1**	**28.8**	**5.0**	**0.3**	**44.9**	**25.5**	**1.3**	**32.2**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

Table 12.—Mean annual percentages of fine sediments from core sampling in the Oxbow spawning area, South Fork Salmon River, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	35.0	1.1	19.0	31.4	1.0	20.0	7.3	0.4	36.5	12.7	0.4	20.7
1978	40	36.4	0.6	10.6	32.7	0.6	11.3	11.6	0.6	32.2	11.8	0.2	12.6
1979	40	34.9	1.0	17.5	31.2	1.0	19.5	10.1	0.5	32.1	12.7	0.3	15.3
1980	40	32.0	1.3	25.9	27.7	1.2	27.8	7.2	0.3	29.2	22.0	1.1	31.1
1981	40	31.4	0.7	14.8	27.5	0.7	15.3	8.3	0.4	27.3	22.0	1.0	27.4
1982	40	30.5	1.3	26.4	26.8	1.2	29.0	6.8	0.4	37.9	24.1	1.8	47.5
1983	40	36.2	0.9	16.5	31.9	0.9	16.9	6.3	0.3	33.9	19.0	1.0	32.9
1984	40	33.5	0.7	13.2	29.4	0.7	14.8	5.0	0.3	43.1	20.0	0.8	26.4
1985	40	36.6	0.9	14.8	32.4	0.8	16.1	5.4	0.3	35.9	17.0	0.7	26.9
1986	40	35.6	0.7	12.6	29.8	0.6	13.7	5.7	0.4	44.7	18.3	0.7	23.4
1987	40	35.5	0.7	13.2	30.3	0.7	13.7	6.6	0.3	25.4	18.8	0.6	19.0
1988	40	29.7	1.3	27.6	24.6	1.2	29.8	4.4	0.2	31.1	25.4	1.6	38.9
1989	40	30.0	1.2	24.8	24.9	1.1	27.0	5.2	0.3	33.5	25.6	1.5	37.2
1990	40	31.7	1.4	27.1	26.2	1.3	31.6	5.5	0.3	37.2	23.2	1.6	44.6
1991	40	27.1	1.1	25.8	21.9	0.9	26.6	4.6	0.3	41.3	26.6	1.6	37.6
1992	40	28.3	1.3	28.5	23.7	1.3	33.6	5.9	0.4	42.6	27.8	2.0	46.4
1993	20	21.8	1.4	28.5	16.7	1.1	30.2	3.4	0.2	29.8	38.0	3.2	37.6
1994	40	33.2	1.1	20.1	24.3	1.1	27.8	3.0	0.5	100.0	26.4	1.6	37.8
1995	40	34.1	1.2	22.8	27.4	1.1	26.3	6.1	0.3	32.3	19.5	1.0	32.9
1996	40	32.2	1.3	25.9	26.7	1.2	28.0	5.9	0.4	40.7	22.2	1.3	36.2
1997	40	36.3	0.7	12.9	31.6	0.7	14.2	7.6	0.3	29.1	17.1	0.5	19.2
1998	40	29.2	1.1	23.5	23.2	1.0	28.3	5.9	0.4	39.0	23.6	1.0	25.5
1999	40	31.3	1.5	29.8	25.6	1.5	37.5	6.8	0.5	50.6	22.2	1.4	38.9
2000	40	29.4	1.1	24.1	23.4	1.1	30.7	5.7	0.5	56.4	23.2	1.1	31.1
2001	40	27.6	1.1	25.8	21.4	1.1	32.8	4.6	0.4	52.0	22.8	1.0	27.5
2002	40	29.5	1.4	29.7	25.0	1.4	34.4	6.4	0.8	81.8	26.0	1.6	38.4
2003	40	33.5	1.4	27.1	28.5	1.5	33.6	7.1	0.5	43.6	20.0	1.0	31.8
Average	**39**	**31.9**	**1.1**	**21.8**	**26.9**	**1.0**	**24.8**	**6.2**	**0.4**	**41.5**	**21.8**	**1.2**	**31.3**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

Table 13.—Mean annual percentages of fine sediments from core sampling in the Ice Hole spawning area, Johnson Creek, 1977-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1977	40	24.4	0.8	20.9	21.8	0.8	22.3	4.8	0.3	41.6	17.2	0.5	16.5
1978	40	25.5	0.7	16.6	23.1	0.7	18.2	6.5	0.3	33.5	16.4	0.4	13.6
1979	40	23.1	0.7	19.6	19.5	0.6	18.5	6.0	0.2	25.0	18.3	0.3	11.8
1980	40	25.4	1.2	29.2	22.3	1.1	30.3	5.5	0.3	37.7	29.5	1.6	34.2
1981	40	25.9	0.8	19.4	22.8	0.8	21.7	4.6	0.2	24.5	26.3	1.0	23.3
1982	40	27.3	1.0	23.3	24.4	1.0	25.6	4.7	0.3	41.2	25.4	0.9	22.7
1983	40	27.9	1.1	24.4	24.9	1.0	26.5	4.2	0.3	46.9	25.5	1.2	28.5
1984	40	27.9	0.9	20.3	25.0	0.9	22.5	3.3	0.2	36.3	23.7	0.7	19.7
1985	40	32.3	0.9	18.0	29.4	0.9	18.8	3.6	0.2	41.2	20.7	1.1	34.0
1986	40	31.6	1.0	19.0	28.4	0.9	20.3	4.2	0.3	39.6	21.5	1.0	28.6
1987	40	27.9	1.0	23.4	24.6	1.1	28.1	5.2	0.2	25.1	26.7	1.8	43.7
1988	40	26.1	1.2	28.6	22.7	1.2	33.5	4.8	0.3	43.6	31.7	2.4	48.9
1989	40	25.7	0.7	16.6	21.9	0.7	19.4	4.2	0.2	24.2	28.5	1.2	26.6
1990	40	23.7	0.9	24.2	20.9	0.9	27.1	3.4	0.2	33.5	29.9	1.8	38.3
1991	40	28.3	1.1	24.7	25.1	1.1	27.9	4.3	0.2	31.8	26.9	1.8	42.5
1992	40	26.2	1.4	33.7	23.4	1.3	34.2	3.5	0.3	46.0	32.5	2.9	55.8
1993	40	30.4	1.0	21.8	26.2	0.9	22.6	4.2	0.2	36.3	23.4	1.4	38.4
1994	40	30.7	0.9	19.2	26.8	1.0	22.9	2.9	0.4	96.6	28.0	1.8	40.8
1995	40	33.3	0.8	15.7	29.2	0.8	17.7	5.4	0.3	36.1	18.8	0.7	24.5
1996	40	28.5	1.4	31.6	24.3	1.2	32.0	3.7	0.2	38.4	29.5	2.8	60.5
1997	40	27.8	0.6	14.7	23.6	0.6	16.2	5.3	0.2	21.1	26.1	0.9	22.7
1998	40	26.9	1.0	23.9	22.9	0.9	25.0	5.6	0.3	32.8	27.5	1.8	40.6
1999	40	26.9	0.9	22.2	23.0	0.9	23.5	4.6	0.3	35.8	27.4	1.4	32.1
2000	40	24.5	1.5	39.6	20.8	1.5	44.5	5.3	1.3	157.6	37.8	2.1	35.5
2001	40	30.5	1.2	25.2	26.5	1.2	28.0	3.8	0.2	27.9	25.8	1.8	43.4
2002	40	30.1	1.1	23.4	26.5	1.1	27.0	4.3	0.2	29.7	26.4	1.7	41.0
2003	40	24.4	1.3	34.7	20.5	1.4	42.5	5.2	0.4	46.5	34.1	2.9	52.8
Average	**40**	**27.5**	**1.0**	**23.5**	**24.1**	**1.0**	**25.8**	**4.6**	**0.3**	**41.9**	**26.1**	**1.5**	**34.1**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).

SECESH RIVER

Table 14.—Mean annual percentages of fine sediments from core sampling in the Corduroy Junction spawning area, Lake Creek, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1981	40	16.3	1.1	44.2	9.4	0.6	43.3	5.4	0.6	66.8	48.0	3.4	45.2
1982	40	14.1	0.9	39.1	9.2	0.6	39.0	2.9	0.3	59.9	47.2	3.3	44.2
1983	40	16.8	0.9	35.0	11.0	0.7	38.5	3.9	0.2	38.1	47.7	3.3	43.7
1984	40	19.5	1.3	43.4	12.9	1.0	49.6	4.3	0.3	43.3	37.6	3.6	59.9
1985	40	22.2	1.1	30.1	14.4	0.8	34.2	5.7	0.4	40.3	32.8	1.9	37.0
1986	NA[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	40	22.3	1.6	45.6	14.9	1.0	43.5	5.2	0.8	91.1	37.7	4.3	71.7
1988	38	33.1	1.4	25.4	21.9	1.4	39.0	8.5	0.5	33.2	19.4	1.2	37.5
1989	40	23.7	1.5	40.6	16.1	1.3	49.2	5.1	0.3	38.0	28.6	2.1	45.9
1990	37	28.2	1.3	28.2	19.6	1.1	32.8	6.2	0.3	32.9	25.0	1.7	41.6
1991	40	28.5	1.2	25.9	18.1	0.9	30.1	7.4	0.9	77.8	24.4	1.7	43.9
1992	40	26.8	1.6	36.9	18.5	1.5	51.1	6.5	0.4	40.3	26.8	1.8	43.0
1993	40	17.7	1.9	67.0	12.6	1.6	82.2	3.2	0.3	54.3	43.2	3.7	54.4
1994	40	21.9	1.6	47.6	13.9	0.8	35.7	5.6	0.8	94.7	34.3	3.1	58.0
1995	40	23.9	1.7	44.8	16.8	1.1	42.0	4.8	0.6	80.1	30.2	2.4	49.4
1996	40	20.9	1.4	43.0	14.0	1.0	46.1	4.7	0.4	54.8	35.7	3.8	67.4
1997	40	19.4	1.3	41.8	13.8	1.0	45.2	3.6	0.3	53.6	39.6	3.9	62.0
1998	38	23.1	1.6	42.7	16.1	1.4	53.5	5.0	0.3	42.2	35.0	3.4	59.8
1999	40	26.5	1.2	27.4	18.3	1.0	35.2	5.8	0.5	53.9	25.4	1.5	37.8
2000	40	23.2	1.1	29.3	15.3	0.8	34.5	5.6	0.3	38.0	28.7	1.7	38.3
2001	40	25.8	1.6	38.3	17.0	0.9	33.4	6.2	1.1	107.3	27.7	1.9	42.3
2002	40	16.3	1.1	44.2	9.4	0.6	43.3	5.4	0.6	66.8	48.0	3.4	45.2
2003	40	14.1	0.9	39.1	9.2	0.6	39.0	2.9	0.3	59.9	47.2	3.3	44.2
Average	**40**	**22.0**	**1.3**	**39.1**	**14.7**	**1.0**	**42.7**	**5.2**	**0.5**	**57.6**	**35.0**	**2.7**	**48.7**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

Table 15.—Mean annual percentages of fine sediments from core sampling in the Threemile Creek spawning area, Lake Creek, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1981	40	25.8	1.1	28.0	13.8	0.6	27.6	9.4	0.6	37.7	22.9	2.2	60.5
1982	40	24.7	1.0	26.3	13.1	0.6	30.7	9.0	0.7	46.0	23.0	1.5	40.9
1983	40	28.9	1.2	25.5	17.1	0.9	31.7	9.1	0.5	32.1	19.8	1.2	38.2
1984	40	28.8	1.0	22.7	15.7	0.6	23.3	9.7	0.6	39.3	17.7	0.9	32.0
1985	40	28.0	1.5	33.1	15.0	0.9	39.7	10.0	0.6	35.9	19.7	1.6	51.0
1986	30	29.2	1.6	29.9	16.7	1.1	35.7	9.3	0.6	38.3	19.4	1.7	46.7
1987	40	31.7	1.3	25.7	19.4	1.0	34.1	9.1	0.4	28.3	18.0	1.6	55.8
1988	40	27.2	1.4	32.9	14.8	0.9	36.8	9.6	0.8	52.5	18.0	0.9	33.3
1989	39	30.8	0.9	18.5	17.1	0.8	29.1	10.8	0.6	36.7	15.8	0.6	24.7
1990	40	34.9	1.5	27.7	21.6	1.1	31.4	10.1	0.8	47.2	13.8	0.7	32.0
1991	40	32.6	1.3	25.4	20.0	1.4	44.0	10.2	0.6	36.1	15.8	0.8	30.8
1992	10	57.5	4.4	24.1	43.9	4.9	35.0	11.1	1.5	43.5	7.3	1.0	42.9
1993	40	23.2	1.8	49.2	12.4	1.2	58.7	8.6	0.8	62.4	30.7	3.4	69.7
1994	40	30.0	2.1	44.1	13.6	0.9	40.1	12.8	1.5	75.0	18.9	1.8	59.3
1995	40	35.9	2.6	45.4	19.1	1.4	46.3	13.1	1.5	72.7	16.1	1.5	60.4
1996	40	31.4	1.9	38.4	17.3	1.0	36.3	10.9	1.0	57.9	18.2	1.6	56.1
1997	40	28.8	1.8	39.7	17.7	1.2	43.4	7.8	0.6	51.6	20.8	1.9	56.3
1998	40	30.4	1.3	26.6	19.8	1.1	34.3	7.9	0.4	35.5	18.9	1.1	35.3
1999	40	31.9	2.2	44.6	18.5	1.1	39.2	10.8	1.6	93.5	18.4	1.4	49.0
2000	40	34.3	1.8	33.3	19.5	1.2	37.8	12.0	1.0	52.1	16.2	1.5	59.6
2001	40	32.3	1.2	23.9	19.9	1.0	30.7	9.4	0.5	31.8	16.8	1.1	41.0
2002	40	25.8	1.1	28.0	13.8	0.6	27.6	9.4	0.6	37.7	22.9	2.2	60.5
2003	40	24.7	1.0	26.3	13.1	0.6	30.7	9.0	0.7	46.0	23.0	1.5	40.9
Average	**38**	**30.8**	**1.6**	**31.3**	**18.0**	**1.1**	**35.8**	**10.0**	**0.8**	**47.4**	**18.8**	**1.5**	**46.8**

[a] GMPD - Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

Table 16.—Mean annual percentages of fine sediments from core sampling in the Burgdorf spawning area, Lake Creek, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1981	40	19.4	1.0	32.9	12.8	0.7	34.5	4.5	0.3	37.7	39.5	2.6	42.0
1982	40	20.4	1.1	32.6	13.4	0.7	34.6	4.9	0.3	37.9	38.3	2.9	47.7
1983	40	20.8	1.1	33.5	13.4	0.8	36.7	5.4	0.3	33.4	41.1	3.3	51.1
1984	40	19.2	1.1	34.8	12.3	0.8	42.7	4.4	0.3	41.5	38.0	2.5	41.8
1985	40	22.0	0.9	26.7	13.9	0.7	30.0	5.6	0.3	35.7	33.3	2.1	40.5
1986	NA[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	40	21.6	1.4	40.1	14.2	1.1	49.5	4.7	0.4	48.3	39.1	3.6	58.0
1988	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1989	39	29.0	1.3	27.4	22.8	1.3	35.1	3.4	0.7	127.8	23.0	1.6	44.0
1990	40	19.6	1.5	47.3	12.7	1.2	59.7	4.3	0.4	66.2	39.4	3.2	51.1
1991	39	20.4	1.4	42.0	13.5	1.1	50.8	4.5	0.3	48.1	40.1	3.2	49.5
1992	40	19.8	1.1	34.2	13.6	0.9	42.3	4.4	0.3	41.5	41.5	2.4	36.0
1993	30	21.5	1.2	30.9	15.7	1.1	37.4	3.6	0.3	42.0	38.3	3.1	44.5
1994	30	21.0	1.3	33.8	14.4	0.9	36.2	3.7	0.4	54.9	37.9	2.8	41.1
1995	40	14.2	1.3	59.0	9.3	1.0	65.6	3.0	0.3	62.5	55.3	5.6	63.7
1996	40	16.8	1.0	38.1	10.3	0.7	40.9	3.8	0.3	55.6	40.7	3.4	53.4
1997	40	18.5	0.9	31.4	12.3	0.7	35.8	3.8	0.2	36.9	36.1	2.3	40.9
1998	40	16.7	1.4	52.9	11.2	1.0	56.7	3.3	0.4	71.0	54.1	5.9	68.6
1999	40	18.5	1.5	50.4	12.7	1.1	55.3	3.8	0.3	55.8	47.4	4.5	59.4
2000	40	19.6	1.0	32.7	13.0	0.8	39.8	4.2	0.2	37.4	40.1	2.6	41.0
2001	40	21.1	1.3	39.1	14.4	1.0	45.0	4.0	0.4	55.8	39.1	3.0	48.4
2002	40	20.2	1.5	48.0	14.0	1.2	52.7	3.9	0.3	55.7	41.5	4.0	60.6
2003	40	21.1	1.5	45.9	13.8	1.1	50.4	5.3	0.4	48.4	42.7	4.5	66.3
Average	**38**	**30.8**	**1.6**	**31.3**	**18.0**	**1.1**	**35.8**	**10.0**	**0.8**	**47.4**	**18.8**	**1.5**	**46.8**

[a] GMPD - Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

Table 17.—Mean annual percentages of fine sediments from core sampling in the Secesh Meadows spawning area, Secesh River, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1981	40	14.2	0.6	26.8	8.6	0.5	33.4	4.1	0.2	35.5	48.9	2.4	31.0
1982	40	17.9	0.9	32.3	11.8	0.6	33.6	4.4	0.2	31.8	38.2	2.8	46.2
1983	40	18.9	0.8	28.3	12.6	0.6	29.7	4.4	0.3	36.2	40.7	2.3	35.9
1984	40	18.6	1.1	36.7	12.6	0.7	37.4	4.0	0.3	43.2	36.4	2.9	51.1
1985	40	21.2	1.2	35.1	14.3	0.9	40.6	4.8	0.3	38.8	36.5	2.5	42.9
1986	40	20.6	1.0	30.5	13.8	0.8	34.6	4.9	0.3	32.7	38.6	2.6	42.9
1987	40	21.2	1.1	33.3	14.4	0.8	36.5	4.9	0.3	44.4	40.4	2.7	41.5
1988	NA[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1989	40	27.2	1.0	23.4	19.3	0.9	28.4	5.6	0.4	43.2	26.8	1.4	32.8
1990	40	22.7	1.1	30.4	15.7	0.8	30.7	4.9	0.4	49.4	33.7	2.0	37.5
1991	40	23.0	1.0	28.1	16.4	0.8	32.4	4.8	0.3	41.7	32.5	2.1	41.3
1992	40	25.2	1.0	26.0	17.0	0.8	30.2	4.6	0.3	45.5	29.3	1.9	41.7
1993	40	24.0	0.9	25.0	17.1	0.8	29.5	4.6	0.2	32.5	30.5	1.6	32.4
1994	40	24.2	0.9	23.5	17.6	0.8	29.1	3.9	0.3	45.0	32.8	1.9	36.9
1995	23	16.8	1.5	43.5	11.4	1.2	49.7	3.4	0.4	63.5	43.7	4.4	48.8
1996	20	28.0	1.1	17.9	19.5	1.0	21.8	6.4	0.4	29.7	25.7	1.6	28.6
1997	40	15.5	0.8	34.4	11.1	0.6	37.0	2.7	0.2	49.6	47.2	2.0	26.5
1998	20	19.3	1.5	35.1	13.0	1.1	39.4	4.5	0.4	43.3	43.3	4.4	45.6
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	20	18.3	1.5	36.2	13.0	1.2	40.0	3.9	0.4	42.3	42.5	3.9	41.4
2001	40	20.6	0.8	25.8	13.3	0.6	26.7	5.3	0.3	34.3	36.3	2.4	41.6
2002	40	25.1	1.1	26.9	17.5	0.9	31.7	5.5	0.3	29.7	29.3	2.2	47.5
2003	20	20.6	1.6	34.2	13.3	1.3	43.5	5.9	0.4	32.0	32.6	2.3	43.7
Average	**35**	**21.1**	**1.1**	**30.2**	**14.4**	**0.8**	**34.1**	**4.6**	**0.3**	**40.2**	**36.5**	**2.5**	**39.9**

[a] GMPD - Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

Table 18.—Mean annual percentages of fine sediments from core sampling in the Chinook Campground spawning area, Secesh River, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	Size	Mean	SE[b]	CV[c]	Mean	SE	CV	Mean	SE	CV	Mean	SE	CV
1981	40	15.5	0.7	26.9	10.0	0.5	29.9	3.7	0.2	29.8	40.3	1.8	28.7
1982	40	15.1	0.5	23.1	9.8	0.4	27.3	3.6	0.1	26.3	46.4	2.0	27.0
1983	40	18.4	0.9	29.4	12.6	0.7	34.7	4.1	0.3	40.3	40.9	2.2	33.4
1984	40	19.8	0.8	26.9	13.7	0.8	35.7	4.1	0.2	29.2	36.8	2.0	34.3
1985	40	19.7	0.8	24.2	13.5	0.6	29.1	4.1	0.1	22.5	37.7	1.7	28.3
1986	NA[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	40	21.2	1.3	38.9	15.2	1.0	43.5	3.9	0.3	49.5	38.5	3.9	63.3
1988	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1989	38	31.1	1.1	21.2	21.5	1.0	29.0	6.9	0.2	19.3	21.6	1.3	37.2
1990	40	24.7	1.0	26.5	19.1	0.9	31.2	3.6	0.2	34.3	29.6	1.6	34.0
1991	40	20.8	1.1	32.9	14.1	0.8	35.5	4.4	0.3	44.1	36.3	2.0	34.7
1992	40	19.4	1.1	35.0	12.9	0.8	38.4	4.4	0.3	41.7	44.5	2.8	40.1
1993	40	21.0	0.9	26.2	15.0	0.7	29.0	3.5	0.2	44.4	35.9	2.3	40.8
1994	40	23.2	1.1	29.4	16.2	1.0	40.3	4.3	0.2	30.3	34.2	2.7	49.3
1995	40	18.6	1.7	58.5	13.3	1.4	64.9	3.6	0.3	58.6	50.6	5.2	64.4
1996	40	23.1	1.3	36.1	17.7	1.1	39.1	3.2	0.2	45.5	37.2	2.9	49.8
1997	40	20.5	1.2	37.9	14.2	1.0	46.6	3.8	0.2	40.2	40.6	2.8	43.8
1998	40	20.6	1.4	43.8	13.9	1.2	55.1	4.4	0.3	42.6	44.0	3.5	50.5
1999	40	19.2	1.6	51.2	13.7	1.3	60.2	3.7	0.3	54.2	45.8	4.3	58.7
2000	40	19.2	1.2	39.2	13.3	1.1	50.0	4.1	0.3	44.6	43.4	3.1	45.8
2001	40	22.6	1.1	30.6	15.3	0.8	33.0	4.7	0.4	50.1	34.9	2.5	45.2
2002	40	21.6	1.6	45.8	15.8	1.3	52.8	3.8	0.2	37.7	39.1	3.5	57.2
2003	40	23.9	1.3	35.6	16.7	1.1	42.7	5.0	0.3	36.9	31.7	2.3	45.2
Average	**40**	**20.9**	**1.1**	**34.3**	**14.6**	**0.9**	**40.4**	**4.1**	**0.2**	**39.1**	**38.6**	**2.7**	**43.4**

[a] GMPD - Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

CHAMBERLAIN CREEK

Table 19.—Mean annual percentages of fine sediments from core sampling in the Chamberlain Creek spawning area, Chamberlain Basin, 1981-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	Size	Mean	SE[b]	CV[c]	Mean	SE	CV	Mean	SE	CV	Mean	SE	CV
1981	40	24.7	1.5	37.2	14.9	0.9	39.3	7.2	0.5	41.6	30.3	2.5	52.0
1982	NA[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1983	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1984	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1988	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1989	37	31.8	1.0	19.2	22.7	0.8	22.3	5.8	0.3	28.3	23.3	1.1	29.4
1990	40	28.6	1.0	21.1	20.8	0.7	22.1	4.7	0.2	26.2	28.4	1.4	31.7
1991	40	26.4	1.0	23.8	18.4	0.8	27.2	5.1	0.2	30.9	33.5	1.9	36.4
1992	40	28.5	1.3	29.4	19.9	0.9	30.0	5.7	0.3	36.2	28.7	2.0	45.0
1993	40	21.9	0.9	25.4	17.1	0.8	29.0	2.8	0.3	59.1	42.2	2.0	29.7
1994	40	22.4	1.5	42.1	15.5	1.0	40.9	4.4	0.5	76.7	41.3	3.5	53.4
1995	40	16.9	1.4	51.6	12.8	1.1	56.1	2.3	0.2	58.8	61.5	5.1	52.2
1996	40	23.9	1.2	31.1	18.5	1.0	34.3	3.0	0.1	29.5	39.6	2.6	42.2
1997	40	15.7	1.1	45.5	11.3	0.9	50.0	2.3	0.2	44.1	55.6	4.1	46.3
1998	40	13.9	1.2	53.8	9.6	0.9	57.5	2.6	0.2	53.4	68.8	6.2	57.4
1999	40	17.2	1.3	47.9	12.4	1.0	53.1	2.7	0.2	50.9	60.0	4.6	48.1
2000	40	19.8	1.3	42.7	15.0	1.0	44.2	3.1	0.2	46.6	52.4	4.4	53.6
2001	40	24.0	1.4	37.4	17.8	1.2	41.8	4.0	0.3	40.7	41.4	3.5	53.5
2002	40	15.0	1.4	58.9	11.5	1.1	62.0	2.3	0.2	64.0	80.9	6.5	51.1
2003	40	15.3	1.2	47.9	10.8	0.9	51.0	3.0	0.2	52.4	75.1	4.5	37.6
Average	**40**	**21.6**	**1.2**	**38.4**	**15.6**	**0.9**	**41.3**	**3.8**	**0.3**	**46.2**	**47.7**	**3.5**	**45.0**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

Table 20.—Mean annual percentages of fine sediments from core sampling in the West Fork Chamberlain Creek, 1991-2003.

	Sample	Large Fines			Coarse Fines			Small Fines			GMPD[a]		
Year	**Size**	**Mean**	**SE[b]**	**CV[c]**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**	**Mean**	**SE**	**CV**
1991	38	29.0	1.3	27.5	17.9	0.9	31.0	8.4	0.4	30.6	23.2	1.5	40.7
1992	40	31.9	1.1	22.1	21.0	0.9	26.5	8.3	0.4	28.4	19.5	1.1	34.4
1993	40	31.4	1.3	25.8	21.3	1.1	31.7	6.9	0.5	42.7	20.9	1.2	35.2
1994	40	25.9	1.0	25.4	18.1	0.9	32.4	5.4	0.3	34.7	23.3	1.1	29.8
1995	40	25.1	1.3	32.2	16.5	0.9	35.9	6.0	0.3	36.0	26.0	2.0	47.7
1996	40	34.2	0.9	16.2	24.6	0.7	18.5	6.6	0.4	33.8	18.4	0.8	28.0
1997	40	28.7	1.1	23.5	19.3	0.9	30.0	6.3	0.2	23.2	22.6	1.3	36.7
1998	40	30.6	0.8	17.3	21.9	0.7	19.4	5.4	0.2	28.3	20.4	1.0	31.8
1999	40	31.5	1.2	24.1	22.5	1.0	27.3	6.1	0.3	33.4	20.3	1.3	40.7
2000	40	33.4	0.8	16.0	23.1	0.8	21.0	7.4	0.4	38.4	18.6	0.9	31.2
2001	40	28.0	1.1	25.5	20.5	0.9	28.3	4.9	0.3	35.7	23.2	1.3	35.4
2002	40	34.9	1.1	19.8	23.6	0.9	24.0	8.3	0.4	30.2	18.8	1.2	40.4
2003	24	33.0	1.4	20.3	21.3	1.1	26.0	8.9	0.6	31.8	21.8	0.9	25.1
Average	**39**	**30.6**	**1.1**	**22.7**	**20.9**	**0.9**	**27.1**	**6.8**	**0.4**	**32.9**	**21.3**	**1.2**	**35.2**

[a] GMPD – Geometric Mean Particle Diameter.
[b] SE – Standard Error of the Mean.
[c] CV – Coefficient of Variation (%).
[d] NA – Not Available.

INTERBASIN COMPARISONS

Table 21.—Multiple comparison[a] of mean large fines among basins by year.

Year	SFSR	Secesh	Chamberlain
1989	26.9 B	30.4 A	31.8 A
1990	28.3 A	23.6 B	28.6 A
1991	27.2 A	24.6 B	27.7 A
1992	27.4 B	25.6 B	30.2 A
1993	28.1 A	25.4 B	26.6 AB
1994	27.5 A	25.8 AB	24.1 B
1995	30.7 A	18.2 C	21.0 B
1996	31.8 A	23.5 C	29.1 B
1997	31.6 A	22.8 B	22.2 B
1998	31.6 A	22.1 B	22.2 B
1999	31.0 A	21.5 C	24.3 B
2000	28.9 A	22.5 B	26.6 A
2001	28.3 A	24.6 B	26.0 B
2002	30.5 A	24.9 B	25.0 B
2003	31.4 A	24.3 B	20.9 C

[a] Mean values in a row with different letters are significantly different ($P \leq 0.10$) by Tukey's HSD test.

Table 22.—Multiple comparison[a] of mean coarse fines among basins by year.

Year	SFSR	Secesh	Chamberlain
1989	22.6 A	20.9 A	22.7 A
1990	23.8 A	15.7 C	20.8 B
1991	22.8 A	16.1 B	18.2 C
1992	23.6 A	16.6 C	20.5 B
1993	23.6 A	17.3 B	19.2 B
1994	21.3 A	18.5 B	16.8 B
1995	26.1 A	11.8 C	14.6 B
1996	27.2 A	14.5 C	21.5 B
1997	26.7 A	14.7 B	15.3 B
1998	26.6 A	14.0 B	15.8 B
1999	26.2 A	14.5 C	17.5 B
2000	24.2 A	15.2 C	19.0 B
2001	23.1 A	16.0 C	19.2 B
2002	26.1 A	16.4 B	17.6 B
2003	26.8 A	11.8 C	14.8 B

[a] Mean values in a row with different letters are significantly different ($P \leq 0.10$) by Tukey's HSD test.

Table 23.—Multiple comparison[a] of mean small fines among basins by year.

Year	SFSR	Secesh	Chamberlain
1989	4.3 C	6.7 A	5.8 B
1990	4.6 B	5.5 A	4.7 B
1991	4.3 B	6.1 A	6.7 A
1992	5.2 A	6.2 B	7.0 A
1993	4.3 B	5.8 A	4.9 B
1994	2.8 B	4.6 A	4.9 A
1995	5.5 A	4.4 B	4.2 B
1996	5.4 AB	6.3 A	4.8 B
1997	6.3 A	5.6 A	4.3 B
1998	6.3 A	5.7 A	4.0 B
1999	5.8 A	4.7 B	4.4 B
2000	5.1 A	5.1 A	5.3 A
2001	4.7 B	6.1 A	4.4 B
2002	5.8 A	6.2 A	5.3 A
2003	6.2 A	5.8 A	4.2 B

[a] Mean values in a row with different letters are significantly different ($P \leq 0.10$) by Tukey's HSD test.

APPENDIX 2. TIME SERIES GRAPHS

SOUTH FORK SALMON RIVER

STOLLE MEADOWS (B081)

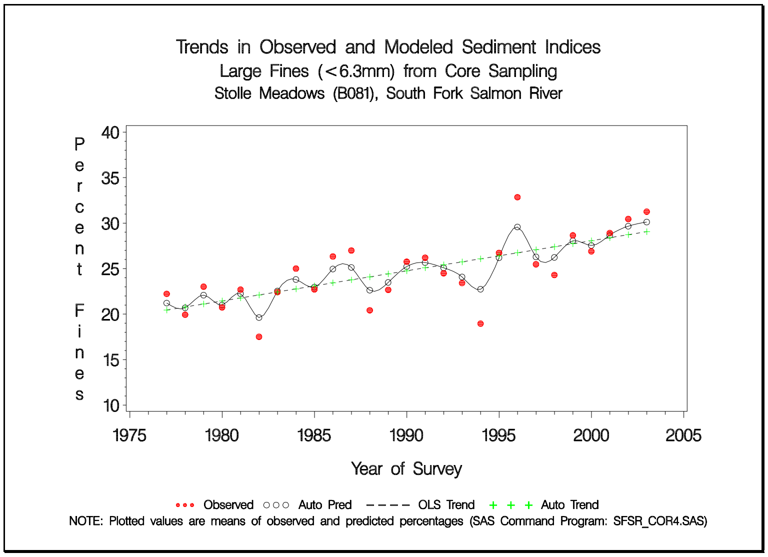

Figure 3.—Time trends in the large fine sediments in the Stolle Meadows spawning area, upper SFSR, 1977-2003.

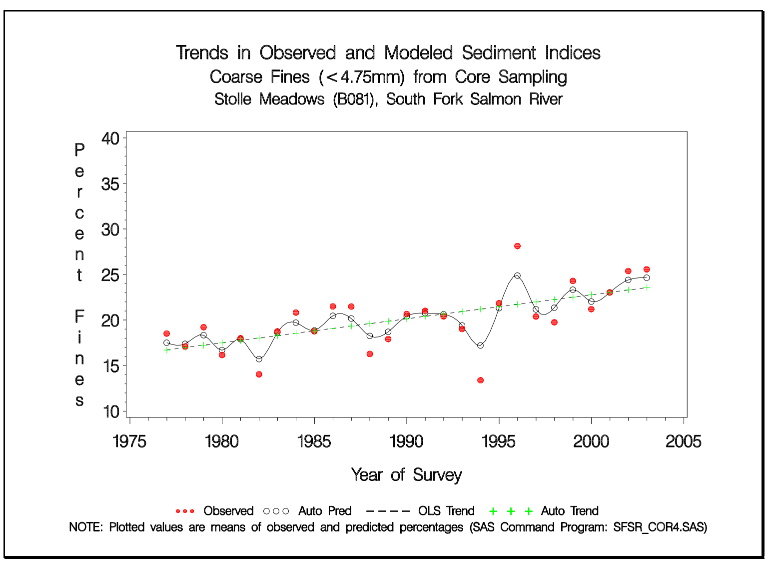

Figure 4.—Time trends in coarse fine sediments in the Stolle Meadows spawning area, upper SFSR, 1977-2003.

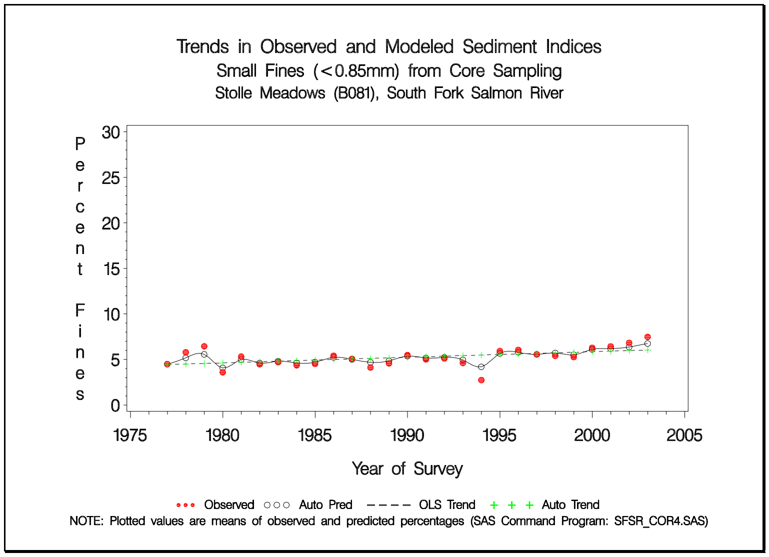

Figure 5.—Time trends in the small fine sediments in the Stolle Meadows spawning area, upper SFSR, 1977-2003.

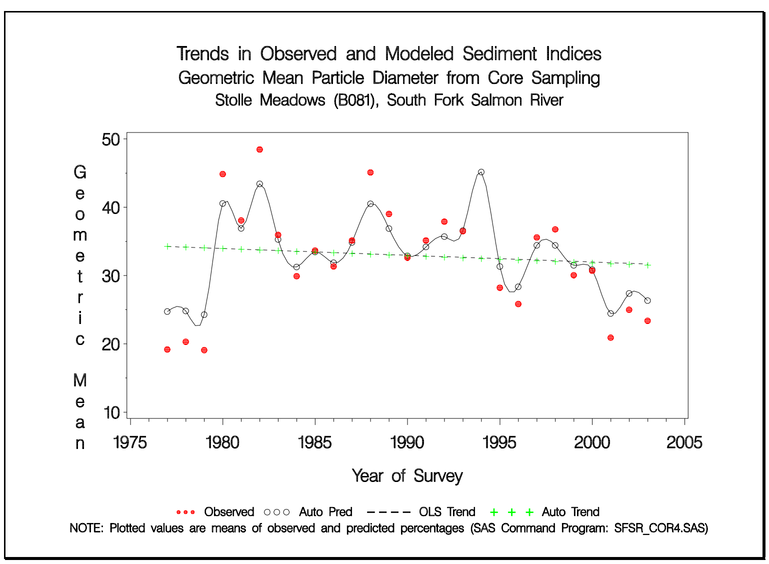

Figure 6.—Time trends in geometric mean particle diameter in the Stolle Meadows spawning area, upper SFSR, 1977-2003.

DOLLAR CREEK (B082)

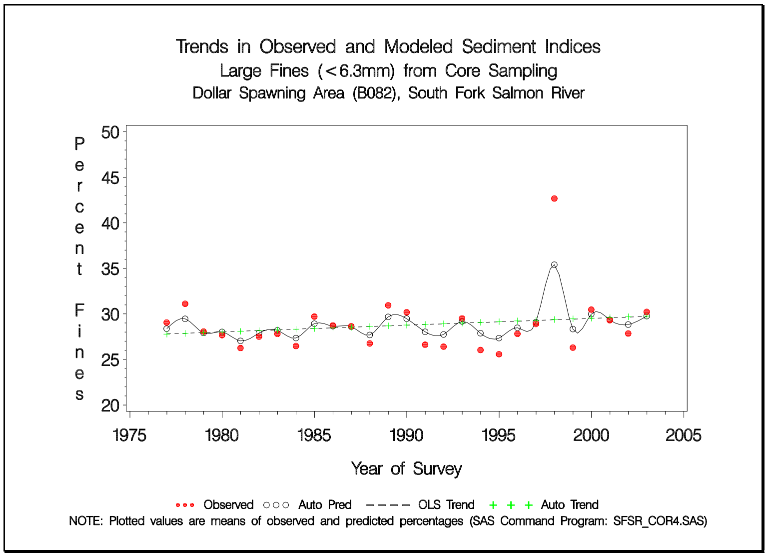

Figure 7.—Time trends in the large fine sediments in the Dollar Creek spawning area, upper SFSR, 1977-2003.

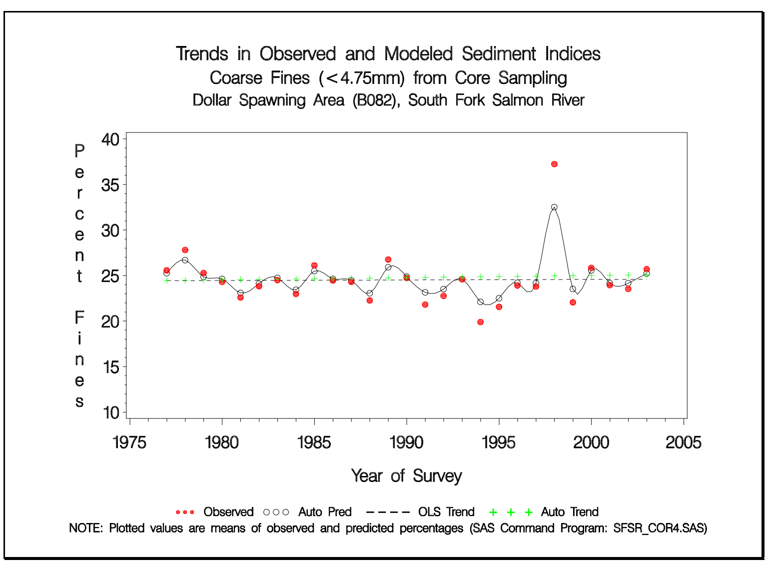

Figure 8.—Time trends in coarse fine sediments in the Dollar Creek spawning area, upper SFSR, 1977-2003.

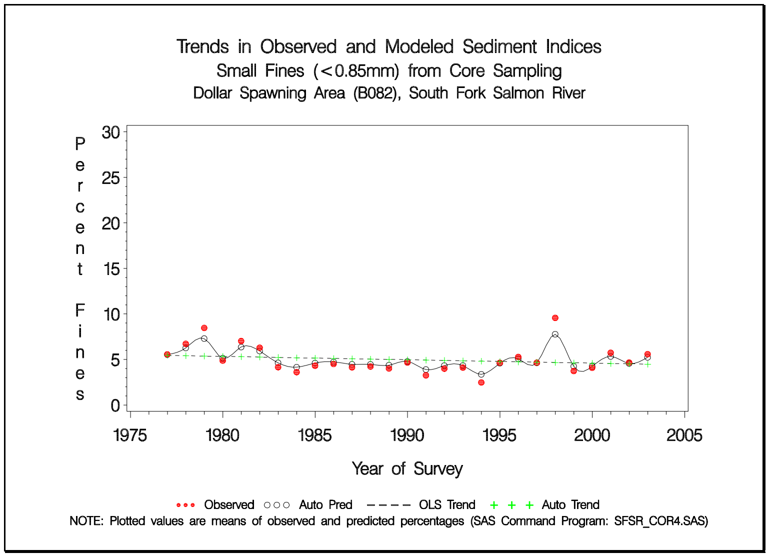

Figure 9.—Time trends in the small fine sediments in the Dollar Creek spawning area, upper SFSR, 1977-2003.

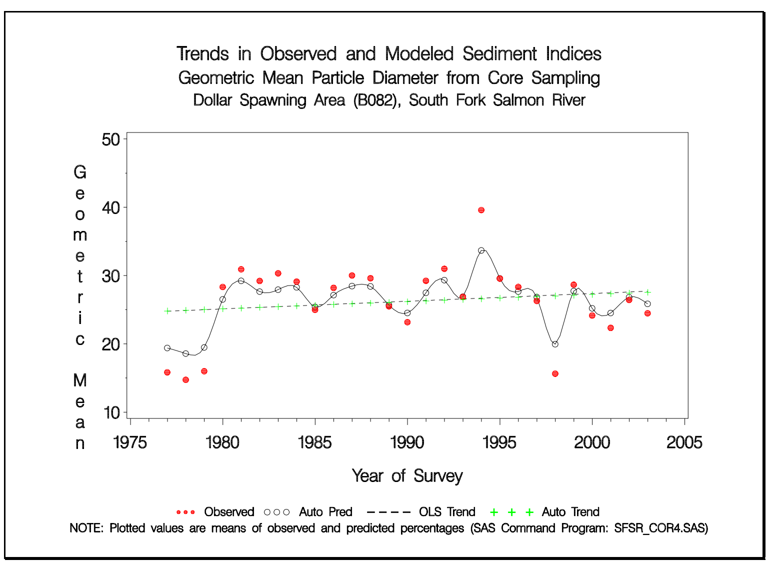

Figure 10.—Time trends in geometric mean particle diameter in the Dollar Creek spawning area, upper SFSR, 1977-2003.

Poverty Flat (E084)

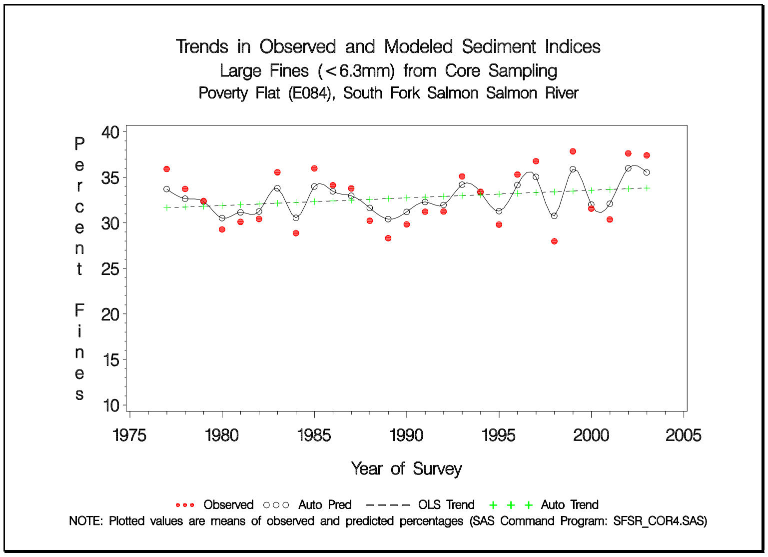

Figure 11.—Time trends in the large fine sediments in the Poverty Flat spawning area, upper SFSR, 1977-2003.

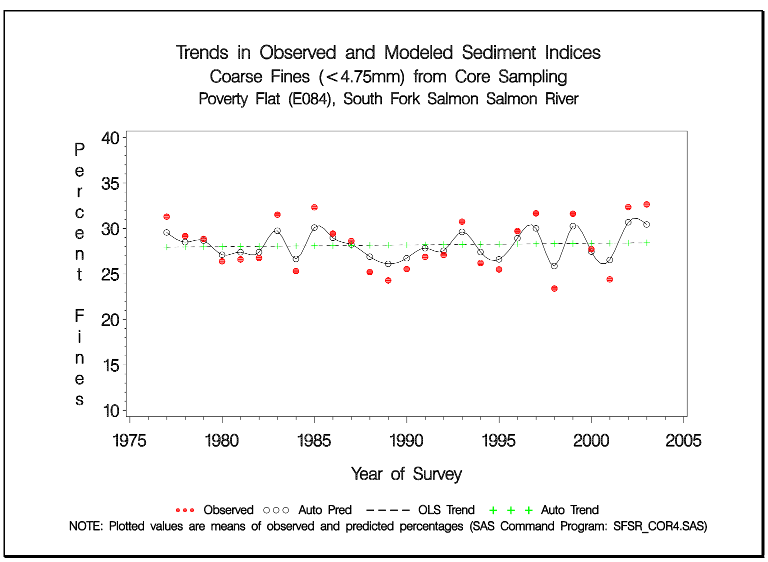

Figure 12.—Time trends in coarse fine sediments in the Poverty Flat spawning area, upper SFSR, 1977-2003.

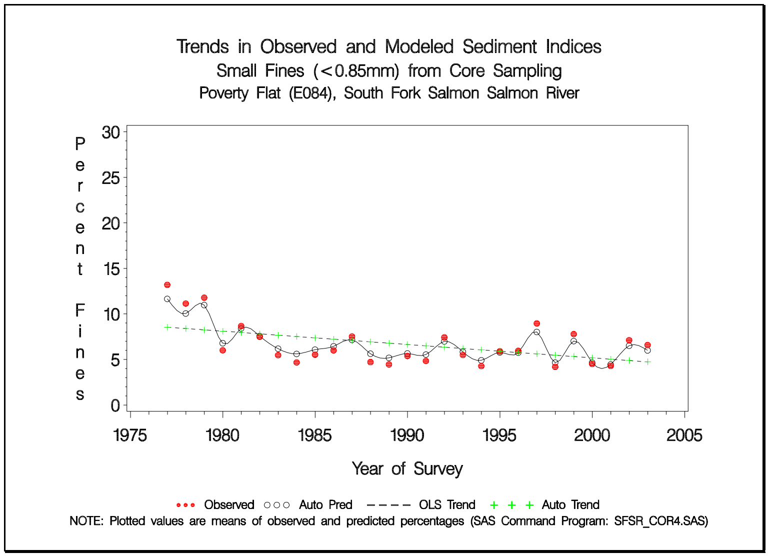

Figure 13.—Time trends in the small fine sediments in the Poverty Flat spawning area, upper SFSR, 1977-2003.

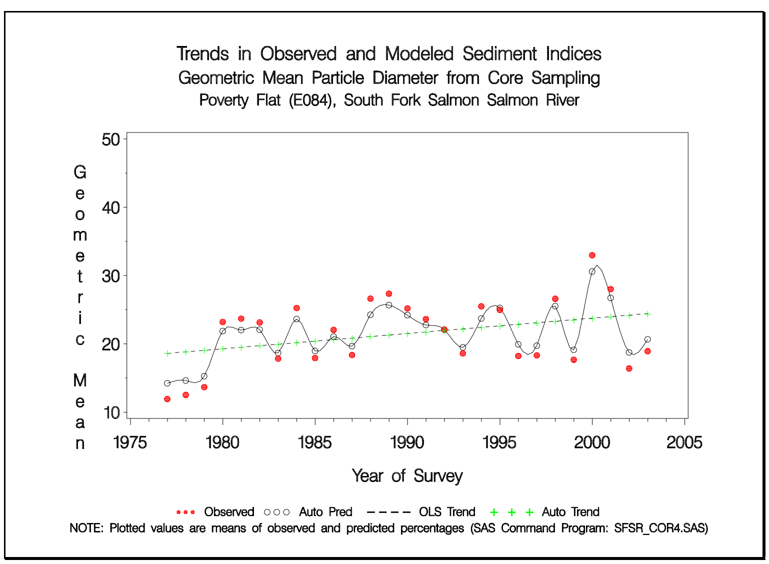

Figure 14.—Time trends in geometric mean particle diameter in the Poverty Flat spawning area, upper SFSR, 1977-2003.

GLORY HOLE (E085)

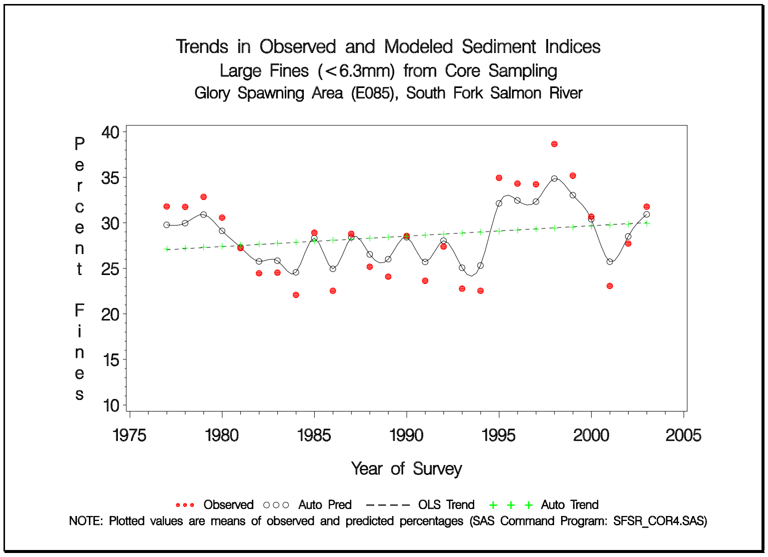

Figure 15.—Time trends in the large fine sediments in the Glory Hole spawning area, upper SFSR, 1977-2003.

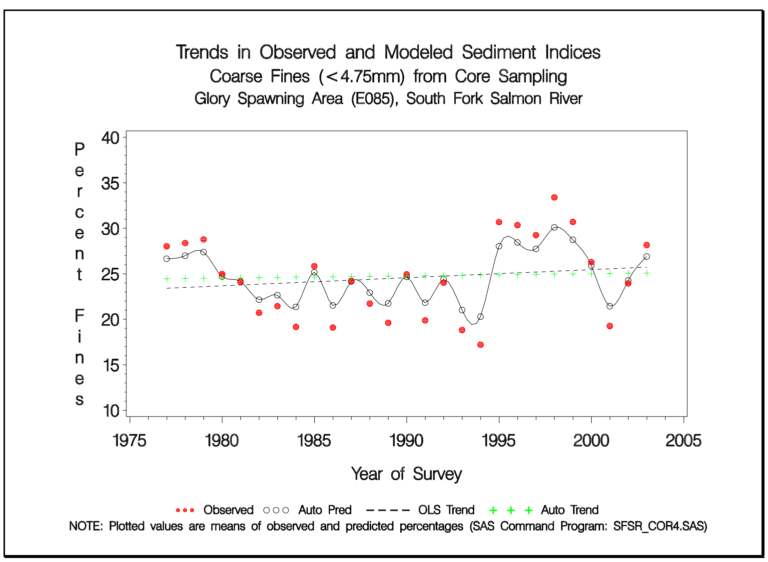

Figure 16.—Time trends in coarse fine sediments in the Glory Hole spawning area, upper SFSR, 1977-2003.

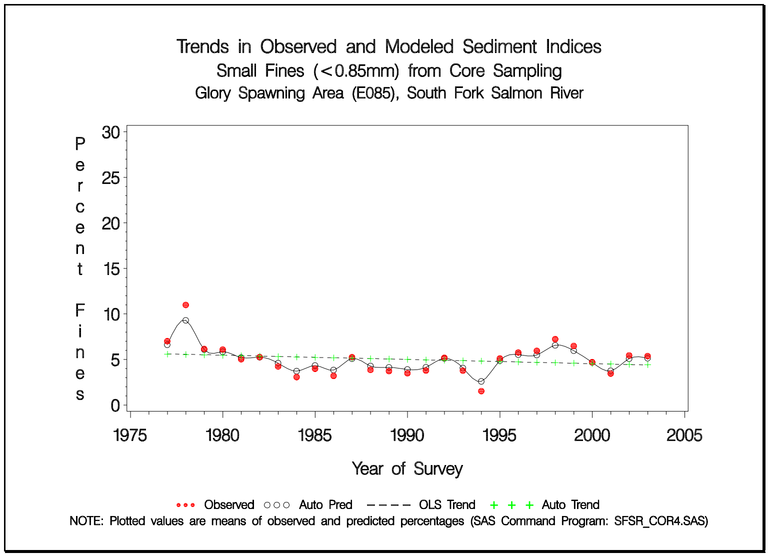

Figure 17.—Time trends in the small fine sediments in the Glory Hole spawning area, upper SFSR, 1977-2003.

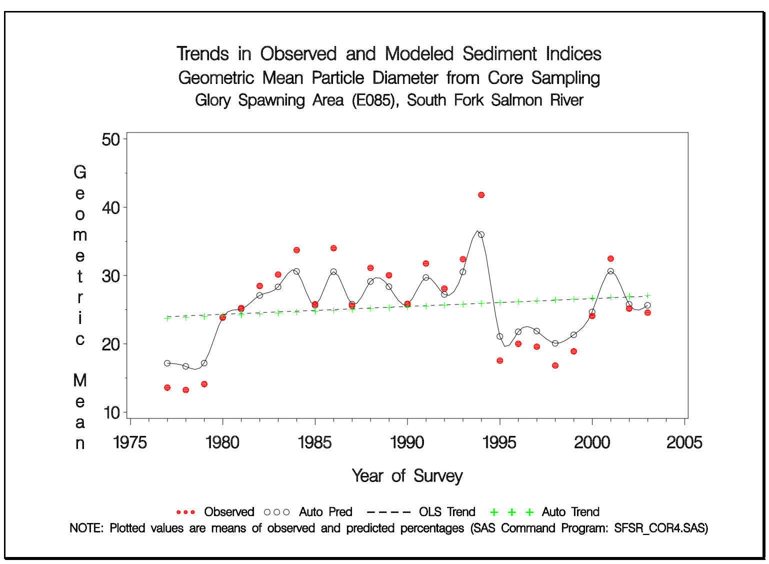

Figure 18.—Time trends in geometric mean particle diameter in the Glory Hole spawning area, upper SFSR, 1977-2003.

Oxbow (E083)

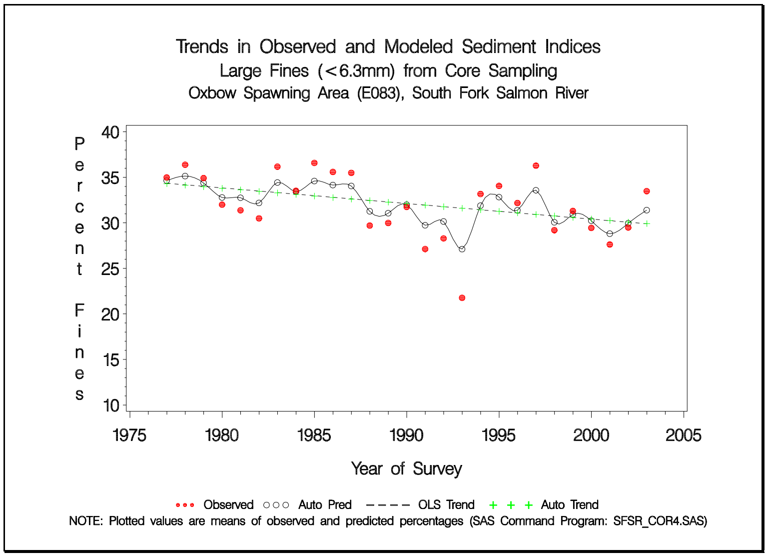

Figure 19.—Time trends in the large fine sediments in the Oxbow spawning area, upper SFSR, 1977-2003.

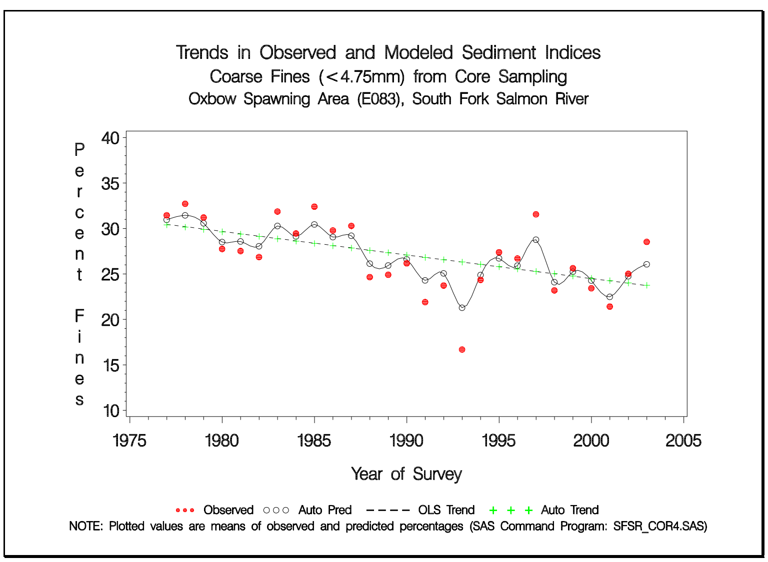

Figure 20.—Time trends in coarse fine sediments in the Oxbow spawning area, upper SFSR, 1977-2003.

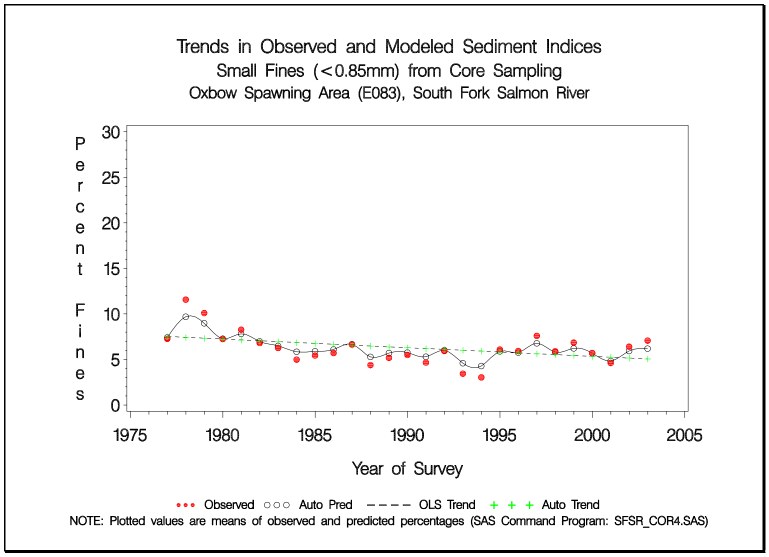

Figure 21.—Time trends in the small fine sediments in the Oxbow spawning area, upper SFSR, 1977-2003.

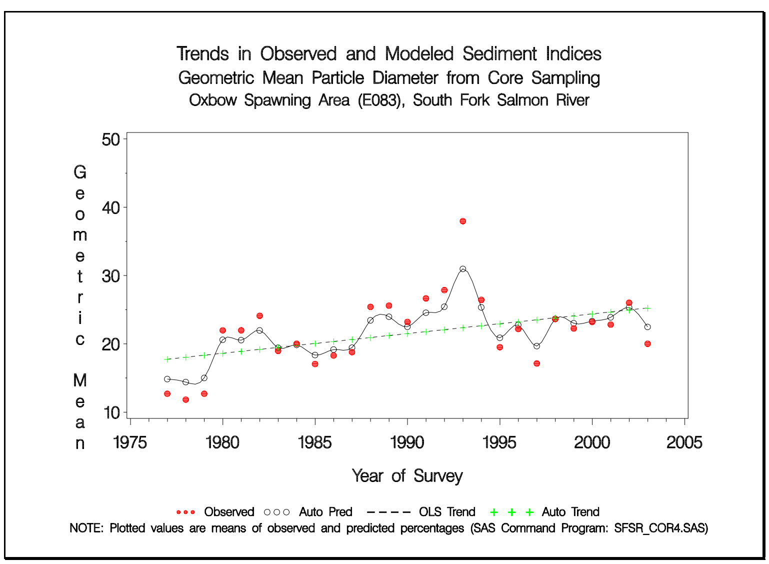

Figure 22.—Time trends in geometric mean particle diameter in the Oxbow spawning area, upper SFSR, 1977-2003.

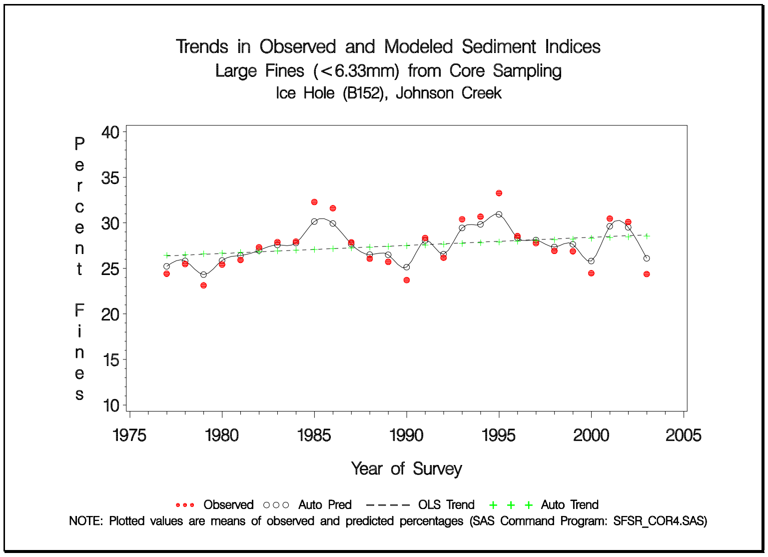

Figure 23.—Time trends in the large fine sediments in the Ice Hole spawning area, upper SFSR, 1977-2003.

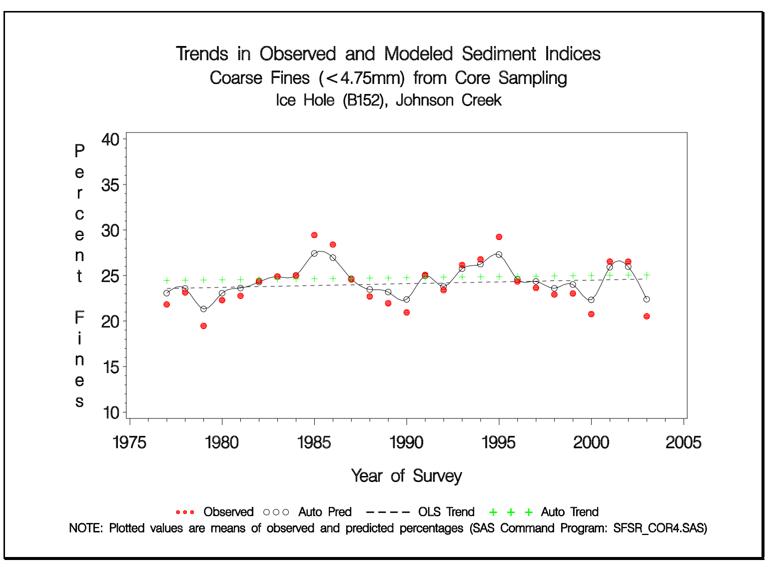

Figure 24.—Time trends in coarse fine sediments in the Ice Hole spawning area, upper SFSR, 1977-2003.

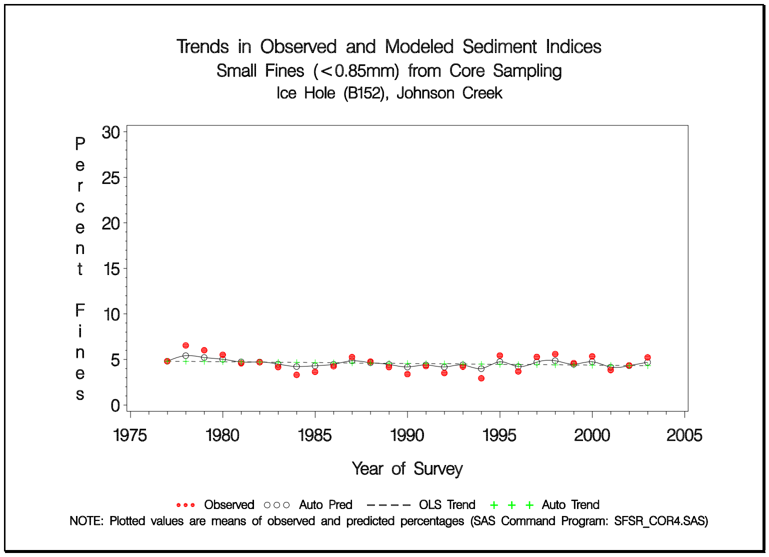

Figure 25.—Time trends in the small fine sediments in the Ice Hole spawning area, upper SFSR, 1977-2003.

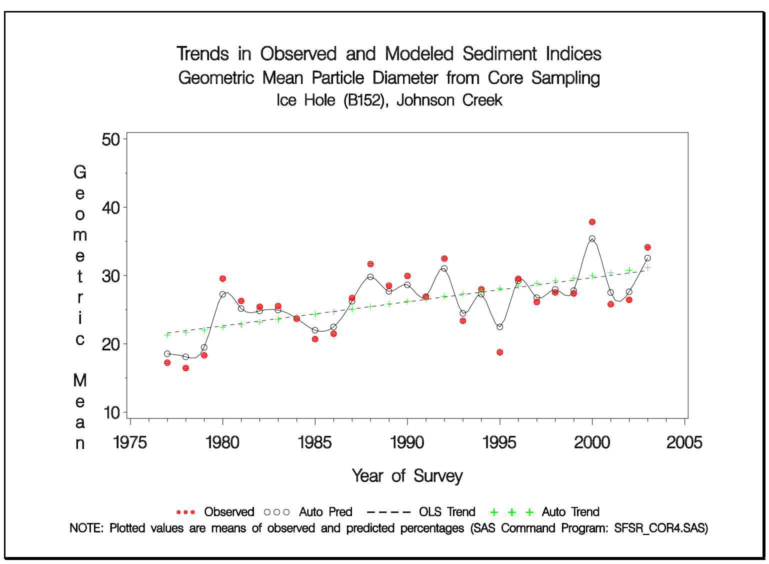

Figure 26.—Time trends in geometric mean particle diameter in the Ice Hole spawning area, upper SFSR, 1977-2003.

CORDUROY JUNCTION (E034)

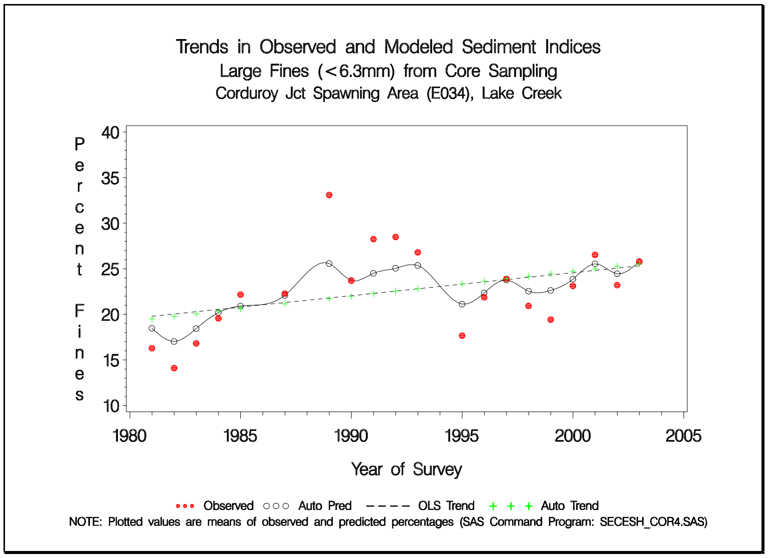

Figure 27.—Time trends in the large fine sediments in the Corduroy Junction spawning area, Lake Creek, 1981-2003.

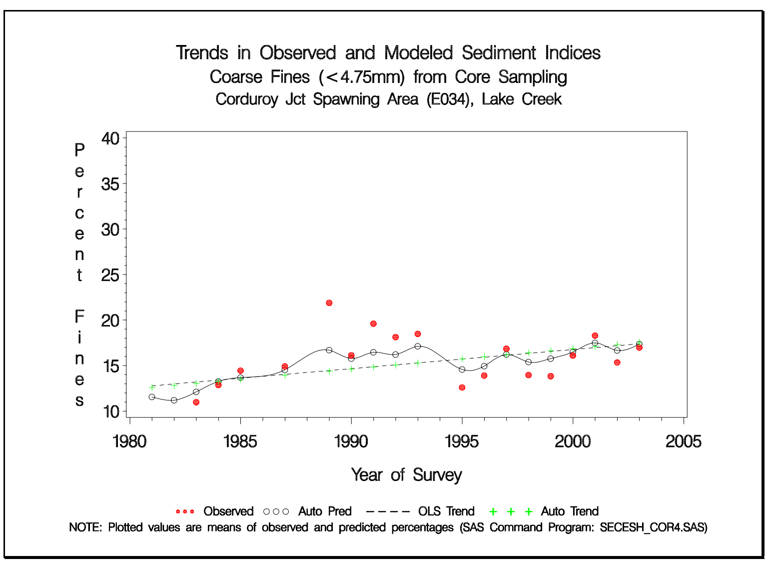

Figure 28.—Time trends in coarse fine sediments in the Corduroy Junction spawning area, Lake Creek, 1981-2003.

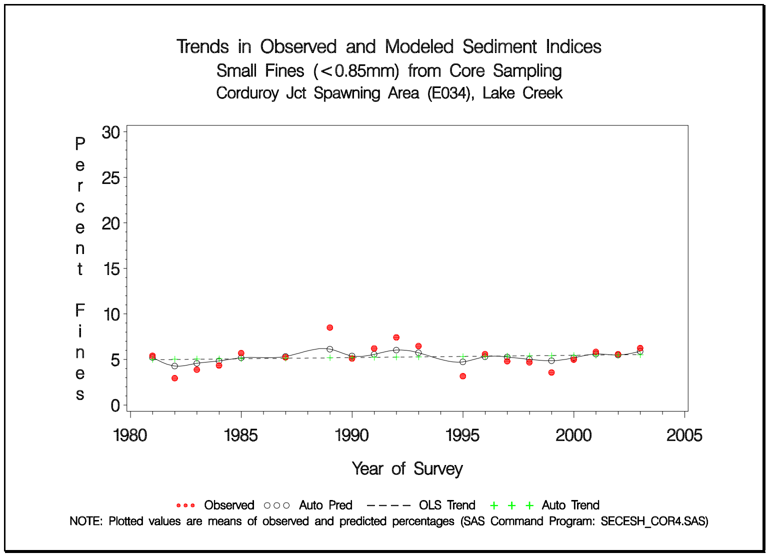

Figure 29.—Time trends in the small fine sediments in the Corduroy Junction spawning area, Lake Creek, 1981-2003.

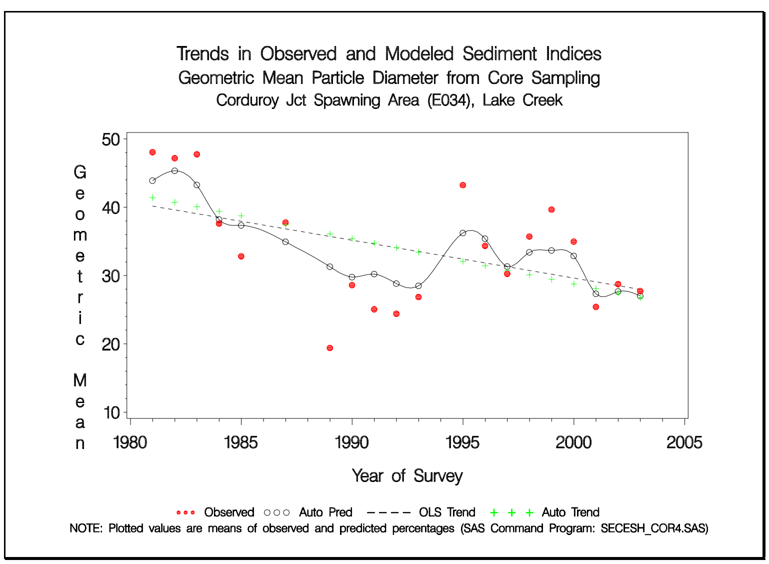

Figure 30.—Time trends in geometric mean particle diameter in the Corduroy Junction spawning area, Lake Creek, 1981-2003.

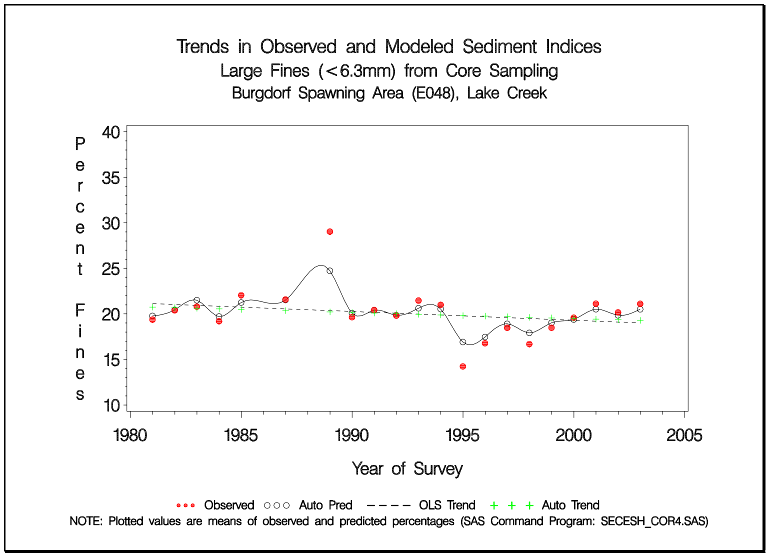

Figure 31.—Time trends in the large fine sediments in the Burgdorf spawning area, Lake Creek, 1981-2003.

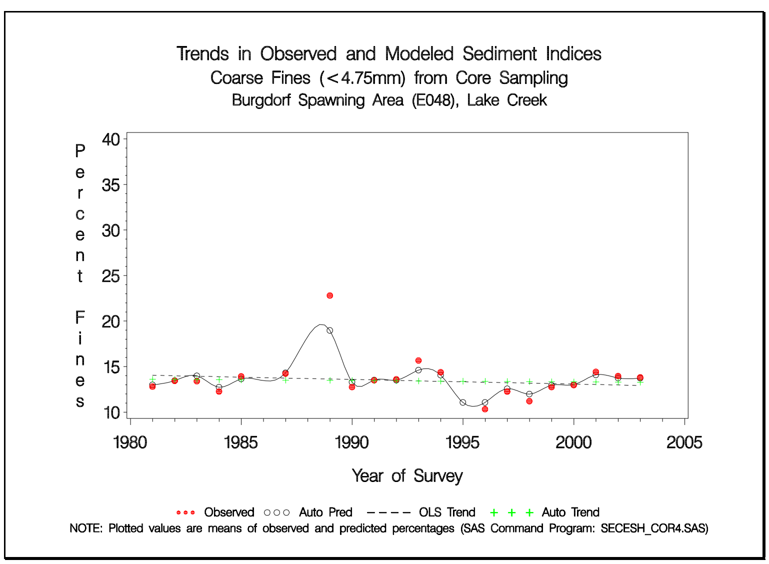

Figure 32.—Time trends in coarse fine sediments in the Burgdorf spawning area, Lake Creek, 1981-2003.

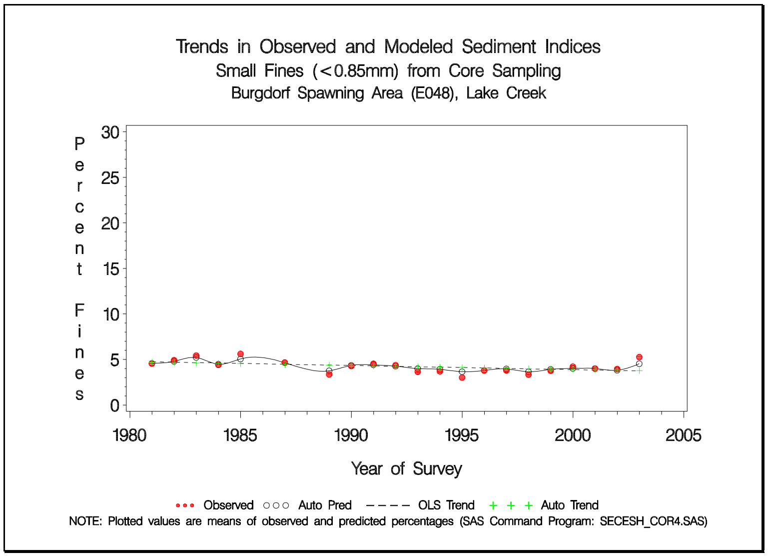

Figure 33.—Time trends in the small fine sediments in the Burgdorf spawning area, Lake Creek, 1981-2003.

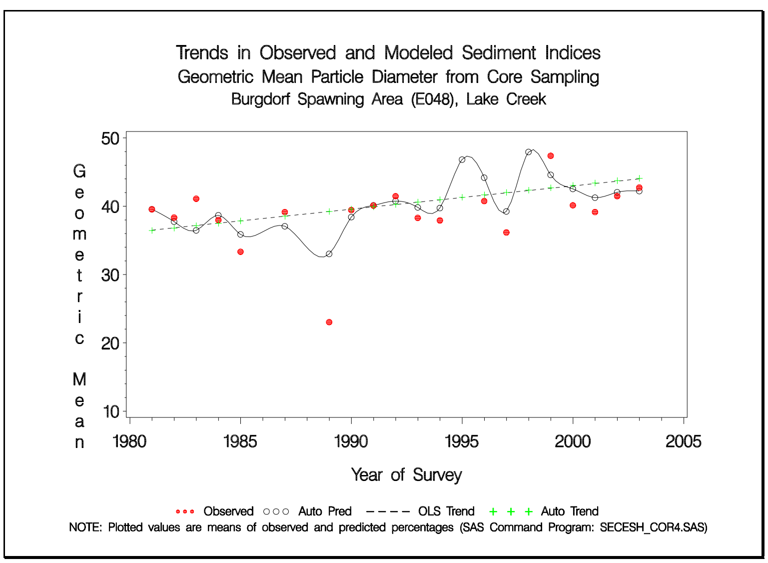

Figure 34.—Time trends in geometric mean particle diameter in the Burgdorf spawning area, Lake Creek, 1981-2003.

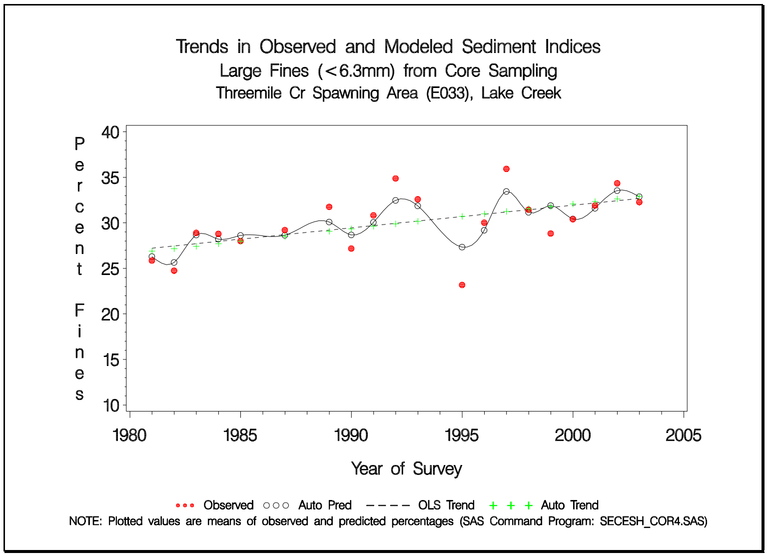

Figure 35.—Time trends in the large fine sediments in the Threemile Creek spawning area, Lake Creek, 1981-2003.

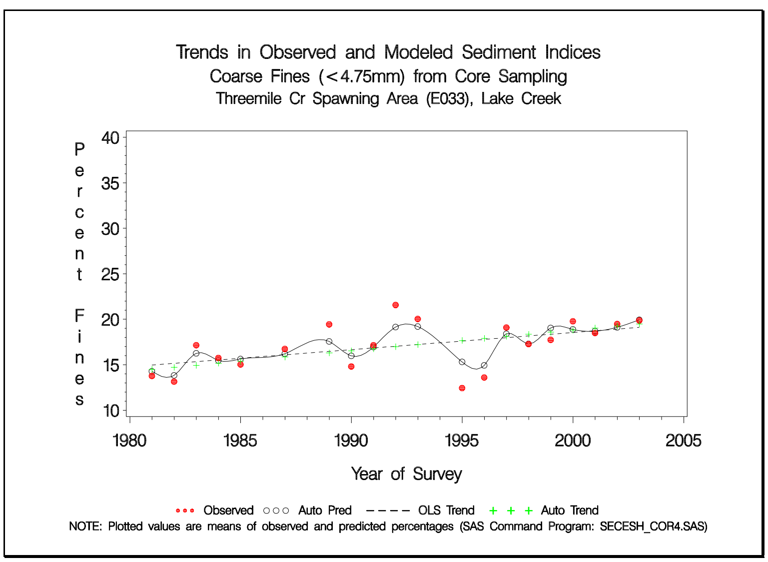

Figure 36.—Time trends in coarse fine sediments in the Threemile Creek spawning area, Lake Creek, 1981-2003.

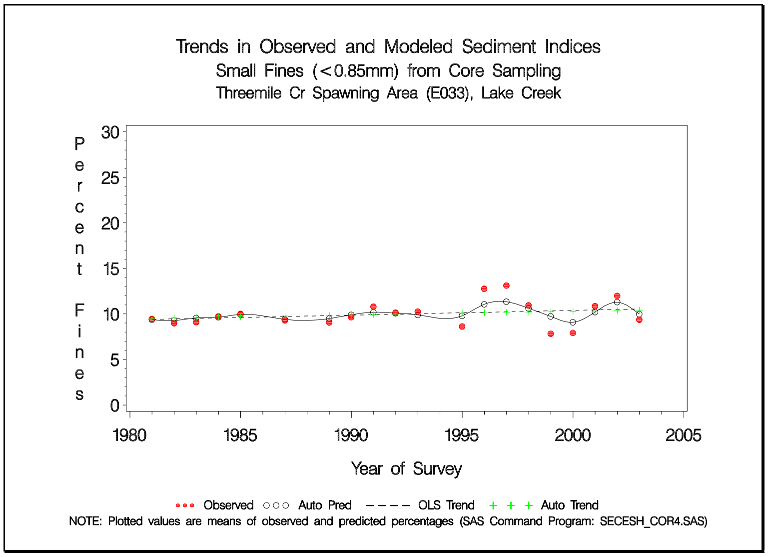

Figure 37.—Time trends in the small fine sediments in the Threemile Creek spawning area, Lake Creek, 1981-2003.

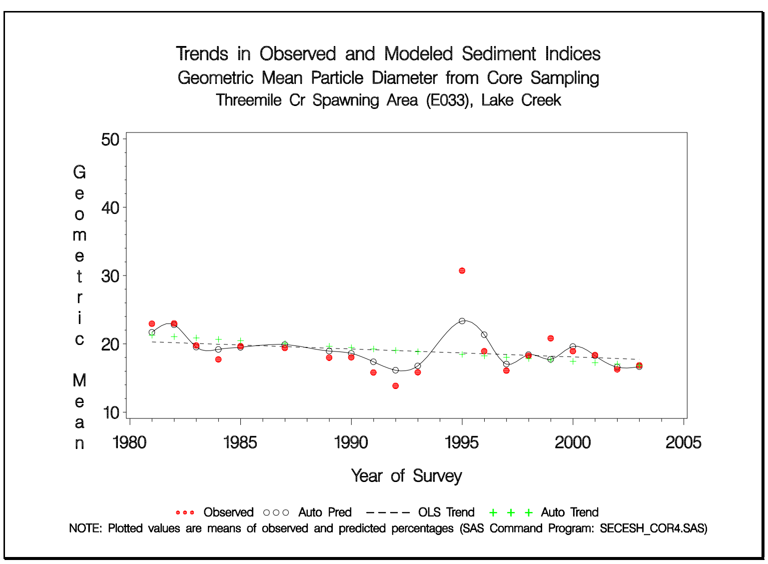

Figure 38.—Time trends in geometric mean particle diameter in the Threemile Creek spawning area, Lake Creek, 1981-2003.

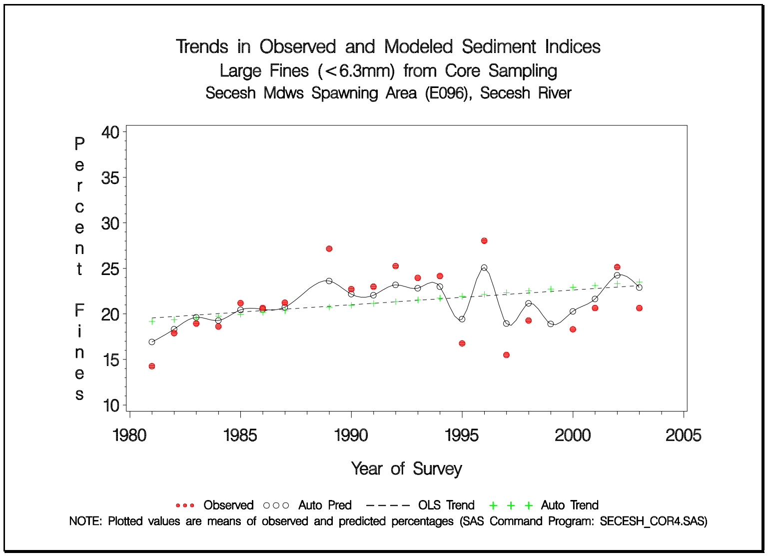

Figure 39.—Time trends in the large fine sediments in the Secesh Meadows spawning area, Secesh River, 1981-2003.

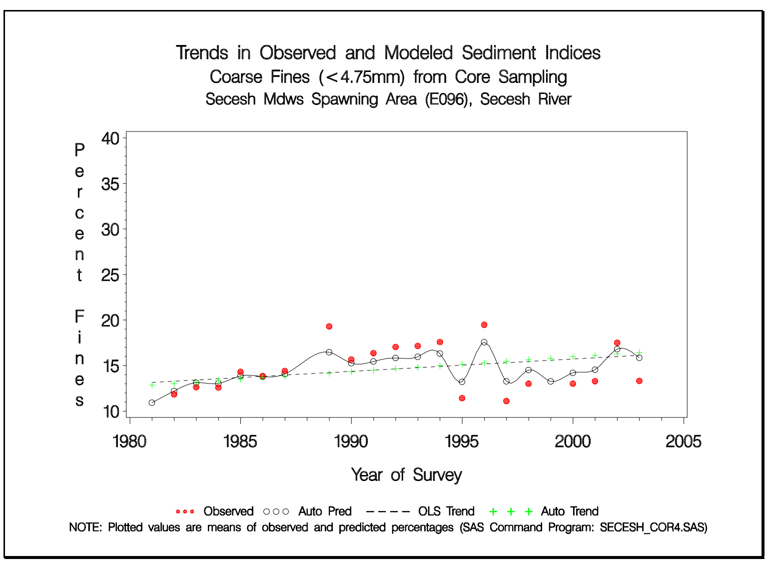

Figure 40.—Time trends in coarse fine sediments in the Secesh Meadows spawning area, Secesh River, 1981-2003.

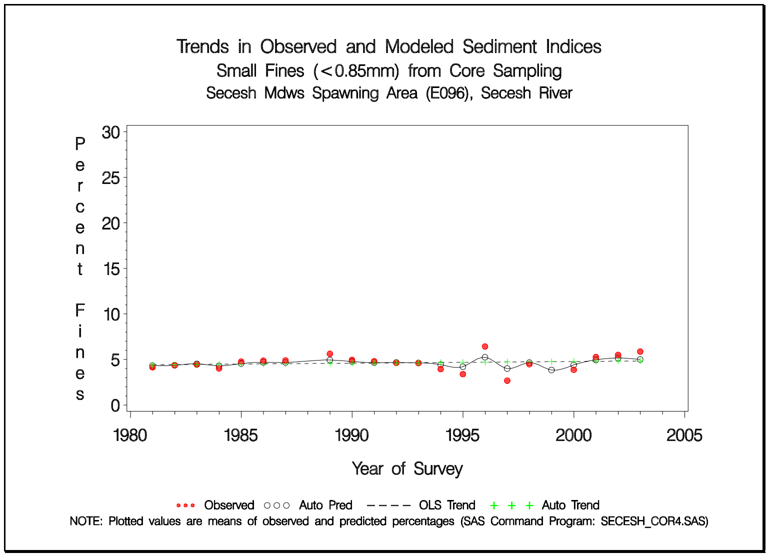

Figure 41.—Time trends in the small fine sediments in the Secesh Meadows spawning area, Secesh River, 1981-2003.

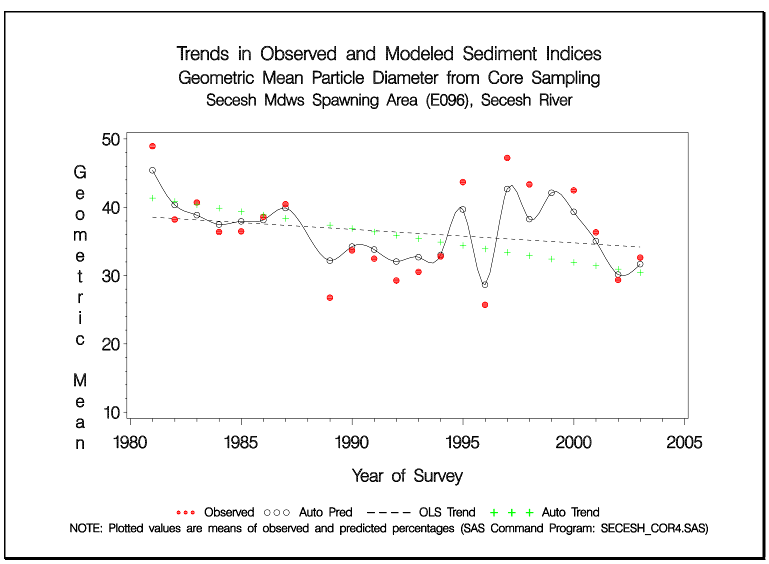

Figure 42.—Time trends in geometric mean particle diameter in the Secesh Meadows spawning area, Secesh River, 1981-2003.

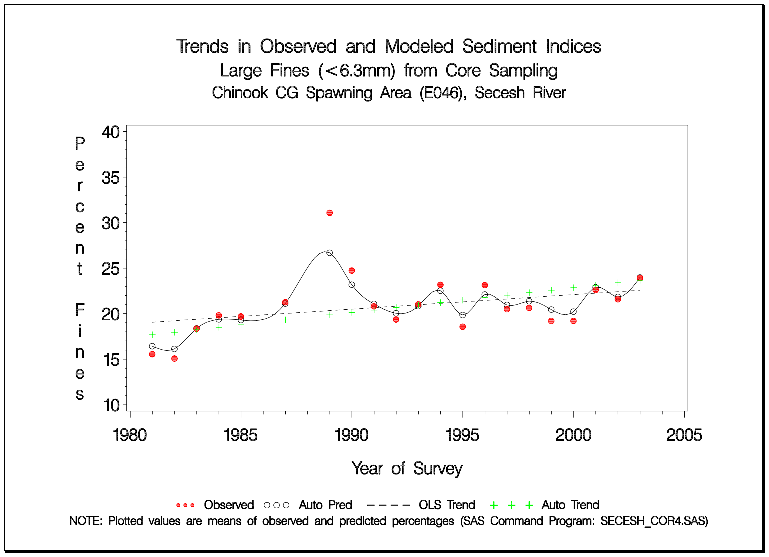

Figure 43.—Time trends in the large fine sediments in the Chinook Campground spawning area, Secesh River, 1981-2003.

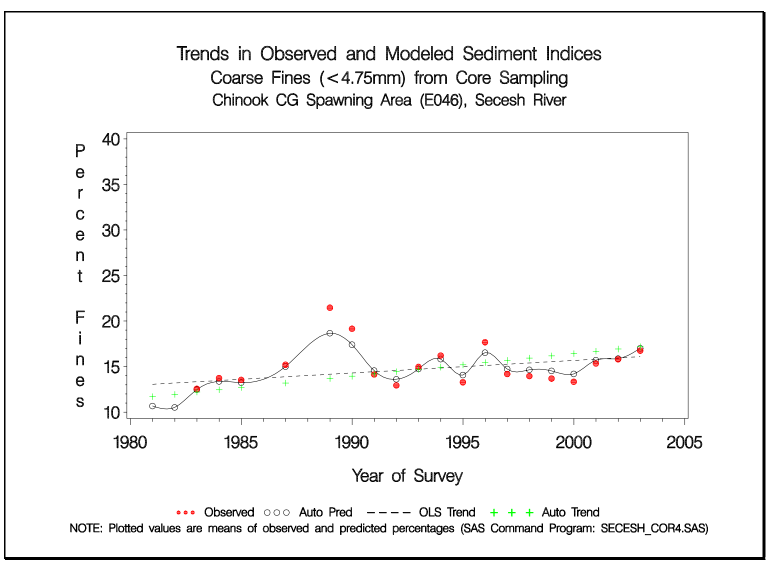

Figure 44.—Time trends in coarse fine sediments in the Chinook Campground spawning area, Secesh River, 1981-2003.

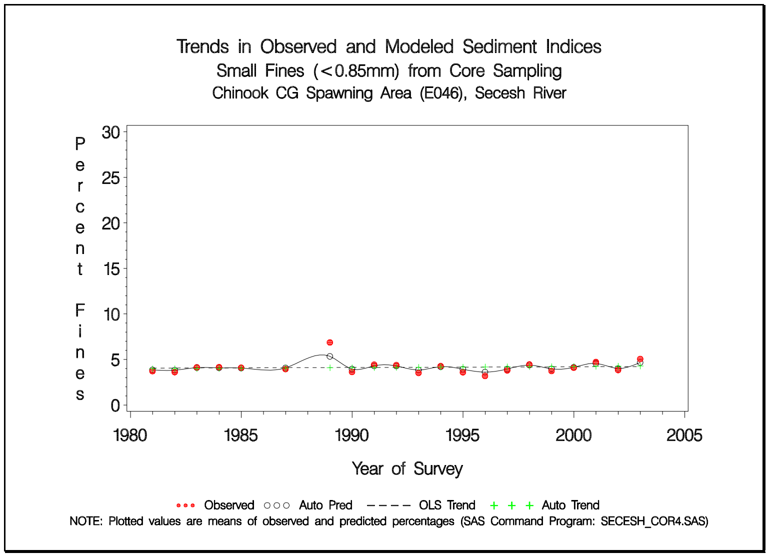

Figure 45.—Time trends in the small fine sediments in the Chinook Campground spawning area, Secesh River, 1981-2003.

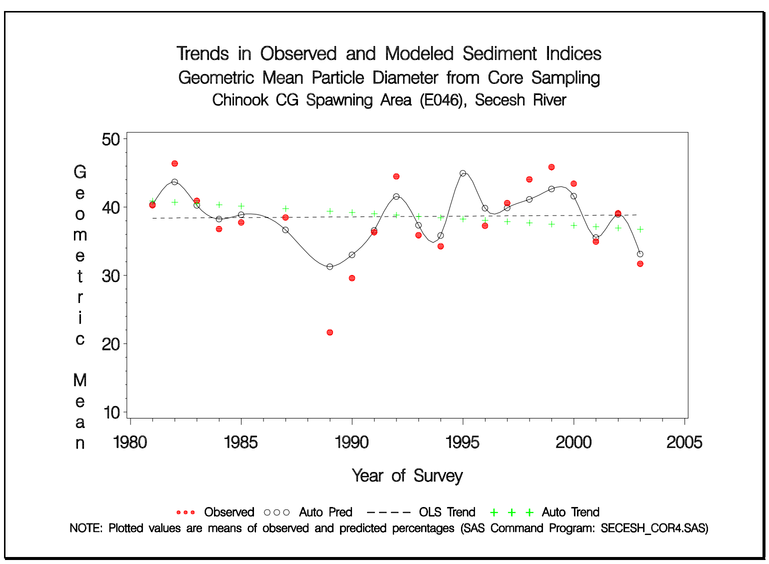

Figure 46.—Time trends in geometric mean particle diameter in the Chinook Campground spawning area, Secesh River, 1981-2003.

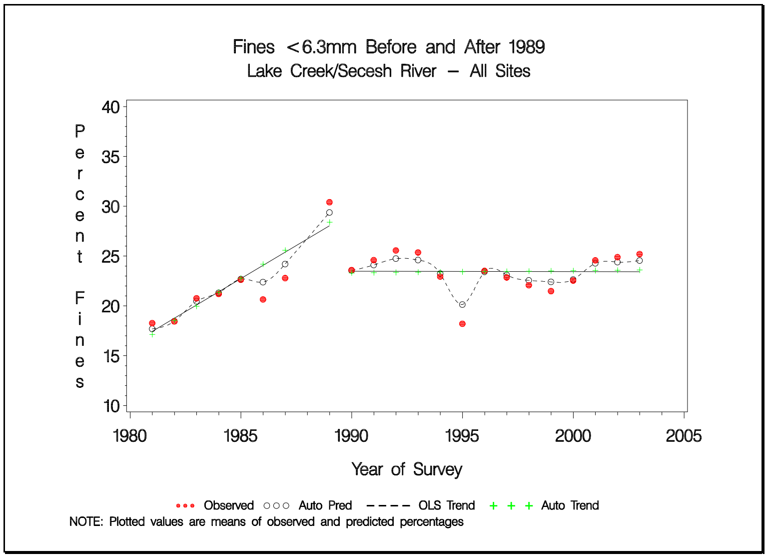

Figure 47.—Time trends in large fine sediments in the Lake Creek and Secesh River spawning areas, up to and after 1989.

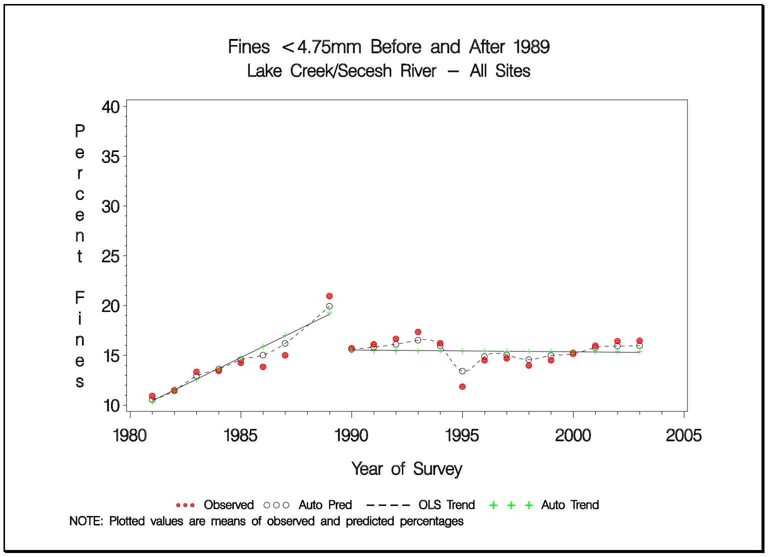

Figure 48.—Time trends in coarse fine sediments in the Lake Creek and Secesh River spawning areas, up to and after 1989.

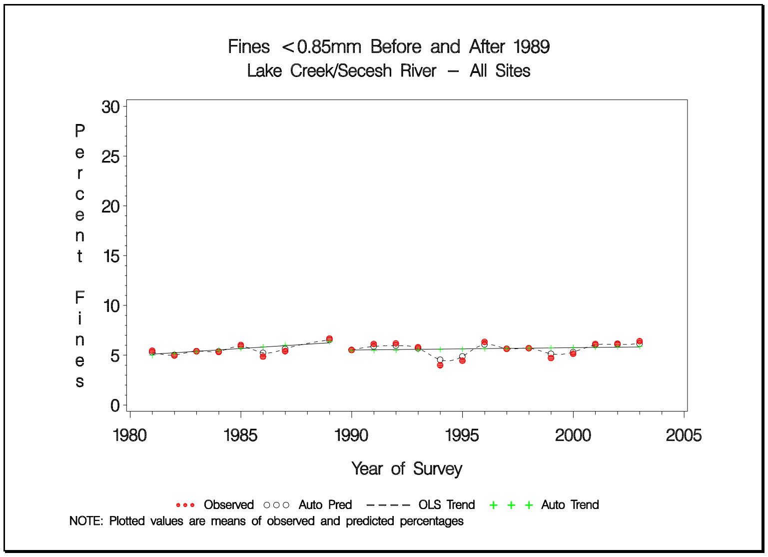

Figure 49.—Time trends in small fine sediments in the Lake Creek and Secesh River spawning areas, up to and after 1989.

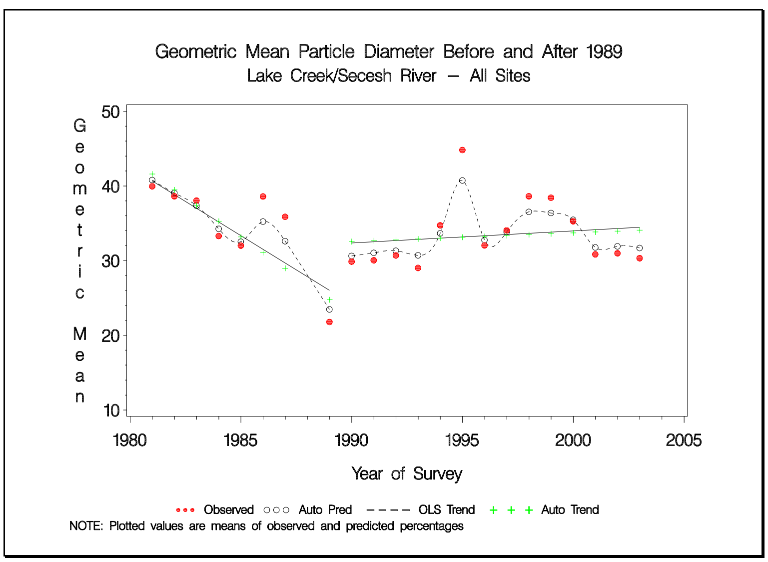

Figure 50.—Time trends in geometric mean particle diameter in the Lake Creek and Secesh River spawning areas, up to and after 1989.

CHAMBERLAIN CREEK (E032)

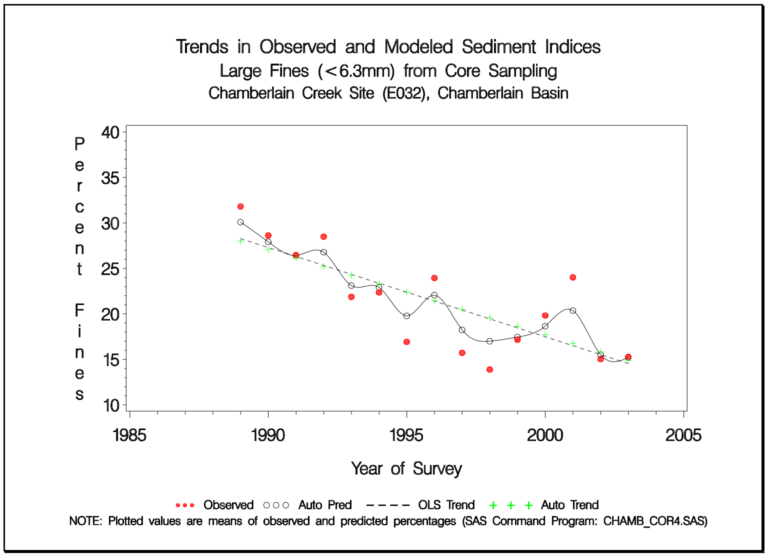

Figure 51.—Time trends in the large fine sediments in the Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

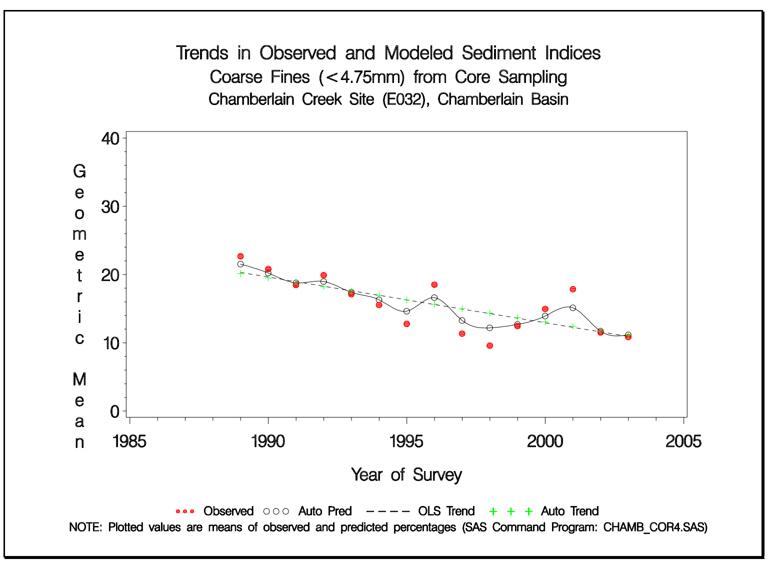

Figure 52.—Time trends in coarse fine sediments in the Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

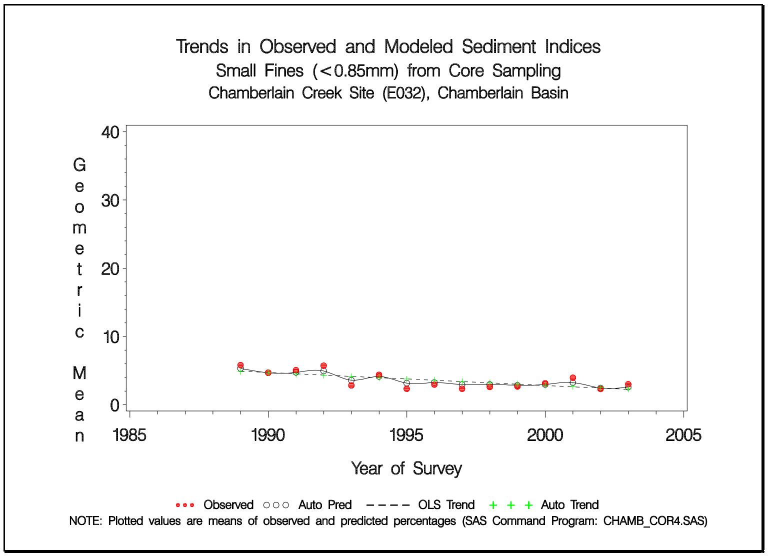

Figure 54.—Time trends in the small fine sediments in the Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

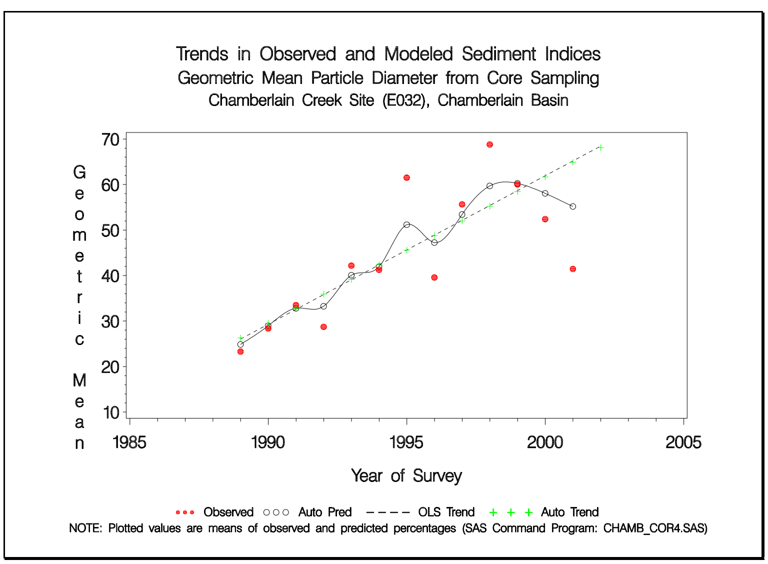

Figure 53.—Time trends in geometric mean particle diameter in the Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

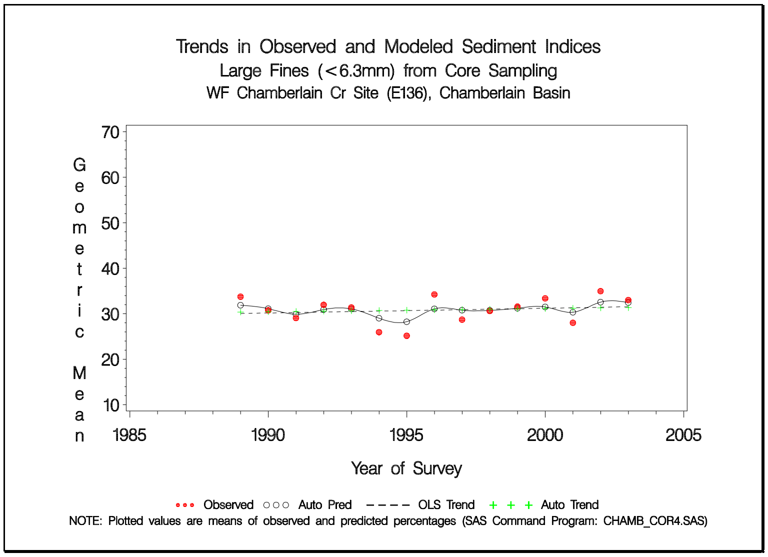

Figure 55.—Time trends in the large fine sediments in the West Fork Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

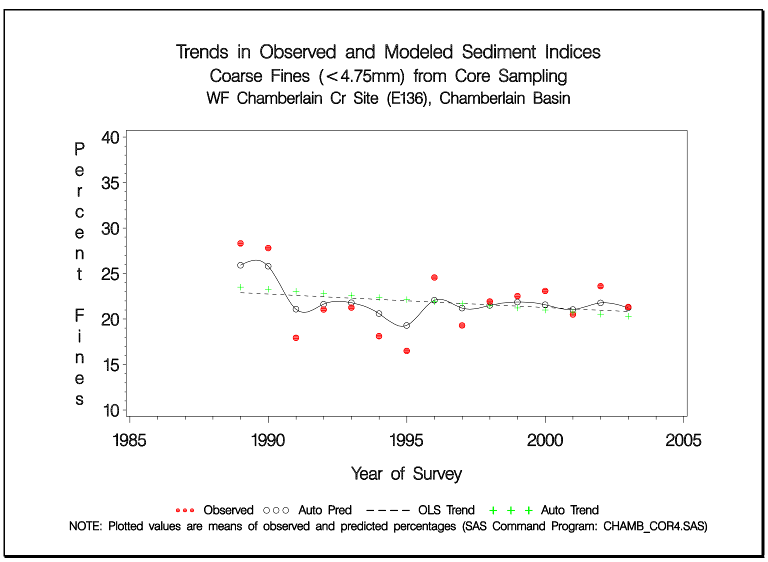

Figure 56.—Time trends in coarse fine sediments in the West Fork Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

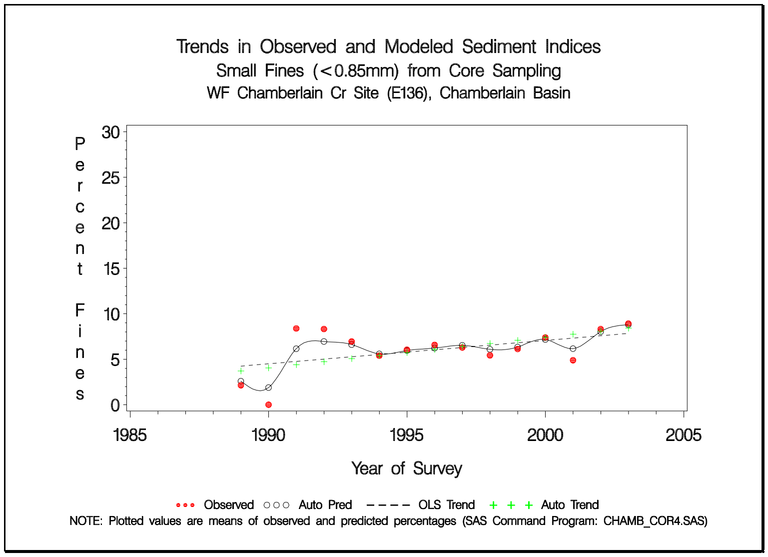

Figure 57.—Time trends in the small fine sediments in the West Fork Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

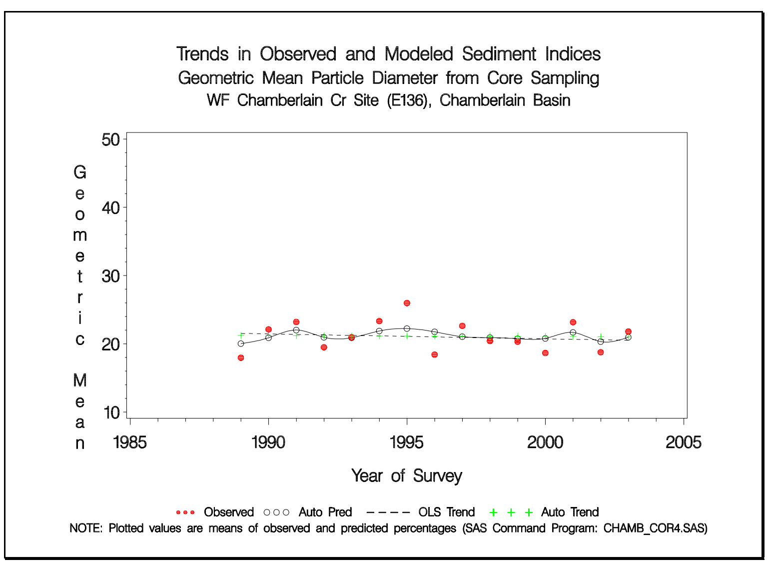

Figure 58.—Time trends in geometric mean particle diameter in the West Fork Chamberlain Creek spawning area, Chamberlain Basin, 1989-2003.

APPENDIX 3. INTRAGRAVEL QUALITY GRAPHS

SOUTH FORK SALMON RIVER

2003 SAMPLING

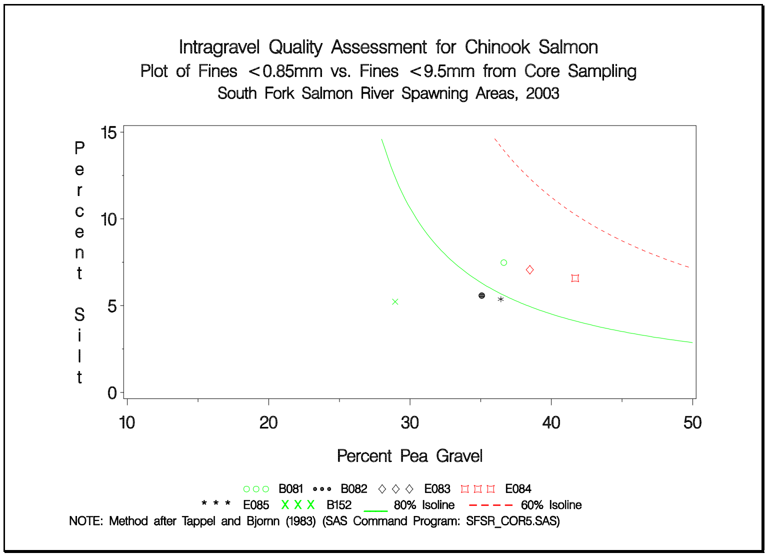

Figure 59.—Egg survival potential for Chinook salmon, upper SFSR spawning areas, 2003.

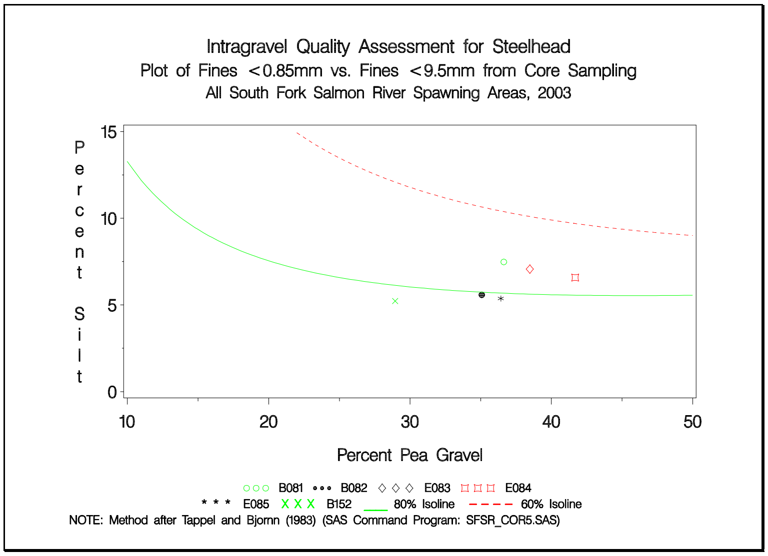

Figure 60.—Egg survival potential for steelhead, upper SFSR spawning areas, 2003.

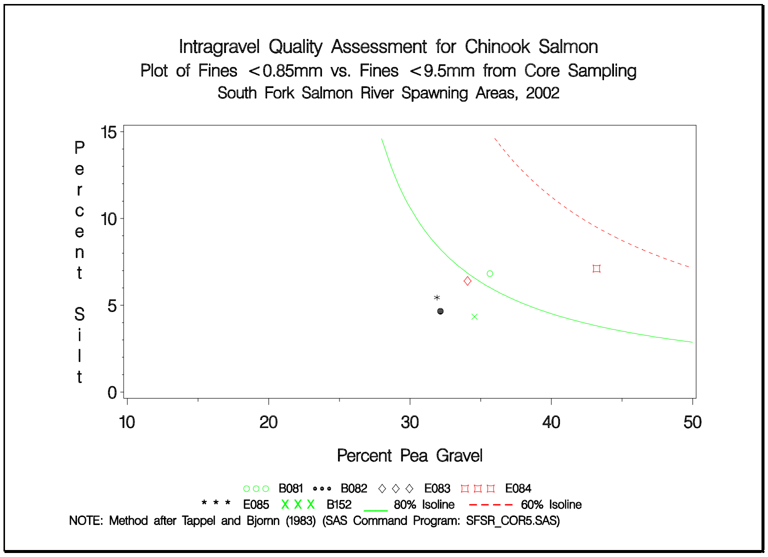

Figure 61.—Egg survival potential for Chinook salmon, upper SFSR spawning areas, 2002.

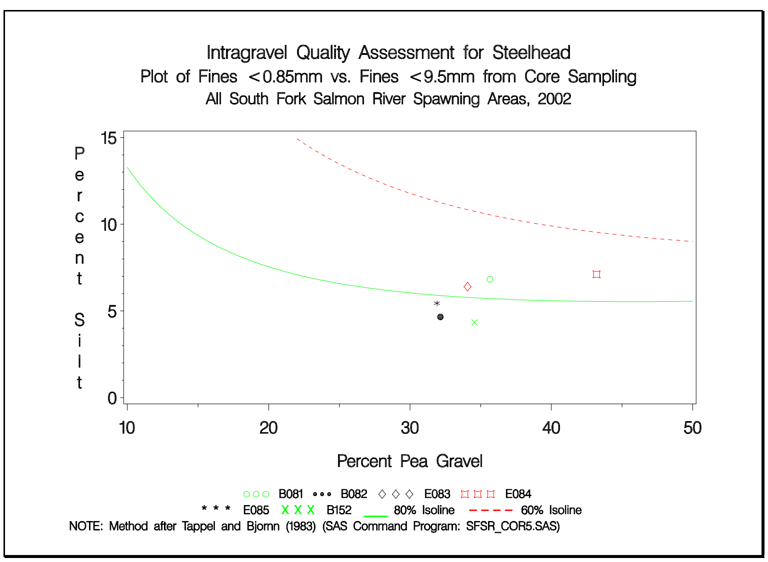

Figure 62.—Egg survival potential for steelhead, upper SFSR spawning areas, 2002.

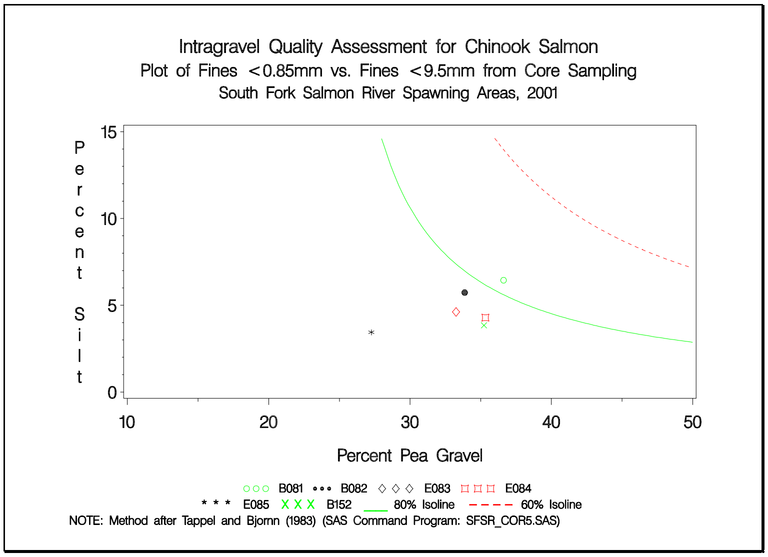

Figure 63.—Egg survival potential for Chinook salmon, upper SFSR spawning areas, 2001.

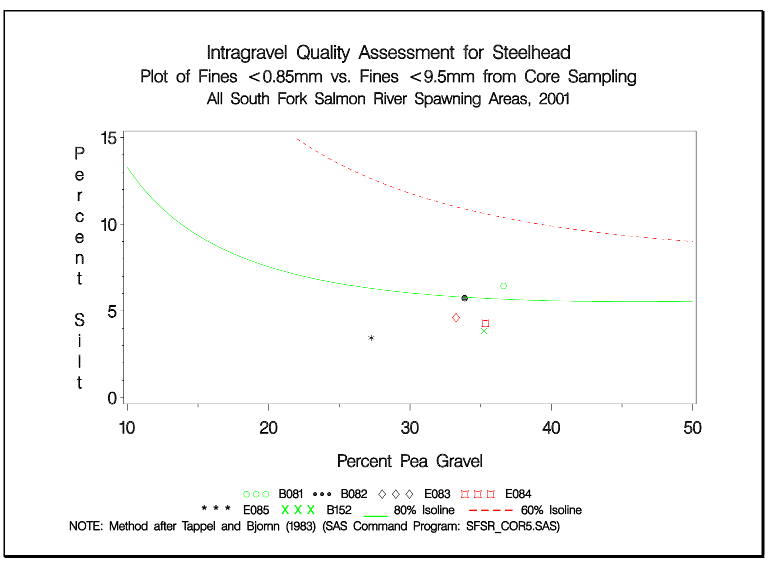

Figure 64.—Egg survival potential for steelhead, upper SFSR spawning areas, 2001.

2003 SAMPLING

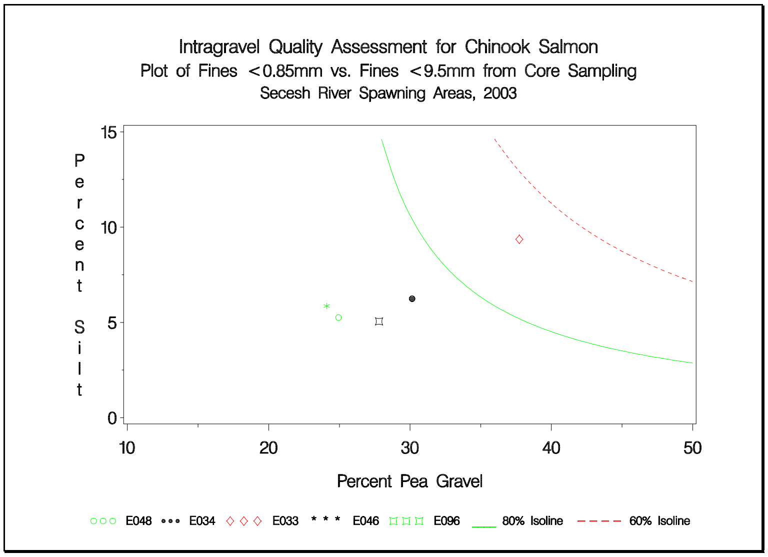

Figure 65.—Egg survival potential for Chinook salmon, Lake Creek and Secesh River spawning areas, 2003.

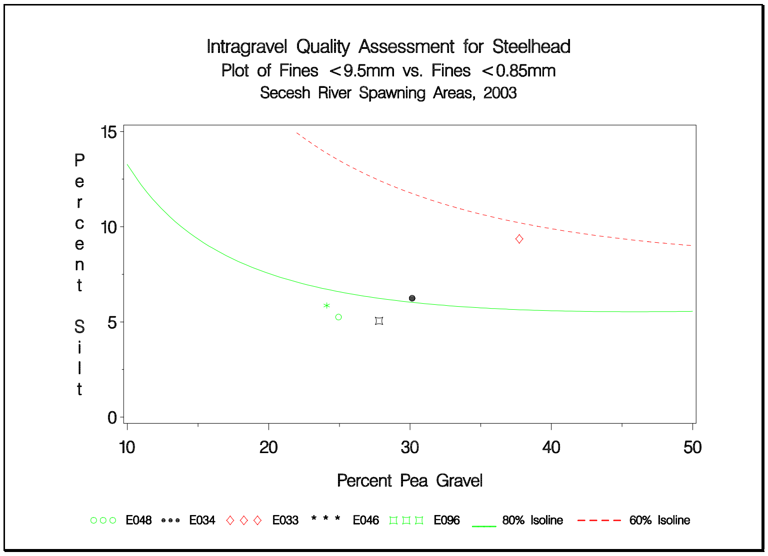

Figure 66.—Egg survival potential for steelhead, Lake Creek and Secesh River spawning areas, 2003.

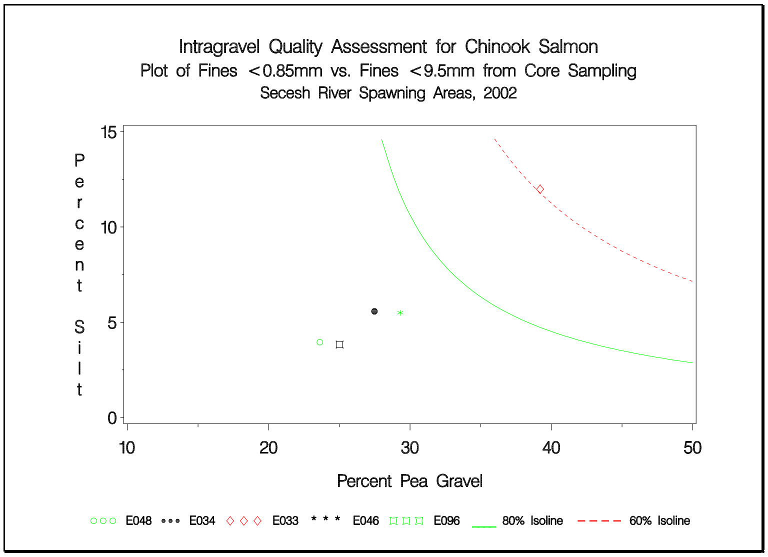

Figure 67.—Egg survival potential for Chinook salmon, Lake Creek and Secesh River spawning areas, 2002.

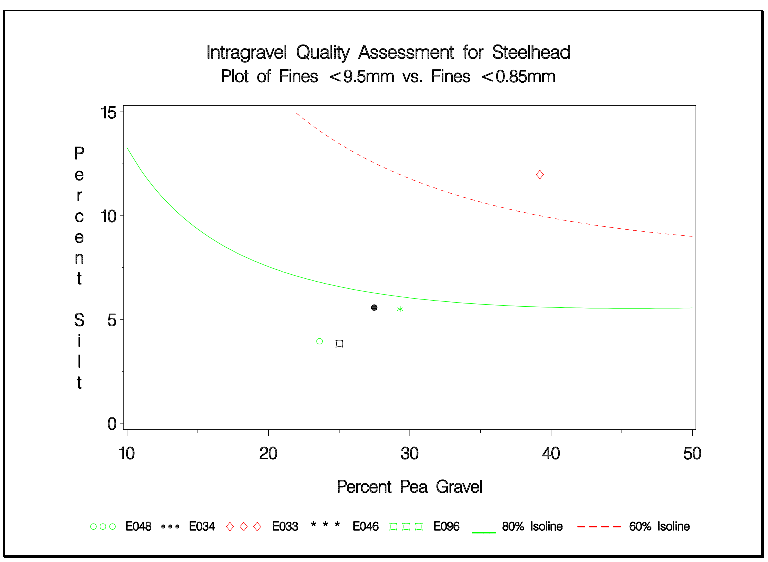

Figure 68.—Egg survival potential for steelhead, Lake Creek and Secesh River spawning areas, 2002.

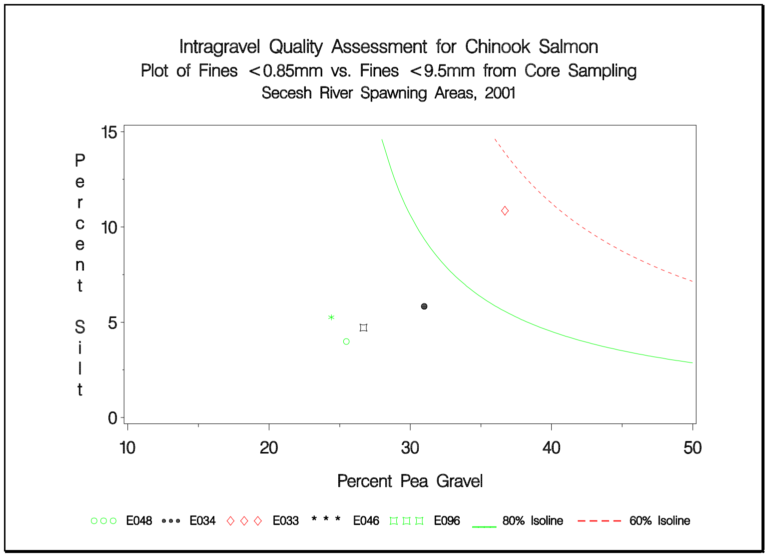

Figure 69.—Egg survival potential for Chinook salmon, Lake Creek and Secesh River spawning areas, 2001.

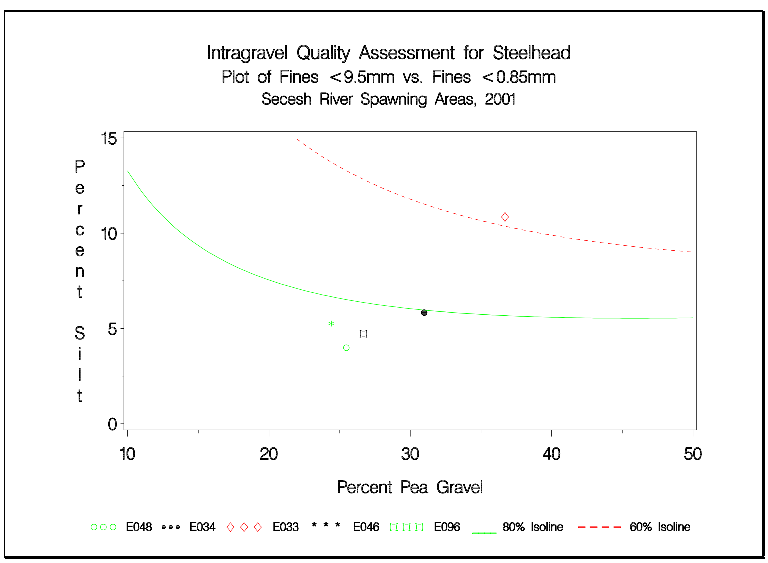

Figure 70.—Egg survival potential for steelhead, Lake Creek and Secesh River spawning areas, 2001.

2003 SAMPLING

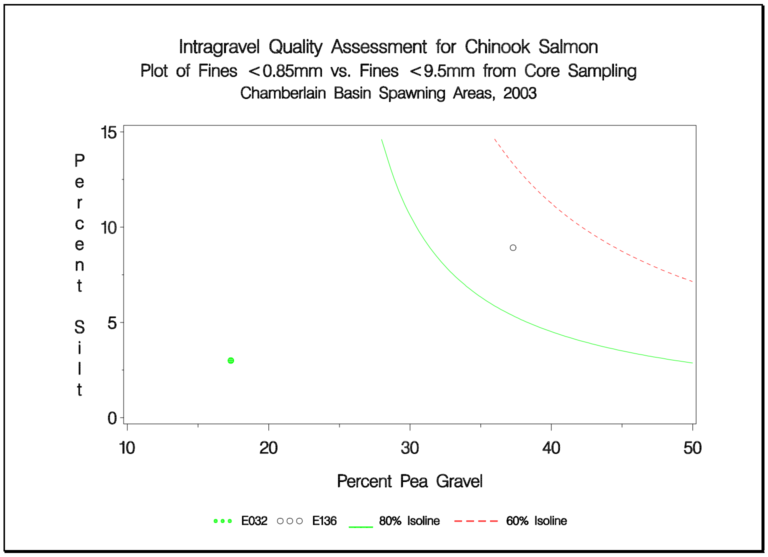

Figure 71.—Egg survival potential for Chinook salmon, Chamberlain Basin spawning areas, 2003.

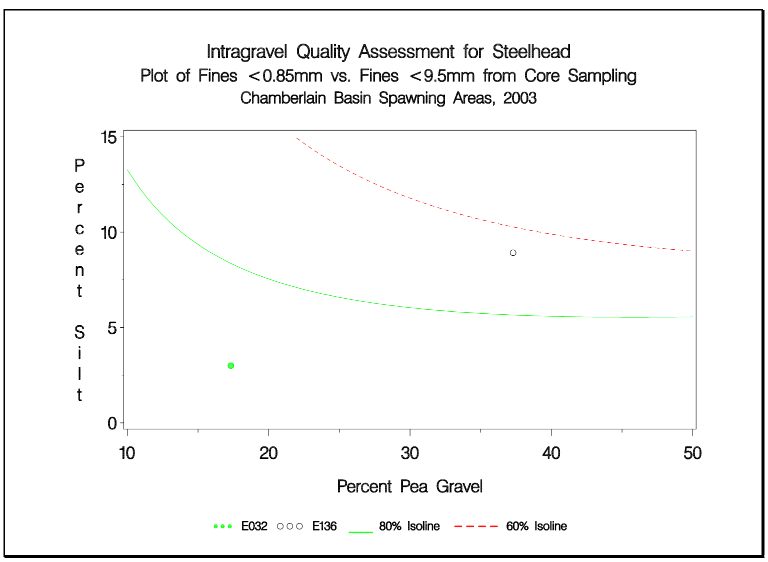

Figure 72.—Egg survival potential for steelhead, Chamberlain Basin spawning areas, 2003.

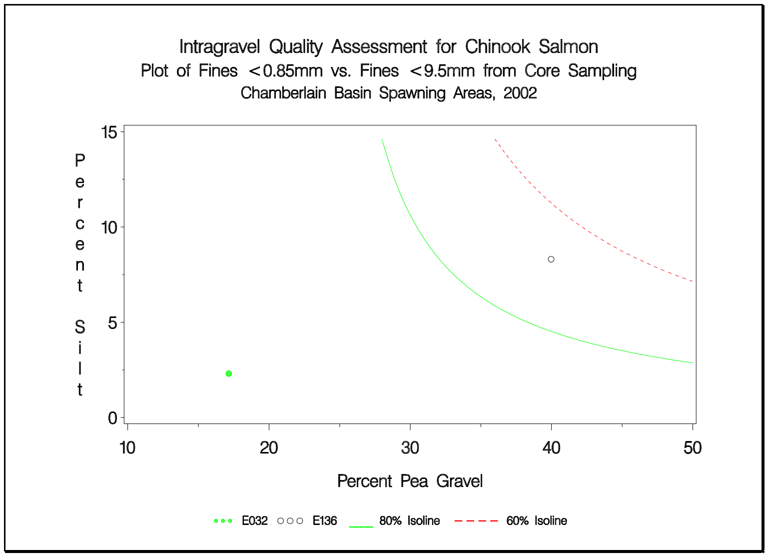

Figure 73.—Egg survival potential for Chinook salmon, Chamberlain Basin spawning areas, 2002.

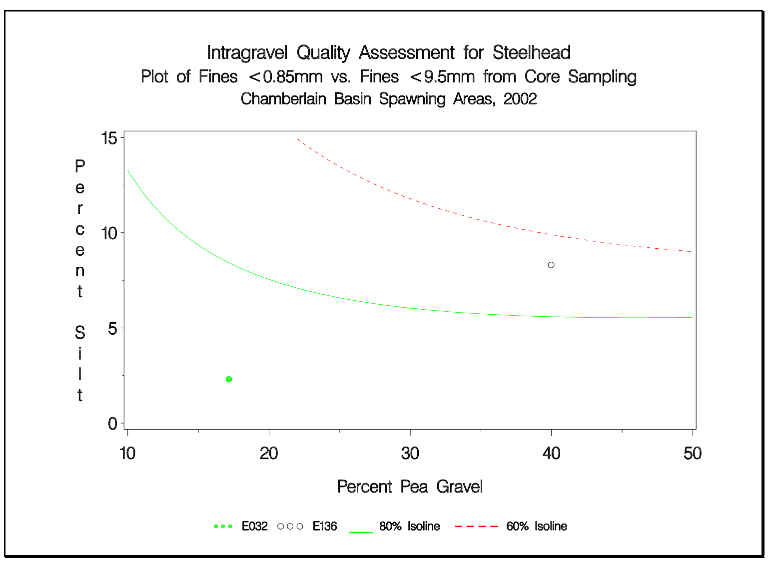

Figure 74.—Egg survival potential for steelhead, Chamberlain Basin spawning areas, 2002.

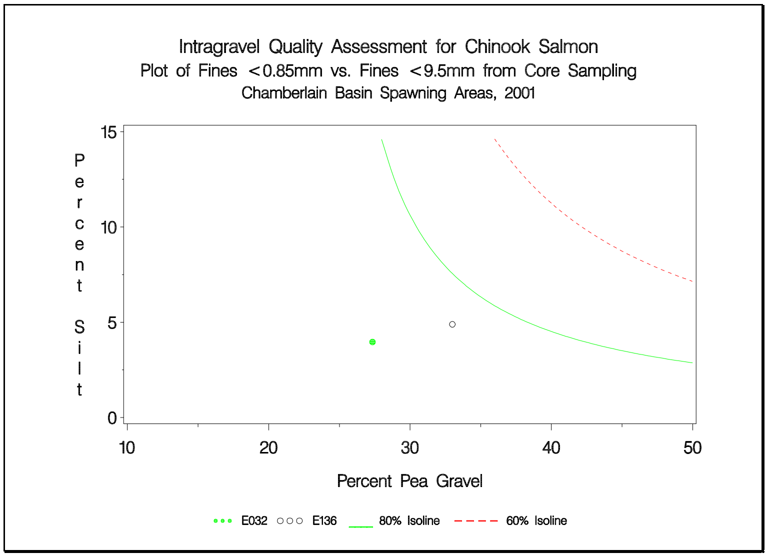

Figure 75.—Egg survival potential for Chinook salmon, Chamberlain Basin spawning areas, 2001.

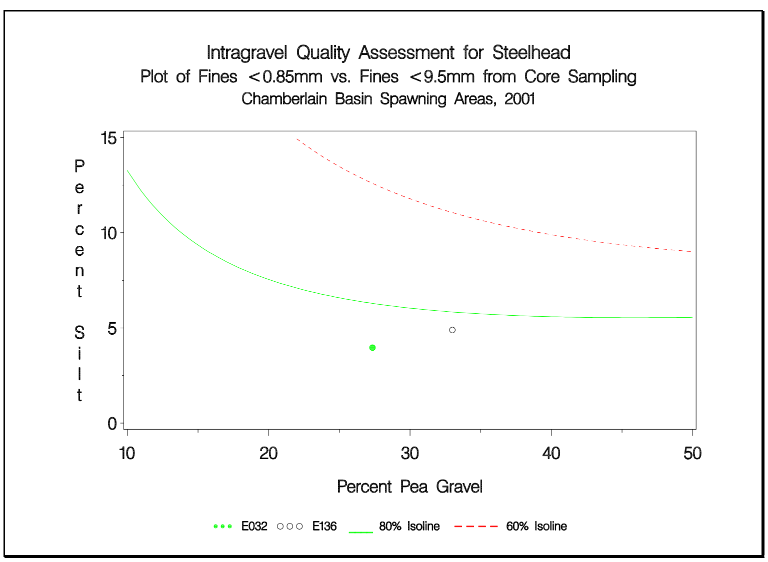

Figure 76.—Egg survival potential for steelhead, Chamberlain Basin spawning areas, 2001.

APPENDIX 4. SFSR PHOTOMONITORING

TIME SERIES IMAGES

PHOTOPOINT 4 (PP-04)

Image 1.—Photopoint 04, 1965 (Photo from Platts 1972).

Image 2.—Photopoint 04, 1972 (Photo from Platts 1972).

Image 3.—Photopoint 04, 1975.

Image 4.—Photopoint 04, 1976.

Image 5.—Photopoint 04, 1977.

Image 6.—Photopoint 04, 1978.

Image 7.—Photopoint 04, 1979.

Image 8.—Photopoint 04, 1981.

Image 9.—Photopoint 04, 1983.

Image 10.—Photopoint 04, 1986.

Image 11.—Photopoint 04, 1987.

Image 12.—Photopoint 04, 1988.

Image 13.—Photopoint 04, 1989.

Image 14.—Photopoint 04, 1990.

Image 15.—Photopoint 04, 1991.

Image 16.—Photopoint 04, 1993.

Image 17.—Photopoint 04, 1994.

Image 18.—Photopoint 04, 1995.

Image 19.—Photopoint 04, 1996.

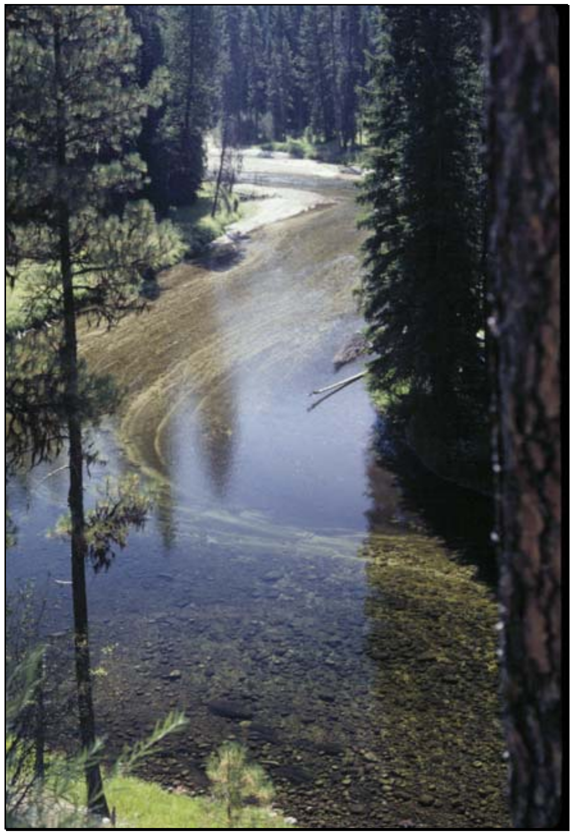

Image 20.—Photopoint 04, 1998.

Image 21.—Photopoint 04, 1999.

Image 22.—Photopoint 04, 2001.

Image 23.—Photopoint 04, 2002.

Image 24.—Photopoint 04, 2003.

PHOTOPOINT 4A-LEFT (PP-04AL)

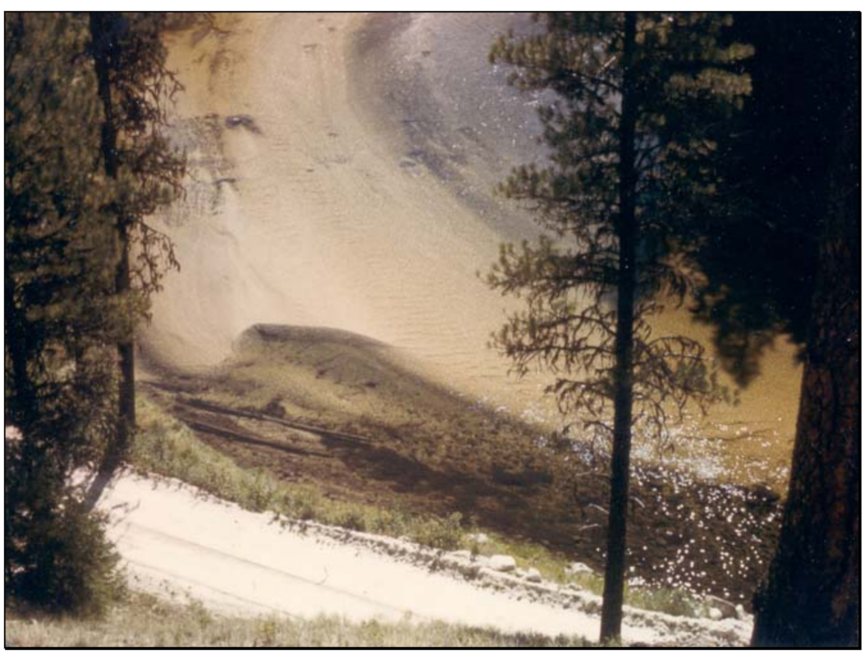

Image 25.—Photopoint 04A, Left, 1975.

Image 27.—Photopoint 04A, Left, 1976.

Image 26.—Photopoint 04A, Left, 1977.

Image 28.—Photopoint 04A, Left, 1978.

Image 29.—Photopoint 04A, Left, 1979.

Image 30.—Photopoint 04A, Left, 1981.

Image 31.—Photopoint 04A, Left, 1983.

Image 32.—Photopoint 04A, Left, 1986.

Image 33.—Photopoint 04A, Left, 1987.

Image 34.—Photopoint 04A, Left, 1988.

Image 35.—Photopoint 04A, Left, 1989.

Image 36.—Photopoint 04A, Left, 1990.

Image 37.—Photopoint 04A, Left, 1991.

Image 38.—Photopoint 04A, Left, 1993.

Image 39.—Photopoint 04A, Left, 1994.

Image 40.—Photopoint 04A, Left, 1995.

Image 41.—Photopoint 04A, Left, 1996.

Image 42.—Photopoint 04A, Left, 1999.

Image 43.—Photopoint 04A, Left, 2001.

Image 44.—Photopoint 04A, Left, 2002.

Image 45.—Photopoint 04A, Left, 2003.

PHOTOPOINT 4A-RIGHT (PP-04AR)

Image 46.—Photopoint 04A, Right, 1975.

Image 47.—Photopoint 04A, Right, 1978.

Image 48.—Photopoint 04A, Right, 1979.

Image 49.—Photopoint 04A, Right, 1981.

Image 50.—Photopoint 04A, Right, 1983.

Image 51.—Photopoint 04A, Right, 1986.

Image 52.—Photopoint 04A, Right, 1987.

Image 53.—Photopoint 04A, Right, 1988.

Image 54.—Photopoint 04A, Right, 1989.

Image 55.—Photopoint 04A, Right, 1990.

Image 56.—Photopoint 04A, Right, 1991.

Image 57.—Photopoint 04A, Right, 1993.

Image 58.—Photopoint 04A, Right, 1994.

Image 59.—Photopoint 04A, Right, 1995.

Image 60.—Photopoint 04A, Right, 1996.

Image 61.—Photopoint 04A, Right, 1998.

Image 62.—Photopoint 04A, Right, 2001.

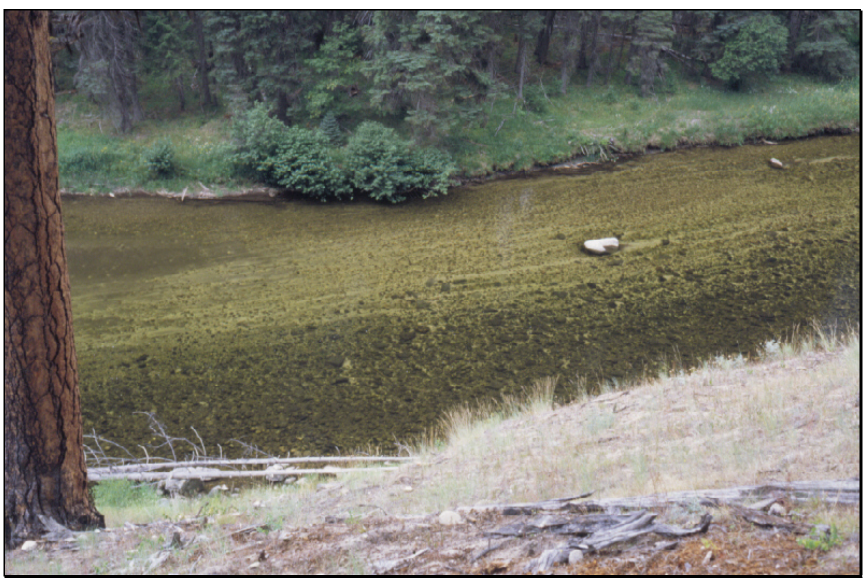

Image 63.—Photopoint 04A, Right, 2002.

Image 64.—Photopoint 04A, Right, 2003.

PHOTOPOINT 5 (PP-05)

Image 65.—Photopoint 05, 1975.

Image 66.—Photopoint 05, 1976.

Image 67.—Photopoint 05, 1977.

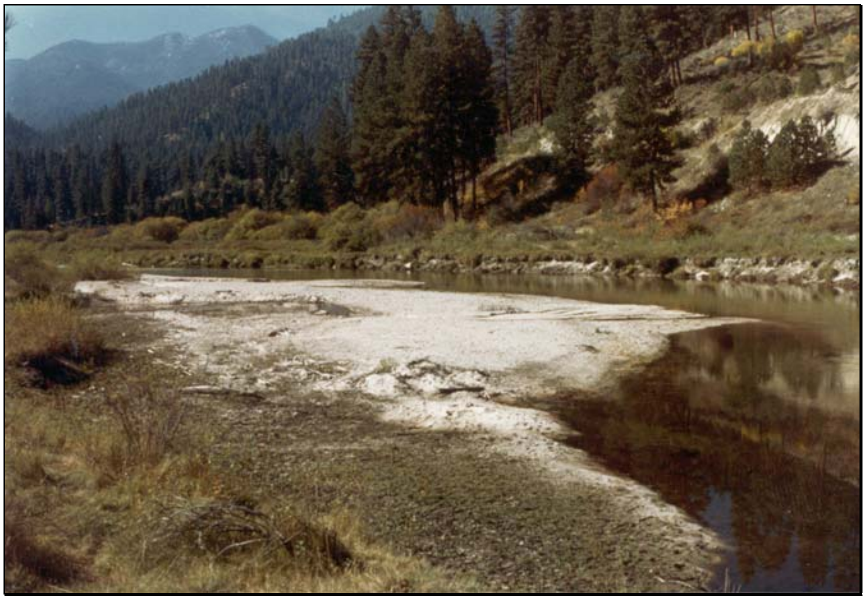

Image 68.—Photopoint 05, 1978.

Image 69.—Photopoint 05, 1979.

Image 70.—Photopoint 05, 1981.

Image 71.—Photopoint 05, 1983.

Image 72.—Photopoint 05, 1986.

Image 73.—Photopoint 05, 1987.

Image 74.—Photopoint 05, 1988.

Image 75.—Photopoint 05, 1989.

Image 76.—Photopoint 05, 1990.

Image 77.—Photopoint 05, 1991.

Image 78.—Photopoint 05, 1992.

Image 79.—Photopoint 05, 1993.

Image 80.—Photopoint 05, 1994.

Image 81.—Photopoint 05, 1995.

Image 82.—Photopoint 05, 1996.

Image 83.—Photopoint 05, 1998.

Image 84.—Photopoint 05, 1999.

Image 85.—Photopoint 05, 2001.

Image 86.—Photopoint 05, 2002.

Image 87.—Photopoint 05, 2003.

Photopoint 5A (PP-05A)

Image 88.—Photopoint 05A, 1975.

Image 89.—Photopoint 05A, 1976.

Image 90.—Photopoint 05A, 1977.

Image 91.—Photopoint 05A, 1978.

Image 92.—Photopoint 05A, 1979.

Image 93.—Photopoint 05A, 1981.

Image 94.—Photopoint 05A, 1983.

Image 95.—Photopoint 05A, 1986.

Image 96.—Photopoint 05A, 1988.

Image 97.—Photopoint 05A, 1989.

Image 98.—Photopoint 05A, 1990.

Image 99.—Photopoint 05A, 1991.

Image 100.—Photopoint 05A, 1992.

Image 101.—Photopoint 05A, 1993.

Image 102.—Photopoint 05A, 1994.

Image 103.—Photopoint 05A, 1995.

Image 104.—Photopoint 05A, 1996.

Image 105.—Photopoint 05A, 1999.

Image 106.—Photopoint 05A, 2001.

Image 107.—Photopoint 05A, 2002.

Image 108.—Photopoint 05A, 2003.

PHOTOPOINT 5B (PP-05B)

Image 109.—Photopoint 05B, 1965 (Photo from Platts [1972]).

Image 110.—Photopoint 05B, 1972 (Photo from Platts [1972]).

Image 111.—Photopoint 05B, 1976.

Image 112.—Photopoint 05B, 1977.

Image 113.—Photopoint 05B, 1978.

Image 114.—Photopoint 05B, 1979.

Image 115.—Photopoint 05B, 1981.

Image 116.—Photopoint 05B, 1983.

Image 117.—Photopoint 05B, 1986.

Image 118.—Photopoint 05B, 1987.

Image 119.—Photopoint 05B, 1988.

Image 121.—Photopoint 05B, 1989.

Image 120.—Photopoint 05B, 1990.

Image 123.—Photopoint 05B, 1991.

Image 122.—Photopoint 05B, 1992.

Image 124.—Photopoint 05B, 1993.

Image 125.—Photopoint 05B, 1994.


Image 126.—Photopoint 05B, 1995.


Image 127.—Photopoint 05B, 1996.

Image 128.—Photopoint 05B, 1999.

Image 129.—Photopoint 05B, 2001.

Image 130.—Photopoint 05B, 2002.

Image 131.—Photopoint 05B, 2003.

PHOTOPOINT 5C (PP-5C)

Image 132.—Photopoint 05C, 1966.

Image 133.—Photopoint 05C, 1976

Image 134.—Photopoint 05C, 1977

Image 135.—Photopoint 05C, 1978.

Image 136.—Photopoint 05C, 1979.

Image 137.—Photopoint 05C, 1981.

Image 138.—Photopoint 05C, 1983.

Image 139.—Photopoint 05C, 1986.

Image 140.—Photopoint 05C, 1987.

Image 141.—Photopoint 05C, 1988.

Image 142.—Photopoint 05C, 1989.

Image 143.—Photopoint 05C, 1990.

Image 144.—Photopoint 05C, 1991.

Image 145.—Photopoint 05C, 1992.

Image 146.—Photopoint 05C, 1993.

Image 147.—Photopoint 05C, 1994.

Image 148.—Photopoint 05C, 1995.

Image 149.—Photopoint 05C, 1996

Image 150.—Photopoint 05C, 1998.

Image 151.—Photopoint 05C, 1999

Image 152.—Photopoint 05C, 2001.

Image 153.—Photopoint 05C, 2002.

Image 154.—Photopoint 05C, 2003.

Photopoint 6 (PP-06)

Image 155.—Photopoint 06, 1972 (from Platts [1972]).

Image 156.—Photopoint 06, 1975.

Image 157.—Photopoint 06, 1976.

Image 158.—Photopoint 06, 1977.

Image 159.—Photopoint 06, 1978.

Image 160.—Photopoint 06, 1979.

Image 161.—Photopoint 06, 1981.

Image 162.—Photopoint 06, 1982.

Image 163.—Photopoint 06, 1983.

Image 164.—Photopoint 06, 1988.

Image 165.—Photopoint 06, 1989.

Image 166.—Photopoint 06, 1990.

Image 167.—Photopoint 06, 1991.

Image 168.—Photopoint 06, 1992.

Image 169.—Photopoint 06, 1993.

Image 170.—Photopoint 06, 1994.

Image 171.—Photopoint 06, 1995.

Image 172.—Photopoint 06, 1996.

Image 173.—Photopoint 06, 1998.

Image 174.—Photopoint 06, 1999.

Image 175.—Photopoint 06, 2001.

Image 176.—Photopoint 06, 2002.

Image 177.—Photopoint 06, 2003.

PHOTOPOINT 6A (PP-06A)

Image 178.—Photopoint 06A, 1975.

Image 179.—Photopoint 06A, 1976.

Image 180.—Photopoint 06A, 1977.

Image 181.—Photopoint 06A, 1978.

Image 182.—Photopoint 06A, 1979.

Image 183.—Photopoint 06A, 1981.

Image 184.—Photopoint 06A, 1983.

Image 185.—Photopoint 06A, 1988.

Image 186.—Photopoint 06A, 1989.

Image 187.—Photopoint 06A, 1990.

Image 188.—Photopoint 06A, 1991.

Image 189.—Photopoint 06A, 1992.

Image 190.—Photopoint 06A, 1993.

Image 191.—Photopoint 06A, 1994.

Image 192.—Photopoint 06A, 1995.

Image 193.—Photopoint 06A, 1996.

Image 194.—Photopoint 06A, 1998.

Image 195.—Photopoint 06A, 1999.

Image 196.—Photopoint 06A, 2001.

Image 197.—Photopoint 06A, 2002.

Image 198.—Photopoint 06A, 2003.

SFSR ROAD

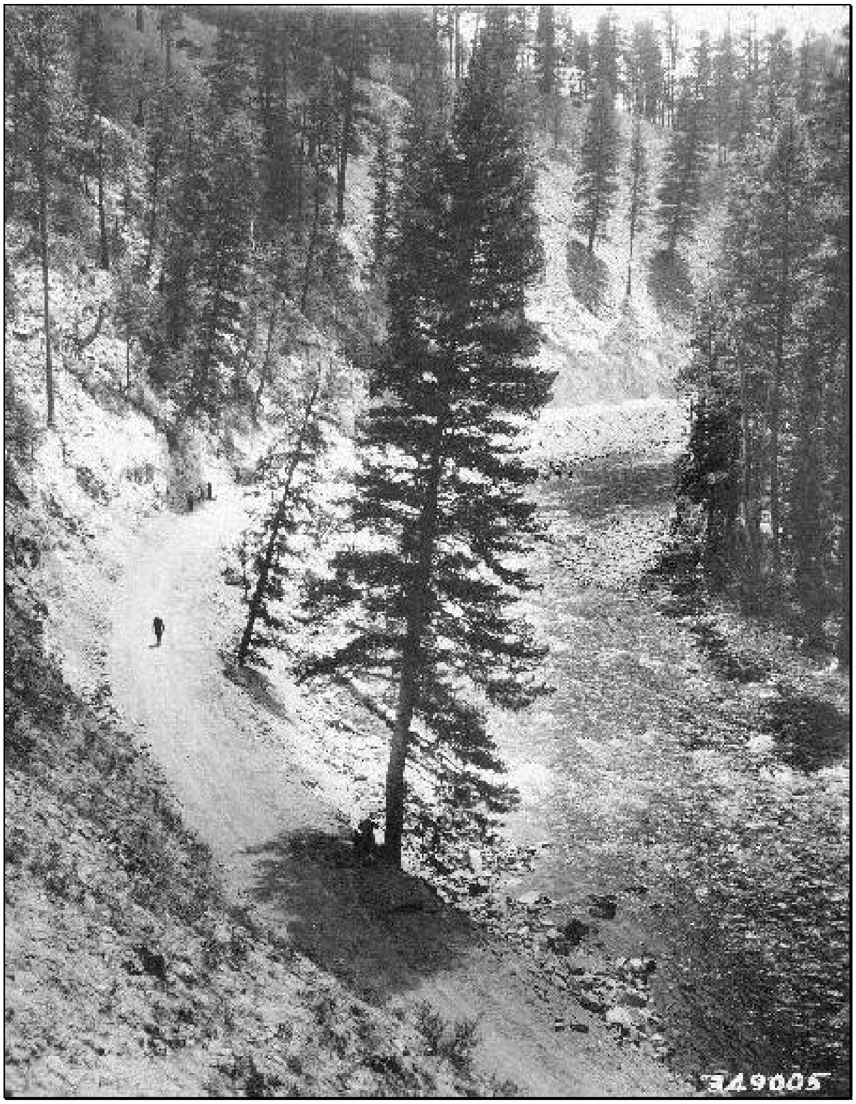

Image 199.—SFSR Road in the Buckhorn Bar area shortly after construction in 1937 (photo scanned from original in PNF archives).

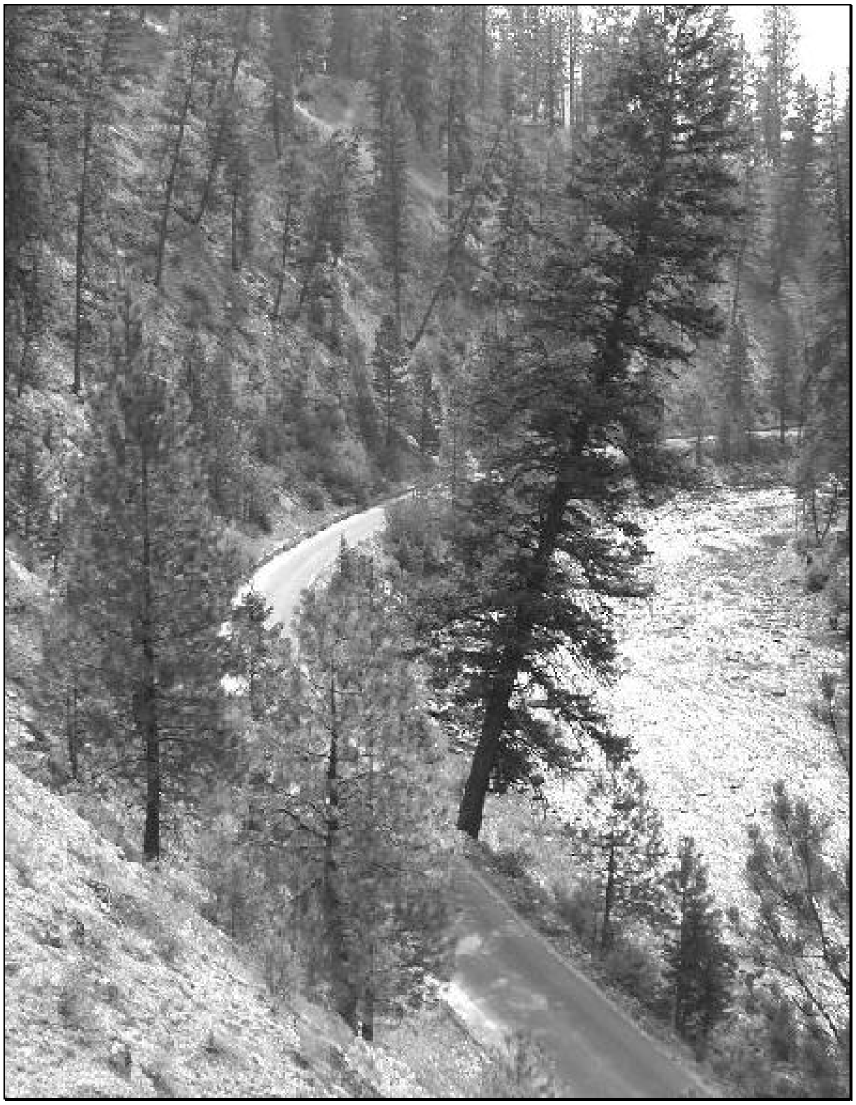

Image 200.—SFSR Road in the Buckhorn Bar area in the summer of 2003 (Photo by Rodger L. Nelson).

Image 201.—SFSR at Poverty Flat in 1955 (photo scanned from original in PNF archives).

Image 202.—SFSR at Poverty Flat in 2000 (Photo by Rodger L. Nelson).

Image 203.—Duning sand in the SFSR pool upstream of Buckhorn Bridge, May, 2002 (Photo by Rodger L. Nelson).

Image 204.—The same SFSR pool upstream of Buckhorn Bridge as above, August, 2002 (Photo by Rodger L. Nelson).

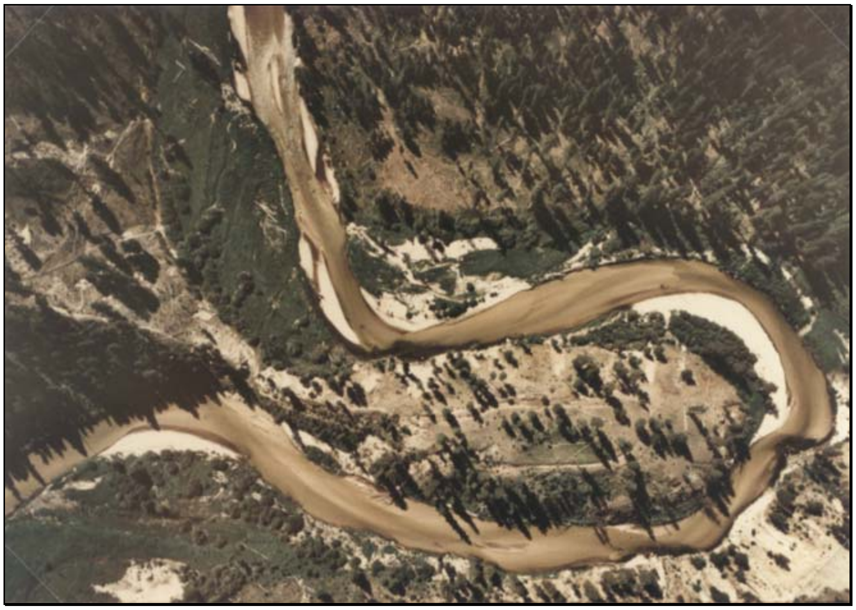

Image 205.—Aerial photograph of the Oxbow of the SFSR in 1965, after the 1964-65 floods but before the breach (from Barta *et al*. [1992]).

Image 206.—Aerial photograph of the Oxbow of the SFSR in 1976, shortly after the breach (from Barta *et al*. [1992]).

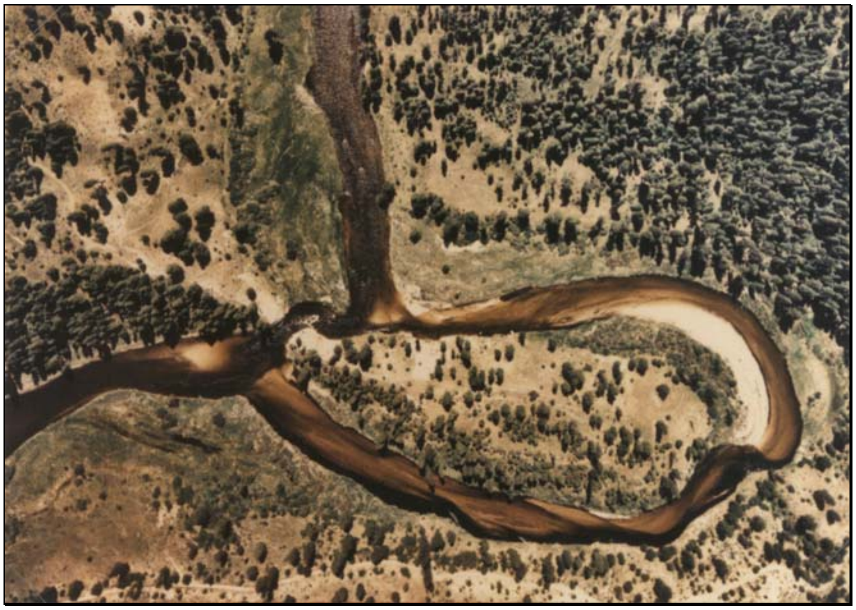

Image 207.—Aerial photograph of the Oxbow of the SFSR in 1989, 15 years after the breach (from Barta *et al*. [1992]).

Image 208.—The Oxbow of the SFSR in 1974 the first summer after the river breached the ridge on the right side of the image diverting some of the flow (from Kulesza and Skabelund [1974]).

Image 209.—The Oxbow of the SFSR in 2003 with all base flow now going through the breach (Photo by Rodger L. Nelson).

Image 210.—The downstream end of the breach in 1974 (from Kulesza and Skabelund [1974]).

Image 211.—he downstream end of the breach in 2001 (Photo by Rodger L. Nelson).

Image 212.—The Oxbow Breach in 1974, the first summer after the river breached this ridge diverting some of the flow (from Kulesza and Skabelund [1974]).

Image 213.—The Oxbow Breach in 1990 (from Barta *et al*. [1992]).

Image 214.—The Oxbow Breach in 2003 with all base flow having been diverted from the Oxbow (Photo by Rodger L. Nelson).

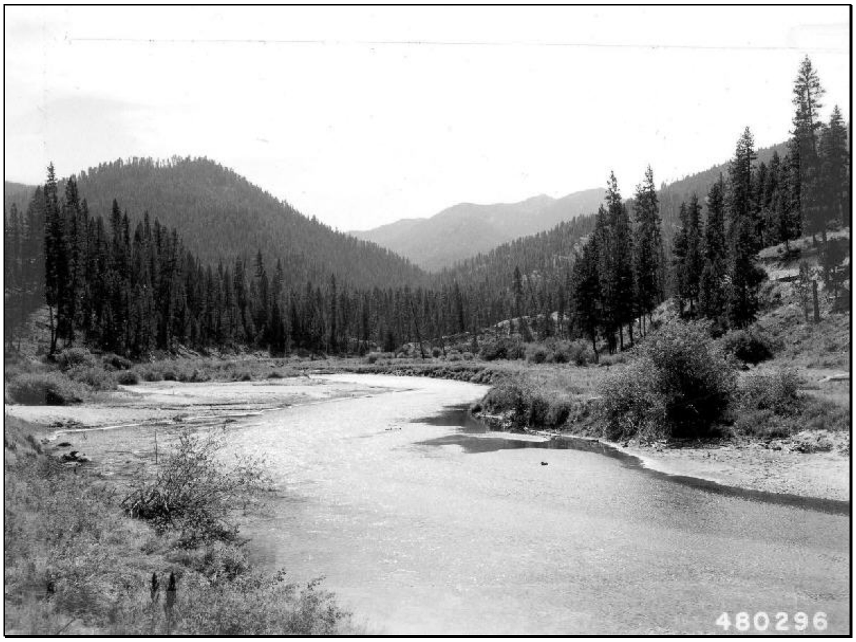

Image 215.—SFSR upstream of Miner's Peak bridge just downstream of the mouth of Phoebe Creek in 1955 (photo scanned from original in PNF archives).

Image 216.—SFSR upstream of Miner's Peak bridge just downstream of the mouth of Phoebe Creek in 2002 (Photo by Rodger L. Nelson).

Image 217.—Sediment excavation from Krassel Hole on the SFSR in 1966; 16,017 yd^3 of sediment were excavated here at this time (Platts 1970; photo scanned from original in PNF archives).

Image 218.—Krassel Hole on the SFSR in 2001 (Photo by Rodger L. Nelson).

Image 219.—The binwall stabilization near Lodgepole Creek and Darling spawning area on the SFSR Road before spring maintenance after a normal winter (ca. 1972, but date uncertain; from Mickelson *et al*. [1973].

Image 220.—The binwall stabilization area in the spring of 2004 (Photo by Rodger L. Nelson).