SRP12475

Instream Flow Recommendations for the Fishes of Aravaipa Creek, Arizona

Submitted to
The Nature Conservancy
Arizona Field Office
300 E. University Blvd.
Tucson, AZ 85705

By Draft Copy

Dr. Thomas B. Hardy
Brent Bartz
Wendy Carter

Twelve-Nine, Inc.
P.O. Box 3464
Logan, UT 84321

June 29, 1990

EXECUTIVE SUMMARY

Instream flow recommendations are presented for four segments of Aravaipa Creek based on the use of the Instream Flow Incremental Methodology Physical Habitat Simulation System (PHABSIM) and an analysis of the hydrologic conditions within the stream. The recommendations in this report are derived from a weighted average of the discharges that optimized available habitat for two federally listed Threatened species while maintaining adequate conditions for all other native species. These target discharges where then compared against historical flow records for each segment, and monthly instream flows were selected which preserved the relationship of the annual hydrograph and resulted in values close to the target discharges with the constraint that selected flows were at or below the observed median monthly discharges. These flow recommendations range from 12 to 32 cubic feet per second, which is similar to the beneficial range of flows permitted to the Bureau of Land Management for Aravaipa Canyon Wilderness. The instream flow recommendations for the Nature Conservancy segments vary somewhat from the BLM permit amounts because of the consideration of longer periods of hydrologic data and because of the additional but straight forward interpretation of that more comprehensive data. Long term changes in predicted available habitat from the PHABSIM models were found to parallel changes in the relative abundance of the native species from 1966 to 1988 and further support the increased discharges for instream flows in order to protect available fish habitat within Aravaipa Creek.

EXECUTIVE SUMMARY

Instream flow recommendations are presented for four segments of Aravaipa Creek based on the use of the Instream Flow Incremental Methodology Physical Habitat Simulation System (PHABSIM) and an analysis of the existing hydrologic conditions within the stream. The analysis of the historical flow records show that the mean monthly averages are significantly higher than the median monthly flows and therefore the present BLM permitted instream flows based on these mean monthly averages imply more available habitat is present than what actually exists for the protection of the resident fish community. The BLM permitted flows were based on a consideration of spikedace and loach minnow adults only, while the recommendations in this report are derived from a weighted average of the discharges that optimized available habitat for all native species and their life stages within the stream. The optimal flow ranges were derived by weighting spikedace and loach minnow results 2:1 for all remaining species and life stages and result in recommended instream flows that are 10 to 20 cfs greater based on median monthly flows. Long term changes in predicted available habitat from the PHABSIM models were found to parallel changes in the relative abundance of the native species from 1966 to 1988 and further support the increased discharges for instream flows in order to protect available fish habitat within Aravaipa Creek.

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INTRODUCTION

At the present time, the Nature Conservancy (TNC) is interested in developing recommendations for instream flows for fisheries habitat within four segments of Aravaipa Creek. These four segments are located on either side of the Bureau of Land Management (BLM) wilderness area, and run through or abut property owned by TNC. These segments are named A (Lower West End), B (Upper West End), C (Lower East End) and D (Upper East End) and are shown on Figure 1. The choice of an applicable and defensible methodology to use in the development of recommendations is of concern, since the State of Arizona is currently reviewing approaches in order to establish guidelines for the water rights application and adjudication process. Although there are continuing discussions about the applicability or validity of the Instream Flow Incremental Methodology (IFIM) and other methods for instream flow determinations (e.g. Mathur et al. 1985, Orth and Maughan 1986), the IFIM is presently preferred or recognized in 38 states and Canadian provinces (Reiser et al. 1989). The approach outlined in this report is based on the application of the IFIM and is intended to meet two broad objectives. First, the use of IFIM is recommended in light of the current draft guidelines for water rights applications in Arizona (Burton et al. 1987) which have identified IFIM as a potentially acceptable methodology. Secondly, the approach outlined below is intended to provide a level of verification of the IFIM results for Aravaipa Creek by comparison to the long term relative population abundance within the system.

MATERIALS AND METHODS

Habitat Mapping and Transect Selection

An important step in the application of the Physical Habitat Simulation (PHABSIM) computer models of the IFIM is the proper selection and placement of transects within the stream system in order to obtain an adequate representation of both the abundance and variability of the available micro-habitats for fish. This was accomplished by an initial on-site inspection and mapping of each stream segment to be modeled where the number and length of each micro-habitat was recorded. Within each segment, the relative linear distance was obtained by recording the number of paces of each specific micro-habitat in a downstream direction. Based on the relative percent composition of specific micro-habitats present within each segment, a total of 8 to 11 transects were selected from within each segment for use in the PHABSIM model. The approximate location and number of transects for each of the 4 segments are indicated in Figures 2 and 3. The location of transects in segment C corresponds to the same general area of the IFIM station analyzed by Turner and Tafanelli (1983). The habitat mapping results were also utilized to develop relative weighting factors applied to each transect in the PHABSIM analysis as described below. This also insured that results for each specific micro-habitat in the analysis were weighted by their observed abundance within each segment of the stream.

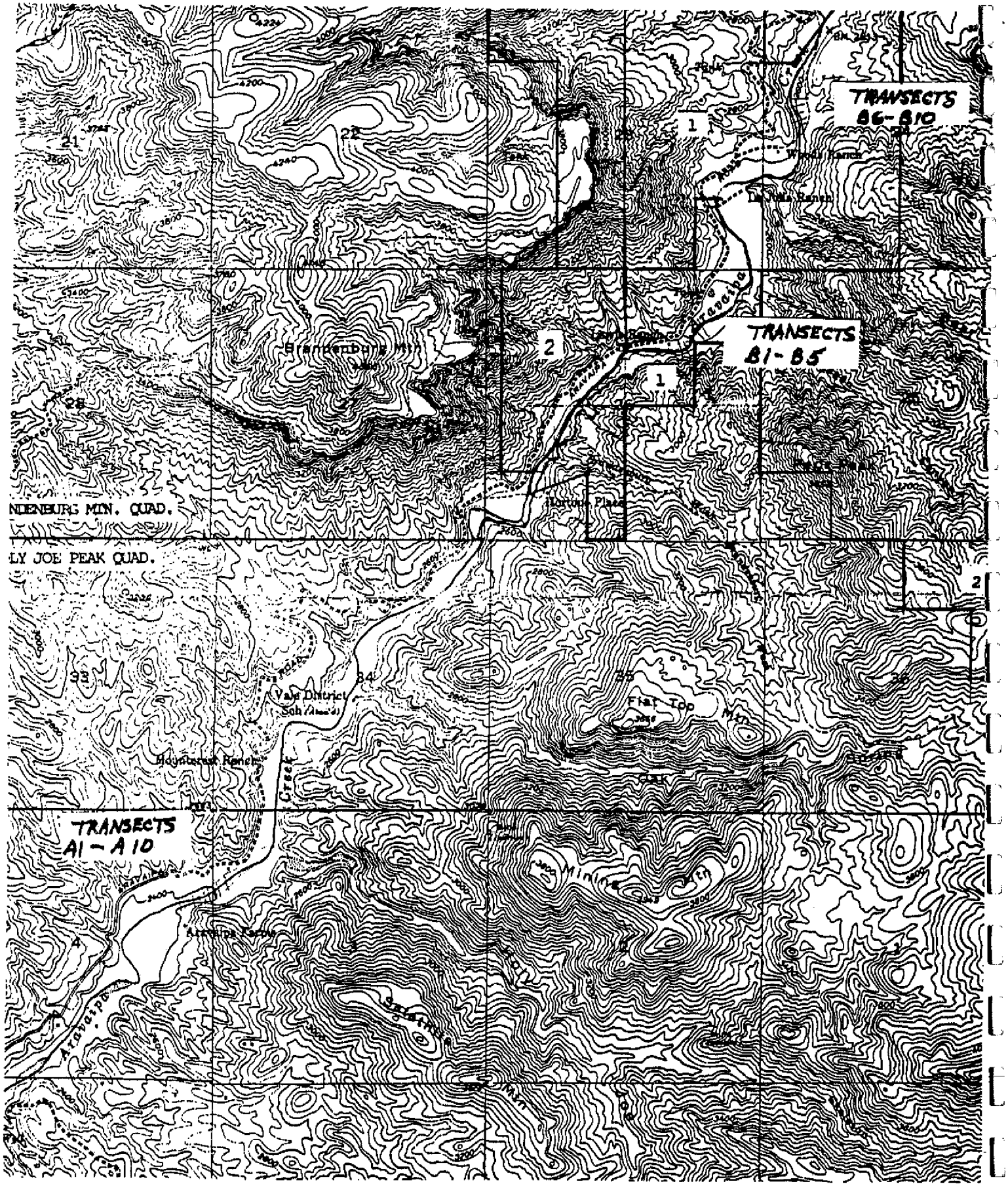

Figure 2. Approximate location of sampling sites and individual transects in Segments A and B.

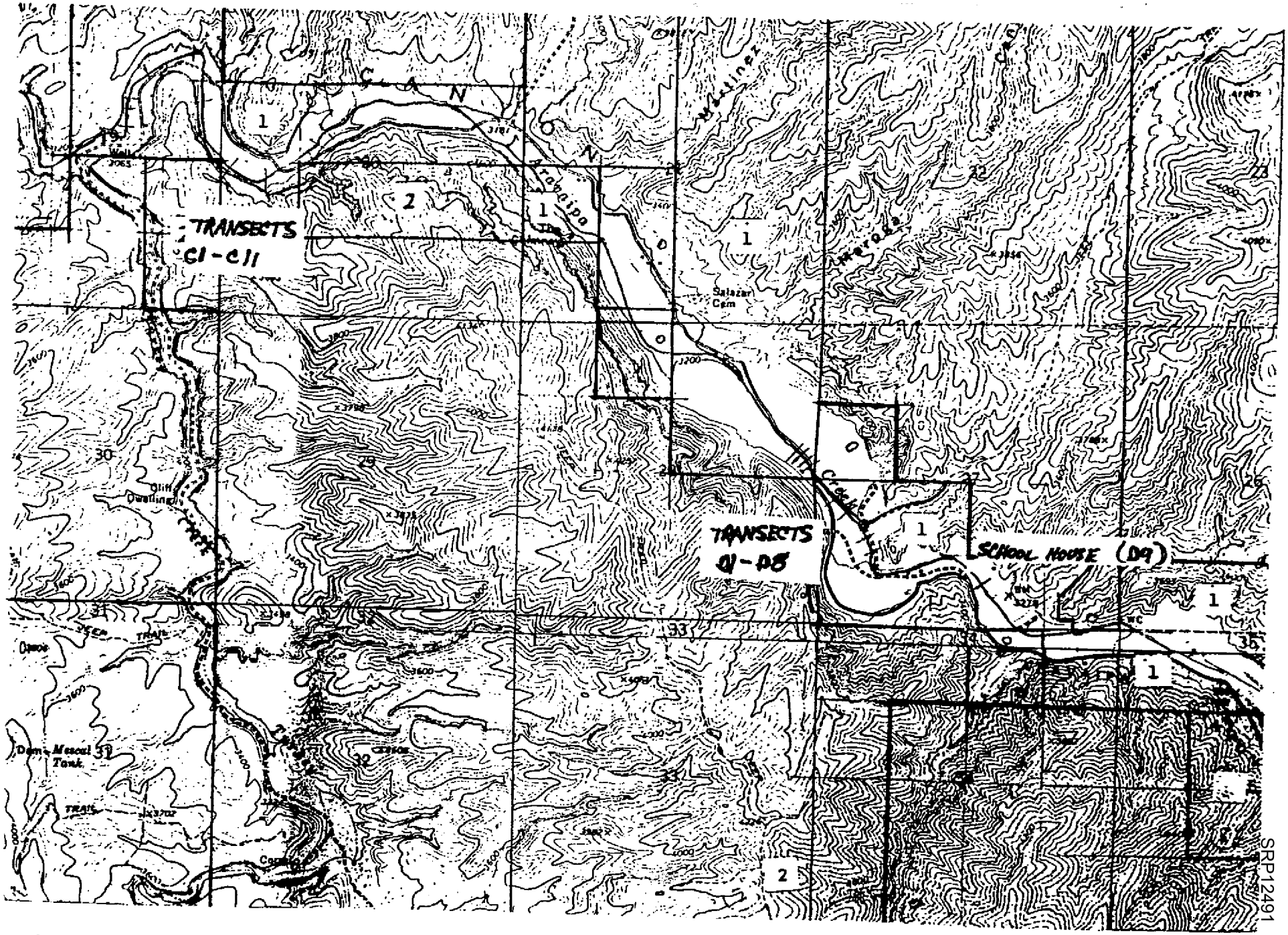

Figure 3. Approximate location of sampling sites and individual transects in Segments C and D.

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Hydraulic Field Measurements

Once the number and specific locations of the micro-habitats were selected, the hydraulic properties within the stream channel were measured by TNC personnel using standard USGS stream gaging techniques as modified for use in the PHABSIM model (Trihey and Wagner 1981). Field measurements at each transect included an estimate of the discharge, water surface elevation, slope of the water surface elevation at the transect, cross-section profile of the stream bed and the distribution of depth, velocity and substrate at a sufficient number of points across the stream channel to measure the variability in micro-habitat features. In addition, an estimate of the Manning's n roughness coefficient was specified for each point above the water surface for use in simulating higher flow conditions in the hydraulic simulation model.

Hydraulic Modeling

Since data provided by TNC was collected at a single discharge and measurements of the bed elevations and water surface elevations at each transects were not made to a common bench elevation at each station, the MANSQ model of PHABSIM was used in the hydraulic simulation of the stage-discharge relationships at each transect. Calibration of MANSQ was based on the selection of the beta coefficient that minimized the velocity adjustment factors over the range of simulated discharges. The IFG4 model was used in the

simulation of individual cell velocities given the stage-discharge relationship developed with the MANSQ model.

The relative weighting for each transect within individual study sites was determined from the relative proportions calculated from the habitat mapping described above. This weighting served to apportion the hydraulic characteristics from the PHABSIM model output at each discharge between the specific habitat components that were observed within the stream. For example, if the percent composition of a particular segment to be modeled contained 80 percent runs, 10 percent riffles, and 10 percent pools then the combined weighting for all transects collected in run habitats would be 80 percent.

Suitability Index Curve Development

Existing data for the utilization of depth and velocity for the native fish species within Aravaipa Creek (Turner and Tafanelli 1983, Minckley 1990) were used as the basis for the development of Suitability Index (S.I.) curves for several size classes (i.e. life-stages) of each species. The species considered were the spikedace (*Meda fulgida*), longfin dace (*Agosia chrysogaster*), Sonoran sucker (*Catostomus insignis*), mountain-sucker (*Pantosteus clarki*), speckled dace (*Rhinichthys osculus*), roundtail chub (*Gila robusta*) and the loach minnow (*Tiaroga cobitis*). The development of S.I. curves was accomplished by curve fitting the frequency distributions of depth and velocity utilization. In the event that insufficient data was available for a particular species and/or

size class, S.I. curves published in Turner and Tafanelli (1983) or Hardy et al. (1989) were used in the analysis.

Habitat Modeling

The HABTAT program of PHABSIM was used to integrate the S.I. curve data sets and the hydraulic simulation results to estimate the amount of Weighted Usable Area (WUA) per 1000 feet of stream for each species and size class used in the analysis. Two different approaches were taken and compared within the HABTAT analysis. First, a simple multiplicative weighting of the depth and velocity component was used in the integration process and assumes that an equal response to depth and velocity is valid when evaluating the usability of a specific simulated cell's hydraulic parameters. This is generally considered the default computation in the application of the HABTAT model. Secondly, a limiting factor approach was used where the lowest S.I. score associated with depth or velocity is used to weight the area of a habitat cell based on its simulated depth and velocity. This approach assumes that the worst component associated with a cell determines whether the organism will use that particular cell. It should be noted that no particular choice in the selection aggregation technique for weighting the cell attributes in HABTAT has any strong basis in theory (EPRI 1986) and that the choice is simply left up the prerogative of the investigator.

The WUA versus discharge relationship for each species and size class were developed for each TNC segment (A,B,C,D)

individually, as well as a combined relationship for segments C and D since this segment was represented by a single flow regime. segments A and B were keep separate in the analyses due to differences in the flow hydrology evident from the gage data in these two segments.

Analysis of Flow Records

TNC provided daily flow records from the USGS gage site below segment A and the Westend BLM gage site immediately above segment B. The USGS period of record analyzed encompassed April 1966 through September 1988. Although data are available from 1930 to 1945, the dates chosen for analysis represented available gage records that corresponded to fisheries relative abundance data in Aravaipa Creek. The 20+ year gap in the record prior to April 1966 also makes the computation of the habitat time series analysis unnecessarily cumbersome and a comparison of the 1930 to 1945 and 1966 to 1976 period demonstrated that the long term flow regimes during these two intervals were very similar. The BLM gage period of record analyzed encompassed December 1981 thorough April 1989. Flow data for the Eastend segments (segments C and D) was provided by TNC based on a correlation analysis of the Westend BLM gage data and existing instantaneous Eastend flow records (see Appendix XI). The period of record analyzed for the Eastend segments was the same as the Westend BLM gage. The daily flow records for all segments were used to develop median monthly flow values for each year for their respective period of records and were used in the habitat

time series analysis and IFIM model verification analyses described below. In addition, flow durations for specific periods of records were also developed from the daily records at each segment for use in the analysis of instream flow recommendations.

Habitat Time Series

The functional relationship between WUA and discharge developed for each species and size class represents the basic output from the PHABSIM model. These data were used in conjunction with the calculated median monthly flows to generate relationships of habitat over time for each segment. These monthly time series data were then used to develop habitat duration plots within each segment for selected time periods for use in developing recommendations of monthly instream flows. Habitat duration plots are essentially the same as a flow duration plot and represents the percent of time that a given magnitude of available habitat is equalled or exceeded during the specified time interval. The resulting habitat time series were also used in the IFIM model verification analyses described below.

Development of Instream Recommendations

Two different approaches were used for the development of instream flow recommendations based on the assumption that TNC wants to optimize conditions for the federally listed species Meda and Tiaroga while maintaining adequate conditions for the remaining resident native species. First, habitat durations for each species

were compared in conjunction with the analyses of available flow and recommendations developed that would maximize the available habitat within the stream during each month. Secondly, in discussions with TNC personnel, it was indicated that a significant increase in the flows within Aravaipa Creek have occurred since 1984 compared to early periods due to a reduction in the consumptive water use as well as higher precipitation rates (see Appendix I). Based on this information, the flow versus habitat characteristics for the pre- and post 1983 period were compared for these two periods and evaluated in light of the initial recommendations made above.

IFIM Model Results Compared with Changes in Fish Abundance

Long term relative abundance data of the fish population within Aravaipa Creek provided by Minckley (1990) were used as a basis to attempt verification of the PHABSIM model output. Fundamentally, the PHABSIM model assumes that physical habitat (i.e. depth and velocity) are limiting factors within the environment and that fish populations will respond to either increases or decreases in available habitat over time. The habitat time series results described above were used to examine whether a relationship between changes in available habitat over time corresponded to observed changes in the relative abundance of the various species. The relative abundance data from the Westend segment only was considered in the analysis and covers the period 1966 through 1988. Consideration of the Eastend segment was

discarded given the relative short period of record available for the flow data (i.e. 1981 to 1988) and the observation that the changes in relative abundance during this period were small relative to the observed changes in relative abundance during the preceding 20 years.

RESULTS AND DISCUSSION

Habitat Mapping

A complete listing of specific micro-habitat types recorded for each stream segment is contained in Appendix II. Table 1 provides a summary listing of the specific micro-habitats selected for the PHABSIM analyses, relative weighting assigned to each transect in the model and the measured discharge at each transect. It is apparent from an examination of these results that deep water habitats represented by either pool or run/pools are rare in all sampled segments of Aravaipa Creek and that micro-habitats are dominated by riffles and runs.

Hydraulic Simulations

Appendix III contains the cross section profiles for each transect used in the PHABSIM analysis. The distance across the stream has been set to a common scale within each segment in order to allow a comparison of the channel cross section characteristics. The apparent truncation of the cross section profiles for transects 1 and 5 in segment C (see Figure III.5) on the right side of the

Table 1. Summary results of habitat mapping indicating microhabitat represented by each transect, length of microhabitat within the segment, percent composition each transect was weighted in the PHABSIM analysis and computed discharge at each transect.

Transect Number	Habitat Type	Length in Segment[1]	Weighting in Percent	Discharge (cfs)
SEGMENT A				
T1	SHALLOW POOL	148	10	6.2
T2	POOL/RUN	25	2	6.7
T3	SHALLOW RIFFLE	148	10	6.7
T4	SHALLOW RUN	267	17	6.4
T5	POOL	44	3	5.8
T6	SHALLOW RIFFLE	148	10	5.5
T7	SHALLOW RIFFLE/RUN	94	6	5.8
T8	SHALLOW RUN	267	17	5.3
T9	STEEP RIFFLE	197	13	5.2
T10	STEEP RIFFLE	197	13	6.1
	Total Length	1535	Mean	6.0
SEGMENT B				
T1	RUN	900	14	10.0
T2	RIFFLE/RUN	710	11	10.3
T3	POOL/RUN	250	4	9.1
T4	SHALLOW RIFFLE	512	8	9.5
T5	STEEP RIFFLE	960	15	8.9
T6	RIFFLE\RUN	710	11	10.5
T7	SHALLOW RIFFLE	512	8	12.1
T8	POOL	26	1	11.1
T9	RUN	900	14	9.6
T10	STEEP RIFFLE	960	15	9.8
	Total Length	6440	Mean	10.7
SEGMENT C				
T1	RIFFLE/RUN	429	9	7.9
T2	SHALLOW RIFFLE	404	8	8.6
T3	STEEP RIFFLE	323	7	8.1
T4	SHALLOW RIFFLE	404	8	7.8
T5	POOL	132	3	9.9
T6	RUN	474	10	8.1
T7	RIFFLE/RUN	429	9	12.6
T8	SHALLOW RIFFLE/RUN	318	6	11.0
T9	STEEP RIFFLE	323	7	9.0
T10	RIFFLE	1196	24	8.2
T11	RUN	474	10	7.7
	Total Length	4906	Mean	9.0

1 = Lengths are based on pacing and represent approximately 3.5 linear feet.

Table 1. (continued)

Transect Number	Habitat Type	Length in Segment[1]	Weighting in Percent	Discharge (cfs)
SEGMENT D				
T1	RUN	290	11	7.5
T2	STEEP RIFFLE	421	16	7.5
T3	SHALLOW RUN	116	4	1.7[2]
T4	STEEP RIFFLE	421	16	6.0
T5	SHALLOW RUN	116	4	6.4
T6	SHALLOW RIFFLE	335	13	5.3
T7	SHALLOW RIFFLE	335	13	2.5
T8	SHALLOW RIFFLE	335	13	3.3
T9	RUN	290	11	9.8
	Total Length	2659	Mean	5.5

1 = Lengths are based on pacing and represent approximately 3.5 linear feet.
2 = Low discharge a result of water diversions.

stream channel is due to the presence of vertical cliff faces at these locations. In the instance, the bed elevations were extended vertically to 10 feet at the right-most vertical. Appendix IV provides the IFIM hydraulic data sets for each segment which contains the observed water surface elevations, estimated discharges, x-distances, bed elevations, velocities and substrates recorded at each vertical along the stream profile.

The MANSQ hydraulic simulation model was utilized to develop the stage discharge relationships at each transect over the range of flows considered in the analysis. Simulated flows used in the analyses for all segments were between 0 and 60 cfs. Although this upper flow magnitude is above the "rule of thumb" for simulating discharges above the calibrated discharges, the observed Velocity Adjustment Factors (VAF) over this range for all data sets remained generally within the good to fair evaluation criteria of 0.85 to

1.15 (Milhous et al. 1984). Exceptions to this were transects located in pools and shallow low velocity runs (see Table 1). These transects were marginal to poor (VAF > 1.15 or < 0.85) at discharges greater than about 2.5 the measured or calibrated discharges (e.g. greater than about 20 to 25 cfs). Since these micro-habitats represented rarer habitats within Aravaipa Creek and were considered an important element of the overall habitat diversity, it was decided that the exclusion of these key micro-habitats in the evaluation of available habitat was not desirable. Furthermore, the analysis of the median monthly discharges showed that a significant number of the median monthly flows during the period 1981 through 1988(9) in all segments were at or above 25 cfs. Failure to simulate flows over the higher range (i.e. 25 to 50 cfs) would have precluded a consideration of a significant portion of the analyses. So how did you handle it?

Suitability Index Curves

Table 2 lists the final S.I. curve sets developed and utilized in the PHABSIM model runs. A complete listing of the S.I. curve coordinates, frequency plots of the observed utilization data for depth and velocity taken from Turner and Tafanelli (1983) and Minckley (1990) and plots of the S.I. curve sets are contained in Appendix V. Raw data on depth and velocity utilization taken from Minckley (1990) were listed as large, medium and small and were partitioned into life stages as adult, juvenile and fry for analysis and consistency with data presented in Turner and

Tafanelli (1983). For those species with life stage listings of fry/juvenile in Table 2, insufficient data on depth or velocity utilization was available so these two groups were pooled to develop a single set of S.I. curves representative of these size class. S.I. curves for the adult Sonoran sucker were taken directly from Turner and Tafanelli (1983) due to a lack of sufficient utilization data to develop S.I. curves. The S.I. curves for roundtail chub and speckled dace were taken from Hardy et al. (1989) using utilization data collected in the Virgin River.

Table 2. Suitability Index curve ID numbers and source of data for each species and life stage used in the IFIM analyses if curve data were derived from published sources.

ID NUMBER	SPECIES	LIFE STAGE
10001	LONGFIN DACE	ADULT
10002	LONGFIN DACE	FRY/JUV
10101	SONORAN SUCKER	ADULT [1]
10201	ROUNDTAIL CHUB	ADULT [2]
10202	ROUNDTAIL CHUB	JUVENILE [2]
10203	ROUNDTAIL CHUB	FRY [2]
10301	SPIKEDACE	ADULT
10302	SPIKEDACE	JUVENILE
10303	SPIKEDACE	FRY
10401	MOUNTAIN SUCKER	ADULT
10402	MOUNTAIN SUCKER	FRY/JUV
10501	SPECKLED DACE	ADULT [2]
10502	SPECKLED DACE	FRY/JUV [2]
10601	LOACH MINNOW	ADULT
10602	LOACH MINNOW	FRY/JUV

1 = Taken from Turner and Tafanelli (1983).
2 = Taken from Hardy (1989).

S.I. curves were developed from the frequency of utilization data using the CURVE program (Hardy and Mathias 1989) which is now part of the PHABSIM model system (Milhous et al. 1989). This program was used to fit exponential polynomial probability density functions (Hardy et al. 1982), normalized frequency distributions and running filters to the utilization data. The results for these various curve fitting techniques were compared to the observed frequency distributions and final selection of a particular approach was made using professional judgement on how well the S.I. curve represented the underlying frequency distribution. In general, the resulting S.I. curve sets are in close agreement with those presented in Turner and Tafanelli (1983).

Habitat Modelling Comparisons

As noted previously, both the multiplicative and lowest limiting factor approaches were initially considered in the development of available habitat using the HABTAT computer model of PHABSIM. A systematic examination of the relationships between available habitat computed as Weighted Usable Area (WUA) per 1000 feet of stream for all species and life stages using each aggregation technique demonstrated that functional relationships between flow and discharge were essentially the same except for an offset in the magnitude of the computed WUA values. An example comparing both model runs for all species and life stages at segment D are provided in Appendix VI. Based on these results,

only the multiplicative approach was considered in all subsequent analyses and presentation of model results.

Habitat as a Function of Discharge

The functional relationships between WUA and discharge for all species and life stages for all modeled segments are provided in Appendix VII. Appendix VII also provides these results in tabular form. Figures 4 through 8 show a comparison of the WUA results obtained in this analysis for selected species at all segments with the results reported in Turner and Tafanelli (1983) (same as segment C). It should be noted that in the following discussions on the comparison of the present results with the work of Turner and Tafanelli, differences in WUA predications are to expected given differential weighting of micro-habitats, differences in the final S.I. curve sets and specific locations of individual transects all contribute to the observed variation in the WUA predictions in the PHABSIM model results.

The range of discharges at which optimal habitat conditions occur for spikedace adults in segments C and B (see Figure 4), are in close agreement with the results of Turner and Tafanelli. Optimal habitat in these two segments generally occurs between 20 and 25 cfs, while the results for segments A and D show maximum habitat occurring over a lower range of discharges between 10 and 20 cfs. In general, available habitat for the adults drops rapidly below 10 to 15 cfs for all segments. The results for the juveniles however (see Figure VII.4 in Appendix VII), in segments B and C

indicate that optimal habitat occurs over a much greater flow magnitude of 30 and 35 cfs. Optimal ranges in segments A and D are essentially the same as that observed for the adults. As would be expected, the results for the fry life stage of spikedace (see Figure VII.4) show optimal conditions over a lower discharge range between 5 and 10 cfs. Overall, the combined adult and juvenile life stages which are representative of habitat utilization over the greatest period of the year would suggest optimal conditions for these species occur in the range of 20 to 25 cfs.

The results for the adult loach minnow in Figure 5 also suggest that optimal habitat conditions are found between 20 to 30 cfs in segments A and B, and between 15 and 20 for the remaining segments. As was observed for the spikedace, habitat availability drops rapidly below about 10 to 15 cfs at all segments. The combined fry/juvenile habitat curves for all segments in Figure VII.7 show optimal flow ranges between 10 and 15 cfs and available habitat drops rapidly below this range. This is also to be expected, given the general relationships between depth and velocity utilization reflected in the S.I. curves for this "life stage" (see Figure V.23 and V.24).

A comparison of the results for the Sonoran sucker and roundtail chub (see Figures 6, and 8), indicate that habitat availability increases with increasing discharge over the entire range of simulations as opposed to the results of Turner and Tafanelli which show a peak in available habitat between 5 and 10 cfs with little change with increasing flows. Turner and Tafanelli

did not use their results for these species in their instream flow recommendations based on the small sample sizes available for the development of S.I. curves from Aravaipa Creek. The utilization of roundtail chub S.I. curves from the Virgin River in this study is felt to provide an adequate representation of the response of this species habitat to changes in flow magnitude. The relationships between available habitat and discharge for the juvenile and fry life stages of roundtail chubs (see Figure VII.3) follows the results for the adults in the present analysis depicted in Figure 8.

The results of Turner and Tafanelli for the mountain sucker in Figure 7 is also different from the results obtained for all segments in the present analysis. Optimal habitat conditions for their results occurs between 5 and 10 cfs while the present results suggest optimum habitat occurs between 30 and 40 cfs for each segment. The WUA relationship for the fry/juvenile curves (see Figure VII.5 are generally similar to the adults, except that optimal habitat occurs between 20 and 30 cfs.

The results for longfin and speckled dace (see Figures VII.1 and VII.6) show that adult habitat for these species are maximized between 10 and 20 cfs while the fry/juvenile life stages peak slightly lower at 10 to 15 cfs. For both species, habitat availability drops off rapidly at flows below 10 cfs for all life stages.

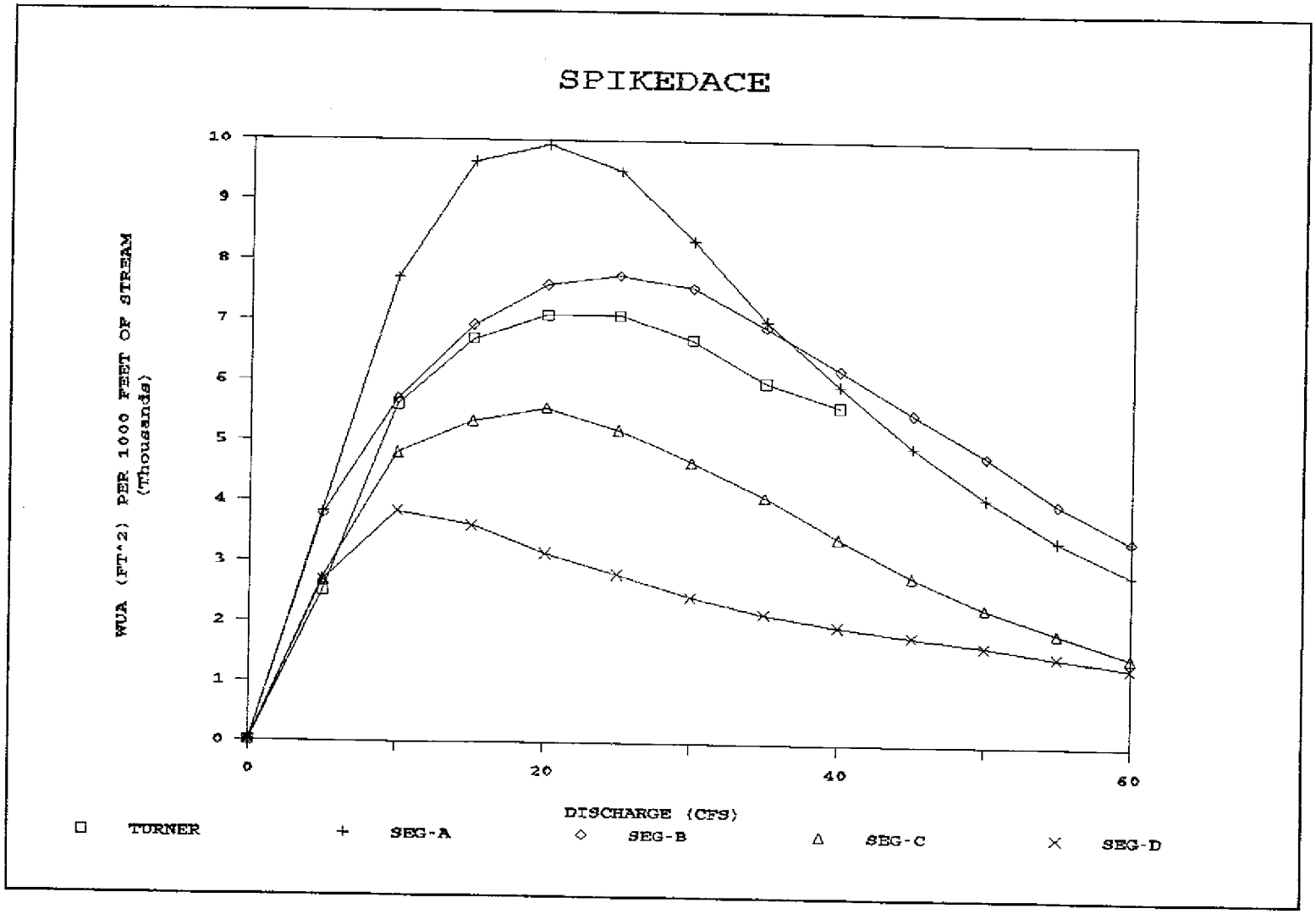

Figure 4. Comparison of WUA for Spikedace from Turner and Tafanelli (1983) and the present PHABSIM model results.

SRP12507

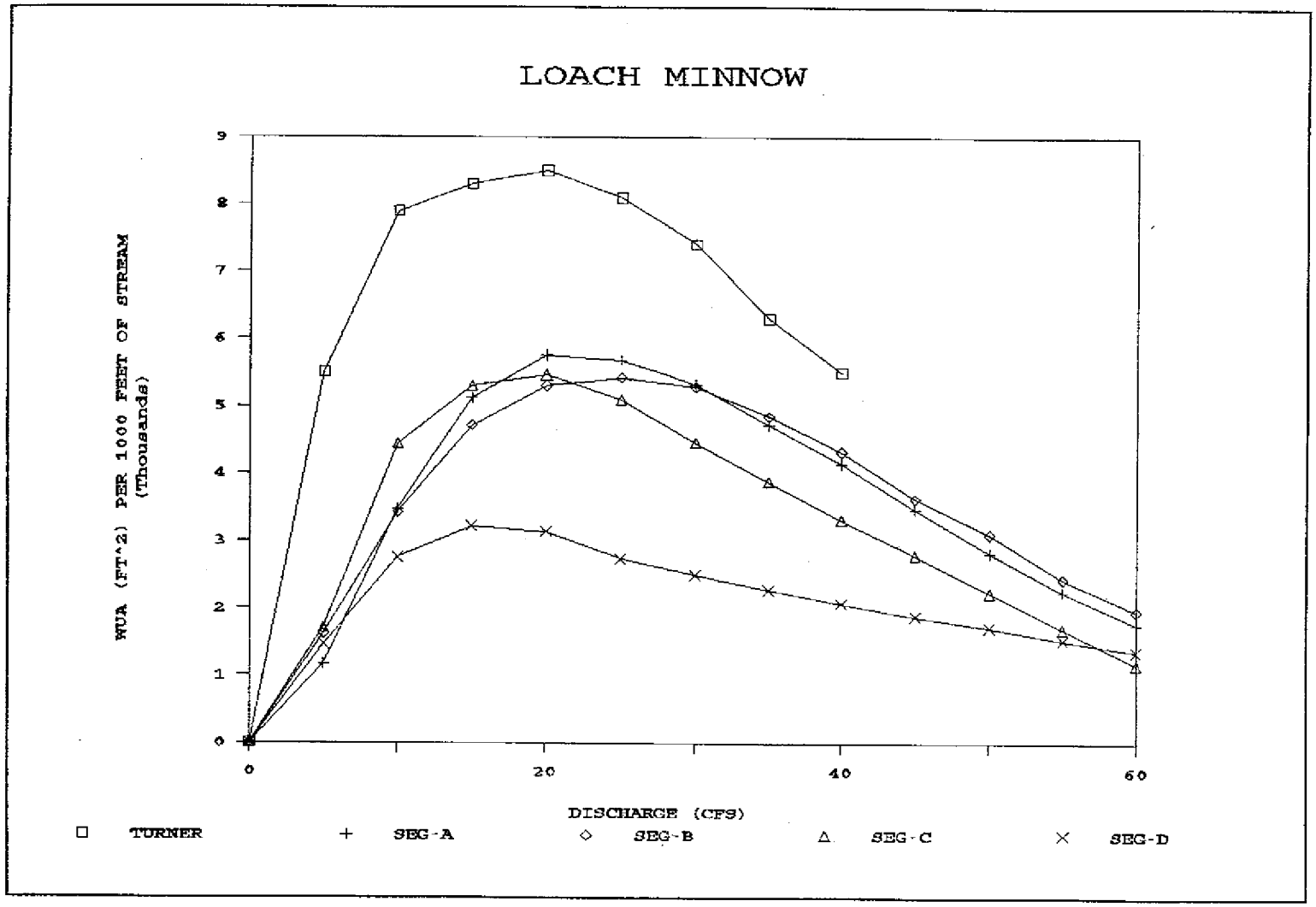

Figure 5. Comparison of WUA for Loach Minnow from Turner and Tafanelli (1983) and the present PHABSIM model results.

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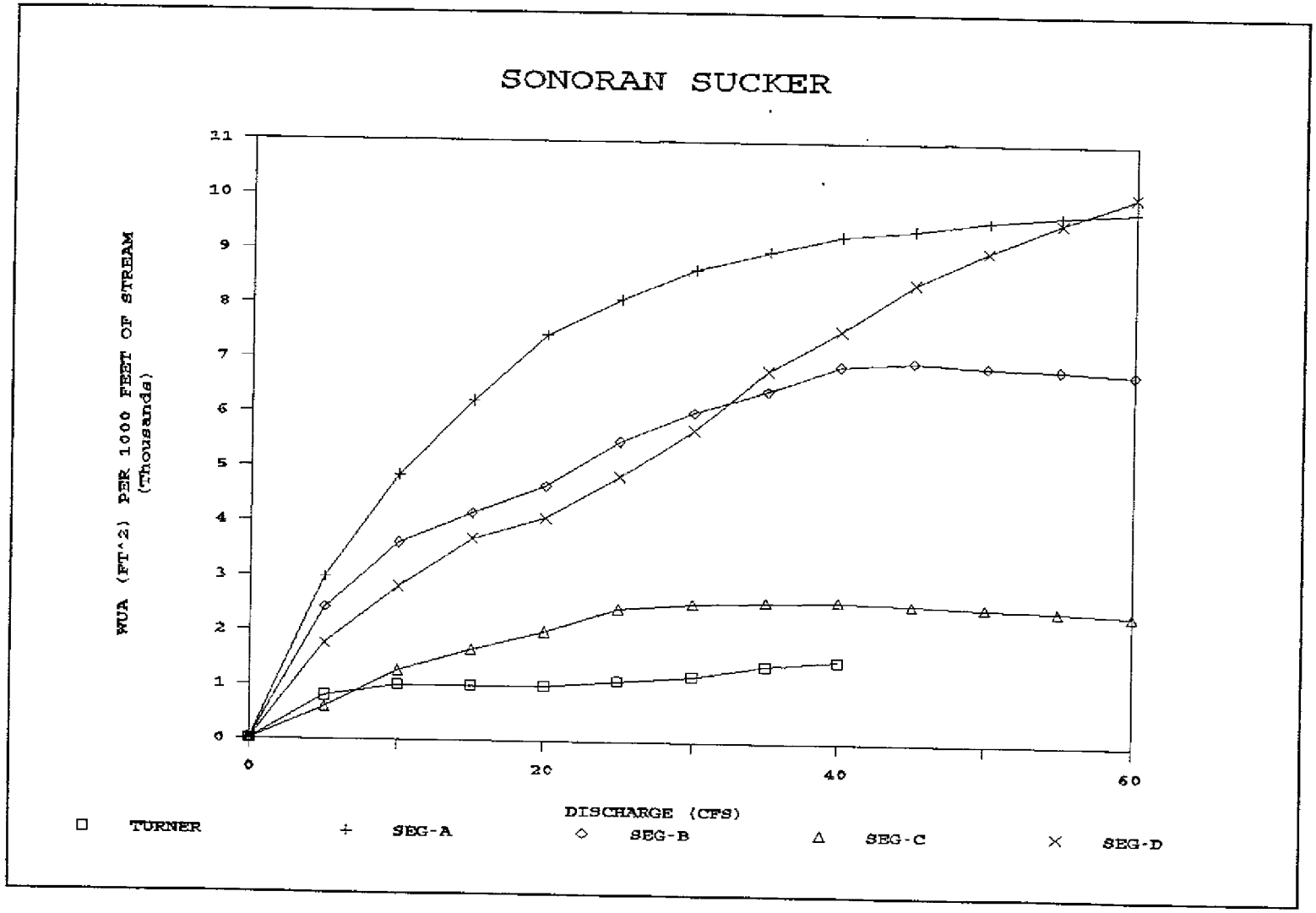

Figure 6. Comparison of WUA for Sonoran Sucker from Turner and Tafanelli (1983) and the present PHABSIM model results.

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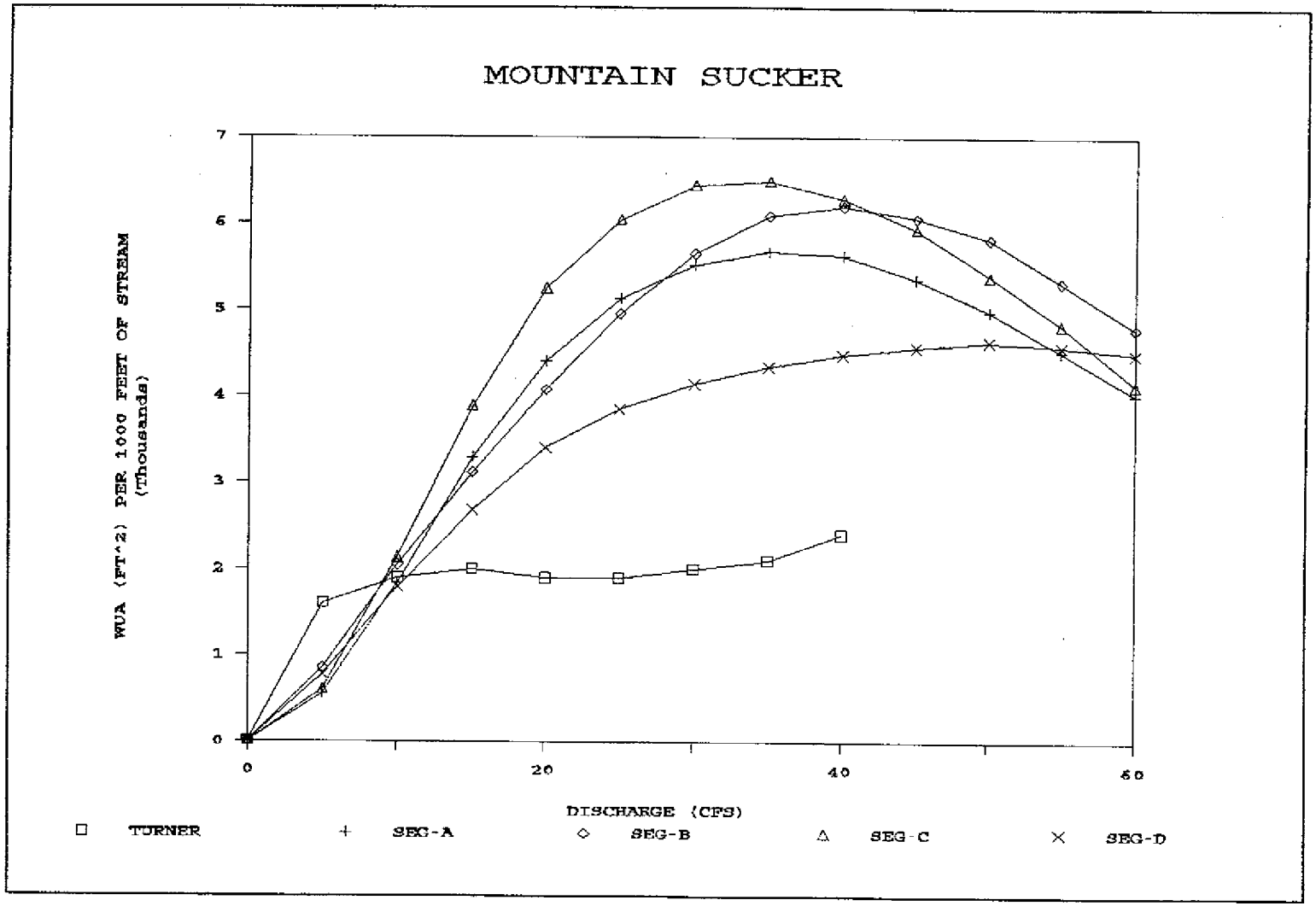

Figure 7. Comparison of WUA for Mountain Sucker from Turner and Tafanelli (1983) and the present PHABSIM model results.

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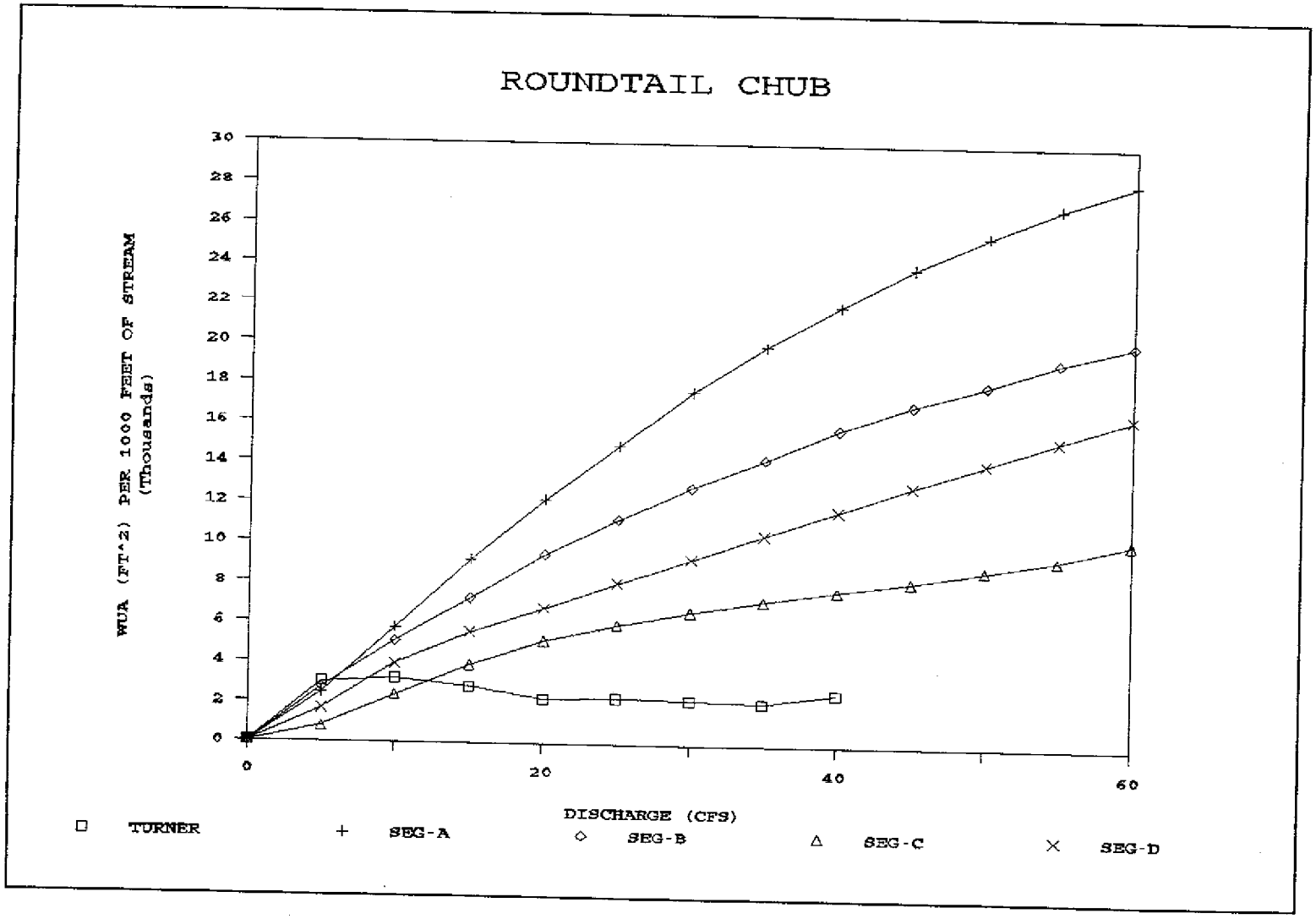

Figure 8. Comparison of WUA for Roundtail Chub from Turner and Tafanelli (1983) and the present PHABSIM model results.

SRP12511

A single combined WUA versus discharge curve was developed from the individual results in segments C and D and used in all further analyses at this station (Appendix VIII). A composite curve was utilized since only the Eastend gage data was available. The composite curves for each species and life stage were derived by a weighted average where the WUA per 1000 feet of stream in each segment was multiplied by the relative reach length obtained from the habitat mapping in that segment, the two resulting curves added, and then dividing the sum by the total relative reach lengths for both segments. The WUA versus discharge curves in segments A and B were not combined since each segment had distinctly different flow characteristics based on an examination of the USGS and BLM Westend gage data. A comparison of the combined WUA versus discharge relationships for each species and life stage with the original curves contained in Appendix VIII shows that none of the basic relationships were altered in the aggregation process. This is to be expected given the close similarity between the relationships for all species and life stages in these segments.

In summary, it is particularly important to note that the objective of TNC is to develop instream flow recommendations that optimize conditions for the federally listed species Meda and Tiaroga while maintaining adequate conditions for the remaining resident native species. The results from this study indicate that optimal habitat conditions for adult spikedace and loach minnow occur at discharges which are similar but slightly greater

than those proposed by Turner and Tafanelli. However, it must be remembered that their recommendations did not consider any of the other native species. When the remaining species and life stages of the resident native fish are considered, the range of discharges at which available habitat is optimized will necessarily be greater given the relationships in habitat versus flow noted for mountain suckers, sonoran suckers, and roundtail chubs. Utilizing the results of WUA versus discharge (Appendices VII and VIII) the discharge at which maximum habitat occurred for each species and life stage was tabulated for each study segment. A weighted average of these discharges was then computed by weighting the discharges for all life stages of spikedace and loach minnow twice that of all remaining species and life stages. The choice of a 2:1 weighting for the endangered versus other species was chosen to both reflect the management goals of TNC and to avoid over weighting the WUA versus discharge relationships of sonoran suckers, mountain suckers, and roundtail chubs which have maximum habitat values at or near the upper range of simulated discharges. This "under" weighting of these species is further supported from the flow duration analyses discussed below which indicates that these higher median monthly discharges (e.g. 50 to 60 cfs) occur infrequently within Aravaipa Creek (see Figures 9 through 12). The resulting computed discharges were 24, 28, 24 and 25 cfs for segments A, B, and C/D, respectively. Consequently, instream flow recommendations based on the current work are higher than those

proposed by Turner and Tafanelli and reflect the consideration of these other native species as discussed below.

Historical Periods of Records

The 1931 to 1988 and the 1966 to 1988 median monthly flows obtained from the daily flow records at the USGS Westend gage are presented in Figures 9 and 10. Appendix IX provides summaries of the monthly minimum, mean, median and maximum discharges for this same period of record. Figure 10 suggests that three distinct flow periods may exist and are delineated by pre- 1977, 1977 through 1983, and 1984 to the present. The average median monthly flows for each of these periods was 12.4 cfs, 24.0 cfs and 33.1 cfs. The average monthly minimum values for each period were 7.4 cfs, 14.7 cfs and 23.9 cfs, respectively. It is also apparent that during the later two periods the magnitude and frequency of large flood events has increased relative to the period prior to 1977.

The 1981 to 1989 median monthly flows obtained from the daily flow records at the BLM Westend gage and the median monthly flows for the Eastend segment derived by correlation analyses between the Eastend instantaneous data and BLM Westend gage data (Appendix XI) are presented in Figures 11 and 12. The associated monthly summaries for these two gages are provided in Appendix XI. The average median monthly flows for the Westend BLM gage during the 1981 to 1983 period was 19.3 cfs while the average from 1984 to

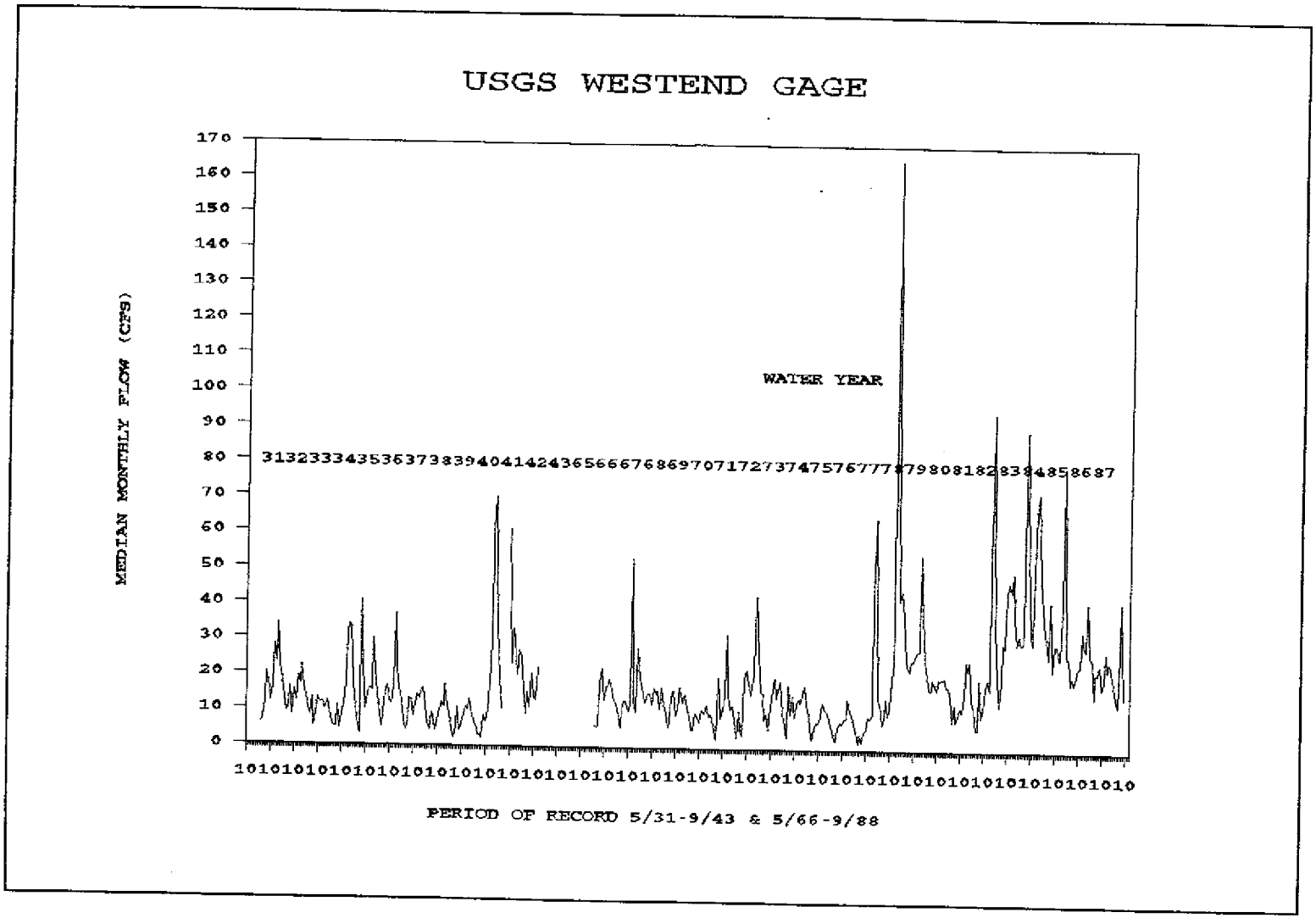

Figure 9. Median monthly flows for the USGS Westend Gage for the period 1931-1988.

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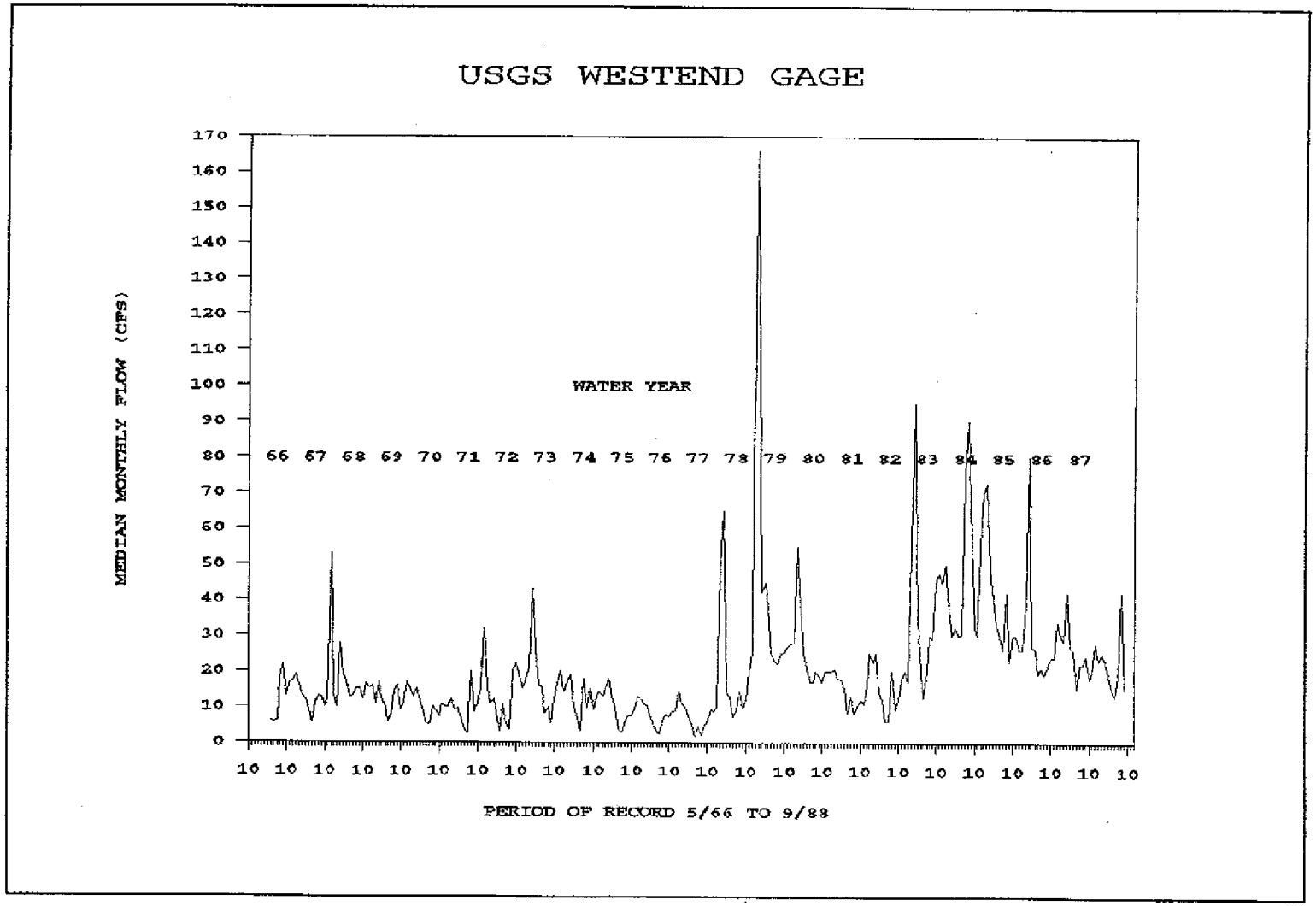

Figure 10. Median monthly flows for the USGS Westend Gage for the period 1966-1988.

SRP12516

1989 was 29.5 cfs. Average minimum flows prior to 1984 were 15.3 cfs and 24.2 cfs during the period 1984 to 1989. This change in flow characteristics around 1983 was also observed in the USGS flow records as noted above. Changes in the Eastend gage data are the same since these data are derived from correlations with the BLM Westend gage data.

A comparison of the USGS and BLM Westend data for the period 1981 to 1988 is provided in Figure 13. It is evident that the USGS median monthly flows are generally greater and more variable over time. The average median flows during 1981 to 1983 at the USGS are approximately 6 cfs greater than the BLM Westend gage. During the 1984 to 1988 period, the USGS average median monthly flows were less than 3 cfs greater when compared to the BLM Westend data.

Flow Duration Analysis

Flow duration curves derived from the 1966 to 1988 period of record at the USGS Westend gage and the 1981 to 1989 period of record at the BLM Westend and Eastend gages are presented in Figure 14. Figures 15 and 16 show the flow duration curves for the 1981 to 1983 and the 1984 to 1988(9) for the respective gage sites. It is apparent that a comparison of the long term flow duration curves for the USGS gage is strongly influenced by the lower flow magnitudes prior to 1977. The fifty percent exceedance flow magnitude derived from the entire period of record is 17 cfs. In contrast, the 50 percent exceedance values for the 1981 to 1983 and 1984 to 1988 periods were 18 cfs and 24 cfs respectively. Fifty

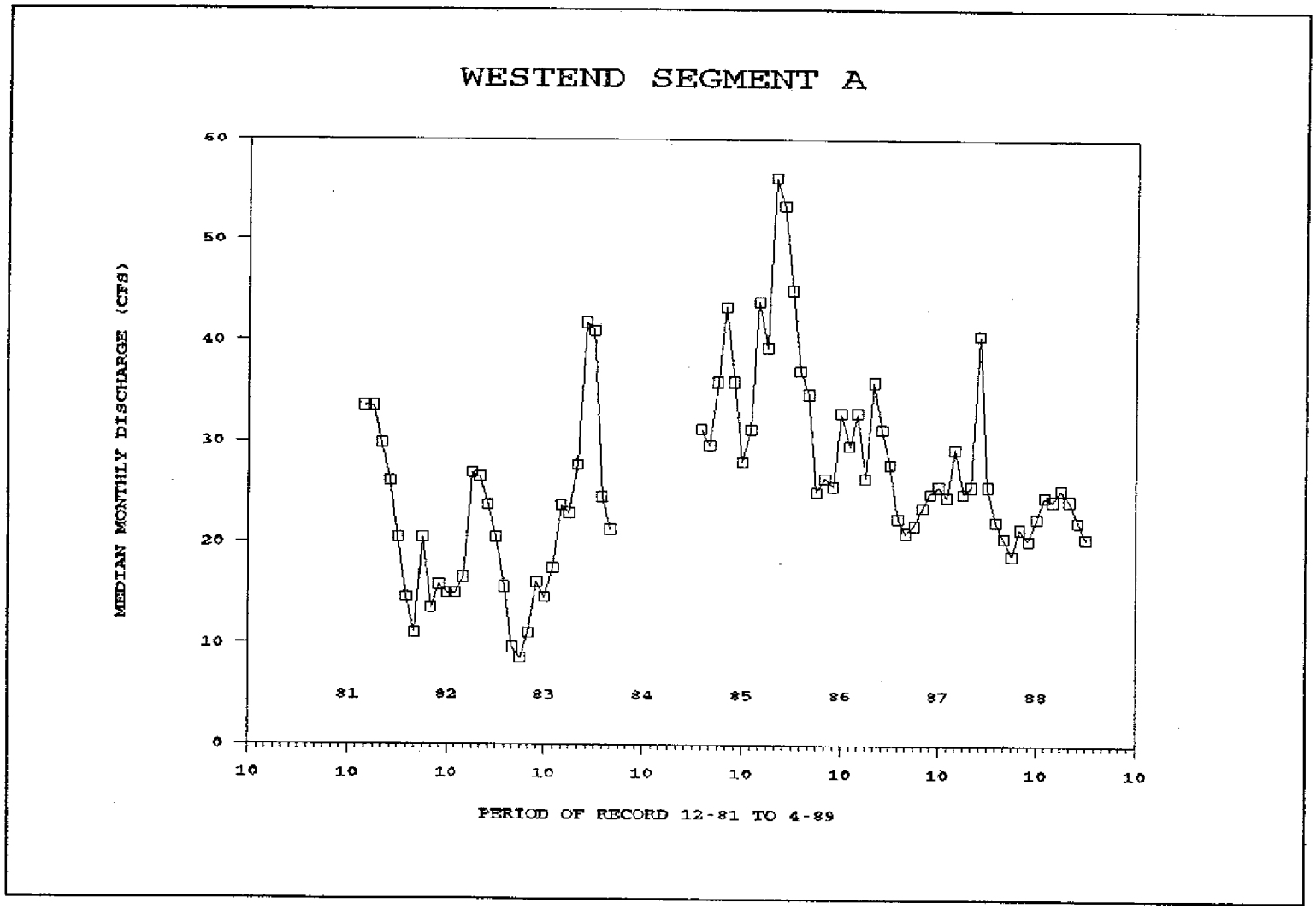

Figure 11. Median monthly flows for the BLM Westend Gage for the period 1981-1989.

SRP12518

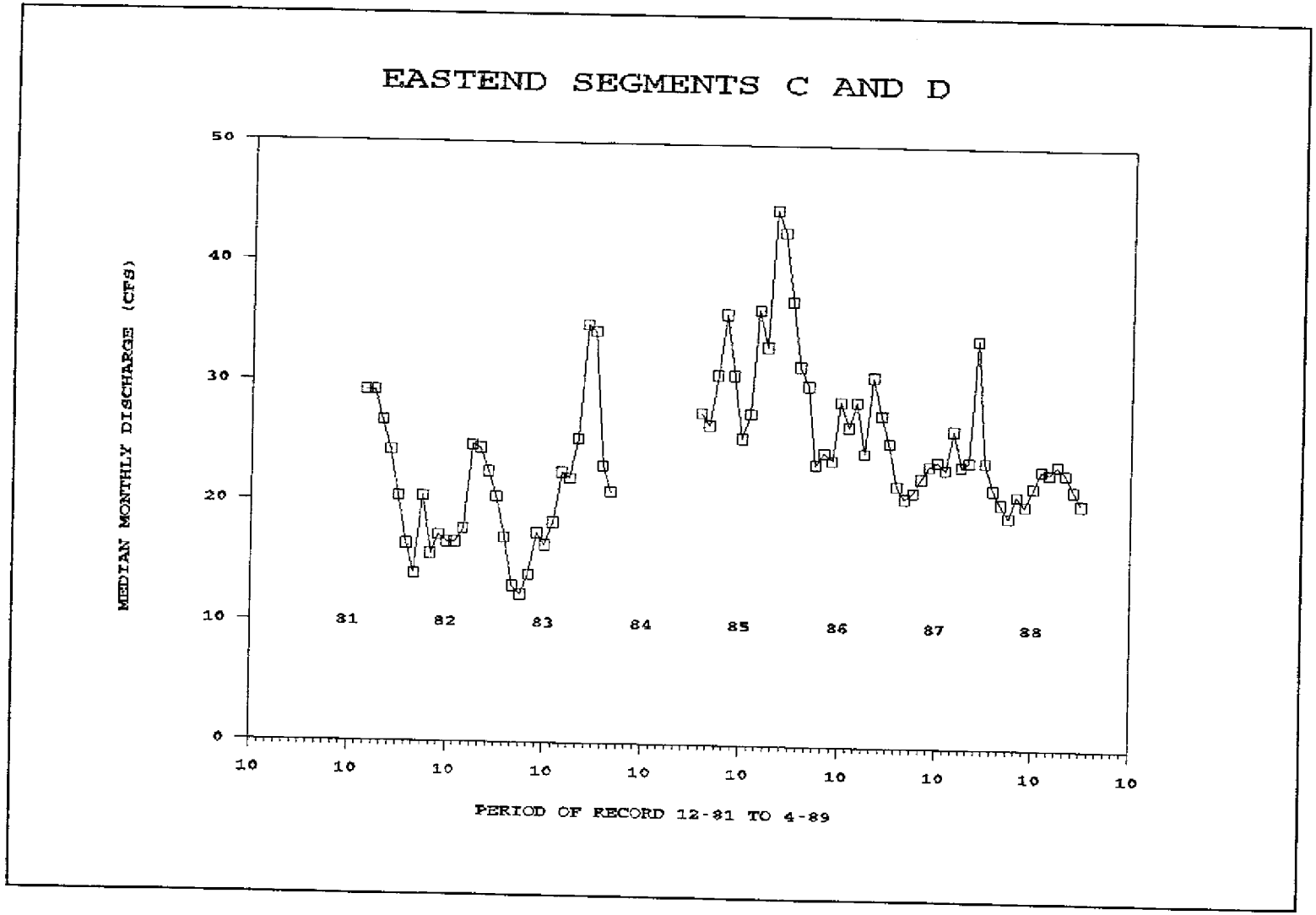

Figure 12. Median monthly flows for the Eastend Gage for the period 1981-1989.

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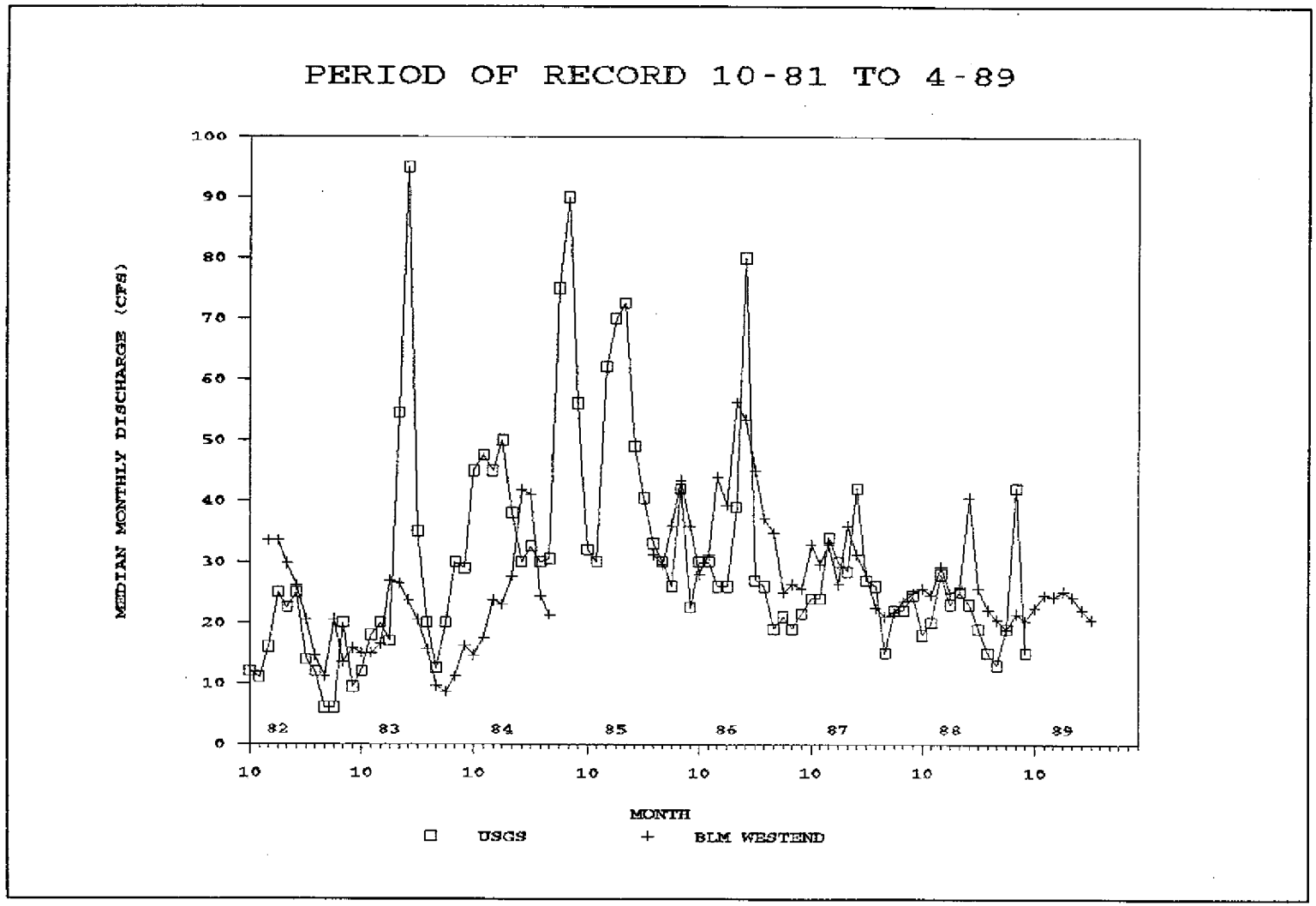

Figure 13. Comparison of the median monthly flows for the USGS and BLM Westend Gages for the period of record 1981-1989.

SRP12520

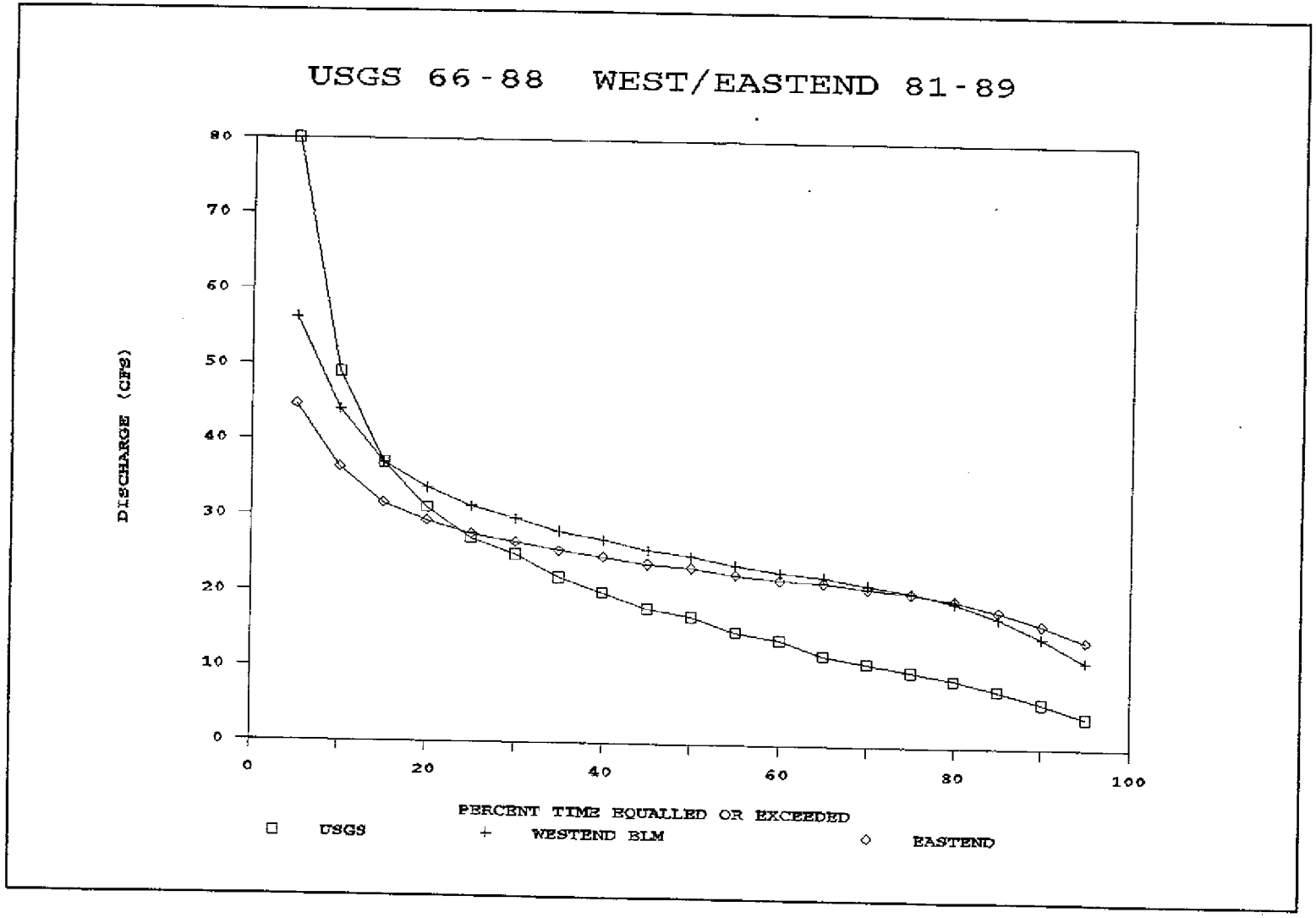

Figure 14. Comparison between the USGS, BLM Westend and Eastend median monthly flow duration for their respective period of records.

SRP12521

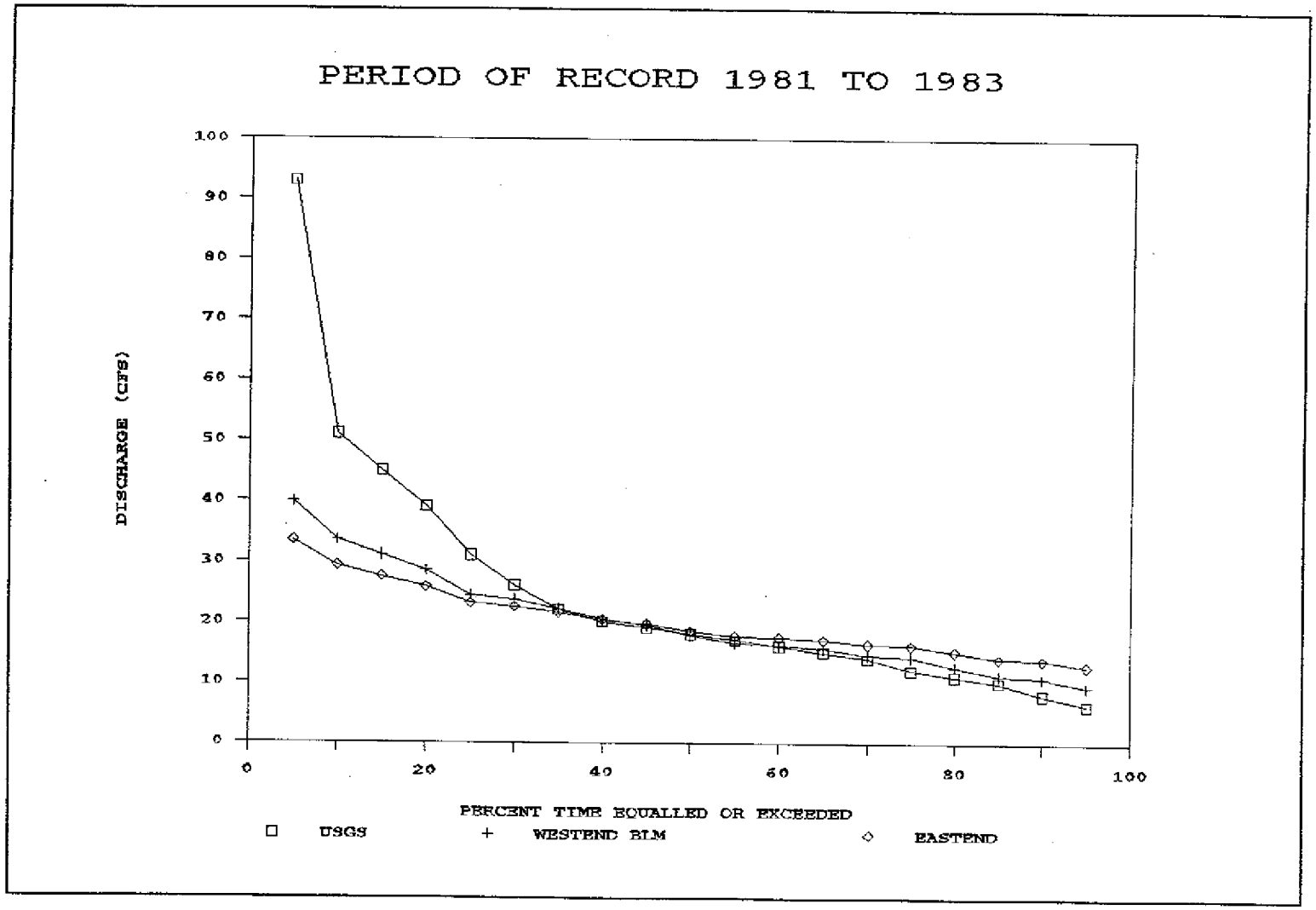

Figure 15. Comparison between the USGS, BLM Westend and Eastend median monthly flow duration for the period of record 1981-1983.

SRP12522

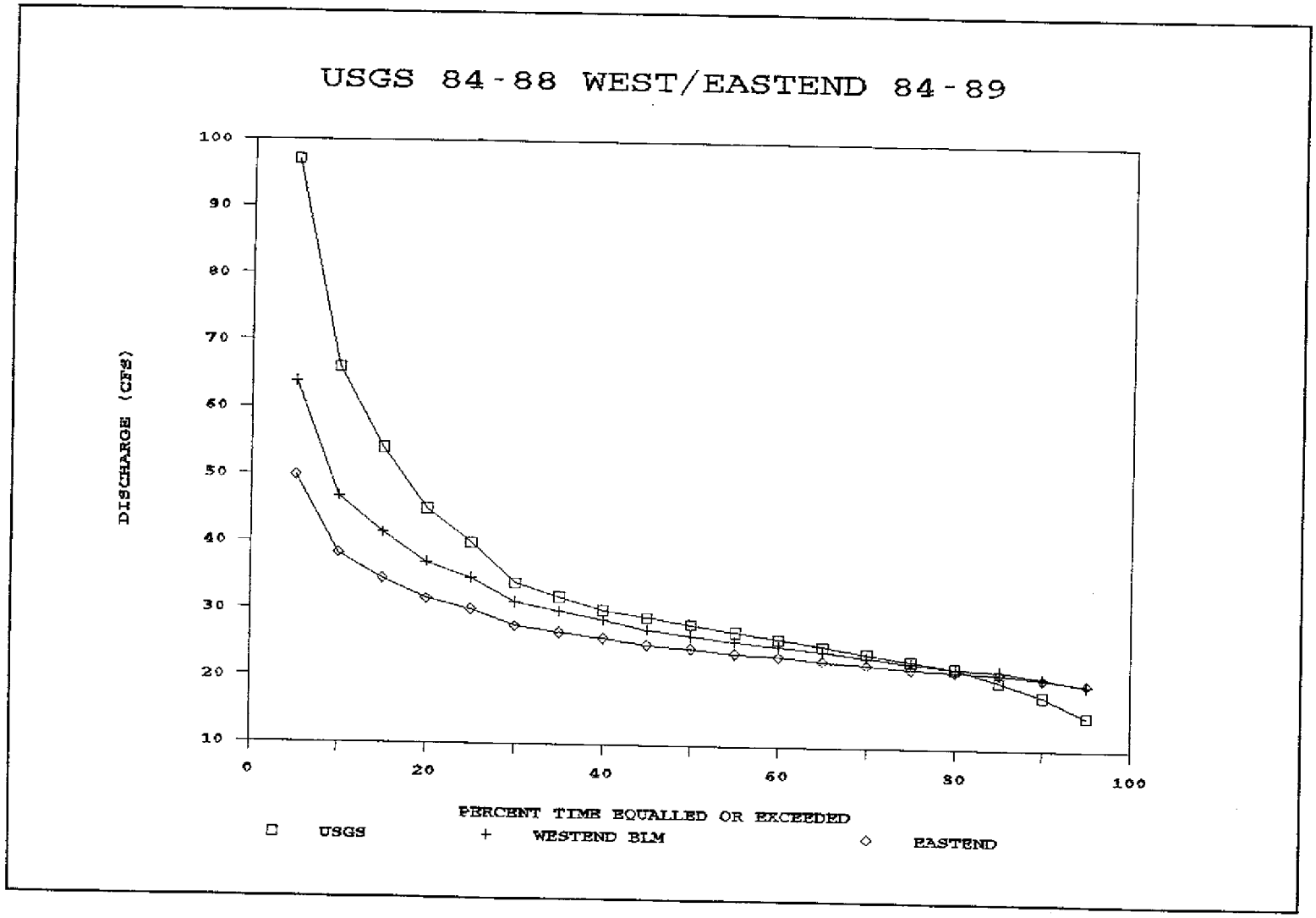

Figure 16. Comparison between the USGS, BLM Westend and Eastend median monthly flow duration for the period of record 1984-1988(9).

SRP12523

percent exceedance values for the BLM Westend gage and the correlated Eastend gage were 17.8 cfs and 18.5 cfs for the period 1981 to 1983 and 26.4 cfs and 24.4 cfs for the period 1984 to 1989. The similarity in the flow durations over the 30 to 60 percent exceedance ranges for all three gages during the 1981 to 1983 period is readily apparent in Figures 15.

The median monthly flows computed for each month based on the available daily flow data for 1966 to 1988 at the USGS Westend gage and the period 1981 to 1989 at the BLM Westend and Eastend gages are presented in Figure 17. Figures 18 and 19 provide the median monthly values for the 1981 to 1983 and 1984 to 1988(9) periods at the respective gage site. As would be expected based on the results for the flow duration analyses for these same time periods (see Figures 14, 15, and 16), median monthly flows are considerably greater for the 1984 to 1988(9) period. The significance of these flows on the development of instream flow recommendations is considered below. It is also interesting to observe the shift in the location of the peak median monthly discharges in the 1981 to 1983 period from February-March to January-February.

Habitat Time Series

Habitat time series for each species and life stage were run for the periods of record noted above at each site. These data were used to develop habitat duration plots for the same time periods as summarized for the flow duration analyses discussed above. The time series plots for each species and life stage were

excluded from the report to conserve space as they required over 60 additional pages of output. In addition, after a comparison of the WUA versus discharge relationships for each life stage for individual species (see Appendix VII), only the adult life stages were continued further in the analyses. This is justified from the observation that both the magnitude and functional relationships for each life stage were somewhat similar and under the assumption that a consideration of all adults represented the range of micro-habitat utilization for these other life stages. This is supported by a comparison of the S.I. curves for the juvenile and fry life stages with the range of S.I. curves represented by the adults (Appendix V).

Habitat Duration Analyses

The habitat duration analyses for the adult life stages for each species are contained in Appendix X for the period of records 1981 to 1983 and 1984 to 1988(9) for segments A, B, and C and D combined. The habitat durations for the period of record 1966 through 1988 are considered below in the PHABSIM model verification analyses. These results show that the predicted amounts of available habitat over these two time periods for longfin dace, Sonoran suckers, roundtail chub, spikedace, and speckled dace showed a consistent pattern between segments. Loach minnows and mountain suckers on the other hand showed little variation in available habitat between segments.

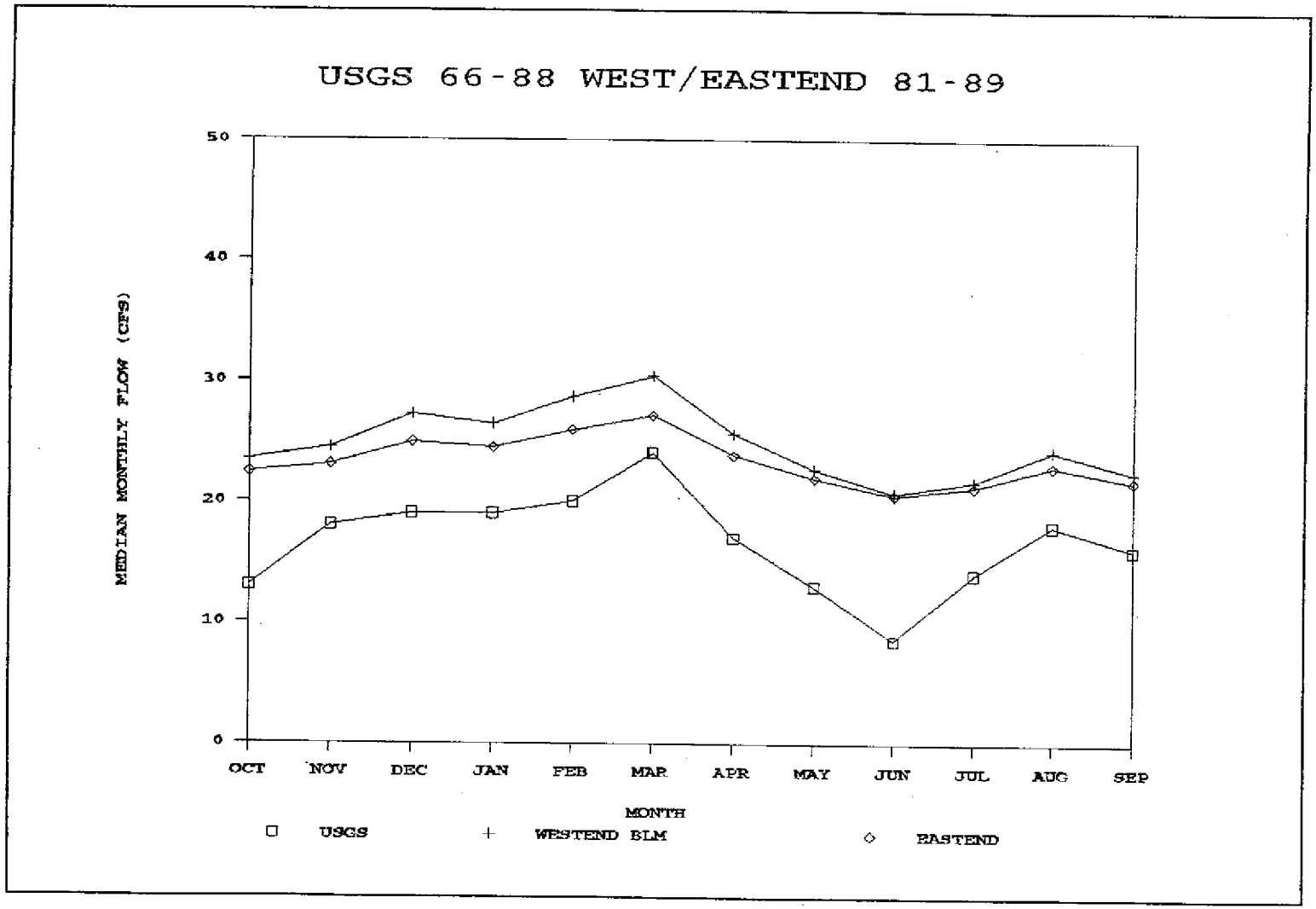

Figure 17. Comparison on the median monthly flows at the USGS, BLM Westend and Eastend Gage data for their respective periods of record.

SRP12526

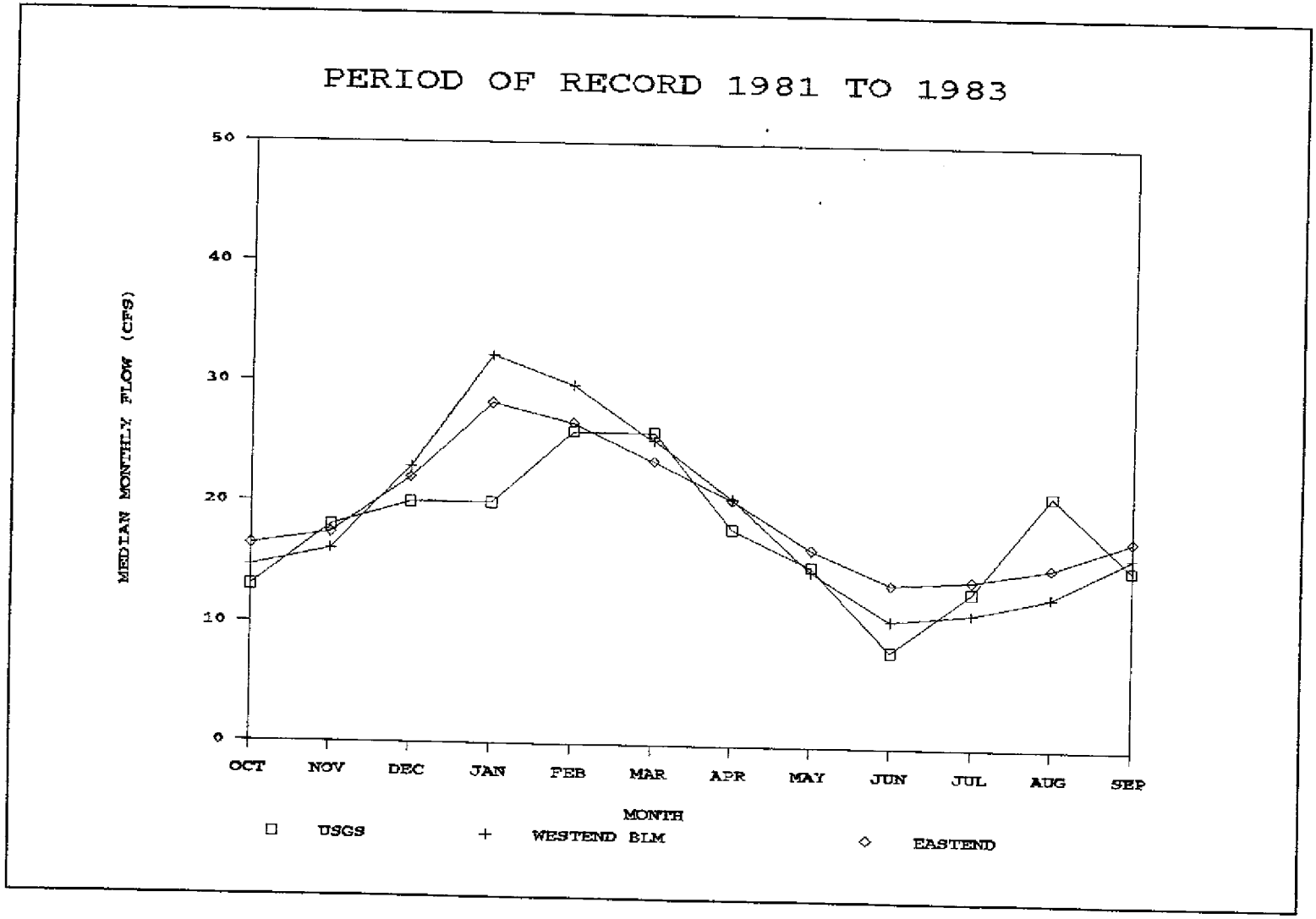

Figure 18. Comparison on the median monthly flows at the USGS, BLM Westend and Eastend Gage data for the period of record 1981-1983.

SRP12527

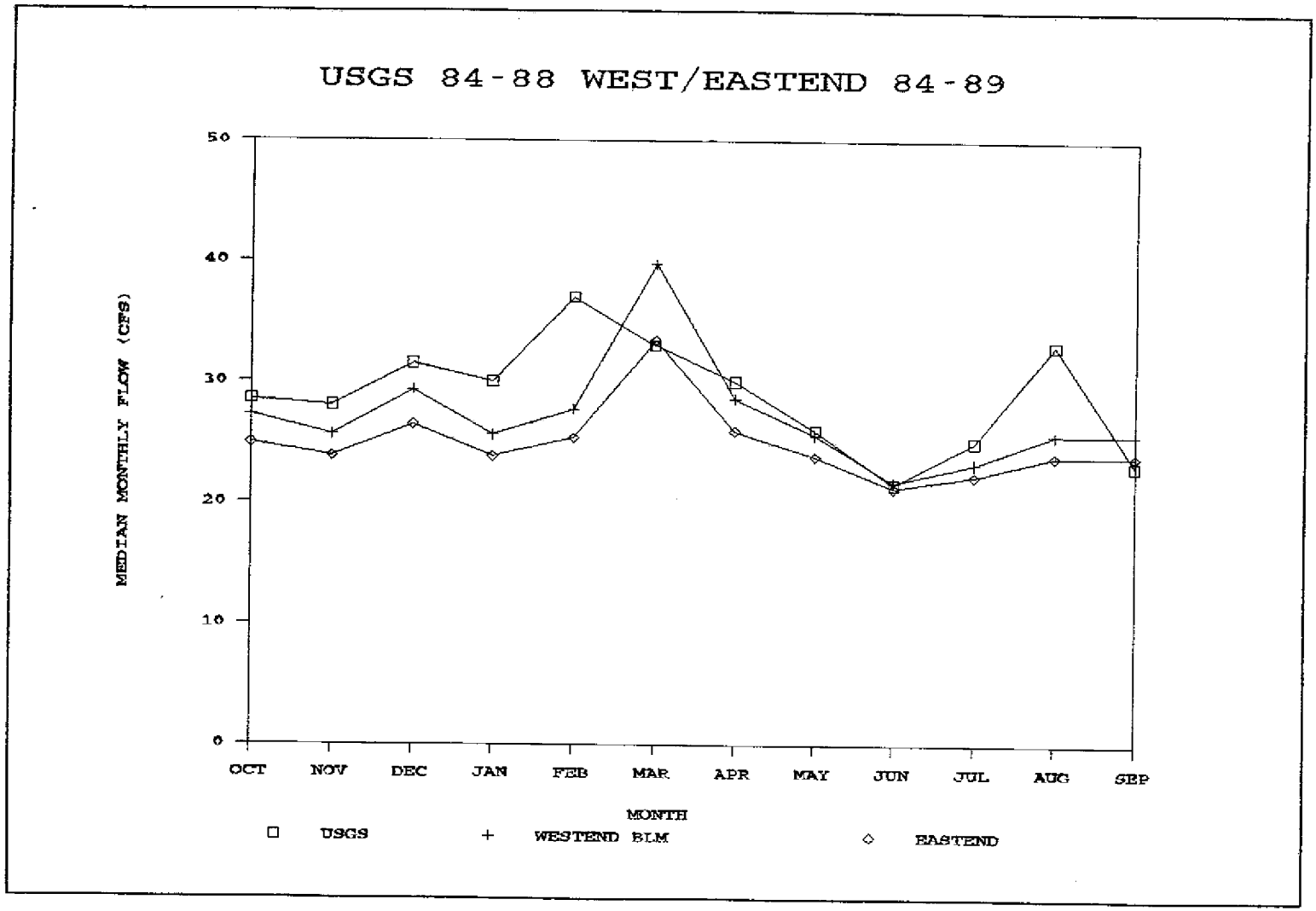

Figure 19. Comparison on the median monthly flows at the USGS, BLM Westend and Eastend Gage data for the period of record 1984-1988(9).

SRP12528

Instream Flow Recommendations

As an initial step in the recommendation of monthly flows to protect fish habitat within Aravaipa Creek, the existing information used in the original BLM permit application was reviewed (BLM 1988) in light of the results obtained in the current analyses. First, the flows permitted to the BLM were limited to the amount applied for, which was 15 cfs year round, or 10,860 acre feet. The 15 cfs application amount was the sum of a 10 cfs minimum flow for adult loach minnow and spikedace habitat just upstream from the BLM Eastend gage, and a 5 cfs recreation flow. The 10 cfs minimum fish flow was based on the Turner and Tafanelli habitat utilization curves which indicated that the habitat for the adult spikedace was maximized at 20-25 cfs, that the habitat for the adult loach minnow was maximized at 15-25 cfs, and that there were steep declines in the habitat for both occurring when flows dropped below 10-15 cfs. The 10,860 acre foot permit amount, however, was not uniformly allocated as a 15 cfs instream flow in each month of the year, but was distributed throughout the year to mimic a more natural distribution of monthly flows. That more natural distribution, however, was apparently constrained by the monthly means for a discontinuous 21 year period of record at the USGS gage (1920, 1932-42, 1967-1975). Table 3 compares the BLM permitted amounts with: the monthly means for this 21 year period of record, the monthly means and medians for the USGS gage of the 1966-1988 and 1984-1988 periods of record, and the monthly means and medians for the BLM Westend gage over the 1981-1989 period of record.

Table 3. Comparison of median and average monthly flows at the USGS Westend gage for the period 1966 to 1988 and 1984 to 1988, the BLM Westend gage for the period 1981 to 1989 with the existing permitted BLM instream flows and original 21 year period of record used in the BLM permit application (all flows are in cfs).

		USGS				BLM WESTEND	
Month	BLM Permit	21 year Mean	1966-88 Mean	1966-88 Median	1984-88 Median	1981-89 Mean	1981-89 Median
JAN	20	25	40	19	30	33.3	26.4
FEB	25	58	56	20	37	37.3	28.7
MAR	20	43	64	24	33	46.9	30.4
APR	10	14	21	17	30	29.2	25.6
MAY	10	10	16	13	26	24.3	22.7
JUN	9	9	13	8.5	22	20.3	20.7
JUL	10	21	21	14	25	26.0	21.7
AUG	20	30	29	18	33	30.3	24.2
SEP	11	23	26	16	23	25.7	22.4
OCT	15	28	77	13	29	24.2	23.5
NOV	10	15	24	18	28	26.1	24.4
DEC	20	39	57	19	32	30.9	27.2

As can be seen from Table 3, monthly means indicate significantly higher flow availability than monthly medians. The medians are not influenced by exceptionally high or low flow events and are therefore a better indicator of "normal" flow conditions. But as also can be seen from Table 3, the period of record is also a significant assumption. The monthly medians for the shorter, and wetter 1984-1988 period of record for the USGS gage almost always equal or exceed the monthly means for the 21 year period assumed for the BLM permit. The only exception is the month of December, where the mean over the 21 year period still exceeds the median for the shorter period. A key assumption for the BLM permit, then, is that the 21 year record provides an appropriate indication of future hydrologic conditions. This 21 year record may not be an

appropriate indication of future hydrologic conditions on Aravaipa Creek, however, since it may reflect a level of irrigation depletions that has been discontinued (see Appendix I) and/or abnormally low precipitation or groundwater discharge (see Figures 9 and 10).

The recommendation for increased monthly discharges for instream flows is further supported by a comparison of predicted available habitat using average monthly flows in the existing BLM permit and median monthly flows for the period 1984 to 1988(9) at all stream segments with the current PHABSIM results (see Table 3). This comparison is illustrated in Figures 20, 21, and 22. The available habitat in these Figures were derived from a weighted average of all species and life stages WUA discharge curves, using the 2:1 ratio between all life stages of spikedace and loach minnows versus the other species. Hence the term community habitat in these Figure legends. It is significant to note that for all three segments, the available habitat values using the median flows and weighted community curves are always greater than the BLM permitted average monthly flows. This strongly suggests that the existing BLM permitted flows significantly under estimate the available habitat for the entire resident fish community in all segments of Aravaipa Creek studied.

It is also apparent from an examination of the relative abundance data provided in Tables 4 through 6, that flow conditions during the period from 1984 to the present coincide with an increase in the relative abundance of both the Loach minnow and Spikedace.

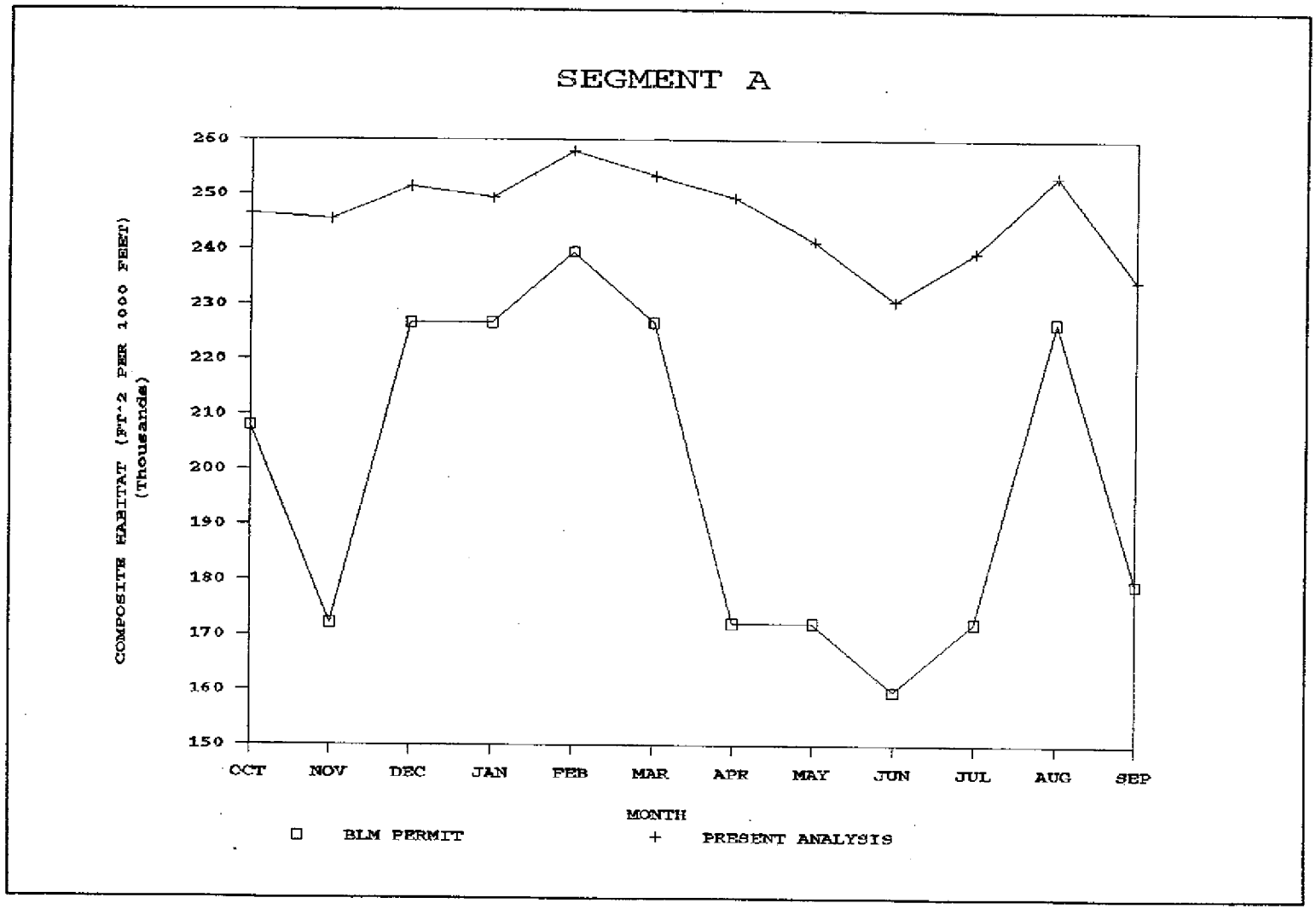

Figure 20. Comparison between available habitat based on the BLM instream flow average monthly permitted discharges and the median monthly discharges for the 1984-1988 period of record at the USGS Westend Gage site.

SRP12532

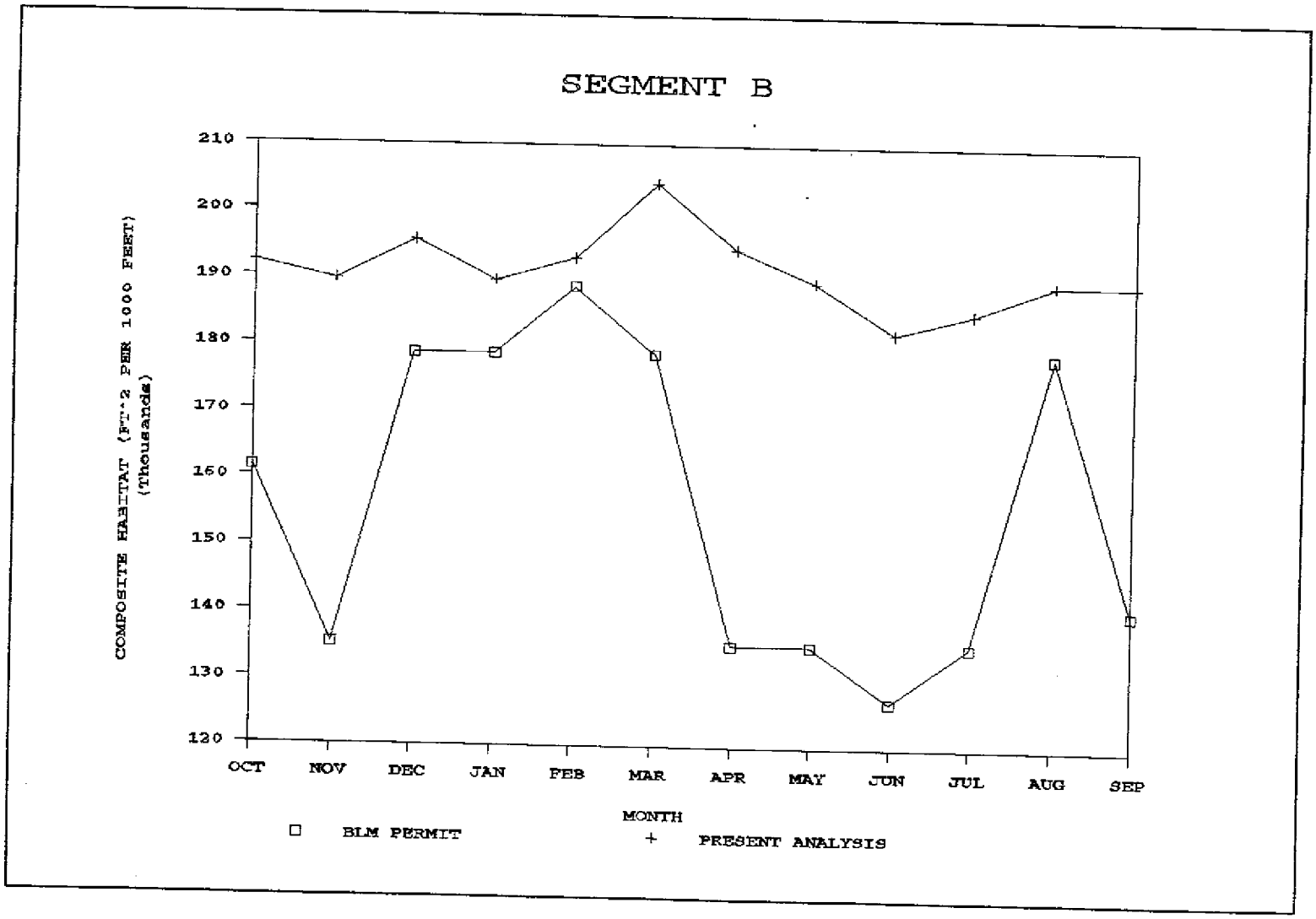

Figure 21. Comparison between available habitat based on the BLM instream flow average monthly permitted discharges and the median monthly discharges for the 1984-1989 period of record at the BLM Westend Gage site.

SRP12533

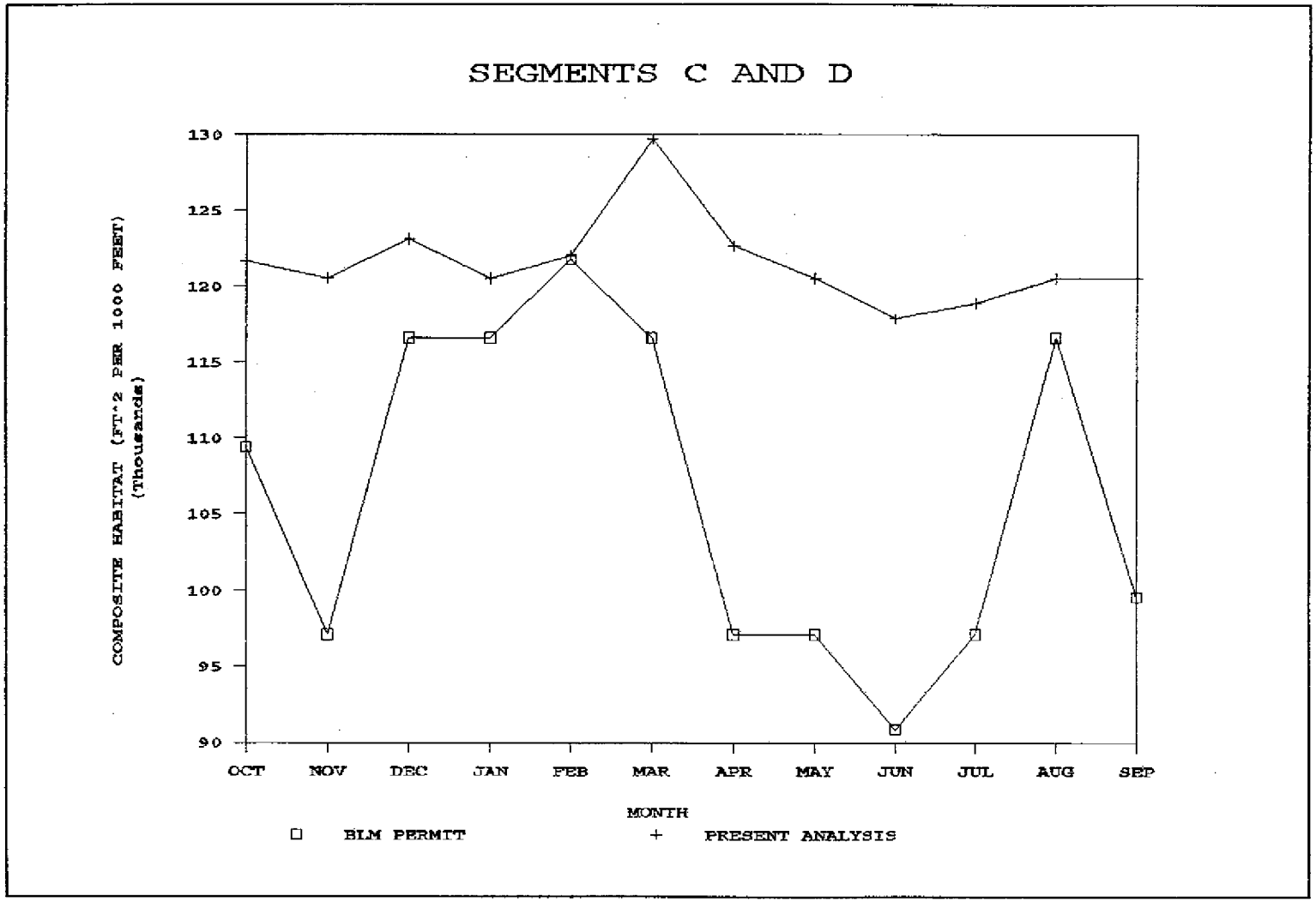

Figure 22. Comparison between available habitat based on the BLM instream flow average monthly permitted discharges and the median monthly discharges for the 1984-1989 period of record at the BLM Eastend Gage site.

SRP12534

Table 4. Relative abundance of native fishes, in percentages of total fishes collected at lower Aravaipa Creek, Pinal County, Arizona (Wood's Ranch diversion to mouth, from Minckley 1990).

Need a Key

Years	AC	RO	MF	GR	TC	PC	CI	OT	N
1966	81.9	0.0	3.1	1.0	2.3	10.9	0.8	1	~1500
1967	83.5	0.0	1.1	1.7	0.8	9.7	3.2	3	1457
1968		NO	DATA						
1969	88.7	0.0	0.3	2.0	0.3	6.7	2.0	0	807
1970	83.2	0.0	0.9	0.3	0.9	11.3	3.4	3	1193
1971		NO	DATA						
1972	82.0	0.0	1.3	0.0	1.9	12.6	2.2	1	417
1973		NO	DATA						
1974	70.0	0.0	1.0	4.0	0.0	18.0	7.0	13	11465
1975	73.5	0.0	1.4	1.0	5.7	13.0	4.5	19	21384
1976	78.1	0.0	3.8	0.2	0.7	12.4	4.8	7	8450
1977	60.2	0.3	5.1	0.8	0.8	27.1	5.7	16	1599
1978	50.4	0.0	3.3	0.2	0.1	32.1	13.9	0	3114
1979	55.3	1.0	6.1	2.6	1.1	23.7	10.3	1	1684
1980	64.5	0.0	9.4	1.1	1.0	19.5	4.5	1	743
1981	54.4	0.0	5.1	3.1	0.8	29.4	8.5	23	1655
1982		NO	DATA						
1983	49.1	0.0	18.4	0.0	0.9	21.7	9.9	43	566
1984	35.4	0.0	19.9	1.1	3.4	18.7	21.5	37	800
1985	23.5	0.0	21.7	4.1	4.1	26.6	20.0	135	1259
1986	27.1	0.0	35.5	3.0	5.7	22.1	6.6	43	475
1987	19.3	0.0	20.7	0.1	6.3	38.7	14.9	84	746
1988	28.4	0.0	17.9	0.3	4.1	41.4	7.9	116	1133

AC - longfin dace
RO - speckled "
MF - spikedace
GR - roundtail chub
TC - loach minnow
PC - desert sucker
CI - Sonora sucker
OT - ?

Table 5. Relative abundance of native fishes, in percentages of total fishes collected at upper Aravaipa Creek, Graham County, Arizona (Headwaters to above Turkey Creek confluence, from Minckley 1990).

Years	AC	RO	MF	GR	TC	PC	CI	OT	N
1965	50.0	1.0	5.0	0.0	4.0	32.5	7.5	0	2964
1966	26.7	4.1	1.9	4.3	5.2	31.9	26.0	0	4684
1967	44.0	2.5	1.0	3.7	3.9	27.1	17.8	0	455
1968		NO DATA							
1969	47.5	3.1	0.7	5.4	6.0	23.4	13.9	0	655
1970	51.1	2.9	1.3	2.7	7.4	30.7	3.9	0	2831
1971		NO DATA							
1972	55.6	0.3	0.3	0.0	15.8	16.3	11.7	0	755
1973	87.0	5.5	0.8	0.2	0.5	4.5	1.5	0	1500
1974	81.5	3.5	11.5	0.0	0.3	3.0	0.5	0	3875
1975	79.9	4.7	1.2	2.3	0.4	9.1	2.2	0	11425
1976	55.8	16.5	2.2	1.9	0.9	12.4	10.3	0	6750
1977	51.9	21.3	1.0	3.5	1.1	13.2	8.0	0	1084
1978	40.7	20.7	1.7	1.0	0.8	10.9	24.2	0	409
1979	33.3	19.4	0.9	1.7	2.1	11.5	22.1	0	2117
1980	34.5	11.7	4.3	3.4	9.1	28.7	8.3	0	1114
1981	48.7	9.4	5.7	1.7	5.3	20.9	8.3	0	523
1982	44.4	14.1	5.9	4.1	4.4	17.6	9.5	0	997
1983	20.4	6.0	19.3	2.3	5.7	24.1	22.2	0	1416
1984	17.9	3.1	21.9	2.6	6.3	31.7	16.5	4	494
1985		NO DATA							
1986	21.3	2.4	16.4	11.4	7.1	23.2	18.2	9	288
1987	12.9	0.0	21.4	4.3	12.9	33.3	17.2	17	333
1988	9.4	0.2	19.3	1.0	11.8	37.5	20.8	28	1214

Table 6. Relative abundance of native fishes, in percentages of total fishes collected in the BLM Wilderness Area, Grahman and Pinal Counties, Arizona (Turkey Creek to Wagner Ranch, from Minckley 1990).

Years	AC	RO	MF	GR	TC	PC	CI	OT	N
1950	31.7	5.5	0.0	0.0	14.6	35.5	12.7	0	800
1965	35.1	0.0	18.6	2.8	0.0	25.5	18.0	0	431
1966	22.9	8.2	16.4	5.1	3.3	24.1	20.0	0	1731
1967	27.3	4.1	11.4	9.2	2.1	30.0	15.9	1	2119
1968		NO	DATA						
1969	31.4	2.3	18.7	3.4	11.9	23.8	8.5	19	643
1970	40.6	1.0	9.5	6.7	0.8	29.8	11.6	0	1453
1971		NO	DATA						
1972	29.9	0.0	6.9	11.1	3.4	24.9	23.8	2	3116
1973	27.5	5.5	28.3	6.6	0.0	21.5	9.6	7	1033
1974	36.6	0.0	18.6	6.0	0.4	8.5	29.9	1	345
1975	32.3	4.1	11.1	3.3	1.4	36.1	11.7	0	1666
1976	31.8	6.5	17.0	4.0	0.7	25.4	14.6	7	2982
1977	11.4	9.7	9.3	9.0	3.1	39.1	18.4	3	4655
1978	9.5	11.4	7.4	11.1	1.4	41.4	17.8	0	3117
1979	7.0	7.2	10.4	9.8	0.9	49.1	15.6	1	914
1980	19.4	1.0	14.9	4.7	1.4	44.7	13.9	3	349
1981	10.7	0.0	16.7	12.0	3.9	39.3	17.4	0	550
1982	6.8	0.6	16.4	4.6	1.7	49.6	20.3	2	327
1983	11.0	0.0	29.3	4.7	6.3	27.4	21.3	0	1119
1984	9.4	0.0	27.8	3.9	4.9	41.3	12.7	1	384
1985		NO	DATA						
1986	4.7	0.2	36.7	9.4	11.1	29.7	8.2	4	409
1987	6.4	0.0	30.5	7.6	7.9	38.3	9.3	7	275
1988	10.9	0.0	23.4	14.1	8.4	30.9	12.3	32	943

Increases in relative abundance is also noted for other species with the exception of the Longfin dace and speckled dace over this same period. It is interesting to observe that the median monthly flows during the 1984 to 1988 period described above are very close to the maximum habitat weighted average discharges at which all native species habitat is optimized. These data further support the contention that an increase in the proposed instream flows represent a beneficial use for improving and maintain fish populations within Aravaipa Creek.

The results from the PHABSIM analysis indicate that optimal habitat conditions for all species occur at a discharge range that is 10 to 20 cfs greater than the results reported in Turner and Tafanelli (1983). The present analysis would suggest optimal conditions weighted for the spikedace and loach minnow occur in the range of 20 to 25 cfs versus 15 to 20 cfs for their results.

Based on the analyses presented, Table 7 lists the recommended median monthly flows for each segment of Aravaipa Creek. Table 7 also shows the median monthly flow values for the period 1984 to 1989 for each river segment as well as the existing average monthly flows for the existing BLM instream flow permit. These recommended flows were derived from the target discharge range of 20 to 25 cfs based on the 2:1 optimal habitat weighting for each segment and were adjusted based on available water supply within the reach. A constant multiplier of 80 percent of the observed median monthly flows resulted in recommended flows very close to the target flows for each segment.

Table 7. Median monthly discharges for stream segments A, B, and C-D for the period of record 1984 to 1989, the existing BLM average monthly instream flows and the recommended median monthly flows for Aravaipa Creek (all flows in cubic feet/second).

Observed Median Flow Segment	A	B	C-D	BLM Permit	Recommended A	B	C-D
Oct	29	27	25	15	23	22	20
Nov	28	26	24	10	22	20	19
Dec	32	29	26	20*	25	23	21
Jan	30	26	24	20*	24	20	19
Feb	37	28	25	25*	30	22	20
Mar	33	40	33	20	26	32	27
Apr	30	29	26	10	24	23	21
May	26	26	24	10	21	20	19
Jun	22	22	21	9	17	17	17
Jul	25	23	22	10	20	19	18
Aug	33	26	24	20*	26	20	19
Sep	23	26	24	11	18	20	19

See replacement page 47

IFIM Model Results Compared with Changes in Fish Abundance

Although the results from both the analysis of the average versus median monthly flows as well as the PHABSIM model strongly support the recommendation for increased instream flows, issues still exist on the validity of use the PHABSIM model for the establishment of instream flows in stream systems like Aravaipa Creek. In an attempt to "verify" the PHABSIM model, predictions of available habitat were compared to observed changes in the relative abundance in the fish population in Aravaipa Creek over the period from 1966 to 1988 in segment A. Although relative abundance data was available for segments B, C and D, and several analyses were attempted including auto-correlations, non-parametric rank correlations, etc., these results were inconclusive and are not

reported here. Failure to obtain a relationship for these segments was attributed to the short period of record for the gage data and the observation that changes in relative abundance in the period 1981 to 1989 were "small" compared to the long term changes over the period 1966 to 1989.

First, in the following analysis it must be recognized that the PHABSIM model assumes that physical habitat is the limiting factor controlling the fish populations. Other factors such as biological interactions, water quality and temperature are not considered. Secondly, the relative abundance data used for this verification test is qualitative and no estimates of the changes in population biomass, population structure (i.e. adult, juvenile or fry), or standing crop were available. Minckley (1990) indicated that these data are indicative of general trends and have a high degree of "noise". Rare fish are usually counted most often as much of the field activities were oriented toward collection of these species. Based on these factors, the verification analyses were directed at long term changes in available habitat to long term changes in relative abundance over three discrete time intervals suggested by an examination of the relative abundance data and flow hydrograph within segment A of Aravaipa Creek.

Table 4 provides the relative abundance data for each species on an annual basis adapted from Minckley (1990). These data are presented in graphical form in Figure 23. Based on a visual inspection of these data, three segments of the time series were chosen for comparisons. These periods represent both significant

changes in the relative abundance of the fish population that correspond to changes in the magnitude of the median monthly flows. The selected periods were from 1966 to 1976, 1977 to 1983 and 1984 to 1988.

The flow duration plots and average median monthly flows for each of these time periods are shown in Figures 24 and 15 and clearly illustrate that the flow regime within segment A has shown a sequential increase over each of these time periods. Figure 24 indicates that increases in flow have occurred over the entire range of the low to high exceedance values. This is also reflected in the 5 to 10 cfs or greater increase in the median monthly flow values shown Figure 24 and 25.

The habitat time series data for the adults in segment A were used to compute the available habitat duration plots provided in Figures 26 through 32 for each of the three time periods. The data for longfin dace (Figure 26) shows a sequential drop in the predicted habitat over each time interval with the greatest reduction occurring during the 1984 to 1988 time period. This agrees with the change in relative abundance shown for this species in Figure 23 in which the greatest overall reduction in relative abundance occurs during this time period. The predicted available habitat for the Sonoran sucker (Figure 27) shows an increase over each subsequent time period with the greatest increase during the 1977 to 1983 period. This also agrees well with the observed change in relative abundance for this species in Figure 23. The habitat duration for roundtail chub shown in Figure 28 indicates that

available habitat increased over each time interval by approximately the same amount and is generally supported by the changes in relative abundance over these same time periods. Spikedace (Figure 29) results show that the greatest increase in the predicted habitat occurs during the 1984 to 1988 period which corresponds to the largest increase in relative abundance during this same period.

Figure 30 indicates that the amount of predicted habitat for the mountain sucker increases during each time interval and is reflected in an increase in the relative abundance during each time period. Although the predicted habitat for speckled dace (Figure 31) suggest that little change occurred in available habitat over any of the time intervals, relative abundance during the 1977 to 1983 period did increase substantially. This species however, was only collected by Minckley in 1977 and 1979 (see Table 4) for all years and therefore interpretation of these data are difficult. The habitat duration plots for the Loach minnow shown in Figure 32 suggest that the post 1984 period shows the greatest increase in predicted habitat which is also reflected in the greatest increase in relative abundance during this same interval.

In general, the PHABSIM model predictions of long term available habitat correspond closely to observed changes in relative abundance in each of the three discrete time periods analyzed for all species. The magnitude of change in the habitat duration plots also generally follow the magnitude of changes in relative abundance for species during these time periods. These data would tend to support that the PHABSIM model results for predicted available

habitat are indicative of long term conditions and population responses in Aravaipa Creek and that use of the model results in the recommendation of increased instream flows is warranted.

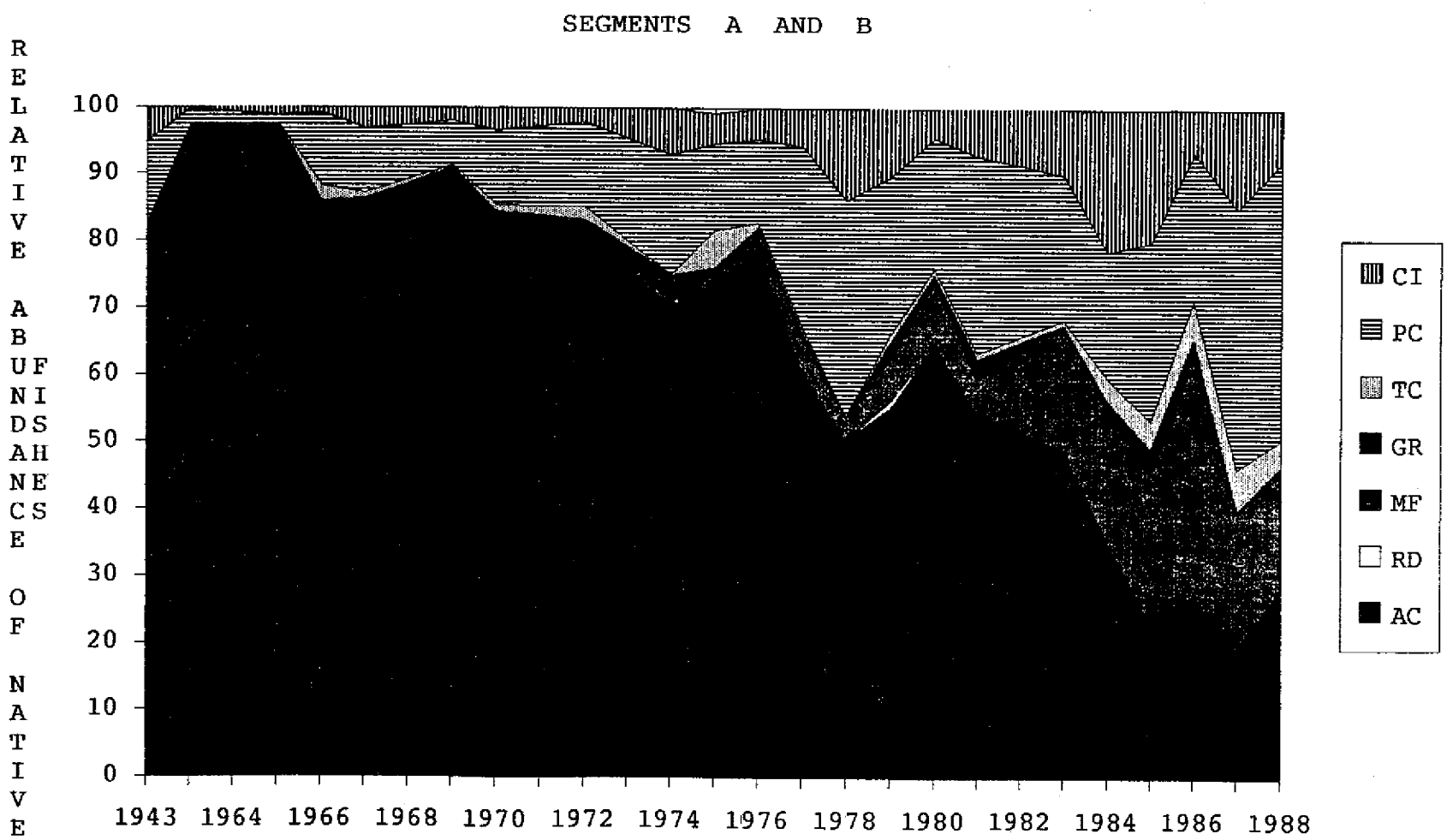

Figure 23. Changes in relative abundance of the fish community in Segments A and B of Aravaipa Creek

SRP12544

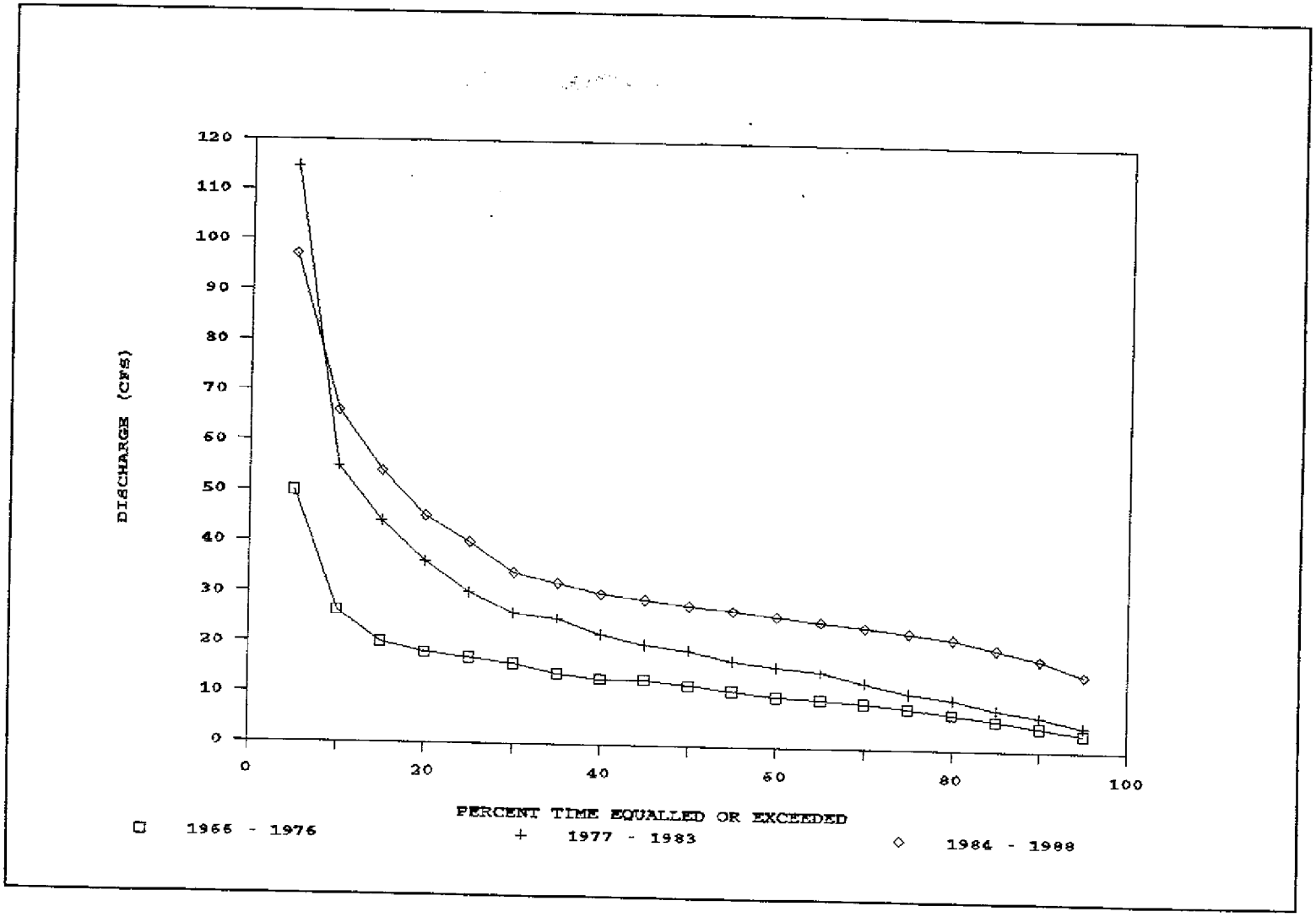

Figure 24. Median monthly flow duration plot for the USGS Westend Gage for the periods of record 1966-1976, 1977-1983, and 1984-1988.

SRP12545

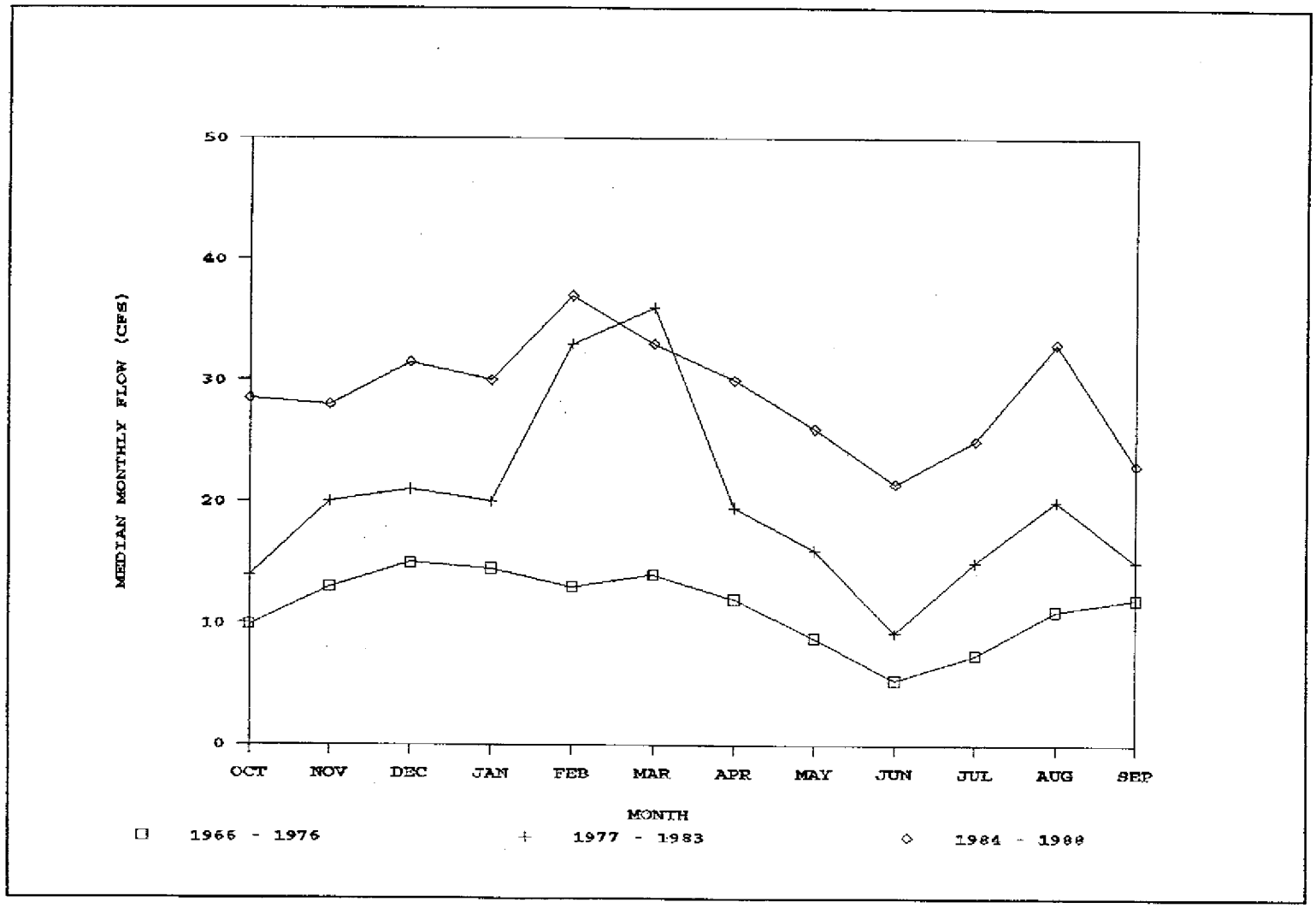

Figure 25. Median monthly flows for the USGS Westend Gage for the periods of record 1966-1976, 1977-1983, and 1984-1988.

SRP12546

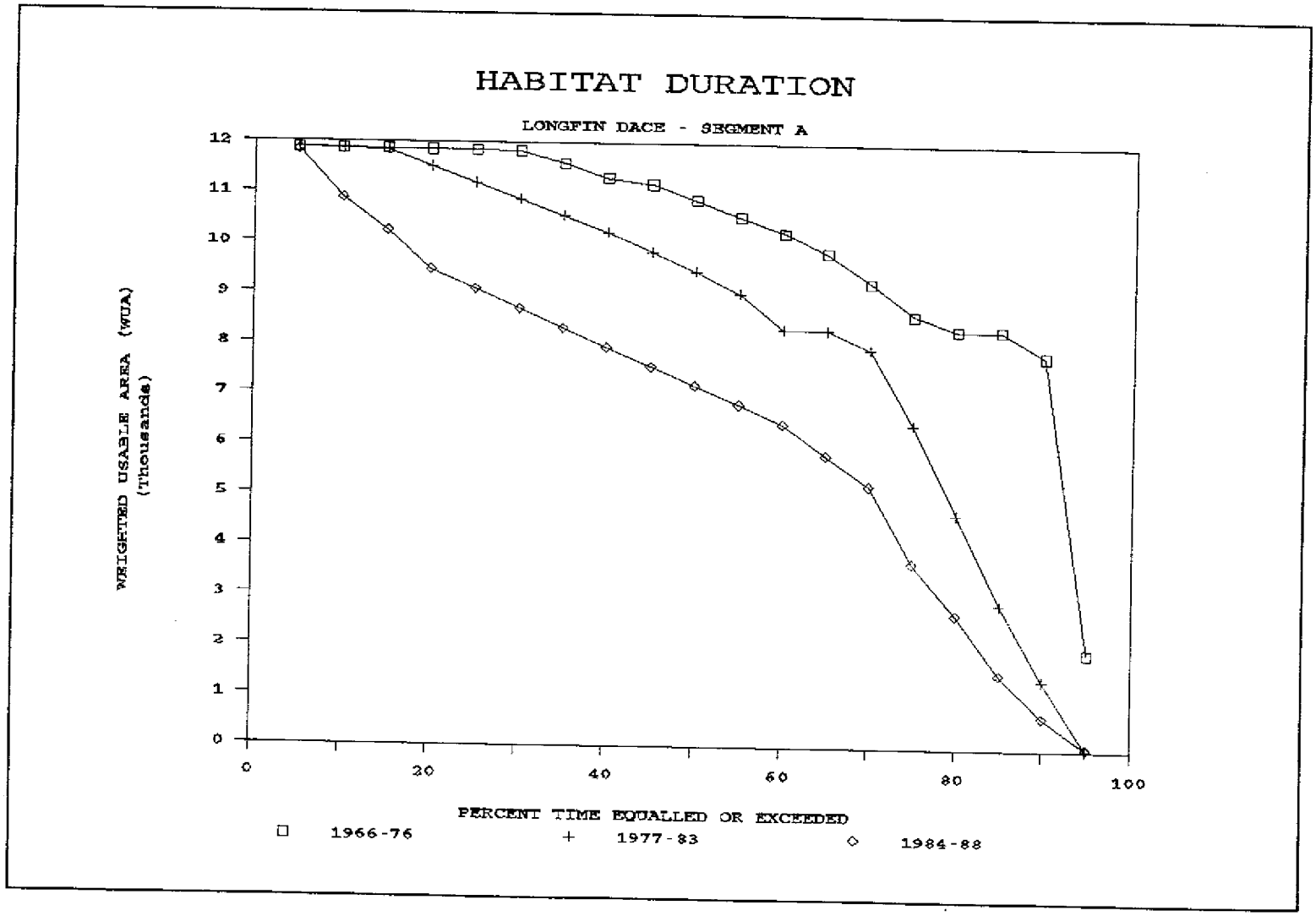

Figure 26. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Longfin Dace in Segment A.

SRP12547

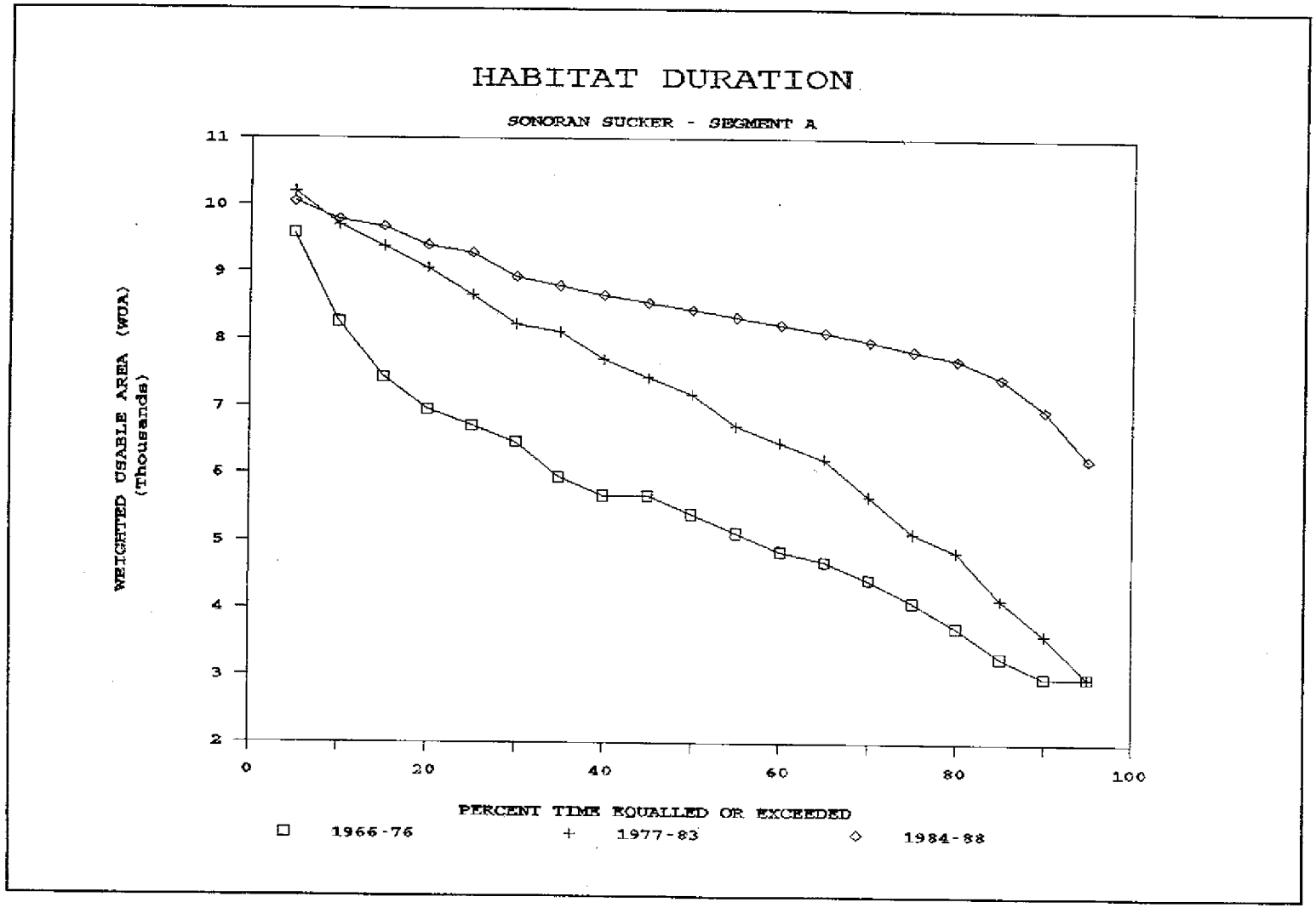

Figure 27. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Sonoran Sucker in Segment A.

SRP12548

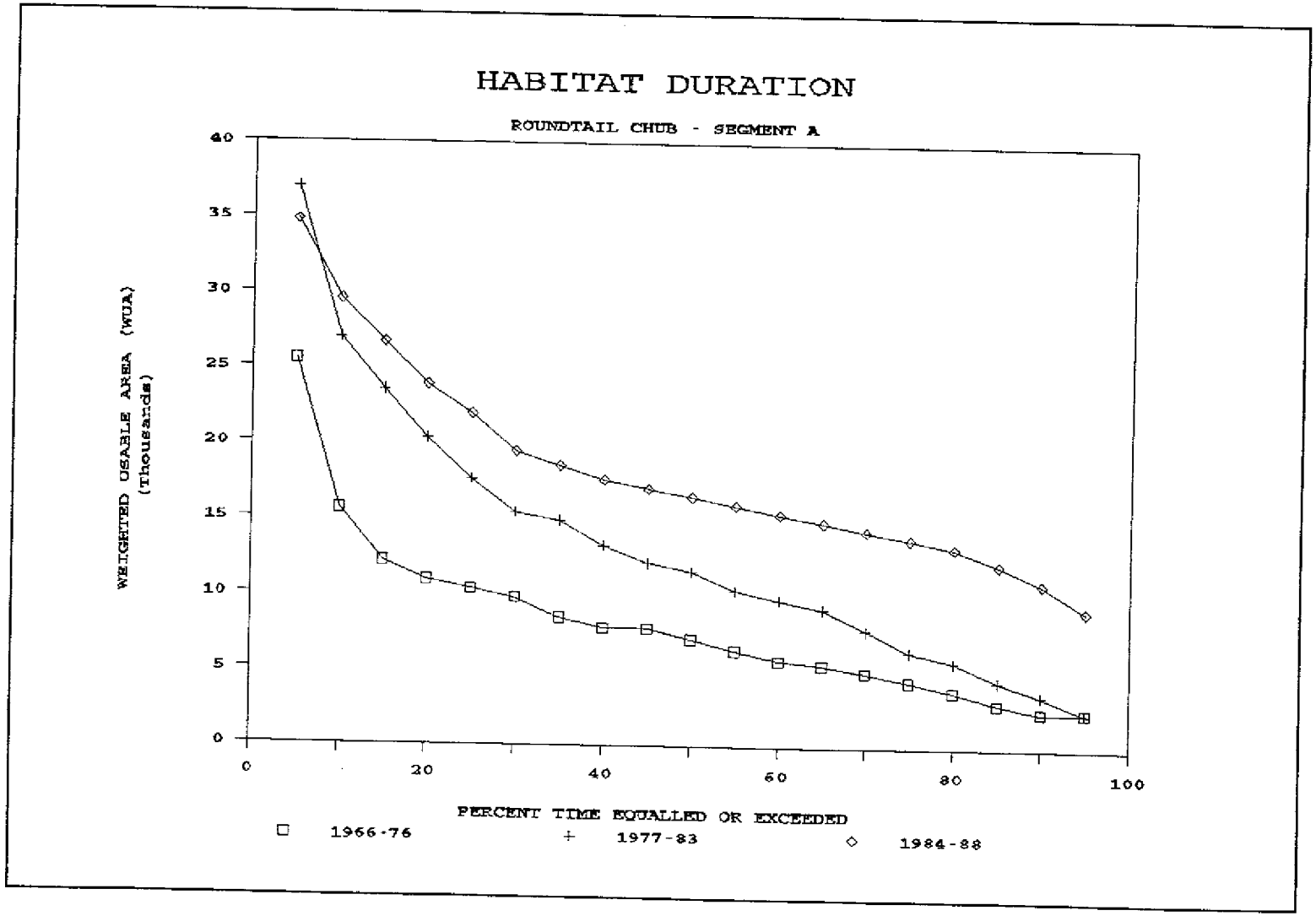

Figure 28. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Roundtail Chub in Segment A.

SRP12549

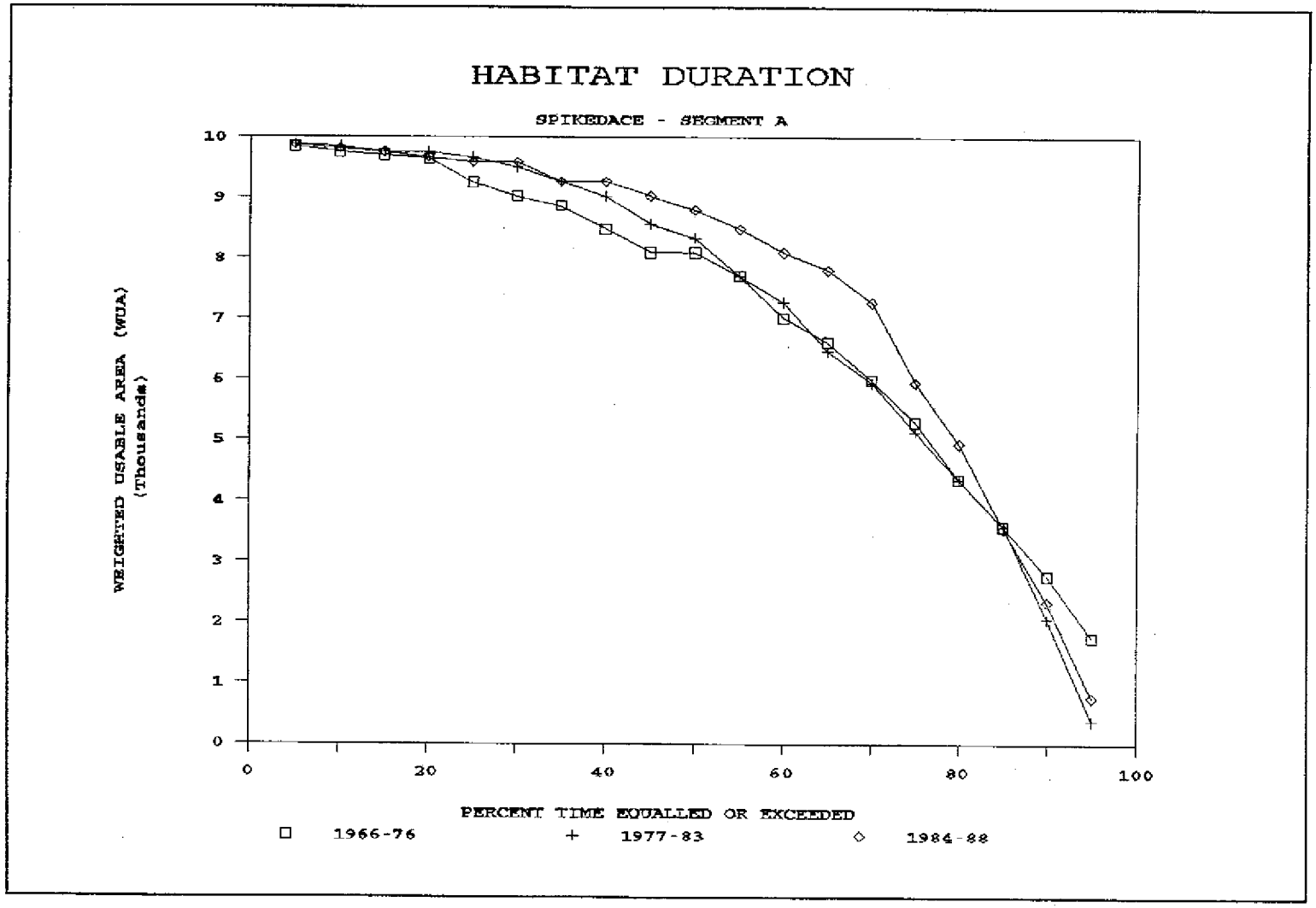

Figure 29. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Spikedace in Segment A.

SRP12550

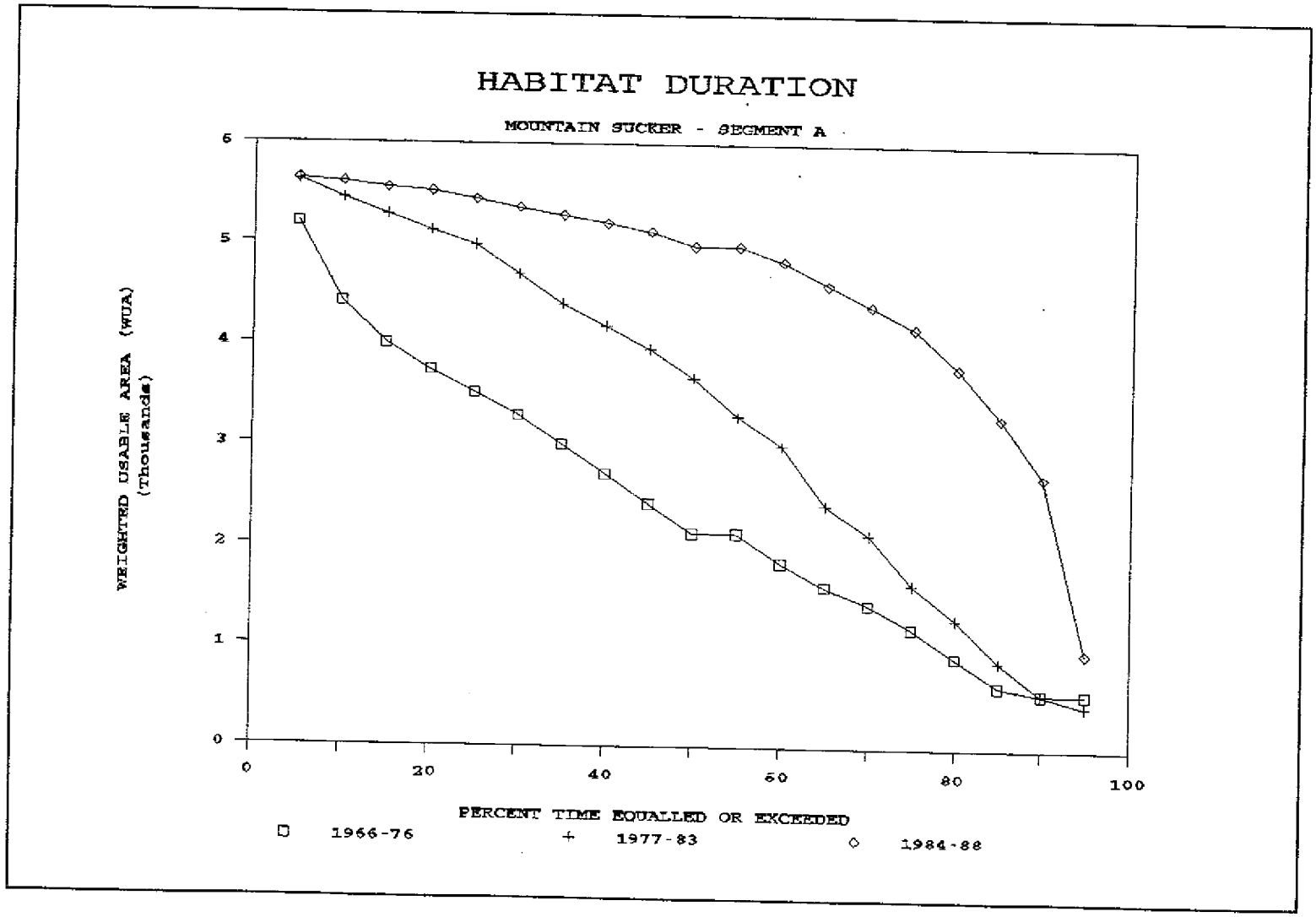

Figure 30. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Mountain Sucker in Segment A.

SRP12551

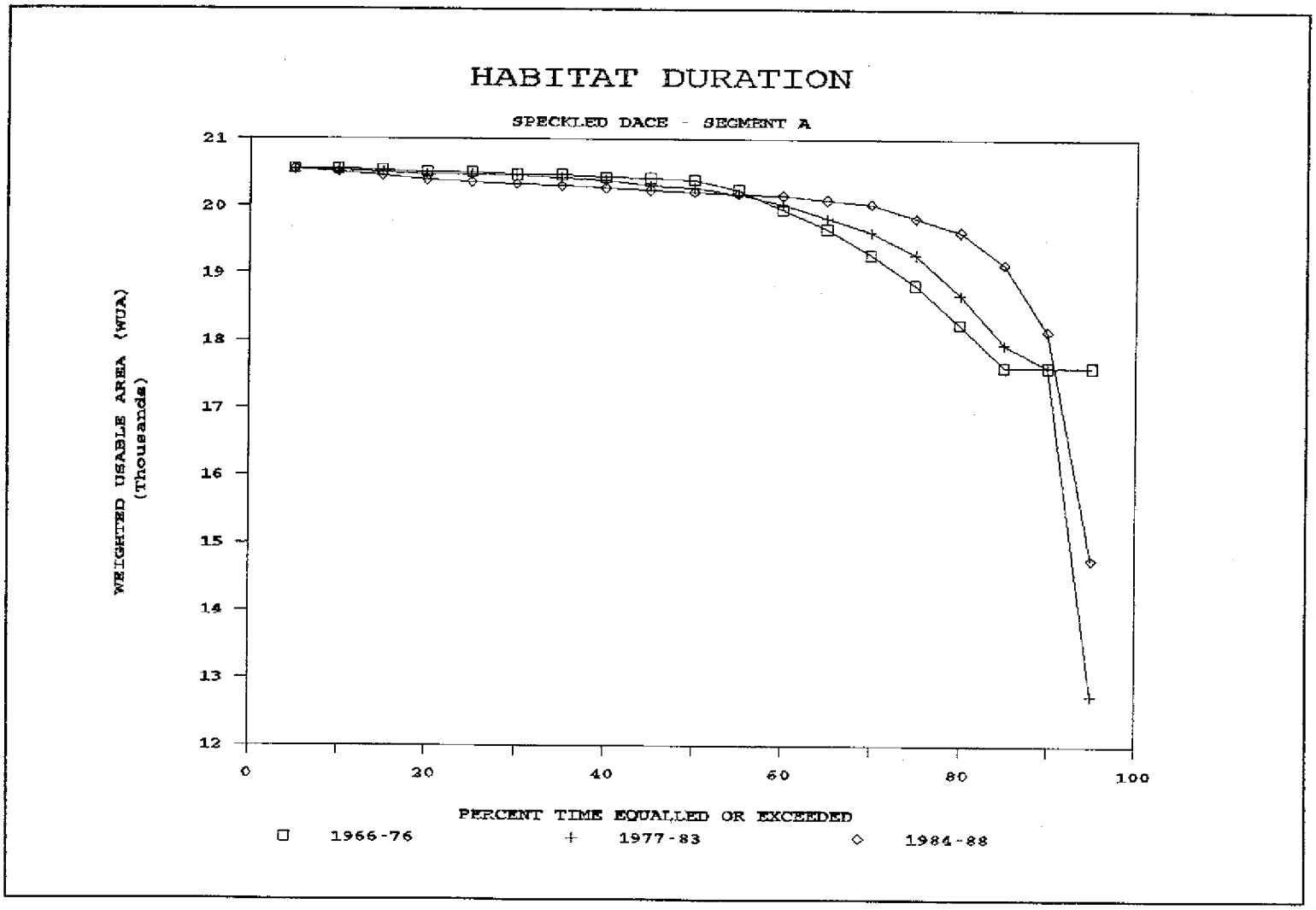

Figure 31. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Speckled Dace in Segment A.

SRP12552

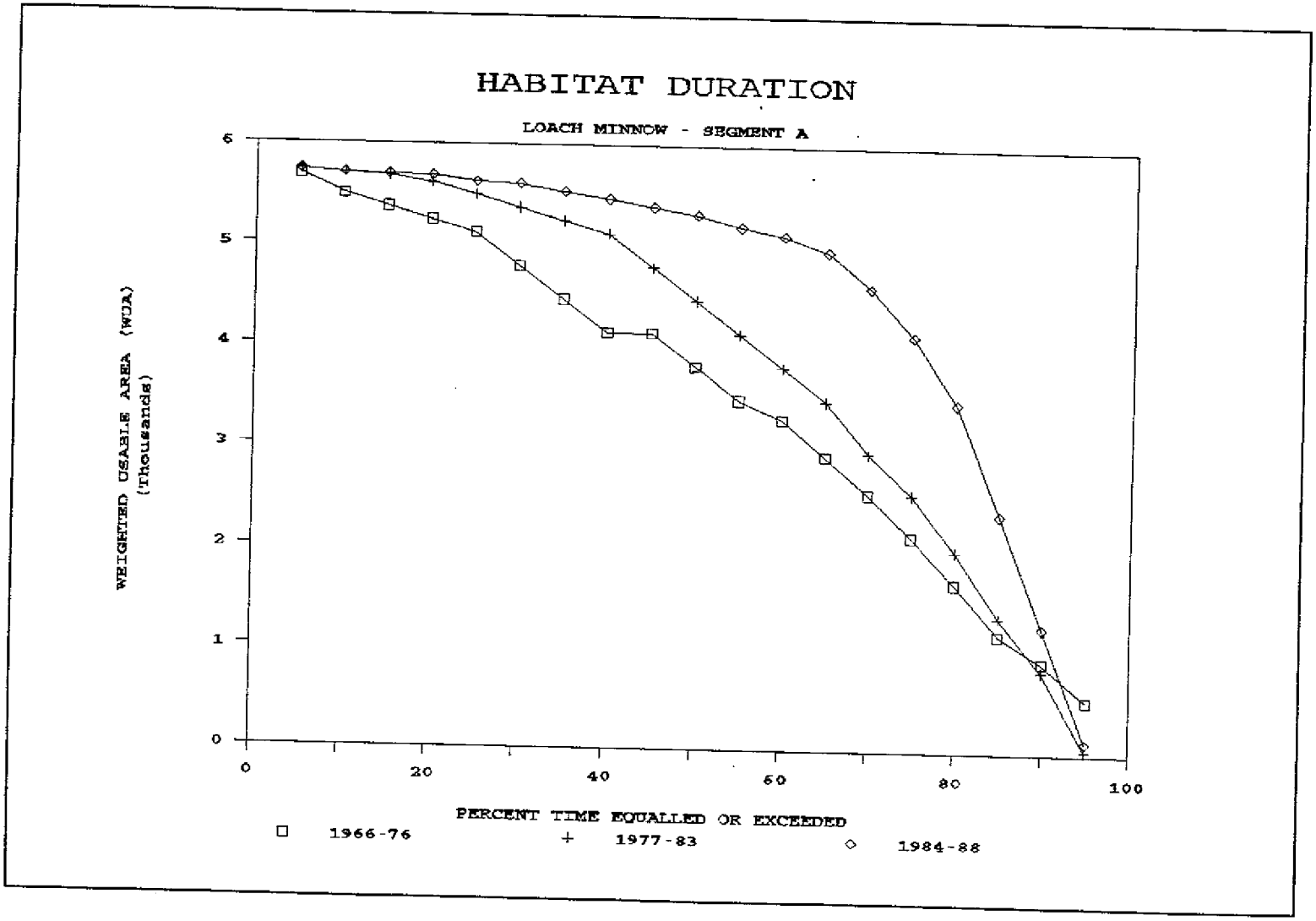

Figure 32. Annual Habitat Duration for period of records 1966-1976, 1977-1983, and 1984-1988 for the adult life stage Loach Minnow in Segment A.

SRP12553

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APPENDIX I

Memorandum to Instream Flow Planning Group
regarding the description of property and present conditions
relative to Instream Flow Application for Aravaipa Canyon
Preserve

MEMORANDUM

TO: Instream Flow Planning Group

FROM: Tom Collazo, Aravaipa Preserve Director

DATE: January 10, 1990

RE: Description of Property and Present Conditions Relative to Instream Flow Application for Aravaipa Canyon Preserve

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INTRODUCTION

On March 17, 1989, the Arizona Department of Water Resource issued to the Bureau of Land Management an instream flow permit for Aravaipa Canyon Wilderness. Since that time, The Nature Conservancy has been preparing its application to protect TNC-owned stream segments at either end of the Wilderness and to build on the protection afforded by the BLM permit. This strategy is based on further analysis of the amount of water available in each stream segment based on current hydrologic conditions and patterns of surface water use.

Where possible, amounts claimed will be based on monthly medians of daily mean flows. If continuous daily flow records are not available for a particular reach of stream, monthly medians of periodic flow measurements will be used. In addition, we will attempt to correlate instantaneous flow data sets from the East End with continuous flow charts from the West End to develop daily means for the East End. In any case, the use of median as opposed to monthly means will be employed to reduce the effect of flood events and provide a more accurate and conservative expression of base flows.

Analysis of biological justification for the amounts claimed will be based in large part on studies being initiated to further determine the range of optimum as well as minimum flows needed to sustain populations of Aravaipa's seven native fish, with particular emphasis on the needs of two federally listed species, spikedace and loach minnow. Where base flow amounts indicate availability of water beyond the minimum needs of fish, appropriation for the beneficial use of protecting optimum fish habitat will be sought.

DESCRIPTION OF STREAM SEGMENTS, AMOUNTS SOUGHT AND MEASUREMENT SITES

The attached map shows the location of the four segments of Aravaipa Creek which pass through The Nature Conservancy's Aravaipa Canyon Preserve. Also shown are the locations of three stream gauges and an established flow measuring site which will provide the data needed to verify actual flow for each of the segments. Following is a summary of the four applications being made:

A. Segment Name: Holy Joe
Location: Within NW 1/4 of Sec. 3 and NE 1/4 of Sec. 4, T6S R17E. (Approx .75 stream mile).
Amount Sought: Monthly medians of daily means taken for WY 1983-1989 at USGS Gauge.
Point of Measurement: USGS Gauge, NW 1/4 of Sec. 9, T7S R17E.
Comments: Point of diversion is below all East and West End diversions. Current use to be documented in second HSR.

B. Segment Name: West End
Location: Begin at point where creek enters the SW 1/4 of Sec. 13, T6S R17E downstream to where it leaves the NE 1/4 of the SW 1/4 of Sec. 26, T6S R17E. (Approx. 2.5 stream miles.)
Amount Sought: Monthly medians of daily means taken for WY 1981-1989 at BLM West End Wilderness Gauge.
Point of Measurement: BLM West End Wilderness Gauge, SE 1/4 of Sec. 13, T6S R17E.
Comments: Point of measurement is below East End diversions but above all West End Diversions. Current use to be documented in second HSR.

C. Segment Name: Lower East End
Location: Begin at point where creek enters the NW 1/4 of the SW 1/4 of Sec. 21, T6S R19E downstream to where it leaves the E 1/2 of Sec. 19, T6S R19E. (Approx. 1.5 stream miles.)
Amount Sought: Monthly medians of periodic flow measurements taken for WY 1978-89 at BLM East End Wilderness Gauge Site (Or monthly medians of daily means correlated from BLM West End Gauge).
Point of Measurement: BLM East End Wilderness Gauge, NE 1/4 Sec. 19, T6S R19E.
Comments: Point of measurement is below all East End diversions. Current use to be documented in second Hydrographic Survey Report (HSR).

D. Segment Name: Upper East End
Location: Begin at point where Aravaipa Creek enters the SW 1/4 of the NE 1/4 of Sec. 35, T6S R19E downstream to point where creek leaves the NE 1/4 of Sec. 28, T6S R19E. (Approx. 2.5 stream miles.)
Amount Sought: Monthly medians of periodic flow measurements taken for WY 1980-89 at Schoolhouse Site.
Point of Measurement: Schoolhouse Site, located in SW 1/4 of SE 1/4 of Sec. 27, T6S R19E.
Comments: Point of measurement is above all surface water diversions except Lackner in Fourmile Canyon.

The attached data sheet compares USGS monthly means for the post-1983 period with means from 21-year period analyzed by Dr. W. L. Minckley in 1981 ("Ecological Studies of Aravaipa Creek, Central Arizona, Relative to Past, Present and Future Uses." Final Report to BLM Safford District Office) and means from the complete 37-year data set. (Minckley's 21 years of record are 1920, 1932-42 and 1967-75. The 37-year record actually includes 39 years: 1919-21, 1931-43 and 1966-88. However, because of incomplete sets of monthly means in Water Years 1919, 1931, 1941, 1943 and 1966, most of the monthly means for the full period of record were calculated by USGS using data from only 35 to 37 years.)

The significantly higher figures for April-June for the post-83 flood period could be a function of the loss of irrigated fields rather than any dramatic increases in rainfall during those months. The reduction in evapotranspiration caused by the removal of a large percentage of riparian vegetation in the 1983 flood may also account for higher flows in subsequent growing seasons. However, as riparian vegetation continues to recover, the impact of this variable probably will decrease when comparisons with pre-83 data sets are made.

Minckley's 1981 report to BLM contains a discussion of discharge relations to precipitation and consumptive use for 21 years of data ending in 1975. His observations include:

"Far lower base flows in summer months must be attributable in part to greater irrigation demands and higher evapotranspiration in the warmer period.

"Frequency distributions of mean daily discharges of Aravaipa Creek further demonstrate differences in winter and summer patterns. [Fig. IV-7, attached]. Summer discharges show a strong tendency for bimodality, with a minimum base flow of about 0.14 m3/s [4.9 cfs], and a second mode in the vicinity of 0.28 m3/s [9.9 cfs]. The first of these represents outflow of springs and seepage from the aquifer that maintains permanency of the system, less consumptive uses such as irrigation on the floodplain. The higher mode, representing a doubling of discharge at the USGS Gage near the lower end of the channel, may reflect periods in which irrigation is not being practiced, or small, local spates resulting from thunderstorms on small catchments. The last must certainly be the case in years of relatively high discharge throughout the summer (such as 1972-73; Fig. IV-7), where the bimodal pattern persists. Winter discharges tend to be unimodal and far less variable than those in summer." (P.38, bracketed items added.)

Minckley's correlations between precipitation data from the Klondyke weather station and flow data from the USGS gauge had mixed results in showing a uniformly direct relationship. The relative saturation of the alluvium appeared to play a big part in whether rainfall events - or seasons - correlate well with flow.

ASSESSMENT OF AVAILABLE FLOW AND IRRIGATION USE

For each stream segment, flow availability is documented by data from the nearest regular measuring station. For Segments B, C and D, the longest period for which good data is available is used to develop median values. For the Holy Joe segment, the USGS Gauge data set for the period after the October 1983 flood serves as the basis for amounts sought.

Although the period after the 1983 flood may have a wet year bias, it also may be the most accurate period for factoring out consumptive uses which appear to depress critical early summer base flows measured at the USGS Gauge. It reflects the current and anticipated future uses of existing surface water rights, and presents a better picture of water availability than earlier data sets which were affected by irrigation of acreage which is no longer usable.

The following information from the DWR's Preliminary Hydrographic Survey Report (1987, pgs. 223-244) indicates that a reduction in irrigation use may account for some of the increased flow recorded in the last six years:

"Nearly 75% of the acreage served by surface water in 1975 was apparently established by 1900, as described in the following table.

Year	1900	1920	1975	1980	1985
Total of acreage continuously served by surface water since its inception."	167	212	226	200	82

The HSR also provides the following breakdown of irrigated acreage:

	Pre-83 Flood Irrigated Acres	Post-83 Flood Irrigable Acres	Acres currently Being Irrigated
East End	133.2	110.3	37.6
West End	72.1	62.5	44.1
East + West	205.3	172.8	81.7

The observed pattern of diversion use in recent years indicates that most diversions were in use during the dry April through June period. Flash floods usually beginning in July destroyed most gravel dams, and the additional precipitation of the late summer period was often adequate to maintain pasture crops on irrigated fields. Although some diversions may have been repaired frequently after flood events, others were not put back into service until after the summer rainy season, sometimes as late as October.

Hard data on seasons or quantities of irrigation use is not available. However, the bimodal pattern of summer discharges indicates that a reduction in flow of as much as 5 cfs at the USGS Gauge may have been attributable to irrigation in years prior to the October 1983 flood (assuming that evapotranspiration rates remained relatively constant for the entire six-month summer period, which includes both the dry April-June period and the wet July-September period).

Potential irrigated acreage on Aravaipa Creek has decreased from an average of 212 acres in the period from 1920 through 1980, to 82 acres in 1985, a reduction of 61 per cent. If 5 cfs is accepted as the average consumptive use on the system for the April-June period prior to the 1983 flood, a 60 per cent reduction of this peak-season use could account for a net gain of 3 cfs for monthly means measured at the USGS Gauge. The availability of this additional 3 cfs beyond the 21-year monthly means is more than demonstrated in the average of monthly means for the six years (1983-88), and in all months except June for the 37-year period. The 37-year mean, which augments the 21-year record with both the "wet bias" years following 1983 as well as the counterbalancing dry years of 1976-77 and 1981-82, adds 2 cfs to the 9 cfs mean discharge for June.

USGS Aravaipa Gauge
Monthly Means

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1983	12	19	28	74	215	311	36	19	14	21	38	53
1984	1098	50	52	51	35	30	33	31	31	91	106	56
1985	34	39	101	106	84	51	41	33	30	28	44	25
1986	32	44	30	26	58	144	29	26	20	27	25	31
1987	42	25	51	30	51	61	30	26	19	21	22	24
1988	18	21	30	28	32	23	20	15	15	33	45	20
6-Yr Mean	206	33	49	53	79	103	32	25	22	37	47	35
21-Yr Mean	28	15	39	25	58	43	14	10	9	21	30	23
37-Yr Mean	56	23	53	37	62	56	18	13	11	33	37	26

BLM W. End Gauge
Monthly Means

81-88	24	25	35	35	40	50	30	25	20	25	28	27

(From Minckley, 1981)

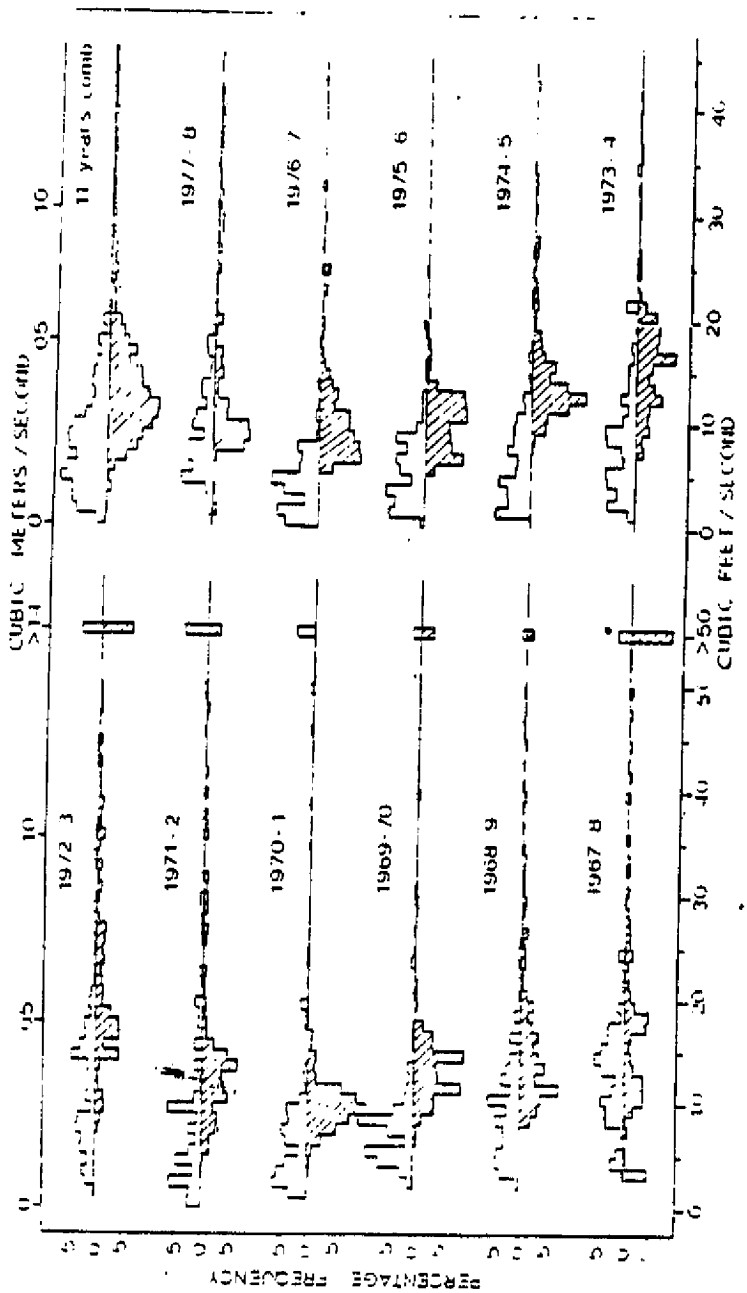

Figure IV-7. Frequency distributions of mean daily discharges in summer (above) and winter (below and hatched) in Aravaipa Creek, Pinal County, Arizona, water-years 1967 - 1977; compiled from U.S. Geological Survey records.

APPENDIX II

Table summaries of habitat mapping used in selection of IFIM transects for each identified segment.

Table II.1 Summary of Habitat Mapping for Segment A used in selection of IFIM transects. ID Number specifies sequential order of habitats in a downstream direction within this segment.

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
1	Steep Riffle	40	17	Pool (Transect A5)	30
2	Shallow Riffle	23	18	Shallow Run (Transect A4)	42
3	Steep Riffle	97	19	Shallow Riffle (Transect A3)	33
4	Shallow Riffle	41	20	Steep Riffle	16
5	Shallow Run	132	21	Pool/run (Transect A2)	25
6	Steep Riffle	45	22	Shallow Riffle (Transect A1)	41
7	Riffle/run/pool	17	23	Shallow Run	26
8	Steep Riffle (Transect A10)	40	24	Shallow Riffle/run	51
9	Shallow Run	55	25	Steep Riffle	39
10	Steep Riffle	40	26	Shallow Run	29
11	Pool	14	27	Shallow Riffle	42
12	Steep Riffle (Transect A9)	28	28	Shallow Run	26
13	Shallow Run (Transect A8)	32	29	Shallow Riffle	126
14	Shallow Riffle/ run (Transect A7)	43	30	Shallow Riffle	37
15	Shallow Riffle (Transect A6)	100	31	Shallow Run	126
16	Shallow Run	11	32	Steep Riffle	49
			33	Shallow Run	55

[1] Approximately 3.0 feet per unit

Table II.2 Summary of Habitat Mapping for Segment A used in selection of IFIM transects. ID Number specifies sequential order of habitats in a downstream direction within this segment.

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
1	Steep Riffle	20	61	Shallow Riffle/run	94
2	Steep Riffle	29	62	Shallow Riffle	51
3	Run	26	63	Steep Riffle	38
4	Shallow Riffle/run	51	64	Riffle/run	34
5	Run	38	65	Steep Riffle	14
6	Pool	9	66	Run/riffle	16
7	Run	32	67	Steep Riffle	100
8	Steep Riffle	86	68	Run	23
9	Run	20	69	Riffle	17
10	Steep Riffle	118	70	Run/pool	60
11	Steep Riffle	45	71	Steep Riffle	28
12	Riffle/run	175	72	Run/pool	20
13	Shallow Riffle	20	73	Braided Run/ riffle	47
14	Steep Riffle	35	74	Steep Riffle	97
15	Run	26	75	Run/pool	24
16	Riffle/run	32	76	Shallow Riffle	15
17	Shallow Riffle	35	77	Run	23
18	Riffle/run	255	78	Steep Riffle	17
19	Shallow Riffle	105	79	Riffle/run	69
20	Steep Riffle	45	80	Steep Riffle	151
21	Run	54	81	Shallow Riffle	26
22	Riffle/run	138	82	Run	56
23	Steep Riffle	36	83	Steep Riffle	27

[1] Approximately 3.0 feet per unit

Table II.2 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
24	Run	16	84	Run	32
25	Steep Riffle	30	85	Steep Riffle	43
26	Run	69	86	Run/pool	102
27	Shallow Riffle	43	87	Steep Riffle	34
28	Steep Riffle	41	88	Riffle/run	48
29	Shallow Riffle	30	89	Steep Riffle	30
30	Steep Riffle	16	90	Run	88
31	Run	72	91	Shallow Riffle Riffle/run	114
32	Steep Riffle	40	92	Run	35
33	Run	30	93	Steep Riffle (Transect B5)	177
34	Shallow Riffle Riffle/run	55	94	Run	35
35	Steep Riffle (Transect B10)	90	95	Shallow Riffle	20
36	Chute	21	96	Run/pool	15
37	Run (Transect B9)	44	97	Run/pool (Transect B3)	29
38	Pool (Transect B8)	17	98	Shallow Riffle	7
39	Run	19	99	Run	49
40	Shallow Riffle (Transect B7)	31	100	Steep Riffle	77
41	Riffle/run (Transect b6)	18	101	Riffle/run (Transect B2)	43
42	Shallow Riffle	27	102	Run (Transect B1)	104
43	Run	175	103	Riffle	26
44	Steep Riffle	64	104	Run	128
45	Steep RIffle	22	105	Shallow Riffle	51

[1] Approximately 3.0 feet per unit

Table II.2 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
46	Run	36	106	Run	26
47	Shallow Riffle	28	107	Shallow Riffle Steep Riffle	66
48	Run	57	108	Run	38
49	Riffle/run	48	109	Shallow Riffle	55
50	Shallow Riffle	15	110	Steep Riffle	55
51	Run	37	111	Shallow Riffle	72
52	Shallow Riffle	15	112	Steep Riffle	49
53	Run	87	113	Run	88
54	Steep Riffle	25	114	Riffle/run	60
55	Shallow Riffle	49	115	Run/riffle	139
56	Steep Riffle	24	116	Riffle	114
57	Shallow Riffle	31	117	Run	147
58	Deep Run	20	118	Shallow Riffle	62
59	Steep Riffle	62	119	Steep Riffle	21
60	Run	90			

[1] Approximately 3.0 feet per unit

Table II.3 Summary of Habitat Mapping for Segment C used in selection of IFIM transects. ID Number specifies sequential order of habitats in a downstream direction within this segment.

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HATITAT TYPE	LINEAR DISTANCE[1]
1	Shallow Riffle	209	43	Riffle	200
2	Shallow Run/riffle	118	44	Run	35
3	Riffle/run	83	45	Steep Riffle	180
4	Narrow Run	23	46	Run (Transect C11)	22
5	Riffle	94	47	Riffle (Transect C10)	129
6	Pool	3	48	Run	29
7	Run	50	49	Steep Riffle (braided)	80
8	Riffle	51	50	Run	18
9	Run	33	51	Riffle	19
10	Riffle	32	52	Run	63
11	Run	40	53	Shallow Riffle	133
12	Riffle	88	54	Steep Riffle (Transect C9)	50
13	Riffle	24	55	Shallow Riffle	130
14	Run	22	56	Shallow Run	37
15	Riffle	30	57	Narrow Run (cutbank)	25
16	Deep Run/pool	120	58	Run	46
17	Steep Riffle	45	59	Narrow fast Run	67
18	Run	16	60	Shallow Riffle/ run (Transect C8)	182

[1] Approximately 3.0 feet per unit

Table II.3 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HATITAT TYPE	LINEAR DISTANCE[1]
19	Steep Riffle	87	61	Split Channel Steep Riffle	144
20	Steep Riffle	152	62	Run (cutbank)	87
21	Steep Riffle	61	63	Shallow Riffle	57
22	Run	34	64	Riffle/run (Transect C7)	60
23	Shallow Riffle	20	65	Riffle/run	26
24	Run	120	66	Run	28
25	Riffle	26	67	Shallow Riffle	44
26	Run	94	68	Riffle	81
27	Riffle	12	69	Run/pool	13
28	Run/pool	8	70	Riffle	27
29	Riffle	23	71	Pool	5
30	Steep Riffle	13	72	Run	30
31	Run/pool	7	73	Riffle	57
32	Riffle	14	74	Run (Transect C6)	24
33	Run	30	75	Riffle/run	316
34	Riffle	22	76	Riffle	66
35	Run	24	77	Pool (Transect C5)	4
36	RIffle	53	78	Riffle	148
37	Steep Riffle	24	79	Shallow Riffle (Transect C4)	60
38	Run	32	80	Steep Riffle (Transect C3)	33
39	Shallow Riffle	35	81	Riffle/run	67
40	Run	29	82	Shallow Riffle (Transect C2)	120

[1] Approximately 3.0 feet per unit

Table II.3 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HATITAT TYPE	LINEAR DISTANCE[1]
41	Shallow Run/riffle	18	83	Riffle/run (Transect C1)	166
42	Run	41	84	Riffle/run	140

[1] Approximately 3.0 feet per unit

Table II.4 Summary of Habitat Mapping for Segment A used in selection of IFIM transects. ID Number specifies sequential order of habitats in a downstream direction within this segment.

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
1	Shallow Run	107	42	Steep Riffle	235
2	Riffle	36	43	Shallow Run (Transect D3)	37
3	Run	27	44	Steep Riffle	45
4	Run	440	45	Run	22
5	Run	120	46	Steep Riffle (Transect D2)	46
6	Riffle	120	47	Run (Transect D1)	175
7	Run	28	48	Steep Riffle	50
8	Broad Run	140	49	Run	26
9	Riffle	15	50	Shallow Riffle	71
10	Steep Riffle	60	51	Shallow Run	19
11	Run	230	52	Shallow Riffle	27
12	Shallow wide run	58	53	Run	55
13	Run	149	54	Steep Riffle	55
14	Steep Riffle	13	55	Run/pool	13
15	Pool	10	56	Run	39
16	Steep fast run	180	57	Steep Riffle	49
17	Channel Widens	120	58	Shallow Run	48
18	Steep Riffle	25	59	Shallow Riffle	54
19	Pool	7	60	Run	22
20	Steep Run	150	61	Shallow Riffle	19

[1] Approximately 3.0 feet per unit

Table II.4 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
21	Shallow Run	200	62	Shallow Run	20
22	Steep Riffle	230	63	Shallow Riffle	70
23	Shallow Run	100	64	Steep Riffle	40
24	Riffle with pocket pools	137	65	Run	26
25	Riffle	100	66	Shallow Riffle	34
26	Broad Braided Channel	83	67	Run	50
27	Channel Narrows	129	68	Steep Riffle	55
28	Deep fast run	140	69	Run	68
29	Steep Riffle	64	70	Braided Run	111
30	Pool	6	71	Steep Riffle	35
31	Shallow Run	22	72	Run/riffle	82
32	Riffle	20	73	Run	33
33	Deep Run	15	74	Shallow Riffle	25
34	Headgate	130	75	Steep Riffle	20
35	Shallow Riffle (Transect D8)	257	76	Run	64
36	Shallow Riffle (Transect D7)	89	77	Shallow Riffle	73
37	Steep Riffle	32	78	Braided shallow run	75
38	Shallow Riffle (Transect D6)	102	79	Riffle	28
39	Shallow Run (Transect D5)	107	80	Broad Run	60

[1] Approximately 3.0 feet per unit

Table II.4 (Continued)

ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]	ID NO.	HABITAT TYPE	LINEAR DISTANCE[1]
40	Steep Riffle	180	81	Split channel Shallow Riffles	100
41	Shallow Riffle	83			

[1] Approximately 3.0 feet per unit

APPENDIX III

Cross sectional profiles for each transect within Segments A, B, C and D.

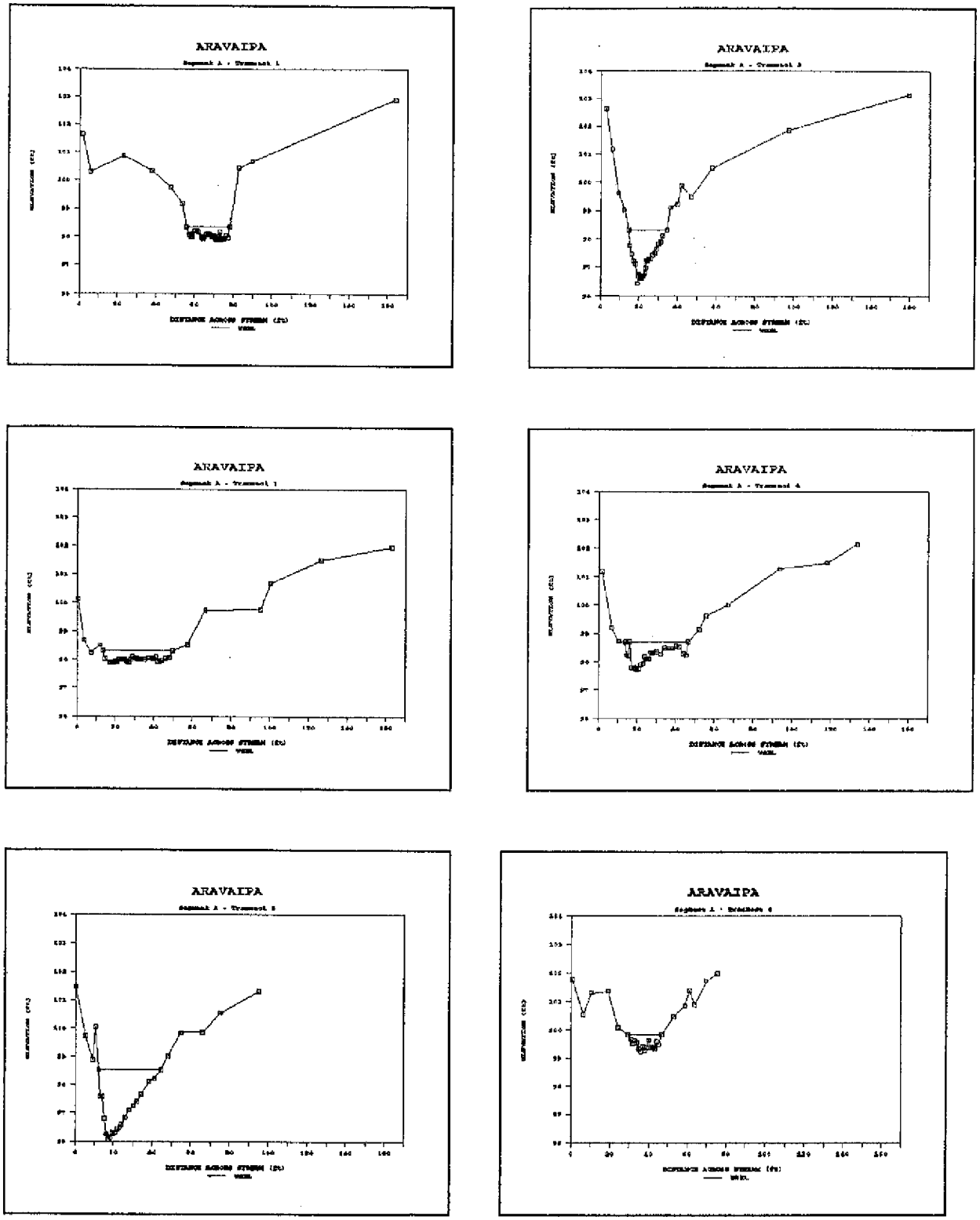

Figure III.1 Cross sectional profiles for Transects A1 through A6 for Segment A.

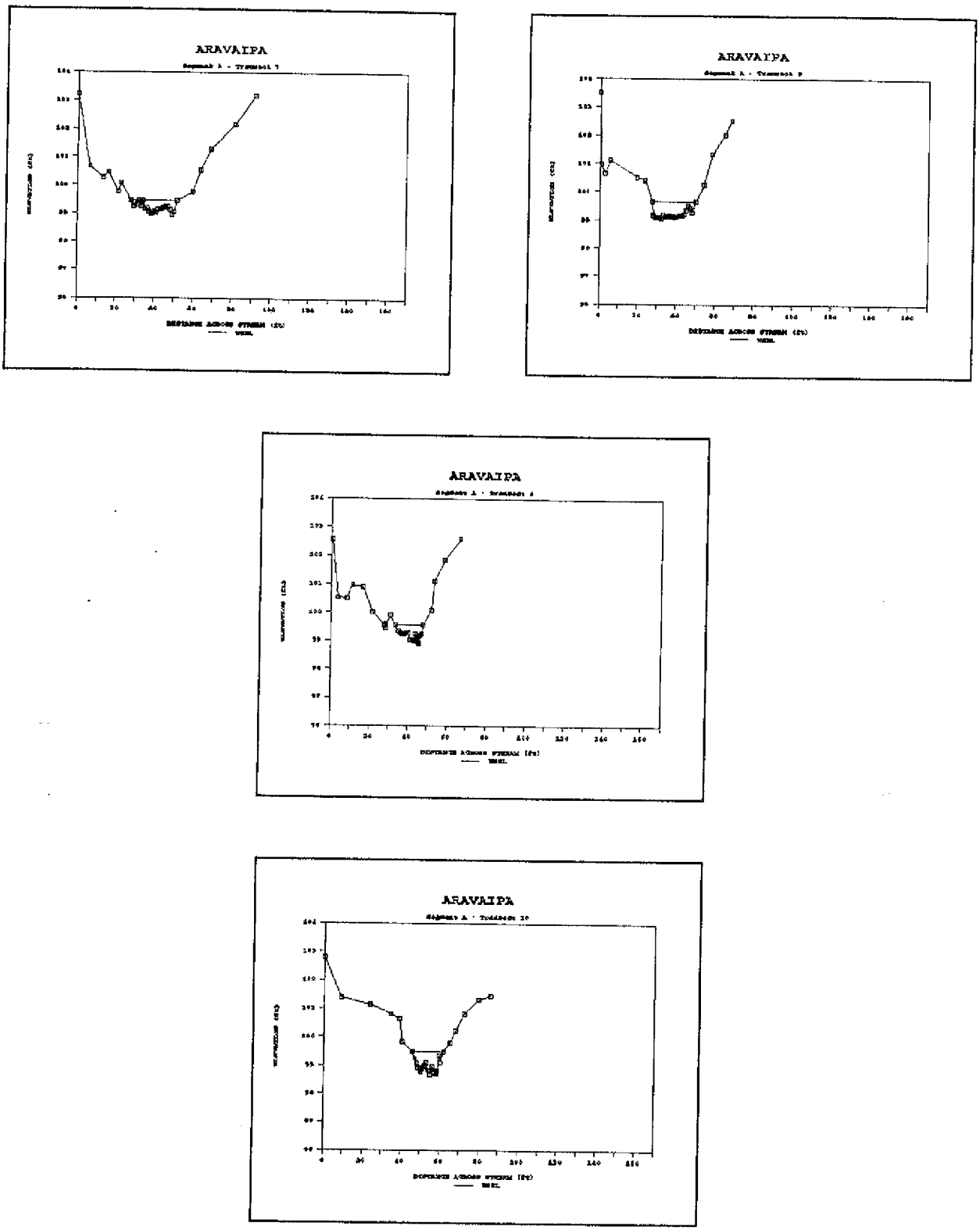

Figure III.2 Cross sectional profiles for Transects A7 through A10 for Segment A.

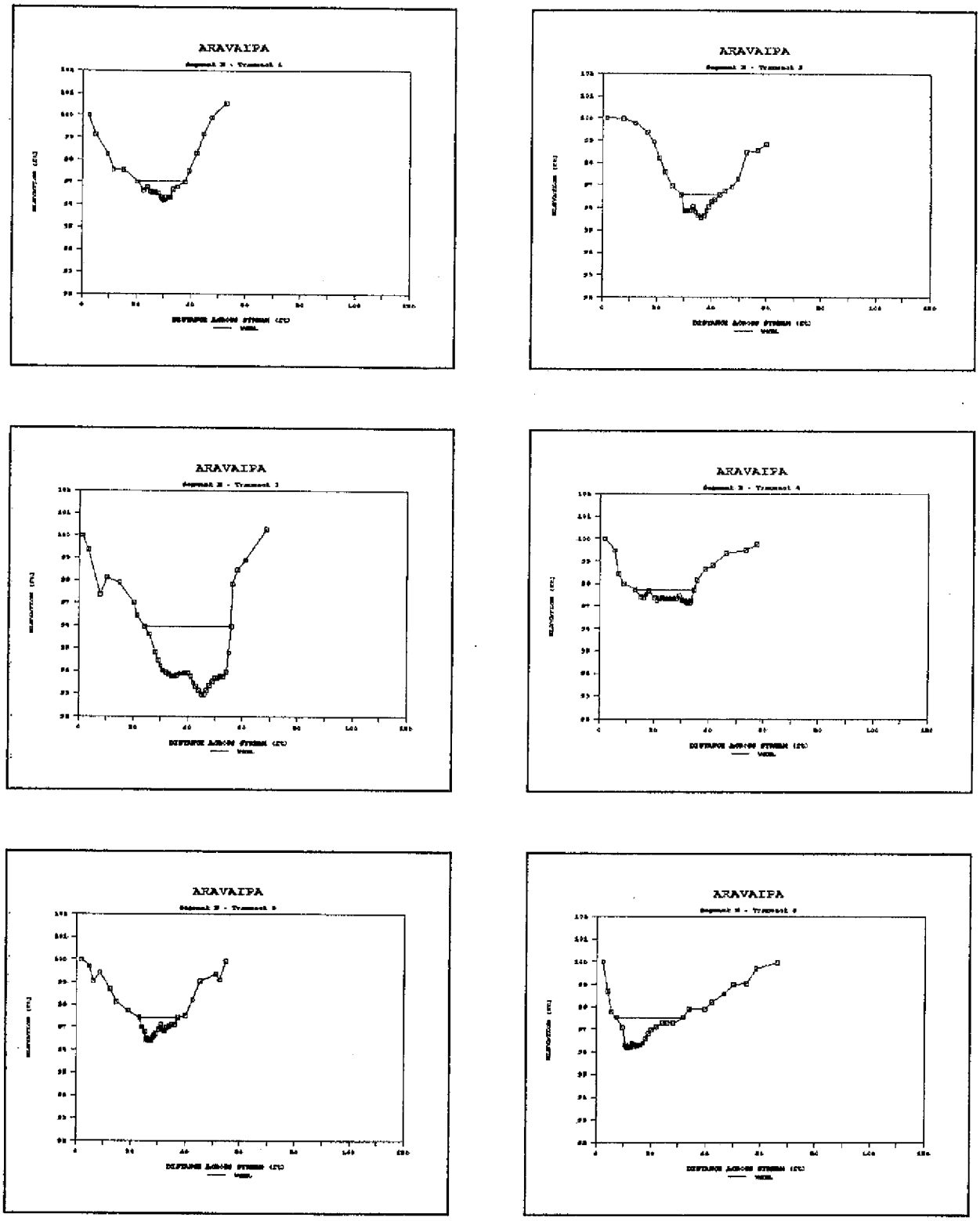

Figure III.3 Cross sectional profiles for Transects B1 through B6 for Segment B.

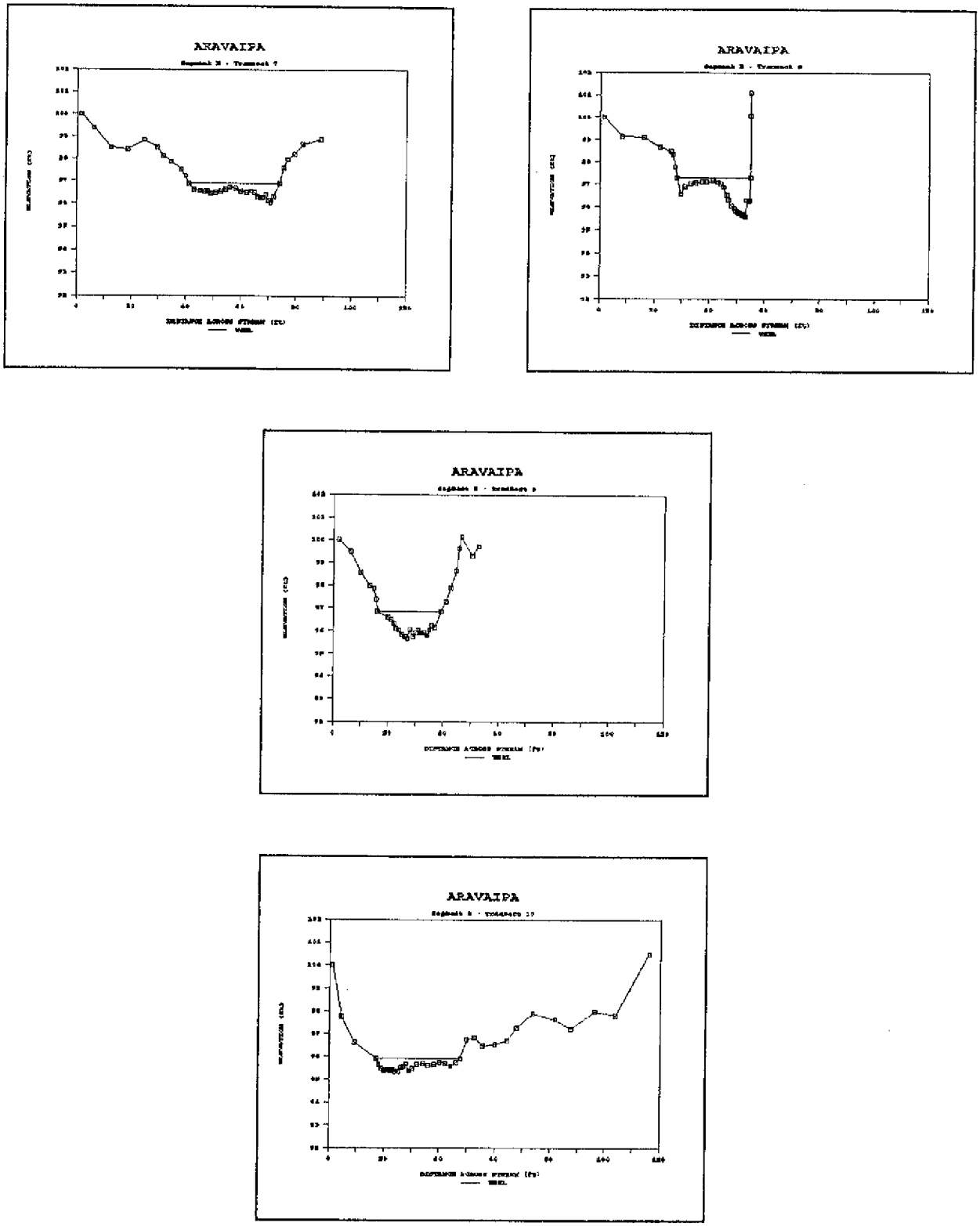

Figure III.4 Cross sectional profiles for Transects B7 through B10 for Segment B.

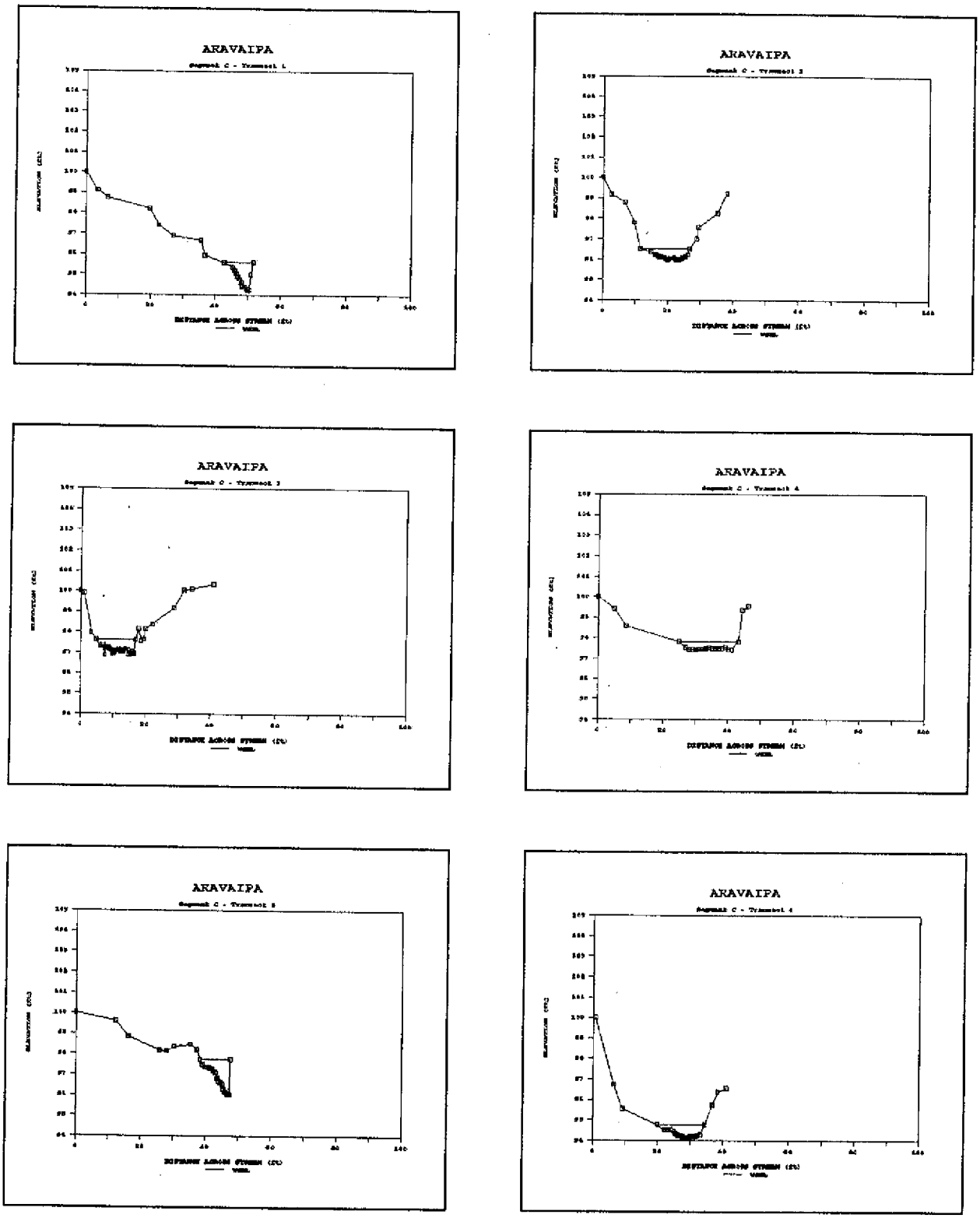

Figure III.5 Cross sectional profiles for Transects C1 through C6 for Segment C.

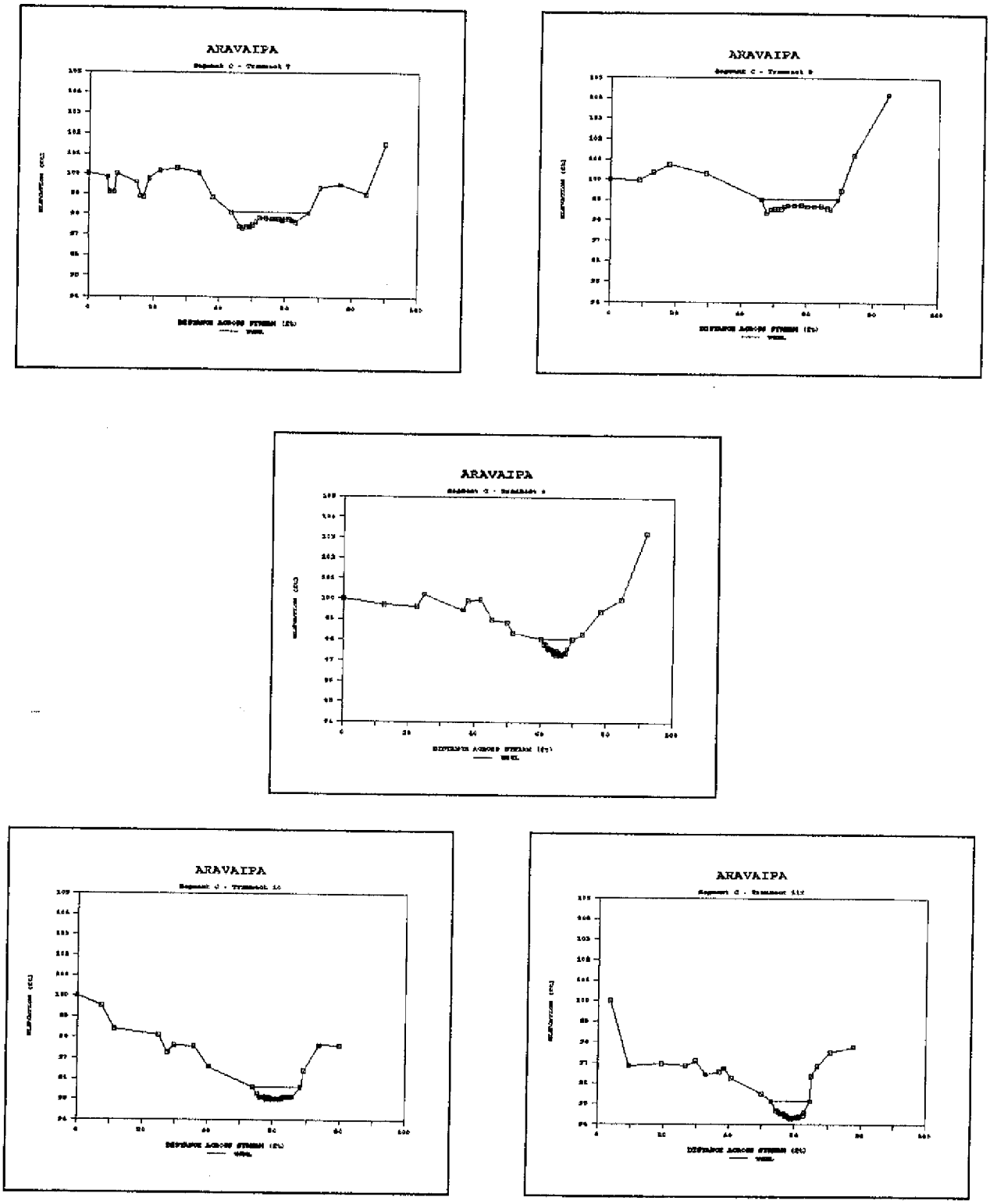

Figure III.6 Cross sectional profiles for Transects C7 through C11 for Segment C.

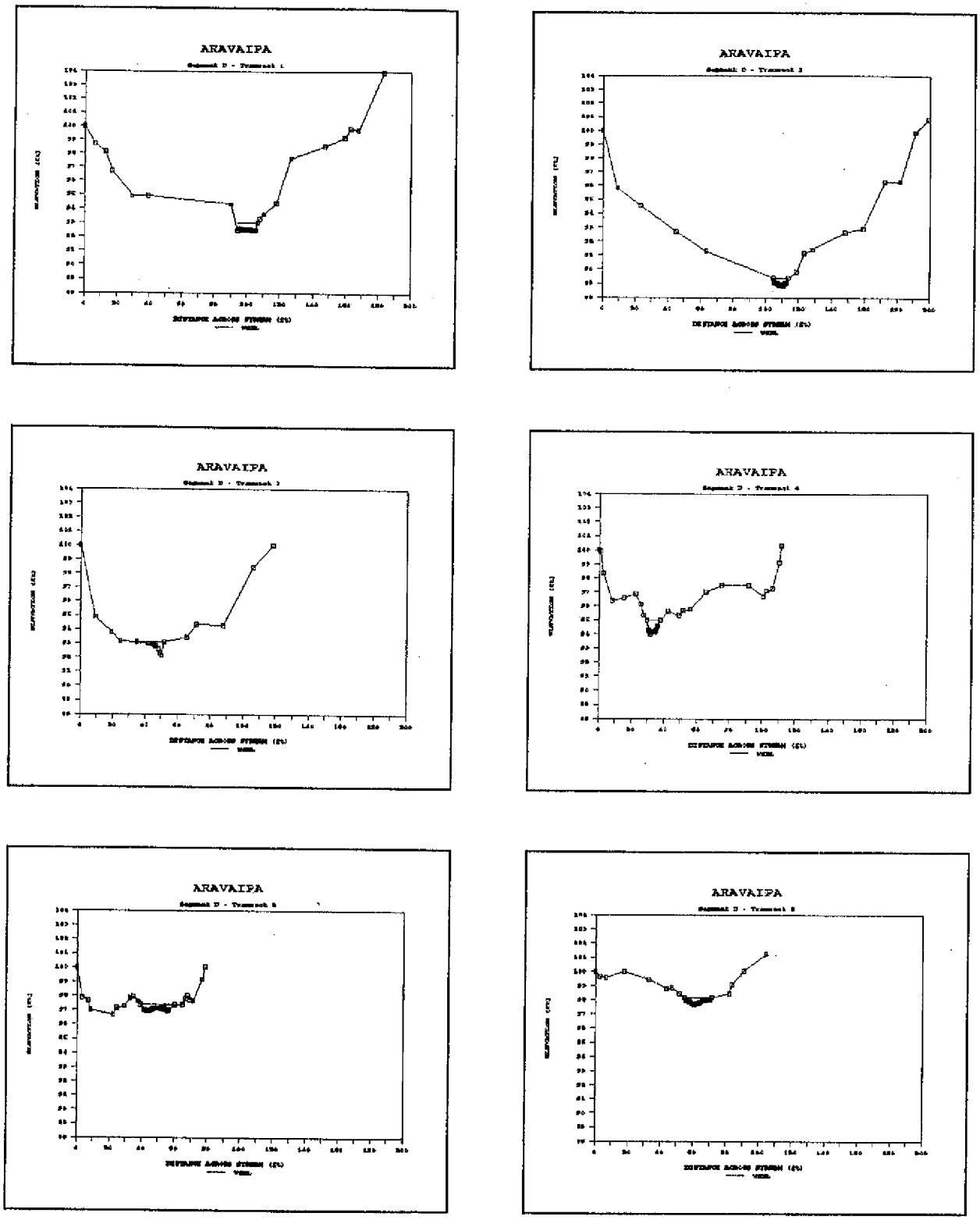

Figure III.7 Cross sectional profiles for Transects D1 through D6 for Segment D.

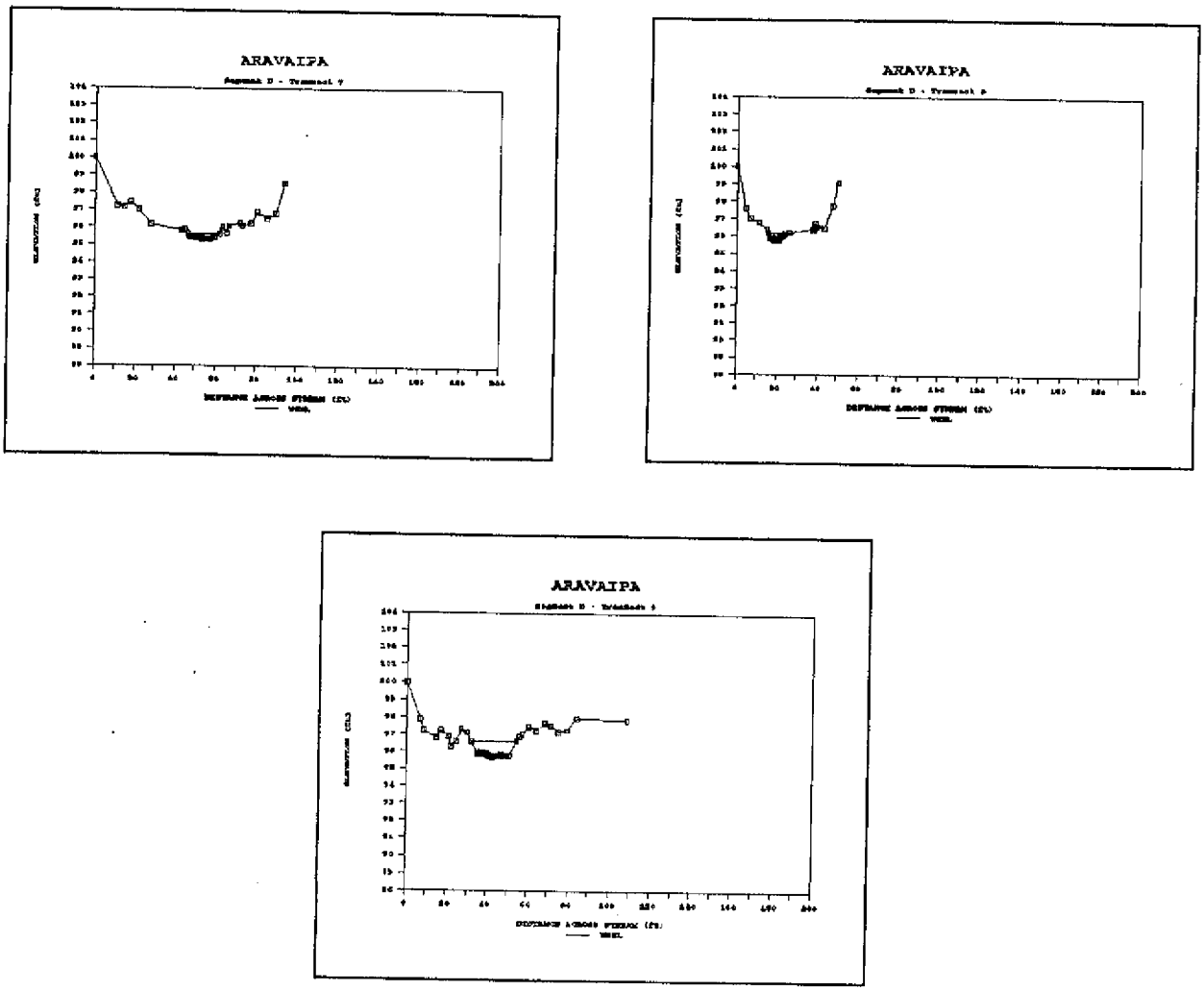

Figure III.8 Cross sectional profiles for Transects D7 through D9 for Segment D.

APPENDIX IV

Summary of PHABSIM transect data for Segments A, B, C, and D.

Table IV.1 Summary of PHABSIM transect data for Segment A.

```
ARAVAIPA CREEK PROJECT
SEGMENT A, 10 TRANSECTS
IOC       0000002000000000000
QARD   6.0
XSEC   1.0        .01.00     97.89    .00684
       1.0  1.6101.6  5.8100.3 23.1100.9 37.8100.3 47.3 99.8 53.6 99.2
       1.0 55.6 98.4 57.0 98.1 58.0 98.0 58.5 98.0 59.0 98.1 60.0 98.2
       1.0 61.0 98.2 62.0 98.2 63.0 98.0 63.5 98.0 64.0 98.0 64.5 97.9
       1.0 65.0 98.0 66.0 98.1 67.0 98.1 68.0 98.1 69.0 98.0 69.5 98.0
       1.0 70.0 98.0 70.5 98.0 71.0 97.9 71.5 97.9 72.0 97.9 72.5 98.0
       1.0 73.0 98.2 73.5 97.9 74.0 97.9 74.5 97.9 75.0 97.9 76.0 98.0
       1.0 77.0 98.0 78.0 98.4 82.9100.4 89.7100.7164.0102.9
NS     1.0 .045 5.40 .045 5.40 .045 5.40  .06 5.40  .05 5.40  .05 5.60
NS     1.0  .05 5.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 5.60  .04 4.60  .05 4.60 .045 4.50
CAL1   1.0     98.36      5.95
VEL1   1.0                              .0001 0.51 0.76 0.75 1.07 0.45
VEL1   1.0 0.79 0.12 0.76 0.94 1.22 1.19 0.24 0.04 0.33 0.66 0.72 1.88
VEL1   1.0 0.68 1.26 2.19 0.25 1.18 1.47 1.50 1.65 1.79 1.94 1.67 0.70
VEL1   1.0 0.04.0001
XSEC   2.0       10.01.00     96.44    .00739
       2.0  2.9102.6  6.1101.2  9.2 99.6 12.3 99.0 14.8 98.3 15.0 97.8
       2.0 16.0 97.5 17.0 97.2 18.0 97.1 19.0 96.4 20.0 96.8 20.5 96.7
       2.0 21.0 96.6 21.5 96.6 22.0 96.7 22.5 96.7 23.0 96.8 23.5 97.0
       2.0 24.0 97.2 24.5 97.2 25.0 97.3 26.0 97.3 27.0 97.4 28.0 97.5
       2.0 29.0 97.6 30.0 97.8 31.0 97.9 32.0 98.1 34.3 98.3 36.1 99.1
       2.0 39.6 99.2 42.0 99.9 46.9 99.5 57.8100.5 97.2101.8159.4103.1
NS     2.0  .04 8.00  .05 8.00  .05 8.00  .04 4.00  .04 4.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 6.40  .04 6.40
NS     2.0  .05 4.50  .05 4.50  .04 6.40 .045 6.40 .045 6.40 .045 4.50
CAL1   2.0     98.33      5.95
VEL1   2.0                     .0001.0001 0.05 0.40 0.29 0.12.0001.0001
VEL1   2.0 0.04 0.35 0.75 0.87 0.71 0.79 0.73 0.74 0.73 0.63 0.45 0.35
VEL1   2.0 0.20 0.10 0.02.0001.0001
XSEC   3.0        2.01.00     97.89    .00380
       3.0   .8100.1  3.7 98.7  7.5 98.3 12.0 98.5 13.5 98.3 14.5 98.0
       3.0 17.0 97.9 18.0 97.9 19.0 97.9 20.0 97.9 21.0 97.9 22.0 98.0
       3.0 23.0 98.0 24.0 98.0 25.0 98.0 26.0 97.9 27.0 97.9 28.0 98.0
       3.0 29.0 98.1 30.0 98.1 31.0 98.0 32.0 98.0 33.0 98.0 35.0 98.0
       3.0 37.0 98.1 39.0 98.0 40.0 98.1 41.0 98.1 42.0 97.9 43.0 97.9
       3.0 44.0 98.0 46.0 98.0 48.0 98.1 49.4 98.3 57.2 98.6 66.6 99.7
       3.0 95.3 99.8100.3100.7126.6101.5163.0102.0
NS     3.0  .04 8.00  .05 4.60  .04 4.60  .05 4.60  .05 4.60  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 6.40  .04 4.60  .05 4.00
NS     3.0 .045 4.60 .045 4.60 .045 4.60 .045 4.60
CAL1   3.0     98.31      5.95
VEL1   3.0                     .0001.0001 1.13 1.37 1.37 1.37 1.08 1.39
VEL1   3.0 1.26 0.67 0.42 0.66 0.76 1.00 0.90 0.50 0.59 0.34 0.23 0.44
VEL1   3.0 0.11 0.22 0.73 0.93.0001 0.64 0.19 0.07.0001.0001
VEL1   3.0
```

Table IV.1 (continued)

```
XSEC   4.0       10.01.00      97.71     .00526
       4.0  1.9101.2  7.0 99.2 10.3 98.7 13.8 98.7 14.5 98.2 15.5 98.2
       4.0 16.0 98.7 17.0 97.8 18.0 97.8 19.0 97.8 20.0 97.7 21.0 97.8
       4.0 22.0 97.9 23.0 97.9 24.0 98.2 25.0 98.1 26.0 98.1 27.0 98.3
       4.0 28.0 98.3 30.0 98.4 32.0 98.3 34.0 98.5 36.0 98.5 38.0 98.5
       4.0 40.0 98.6 42.0 98.5 44.0 98.3 45.5 98.2 46.5 98.7 52.2 99.1
       4.0 55.7 99.6 67.1100.0 93.5101.3117.9101.5133.3102.1
NS     4.0  .04 6.40  .05 6.40 .035 6.40 .035 6.40  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00 .035 6.40 .035 4.00
NS     4.0  .05 4.00  .04 4.60  .06 4.60 .045 4.60 .045 4.60
CAL1   4.0     98.71       5.95
VEL1   4.0                .0001 0.31 0.40       0.55 0.45 0.19 0.65 0.66
VEL1   4.0 0.69 0.61 0.65 0.50 0.46 0.47 0.28 0.36 0.37 0.39 0.39 0.21
VEL1   4.0.0001.0001 0.32 0.32.0001
XSEC   5.0       17.01.00      96.08     .00100
       5.0   .1101.5  5.3 99.7  9.1 98.9 10.4100.0 12.2 98.6 13.0 97.6
       5.0 14.0 97.6 15.0 96.8 16.0 96.3 17.0 96.1 18.0 96.1 19.0 96.3
       5.0 20.0 96.3 21.0 96.3 22.0 96.4 23.0 96.5 24.0 96.6 26.0 96.8
       5.0 28.0 97.1 30.0 97.3 32.0 97.4 34.0 97.6 38.0 98.1 41.0 98.2
       5.0 44.4 98.6 48.1 99.0 54.6 99.9 65.8 99.9 74.9100.6 95.0101.3
NS     5.0  .04 8.60  .05 4.60  .04 4.00 .035 8.00 .035 8.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0 .035 4.00 .035 4.00  .05 4.00  .04 4.60  .06 4.60  .06 4.60
CAL1   5.0     98.55       5.95
VEL1   5.0-                     .0001 0.07 0.06 0.09 0.11 0.19 0.23 0.25
VEL1   5.0 0.27 0.24 0.24 0.20 0.22 0.13 0.09 0.04 0.07.0001.0001.0001
VEL1   5.0.0001
XSEC   6.0        3.01.00      99.25     .00842
       6.0   .6101.8  6.3100.5 10.2101.3 18.9101.4 24.0100.1 29.2 99.8
       6.0 31.0 99.7 32.0 99.5 33.0 99.6 34.0 99.6 35.0 99.4 36.0 99.3
       6.0 37.0 99.4 38.0 99.3 39.0 99.4 40.0 99.7 41.0 99.4 42.0 99.4
       6.0 43.0 99.3 44.0 99.6 45.0 99.5 46.6 99.8 52.9100.5 58.7100.9
       6.0 61.0101.4 63.4100.9 69.5101.7 75.2102.0
NS     6.0 .035 8.00 .045 4.60 .045 4.60 .045 4.60  .05 4.60 .035 4.60
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 4.60 .035 4.60  .05 4.60
NS     6.0  .05 4.60  .05 4.60  .06 4.60  .06 4.60
CAL1   6.0     99.84       5.95
VEL1   6.0                           .0001 0.73 0.18 0.13 0.59 1.07 0.75
VEL1   6.0 1.92 1.16 1.00 1.06 1.19 1.15 0.97 0.99 0.40.0001
VEL1   6.0
XSEC   7.0       10.01.00      98.97     .00409
       7.0   .4103.2  6.6100.7 13.4100.3 16.2100.5 21.3 99.8 22.8100.1
       7.0 28.0 99.4 29.5 99.2 31.0 99.3 32.0 99.4 33.0 99.2 34.0 99.4
       7.0 35.0 99.2 36.0 99.2 37.0 99.1 38.0 99.0 39.0 99.0 40.0 99.1
       7.0 41.0 99.0 42.0 99.1 43.0 99.1 44.0 99.2 45.0 99.2 46.0 99.2
       7.0 47.0 99.3 48.0 99.1 49.0 99.0 50.0 99.1 51.3 99.4 59.9 99.8
       7.0 63.7100.6 68.9101.3 81.5102.2 91.6103.2
NS     7.0 .035 8.00 .035 8.00  .04 4.00  .04 4.00  .05 4.00  .05 4.00
NS     7.0 .035 4.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00 .035 4.60 .035 4.60
NS     7.0  .04 4.60  .05 4.60  .04 4.60 .045 4.60
CAL1   7.0     99.45       5.95
VEL1   7.0                                .0001 0.67 0.39.0001 0.50.0001
VEL1   7.0 1.13 0.77 1.07 1.30 1.86 1.55 1.23 1.31 1.34 0.54 0.59 0.72
VEL1   7.0 0.41 0.47 0.68 0.17.0001
```

Table IV.1 (continued)

```
XSEC   8.0       6.01.00      99.06     .00132
       8.0   .0103.5  1.0101.0  2.8100.7  5.2101.1 19.5100.5 23.6100.4
       8.0 27.2 99.7 28.0 99.2 29.0 99.1 30.0 99.1 31.0 99.1 32.0 99.1
       8.0 33.0 99.2 34.0 99.1 35.0 99.2 36.0 99.2 37.0 99.1 38.0 99.1
       8.0 39.0 99.1 40.0 99.1 41.0 99.2 42.0 99.2 43.0 99.2 44.0 99.2
       8.0 45.0 99.3 46.0 99.5 47.0 99.4 48.0 99.3 49.9 99.7 54.0100.3
       8.0 58.3101.3 65.0102.0 68.2102.5
NS     8.0 .035 8.00 .035 8.00  .06 4.00  .06 4.00  .06 4.60  .06 4.60
NS     8.0  .06 4.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00 .035 4.60 .035 4.00
NS     8.0  .05 4.00  .06 4.60  .06 4.00
CAL1   8.0     99.66       5.95
VEL1   8.0                              .0001.0001 0.39 0.45 0.55 0.60
VEL1   8.0 0.69 0.78 0.75 0.73 0.63 0.75 0.77 0.65 0.61 0.60 0.50 0.39
VEL1   8.0 0.29.0001.0001 0.06.0001
XSEC   9.0       17.01.00      98.88     .00429
       9.0   .8102.5  3.8100.5  8.5100.5 11.1101.0 16.5100.9 21.5100.0
       9.0 27.9 99.6 28.3 99.4 28.6 99.6 30.7 99.9 33.5 99.6 35.0 99.4
       9.0 36.0 99.3 37.0 99.3 38.0 99.2 39.0 99.3 40.0 99.3 41.0 99.0
       9.0 42.0 99.0 42.5 99.1 43.0 99.0 43.5 99.2 44.5 99.1 45.0 98.9
       9.0 45.5 98.9 46.0 99.2 47.0 99.2 47.8 99.6 51.9100.1 53.4101.1
       9.0 58.6101.8 66.4102.6
NS     9.0 .035 8.00 .035 4.60  .05 4.60  .05 4.60  .05 4.60  .04 4.60
NS     9.0 .035 4.60  .00 4.60  .00 4.60 .035 5.00 .035 5.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00 .035 4.50 .035 4.60  .07 4.50
NS     9.0  .05 4.60  .08 4.60
CAL1   9.0     99.57       5.95
VEL1   9.0                              .0001 0.98.0001      .0001 0.84
VEL1   9.0 1.22 1.14 0.16 0.51 0.97 1.32 0.46 0.52 1.54 1.71 1.50 1.55
VEL1   9.0 1.24 0.73 0.41.0001
XSEC  10.0       13.01.00      98.69     .01397
      10.0   .0102.8  8.7101.4 23.8101.2 34.6100.8 39.1100.6 40.5 99.8
      10.0 45.5 99.5 47.0 99.3 48.0 99.1 49.0 98.9 50.0 98.8 51.0 98.9
      10.0 52.0 99.0 53.0 99.1 54.0 98.8 55.0 98.7 56.0 99.0 57.0 98.7
      10.0 58.0 98.7 58.5 98.8 59.5 99.3 60.0 99.1 61.8 99.5 65.1 99.8
      10.0 67.7100.2 72.1100.8 79.4101.3 85.5101.5
NS    10.0 .045 4.60 .045 4.60  .06 4.50  .06 4.50  .08 4.50  .06 4.50
NS    10.0 .035 4.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00 .035 4.60 .035 4.60
NS    10.0  .07 4.60  .07 4.60  .07 4.60  .06 4.60
CAL1  10.0     99.49       5.95
VEL1  10.0                              .0001 0.02 0.29 0.53 0.90 0.79
VEL1  10.0 0.93 1.92 1.21 0.07.0001 1.28 1.23 1.42 0.48 0.35.0001
VEL1  10.0
XSEC  11.0       13.0 .00      98.69     .01397
      11.0   .0102.8  8.7101.4 23.8101.2 34.6100.8 39.1100.6 40.5 99.8
      11.0 45.5 99.5 47.0 99.3 48.0 99.1 49.0 98.9 50.0 98.8 51.0 98.9
      11.0 52.0 99.0 53.0 99.1 54.0 98.8 55.0 98.7 56.0 99.0 57.0 98.7
      11.0 58.0 98.7 58.5 98.8 59.5 99.3 60.0 99.1 61.8 99.5 65.1 99.8
      11.0 67.7100.2 72.1100.8 79.4101.3 85.5101.5
NS    11.0 .045 4.60 .045 4.60  .06 4.50  .06 4.50  .08 4.50  .06 4.50
NS    11.0 .035 4.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00 .035 4.60 .035 4.60
NS    11.0  .07 4.60  .07 4.60  .07 4.60  .06 4.60
CAL1  11.0     99.49       5.95
VEL1  11.0                              .0001 0.02 0.29 0.53 0.90 0.79
VEL1  11.0 0.93 1.92 1.21 0.07.0001 1.28 1.23 1.42 0.48 0.35.0001
VEL1  11.0
ENDJ
```

Table IV.2 Summary of PHABSIM transect data for Segment B.

```
ARAVAIPA CREEK PROJECT
SEGMENT B, 10 TRANSECTS
IOC       00000020000000000000
QARD  10.7
XSEC   1.0        .01.00     96.19    .00550
       1.0  2.5100.0  4.8 99.2  9.4 98.2 11.6 97.5 15.2 97.6 20.4 97.0
       1.0 22.5 96.6 24.0 96.8 25.0 96.6 26.0 96.5 27.0 96.5 28.0 96.5
       1.0 29.0 96.3 29.5 96.2 30.0 96.2 30.5 96.2 31.0 96.3 31.5 96.3
       1.0 32.0 96.3 32.5 96.3 33.5 96.7 35.0 96.8 37.8 97.0 39.4 97.5
       1.0 42.1 98.3 44.6 99.2 47.7 99.9 53.0100.6
NS     1.0  .05 4.60  .05 4.60  .04 4.60 .035 4.50 .035 5.00 .035 5.60
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 4.60 .035 4.60
NS     1.0 .035 4.60  .07 4.60  .07 4.60  .07 4.60
CAL1   1.0     97.00     10.07
VEL1   1.0                        .0001 0.90.0001 0.21 0.97 1.46 2.15
VEL1   1.0 2.10 1.99 2.17 1.93 2.23 2.21 1.85 1.88 0.53 0.40.0001
VEL1   1.0
XSEC   2.0      14.01.00     95.58    .00150
       2.0  1.8100.0  7.9100.0 12.0 99.8 16.4 99.3 18.8 98.9 20.9 98.2
       2.0 23.0 97.6 25.4 97.0 28.9 96.6 30.0 95.9 31.0 95.9 32.0 95.9
       2.0 33.0 96.1 34.0 95.8 35.0 95.7 36.0 95.6 37.0 95.7 38.0 95.9
       2.0 39.0 96.1 40.0 96.3 41.0 96.3 42.9 96.6 44.8 96.8 47.4 96.9
       2.0 49.6 97.3 52.7 98.5 56.7 98.6 60.0 98.8
NS     2.0 .045 4.60 .045 4.60 .045 4.60  .06 4.60  .07 4.60  .07 4.60
NS     2.0  .07 4.60 .035 4.60 .035 4.60  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 4.60 .035 6.50 .035 6.50
NS     2.0  .08 6.50  .06 6.50 .045 6.50 .045 6.00
CAL1   2.0     96.57     10.07
VEL1   2.0                                     .0001 0.45 1.24 1.12
VEL1   2.0 0.84 0.86 1.43 1.52 1.96 1.75 1.51 1.43 0.74.0001
VEL1   2.0
XSEC   3.0      11.01.00     92.95    .00053
       3.0  1.3100.0  3.3 99.4  7.7 97.4 10.4 98.1 14.8 97.9 20.0 97.0
       3.0 21.3 96.4 24.2 96.0 26.0 95.6 28.0 94.8 29.0 94.4 30.0 94.2
       3.0 31.0 94.0 32.0 93.9 33.0 93.8 34.0 93.8 35.0 93.8 36.0 93.8
       3.0 37.0 93.9 38.0 93.9 39.0 93.9 40.0 93.9 41.0 93.8 42.0 93.5
       3.0 43.0 93.3 44.0 93.1 45.0 93.0 46.0 92.9 47.0 93.2 48.0 93.4
       3.0 49.0 93.5 50.0 93.7 51.0 93.7 52.0 93.7 53.0 93.8 54.0 93.9
       3.0 55.0 94.8 55.9 96.0 56.3 97.9 58.0 98.5 60.9 98.9 68.6100.3
NS     3.0  .08 5.40  .08 5.40  .08 6.40  .08 4.00  .08 4.00 .035 4.00
NS     3.0 .035 4.00 .035 4.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 4.50  .04 8.00  .04 8.00  .04 8.00  .04 8.00
CAL1   3.0     95.97     10.07
VEL1   3.0                                   .0001 0.08 0.29 0.27 0.32
VEL1   3.0 0.25 0.30 0.34 0.32 0.30 0.38 0.33 0.47 0.36 0.13 0.08 0.04
VEL1   3.0 0.06 0.05 0.08.0001.0001.0001.0001.0001.0001.0001.0001.0001
VEL1   3.0.0001.0001
XSEC   4.0       4.01.00     97.14    .00420
       4.0  1.9100.0  5.6 99.5  7.1 98.4  8.9 98.0 13.0 97.7 15.0 97.4
       4.0 16.0 97.4 17.0 97.5 18.0 97.7 20.0 97.4 21.0 97.3 22.0 97.3
       4.0 23.0 97.4 24.0 97.3 25.0 97.3 26.0 97.3 27.0 97.3 28.0 97.3
       4.0 29.0 97.5 30.0 97.3 31.0 97.2 31.5 97.2 32.0 97.2 32.5 97.1
       4.0 33.0 97.2 33.5 97.2 34.5 97.7 35.6 98.2 38.4 98.7 41.6 98.8
       4.0 46.2 99.4 53.4 99.5 57.5 99.7
```

Table IV.2 (continued)

```
NS     4.0  .07 4.00  .07 4.00  .05 4.00 .035 4.60 .035 4.60  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 6.50 .035 4.00 .035 4.60 .035 4.60
NS     4.0  .07 4.00  .07 4.00  .07 4.00
CAL1   4.0     97.74     10.07
VEL1   4.0                     .0001.0001 0.48 0.04.0001 0.70 0.88 1.48
VEL1   4.0 1.83 1.75 1.74 1.74 1.87 1.52 1.66 1.29 1.48 1.87 1.56 1.48
VEL1   4.0 1.54 0.86.0001
XSEC   5.0       8.01.00     96.38    .01890
       5.0  1.9100.0  5.0 99.7  6.4 99.1  8.7 99.4 12.4 98.7 14.7 98.1
       5.0 18.9 97.8 23.1 97.4 24.0 97.0 25.0 96.8 25.5 96.5 26.0 96.5
       5.0 26.5 96.4 27.0 96.4 27.5 96.4 28.0 96.5 28.5 96.6 29.0 96.7
       5.0 30.0 96.9 31.0 97.1 32.0 96.8 32.5 96.9 33.0 97.0 34.0 97.0
       5.0 35.0 97.1 36.0 97.1 37.2 97.4 40.1 97.5 42.7 98.2 45.3 99.1
       5.0 51.1 99.4 52.6 99.1 54.8 99.9
NS     5.0  .07 6.50  .07 6.50  .07 6.50  .07 4.60  .07 4.60 .035 4.60
NS     5.0 .035 4.60 .035 4.60  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 4.60 .035 4.60  .05 6.00  .05 4.60
NS     5.0  .07 4.00  .07 4.00  .07 4.00
CAL1   5.0     97.41     10.07
VEL1   5.0                                     .0001.0001 0.17 0.60 1.94
VEL1   5.0 2.38 2.25 1.95 1.46 1.34 1.07 0.92 1.56 1.52 1.66 0.78 0.04
VEL1   5.0.0001 0.61.0001
XSEC   6.0      15.01.00     96.18    .00067
       6.0  2.5100.0  4.0 98.7  5.6 97.8  7.3 97.5  9.5 97.1 10.5 96.3
       6.0 11.0 96.2 11.5 96.2 12.0 96.2 12.5 96.2 13.0 96.3 13.5 96.3
       6.0 14.0 96.2 15.0 96.3 16.0 96.3 17.0 96.4 18.0 96.6 19.0 96.8
       6.0 20.0 97.0 22.0 97.1 24.0 97.3 26.0 97.3 28.0 97.3 31.5 97.5
       6.0 33.8 97.9 39.7 97.9 42.1 98.2 46.7 98.6 50.0 99.0 54.7 99.1
       6.0 58.3 99.7 66.1100.0
NS     6.0  .07 4.60  .07 4.60  .05 4.60  .07 4.60  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 4.60
NS     6.0 .035 4.60 .035 4.60  .04 4.60  .07 4.00  .07 4.00  .07 4.00
NS     6.0  .07 4.60  .07 4.60
CAL1   6.0     97.53     10.07
VEL1   6.0                .0001 0.10 0.54 0.68 1.01 1.72 1.38 0.52 0.15
VEL1   6.0 1.08 0.77 0.97 0.17 0.30 1.06 1.07 0.72 0.54.0001 0.20.0001
VEL1   6.0
XSEC   7.0      11.01.00     96.05    .00815
       7.0  1.5100.0  6.4 99.4 12.4 98.5 18.7 98.4 24.8 98.8 29.6 98.5
       7.0 31.8 98.1 34.6 97.9 38.2 97.5 39.8 97.2 41.1 96.9 43.0 96.6
       7.0 45.0 96.6 47.0 96.5 48.0 96.5 49.0 96.4 51.0 96.5 52.5 96.5
       7.0 54.5 96.6 56.0 96.7 58.0 96.7 60.0 96.5 62.0 96.5 63.5 96.6
       7.0 65.0 96.5 66.0 96.3 67.0 96.3 68.0 96.3 69.0 96.4 70.0 96.1
       7.0 71.0 96.1 72.0 96.3 74.0 96.9 75.4 97.6 77.1 98.0 79.5 98.2
       7.0 82.3 98.7 88.8 98.9
NS     7.0  .06 4.50  .06 4.50 .045 4.60 .045 4.60  .07 4.00  .07 4.00
NS     7.0  .05 4.00  .05 4.00 .035 4.60 .035 4.60 .035 4.60  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 4.60  .07 4.50  .07 4.50  .07 4.60
NS     7.0  .07 4.60  .07 4.60
CAL1   7.0     96.89     10.07
VEL1   7.0                                                   .0001 0.60
VEL1   7.0 0.45 1.37 1.02 1.03 1.30 0.94 1.21 0.02 0.49 0.46 0.35 2.28
VEL1   7.0 0.86 0.44 1.73 0.66 1.70 0.92 1.55 0.72.0001
VEL1   7.0
```

Table IV.2 (continued)

```
XSEC   8.0       8.01.00     95.57    .00048
       8.0  1.7100.0  8.2 99.2 16.0 99.1 21.9 98.7 26.0 98.5 26.7 98.4
       8.0 27.5 97.8 28.1 97.3 29.5 96.6 31.0 96.9 33.0 97.0 35.0 97.1
       8.0 37.0 97.1 39.0 97.1 41.0 97.1 43.0 97.1 44.0 97.0 45.0 96.9
       8.0 46.0 96.5 47.0 96.3 48.0 96.1 49.0 95.9 49.5 95.8 50.0 95.8
       8.0 50.5 95.8 51.0 95.7 51.5 95.7 52.0 95.7 52.5 95.6 53.0 95.6
       8.0 53.5 96.3 54.0 96.3 54.5 96.3 54.7 97.3 54.8100.1 54.9101.1
NS     8.0 .045 6.50 .045 6.50  .06 4.00  .07 4.00  .07 4.00  .07 4.00
NS     8.0  .07 4.00  .07 4.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00 .035 4.50  .00 8.00  .00 8.00
CAL1   8.0     97.27     10.07
VEL1   8.0                                     .0001 0.05 0.01 0.16 0.33
VEL1   8.0 0.67 0.31 0.14 0.04 0.11 0.18 0.48 0.78 0.89 1.10 1.13 1.05
VEL1   8.0 0.98 1.03 1.04 1.02 1.01 0.95 0.75 0.46 0.15.0001
XSEC   9.0        .41.00     95.64    .00230
       9.0  2.0100.0  6.2 99.5  9.9 98.6 13.0 98.0 14.7 97.8 15.5 97.4
       9.0 16.0 96.8 20.0 96.6 21.0 96.5 22.0 96.3 23.0 96.1 24.0 96.0
       9.0 25.0 95.8 26.0 95.7 27.0 95.6 28.0 96.0 29.0 95.8 30.0 95.9
       9.0 31.0 96.0 32.0 95.9 33.0 95.9 34.0 95.8 35.0 96.0 36.0 96.2
       9.0 37.0 96.2 39.2 96.8 40.8 97.3 42.8 97.9 44.4 98.7 45.6 99.6
       9.0 46.5100.2 50.3 99.3 52.5 99.7
NS     9.0 .035 6.50  .04 6.50  .05 6.00  .07 4.00 .035 4.00 .035 4.00
NS     9.0 .035 4.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 4.60  .06 4.00  .06 4.60  .06 4.60  .07 4.60
NS     9.0  .07 4.50  .07 4.50  .07 4.50
CAL1   9.0     96.85     10.07
VEL1   9.0                                .0001 0.15 0.42 0.45 0.60 0.77
VEL1   9.0 1.03 0.55 1.07 1.10 1.03 0.30 0.19 0.62 0.92 0.46 0.18 0.05
VEL1   9.0 0.49.0001
XSEC  10.0      14.01.00     95.35    .00614
      10.0  1.0100.0  4.5 97.8  9.0 96.6 17.0 95.9 18.0 95.7 19.0 95.5
      10.0 20.0 95.4 21.0 95.4 22.0 95.4 23.0 95.4 24.0 95.3 25.0 95.3
      10.0 26.0 95.5 27.0 95.6 28.0 95.7 29.0 95.4 30.0 95.5 32.0 95.7
      10.0 34.0 95.7 36.0 95.6 38.0 95.6 40.0 95.8 42.0 95.7 44.0 95.6
      10.0 46.0 95.7 47.6 95.9 49.8 96.7 52.5 96.9 55.5 96.5 59.9 96.5
      10.0 64.5 96.7 67.7 97.3 73.6 97.9 81.9 97.7 87.4 97.2 96.1 98.0
      10.0103.8 97.8115.9100.5
NS    10.0  .05 4.00  .07 4.50  .05 4.60  .04 4.60  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 4.50  .04 4.50  .04 4.50  .04 4.60 .035 4.00
NS    10.0 .035 4.00  .07 4.60  .07 4.60  .07 4.60 .045 4.60  .06 4.60
NS    10.0  .06 4.60 .035 4.00
CAL1  10.0     95.93     10.07
VEL1  10.0                .0001 0.95 0.88 1.29 0.16 1.65 1.35 1.15 1.99
VEL1  10.0 1.64 2.61 2.01 1.98 1.01 0.16.0001 0.08 0.59 0.34 0.59 0.43
VEL1  10.0.0001.0001
VEL1  10.0
XSEC  11.0      15.0 .00     92.43    .00614
      11.0  1.0100.0  4.5 97.8  9.0 96.6 17.0 95.9 18.0 95.7 19.0 95.5
      11.0 20.0 95.4 21.0 95.4 22.0 95.4 23.0 95.4 24.0 95.3 25.0 95.3
      11.0 26.0 95.5 27.0 92.4 28.0 93.4 29.0 95.4 30.0 95.5 32.0 95.7
      11.0 34.0 95.7 36.0 95.6 38.0 95.6 40.0 95.8 42.0 95.7 44.0 95.6
      11.0 46.0 95.7 47.6 95.9 49.8 96.7 52.5 96.9 55.5 96.5 59.9 96.5
      11.0 64.5 96.7 67.7 97.3 73.6 97.9 81.9 97.7 87.4 97.2 96.1 98.0
      11.0103.8 97.8115.9100.5
```

Table IV.2 (continued)

```
NS    11.0  .05 4.00  .07 4.50  .05 4.60  .04 4.60  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    11.0  .00 0.00  .00 4.50  .04 4.50  .04 4.50  .04 4.60 .035 4.00
NS    11.0 .035 4.00  .07 4.60  .07 4.60  .07 4.60 .045 4.60  .06 4.60
NS    11.0  .06 4.60 .035 4.00
CAL1  11.0     95.93     10.07
VEL1  11.0               .0001 0.95 0.88 1.29 0.16 1.65 1.35 1.15 1.99
VEL1  11.0 1.64 2.61 2.01 1.98 1.01 0.16.0001 0.08 0.59 0.34 0.59 0.43
VEL1  11.0.0001.0001
VEL1  11.0
ENDJ
```

Table IV.3 Summary of PHABSIM transect data for Segment C.

```
ARAVAIPA CREEK PROJECT
SEGMENT C, 11 TRANSECTS
IOC       00000020000000000000
QARD   9.0
XSEC   1.0        .01.00     94.25    .00789
       1.0   .0100.0  3.7 99.1  6.8 98.8 19.7 98.2 22.6 97.4 27.1 96.9
       1.0 35.6 96.7 36.9 95.9 42.7 95.6 45.5 95.4 46.0 95.2 46.5 95.1
       1.0 47.0 94.9 47.5 94.8 48.0 94.6 48.5 94.4 49.0 94.4 49.5 94.3
       1.0 50.0 94.3 50.5 94.3 51.0 95.0 51.7 95.6
NS     1.0  .06 4.00  .06 4.00  .06 4.00  .06 4.00  .06 4.00  .05 4.00
NS     1.0 .035 4.50  .04 4.50 .035 4.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 4.00
CAL1   1.0     95.60      8.98
VEL1   1.0                                          .0001.0001 0.26 0.85
VEL1   1.0 1.20 1.45 1.70 1.90 1.70 1.48 1.40 1.60 2.00.0001
XSEC   2.0        9.01.00     96.00    .00570
       2.0   .0100.0  2.5 99.2  6.7 98.8  9.7 97.8 11.5 96.5 15.0 96.4
       2.0 16.0 96.2 16.5 96.2 17.0 96.2 17.5 96.1 18.0 96.1 18.5 96.1
       2.0 19.0 96.1 19.5 96.0 20.0 96.0 20.5 96.0 21.0 96.1 21.5 96.1
       2.0 22.0 96.1 22.5 96.0 23.0 96.0 23.5 96.0 24.0 96.0 24.5 96.1
       2.0 25.0 96.1 25.5 96.1 26.0 96.2 26.8 96.5 28.8 97.0 29.5 97.6
       2.0 35.2 98.3 38.0 99.2
NS     2.0  .10 4.00  .08 4.00  .05 4.00  .05 4.00 .035 4.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 5.60 .035 4.00 .035 4.00
NS     2.0 .035 4.00  .06 4.00
CAL1   2.0     96.51      8.98
VEL1   2.0                     .0001 0.58 0.38 1.18 1.39 0.95 1.70 1.88
VEL1   2.0 2.10 2.00 2.18 2.80 2.85 2.28 2.25 2.02 2.42 1.90 2.10 1.66
VEL1   2.0 1.64 1.36 0.60.0001
XSEC   3.0        8.01.00     96.88    .02435
       3.0   .0100.0  1.1 99.9  3.3 98.0  4.9 97.6  6.0 97.3  7.0 97.3
       3.0  7.5 96.9  8.0 97.3  8.5 97.3  9.0 97.2  9.5 97.1 10.0 97.0
       3.0 10.5 97.0 11.0 97.1 11.5 97.1 12.0 97.2 12.5 97.1 13.0 97.1
       3.0 13.5 97.1 14.0 97.1 14.5 97.1 15.0 96.9 15.5 96.9 16.0 97.0
       3.0 16.5 97.0 17.1 97.6 17.9 98.2 18.7 97.6 19.4 97.7 20.1 98.2
       3.0 22.1 98.4 28.7 99.2 31.9100.1 34.2100.1 40.9100.3
NS     3.0  .07 4.00  .07 4.00  .07 4.00  .10 4.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 5.60  .00 7.00  .00 7.00  .10 5.00  .10 4.00
NS     3.0 .035 4.00 .035 4.00  .05 4.00  .06 4.00  .06 4.00
CAL1   3.0     97.63      8.98
VEL1   3.0                .0001 0.12 1.12 1.00 1.12 1.55 2.04 1.85 0.85
VEL1   3.0 1.32 1.15 1.62 1.75 2.15 1.58 2.00 2.12 1.65 1.80 1.10 1.25
VEL1   3.0 0.90.0001
XSEC   4.0        7.01.00     97.42    .01260
       4.0   .0100.0  5.0 99.4  8.7 98.6 24.9 97.8 27.0 97.5 28.0 97.4
       4.0 29.0 97.4 30.0 97.4 31.0 97.5 32.0 97.5 33.0 97.5 34.0 97.5
       4.0 35.0 97.5 36.0 97.5 37.0 97.5 38.0 97.5 39.0 97.5 40.0 97.4
       4.0 41.0 97.4 42.9 97.8 44.3 99.4 46.1 99.6
NS     4.0  .06 4.00  .05 4.00 .035 4.00 .035 4.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 5.00  .05 4.00  .06 4.00
CAL1   4.0     97.83      8.98
VEL1   4.0                .0001 0.09 0.62 1.18 2.50 2.28 2.00 1.40 2.02
VEL1   4.0 1.70 2.18 2.10 1.42 0.95 0.47 0.30.0001
```

Table IV.3 (continued)

```
XSEC   5.0       8.01.00      96.02     .00633
       5.0   .0100.0 12.3 99.6 16.0 98.8 25.7 98.2 27.9 98.1 30.2 98.4
       5.0 35.1 98.5 37.3 98.2 38.3 97.7 39.0 97.5 40.0 97.4 41.0 97.3
       5.0 41.5 97.3 42.0 97.3 42.5 97.2 43.0 97.1 43.5 96.8 44.0 96.7
       5.0 44.5 96.6 45.0 96.5 45.5 96.3 46.0 96.1 46.5 96.0 47.0 96.0
       5.0 47.2 96.0 47.6 97.7
NS     5.0  .06 4.00  .06 4.00  .07 4.00 .035 4.50 .035 4.00 .035 4.00
NS     5.0  .10 4.00  .10 4.50  .10 4.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 4.00
CAL1   5.0     97.72       8.98
VEL1   5.0                                          .0001 0.38 0.50 0.70
VEL1   5.0 0.80 0.70 0.80 0.80 1.00 1.00 1.20 1.30 1.30 1.82 2.00 2.26
VEL1   5.0 1.62.0001
XSEC   6.0       3.01.00      94.10     .00374
       6.0   .7100.0  6.4 96.7  9.2 95.5 19.9 94.8 22.0 94.5 23.0 94.5
       6.0 24.0 94.5 25.0 94.4 25.5 94.3 26.0 94.3 26.5 94.2 27.0 94.2
       6.0 27.5 94.2 28.0 94.1 28.5 94.2 29.0 94.1 29.5 94.1 30.0 94.2
       6.0 30.5 94.2 31.0 94.1 31.5 94.2 32.0 94.3 33.0 94.3 34.4 94.8
       6.0 36.6 95.8 38.3 96.4 40.8 96.6
NS     6.0  .07 4.00  .05 4.50  .05 4.50 .035 4.50  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 5.60
NS     6.0 .035 4.00  .07 4.00  .07 4.00
CAL1   6.0     94.79       8.98
VEL1   6.0                .0001 0.09 0.55 1.22 1.45 1.52 1.36 1.90 2.10
VEL1   6.0 1.76 1.90 2.22 2.30 1.96 1.98 1.80 1.22 1.05 0.40 0.10.0001
VEL1   6.0
XSEC   7.0       10.01.00     97.35     .00751
       7.0   .0100.0  5.7 99.8  6.3 99.1  7.8 99.1  8.6100.0 14.7 99.6
       7.0 15.7 98.9 16.8 98.9 18.4 99.8 21.7100.2 27.0100.3 33.5100.1
       7.0 37.8 98.8 43.6 98.1 46.0 97.4 47.0 97.3 48.0 97.4 49.0 97.4
       7.0 50.0 97.5 51.0 97.6 52.0 97.8 54.0 97.8 56.0 97.8 57.0 97.8
       7.0 58.0 97.8 59.0 97.7 60.0 97.8 61.0 97.8 62.0 97.7 63.0 97.6
       7.0 67.0 98.1 70.3 99.3 76.5 99.5 84.4 99.1 90.2101.5
NS     7.0  .00 4.00  .05 4.00 .035 4.00 .035 4.00 .035 4.00 .035 4.00
NS     7.0 .035 4.50 .035 4.50 .035 4.50 .045 4.50 .045 4.50  .06 4.50
NS     7.0  .04 4.50 .035 4.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 4.50  .05 4.00  .06 4.00 .035 4.00 .035 4.00
CAL1   7.0     98.10       8.98
VEL1   7.0
VEL1   7.0     .0001 0.25 1.68 1.85 1.96 1.80 1.76 1.55 1.80 1.20 1.66
VEL1   7.0 1.68 1.70 1.33 1.70 1.10 0.98.0001
XSEC   8.0       9.01.00      98.34     .00532
       8.0   .0100.0  8.8100.0 13.2100.3 18.0100.7 29.0100.3 46.1 99.0
       8.0 47.5 98.3 49.0 98.5 50.0 98.5 51.0 98.5 52.0 98.6 53.0 98.7
       8.0 54.0 98.7 56.0 98.7 58.0 98.8 60.0 98.7 62.0 98.7 64.0 98.7
       8.0 66.0 98.6 67.0 98.6 69.1 99.0 70.1 99.5 74.2101.2 84.5104.2
NS     8.0  .00 4.00  .07 4.00  .04 4.00  .05 4.00  .06 4.50 .035 4.50
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 4.50 .035 4.00  .07 4.00  .10 4.00
CAL1   8.0     99.02       8.98
VEL1   8.0                          .0001 0.10 0.80 2.00 2.35 1.90 1.55
VEL1   8.0 1.65 1.80 1.55 1.75 1.78 1.38 1.10 0.44.0001
XSEC   9.0       6.01.00      97.31     .01203
       9.0   .0100.0 12.5 99.7 22.4 99.6 24.9100.2 36.5 99.4 38.1 99.9
       9.0 41.8 99.9 45.2 99.0 49.8 98.8 51.5 98.3 59.9 98.1 61.0 97.8
       9.0 61.5 97.8 62.0 97.6 62.5 97.6 63.0 97.6 63.5 97.5 64.0 97.4
       9.0 64.5 97.3 65.0 97.5 65.5 97.4 66.0 97.3 66.5 97.3 67.0 97.4
       9.0 67.5 97.4 68.0 97.6 69.6 98.1 72.6 98.3 78.0 99.4 84.3100.0
       9.0 92.0103.2
```

Table IV.3 (continued)

```
NS      9.0  .00 4.00  .05 4.00  .07 4.00  .07 4.00  .07 4.00  .07 4.00
NS      9.0  .07 4.00  .07 4.00  .04 4.50  .10 4.50  .10 5.00  .00 0.00
NS      9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS      9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS      9.0  .00 0.00  .00 0.00  .00 5.60  .10 4.50  .04 4.50  .07 4.00
NS      9.0  .06 4.50
CAL1    9.0     98.08      8.98
VEL1    9.0                                                   .0001 0.17
VEL1    9.0 0.45 0.95 1.34 1.86 2.20 2.35 2.60 3.50 2.30 2.64 1.95 1.98
VEL1    9.0 1.60 0.95.0001
XSEC   10.0       7.01.00     94.99    .00635
       10.0   .0100.0  7.4 99.5 11.2 98.4 24.9 98.1 27.7 97.3 29.7 97.6
       10.0 35.6 97.6 40.2 96.6 53.8 95.6 55.0 95.3 56.0 95.1 56.5 95.1
       10.0 57.0 95.1 57.5 95.1 58.0 95.0 58.5 95.1 59.0 95.1 59.5 95.0
       10.0 60.0 95.0 60.5 95.0 61.0 95.0 61.5 95.0 62.0 95.0 62.5 95.0
       10.0 63.0 95.1 63.5 95.1 64.0 95.1 64.5 95.1 65.0 95.1 65.5 95.1
       10.0 68.2 95.6 69.3 96.4 73.7 97.7 79.9 97.6
NS     10.0 .035 5.00 .035 5.00  .06 5.60  .04 4.50 .035 4.50 .035 4.00
NS     10.0  .04 4.00  .04 4.50  .10 4.50  .00 0.00  .00 0.00  .00 0.00
NS     10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     10.0  .00 4.50  .05 4.00  .04 4.50 .035 4.00
CAL1   10.0     95.60      8.98
VEL1   10.0                                         .0001 0.10 1.10 1.30
VEL1   10.0 1.90 1.56 1.52 2.25 1.80 2.18 1.88 1.50 1.70 1.90 2.05 1.65
VEL1   10.0 1.50 1.10 0.90 0.50 0.35 0.22.0001
XSEC   11.0      24.01.00     94.29    .00556
       11.0  3.8100.0  9.6 96.9 19.5 97.0 26.6 96.8 29.8 97.1 32.9 96.4
       11.0 36.9 96.6 38.4 96.7 40.6 96.3 50.0 95.5 52.8 95.1 54.5 94.7
       11.0 55.0 94.6 55.5 94.5 56.0 94.5 56.5 94.5 57.0 94.4 57.5 94.4
       11.0 58.0 94.4 58.5 94.3 59.0 94.3 59.5 94.3 60.0 94.3 60.5 94.3
       11.0 61.0 94.3 61.5 94.4 62.5 94.4 63.0 94.6 64.8 95.1 65.0 96.4
       11.0 66.7 96.8 70.8 97.5 77.6 97.8
NS     11.0 .035 4.50  .07 4.00  .07 4.00  .04 4.00  .05 4.00  .04 4.00
NS     11.0 .035 4.50  .10 4.50  .10 4.00 .035 4.50  .10 4.50  .00 0.00
NS     11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     11.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .10 4.50  .10 4.50
NS     11.0  .10 4.00  .04 4.00  .05 4.50
CAL1   11.0     95.14      8.98
VEL1   11.0                                                   .0001 0.26
VEL1   11.0 1.00 1.50 2.10 2.20 2.45 1.80 2.30 2.40 1.90 1.50 0.95 0.28
VEL1   11.0 0.15 0.16 0.19 0.02.0001
XSEC   12.0      10.0 .00     94.29    .00556
       12.0  3.8100.0  9.6 96.9 19.5 97.0 26.6 96.8 29.8 97.1 32.9 96.4
       12.0 36.9 96.6 38.4 96.7 40.6 96.3 50.0 95.5 52.8 95.1 54.5 94.7
       12.0 55.0 94.6 55.5 94.5 56.0 94.5 56.5 94.5 57.0 94.4 57.5 94.4
       12.0 58.0 94.4 58.5 94.3 59.0 94.3 59.5 94.3 60.0 94.3 60.5 94.3
       12.0 61.0 94.3 61.5 94.4 62.5 94.4 63.0 94.6 64.8 95.1 65.0 96.4
       12.0 66.7 96.8 70.8 97.5 77.6 97.8
NS     12.0 .035 4.50  .07 4.00  .07 4.00  .04 4.00  .05 4.00  .04 4.00
NS     12.0 .035 4.50  .10 4.50  .10 4.00 .035 4.50  .10 4.50  .00 0.00
NS     12.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     12.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     12.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .10 4.50  .10 4.50
NS     12.0  .10 4.00  .04 4.00  .05 4.50
CAL1   12.0     95.14      8.98
VEL1   12.0                                                   .0001 0.26
VEL1   12.0 1.00 1.50 2.10 2.20 2.45 1.80 2.30 2.40 1.90 1.50 0.95 0.28
VEL1   12.0 0.15 0.16 0.19 0.02.0001
ENDJ
```

Table IV.4 Summary of PHABSIM transect data for Segment D.

```
ARAVAIPA CREEK PROJECT
SEGMENT D, 9 TRANSECTS
IOC       110000010000100000000
QARD   5.5
XSEC   1.0         .01.00      92.41     .00258
       1.0   .0100.0  6.2 98.7 12.8 98.2 17.4 96.7 29.5 94.9 39.7 94.9
       1.0 90.1 94.3 94.3 92.4 95.5 92.6 96.5 92.6 97.5 92.5 98.5 92.5
       1.0 99.5 92.5100.5 92.5101.5 92.5102.5 92.5103.5 92.4104.5 92.4
       1.0105.5 92.5106.8 93.0107.5 93.3110.4 93.6118.1 94.4126.7 97.7
       1.0147.6 98.6159.5 99.2163.2 99.8167.8 99.8183.0103.9
NS     1.0  .05 4.60 .035 4.00 .035 4.00 .035 4.00  .06 4.00  .06 4.00
NS     1.0  .05 5.00  .04 5.40  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     1.0  .00 0.00  .10 4.50  .10 4.00 .035 4.00  .05 4.00  .06 4.50
NS     1.0 .035 4.50  .06 5.00 .035 5.60 .035 5.60 .035 5.60
WSL    1.0      92.98      93.22      93.40      93.56      93.70      93.82
WSL    1.0      93.93      94.03      94.12      94.21      94.29      94.37
WSL    1.0      94.44      94.50      94.56      94.61      94.67      94.71
WSL    1.0      94.76      94.80      94.95      95.07      95.18      95.28
WSL    1.0      95.37      95.46      95.54      95.62      95.70      95.77
CAL1   1.0      93.01       5.54
VEL1   1.0                                     .0001 0.75 1.30 1.55 1.80
VEL1   1.0 1.85 2.04 2.00 1.60 1.50 0.58 0.02.0001
VEL1   1.0
XSEC   2.0        11.01.00      88.84     .01529
       2.0   .0100.0  9.0 95.8 23.2 94.6 45.0 92.7 63.3 91.3104.5 89.4
       2.0105.0 89.2105.5 89.1106.0 89.1106.5 89.0107.0 89.0107.5 89.0
       2.0108.0 88.9108.5 88.9109.0 88.9109.5 88.9110.0 89.0110.5 88.8
       2.0111.0 89.0111.5 89.0112.0 89.0112.5 89.0113.8 89.4118.5 89.8
       2.0123.3 91.2128.0 91.4147.9 92.6158.9 92.9172.2 96.3181.7 96.3
       2.0190.8 99.9198.8100.8
NS     2.0 .045 4.00 .035 4.00 .035 4.00  .10 4.60 .035 4.00  .00 5.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     2.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .10 6.00  .10 4.50
NS     2.0  .07 4.00 .035 4.00 .045 4.00  .10 4.50 .035 4.50 .035 4.50
NS     2.0 .035 4.50  .00 4.00
WSL    2.0      89.40      89.59      89.72      89.82      89.90      89.98
WSL    2.0      90.05      90.11      90.16      90.21      90.26      90.31
WSL    2.0      90.35      90.39      90.44      90.47      90.51      90.55
WSL    2.0      90.58      90.61      90.74      90.85      90.95      91.05
WSL    2.0      91.14      91.22      91.30      91.36      91.42      91.48
CAL1   2.0      89.42       5.54
VEL1   2.0                            .0001 0.75 1.65 1.30 1.75 1.40 1.34
VEL1   2.0 2.60 2.85 3.10 3.00 3.40 2.55 1.70 2.22 2.00 1.15.0001
VEL1   2.0
XSEC   3.0       16.01.00      92.13     .00040
       3.0   .0100.0  9.5 94.9 19.3 93.8 24.7 93.1 35.0 93.1 42.1 93.0
       3.0 44.0 92.9 45.0 92.9 46.0 92.8 47.0 92.8 48.0 92.6 49.0 92.3
       3.0 50.0 92.1 51.6 93.1 65.3 93.4 71.5 94.3 88.0 94.3106.0 98.4
       3.0118.0100.0
NS     3.0  .07 4.00  .06 4.00  .06 4.00  .04 4.00  .10 5.00  .00 0.00
NS     3.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     3.0  .00 0.00  .00 5.00 .035 4.50  .05 4.00  .06 4.00  .10 5.00
NS     3.0 .035 5.00
WSL    3.0      93.03      93.20      93.29      93.36      93.42      93.47
WSL    3.0      93.52      93.56      93.60      93.64      93.68      93.71
WSL    3.0      93.75      93.78      93.81      93.84      93.87      93.90
WSL    3.0      93.93      93.95      94.05      94.15      94.23      94.31
WSL    3.0      94.39      94.46      94.52      94.58      94.64      94.70
CAL1   3.0      93.06       5.54
VEL1   3.0                       .0001 0.12 0.32 0.50 0.58 0.50 0.57 0.80
VEL1   3.0 0.22.0001
```

Table IV.4 (continued)

```
XSEC   4.0       4.01.00      94.01     .00425
       4.0   .0100.0  1.1 99.9  2.6 98.4  8.0 96.4 15.2 96.6 22.7 96.9
       4.0 25.6 96.1 27.6 95.3 29.5 95.0 30.5 94.3 31.0 94.2 31.5 94.0
       4.0 32.0 94.1 32.5 94.1 33.0 94.1 33.5 94.1 34.0 94.2 34.5 94.2
       4.0 35.0 94.3 35.5 94.4 36.0 94.6 37.8 95.0 42.4 95.6 48.9 95.3
       4.0 51.4 95.7 55.5 95.8 65.5 97.0 74.9 97.5 91.4 97.5100.6 96.8
       4.0102.4 97.1106.0 97.3110.2 99.2111.1100.4
NS     4.0 .035 4.00 .035 4.50 .035 4.50  .08 4.00 .035 4.00  .04 4.00
NS     4.0  .04 4.00 .035 4.50  .10 4.50  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     4.0  .00 0.00  .00 0.00  .00 0.00  .10 4.50  .04 4.50  .04 5.60
NS     4.0  .04 4.50  .04 4.60 .035 5.60 .035 5.60 .035 4.50 .035 4.50
NS     4.0 .035 4.50 .035 4.00 .035 4.50  .00 4.50
WSL    4.0      94.96      95.29      95.51      95.67      95.79      95.90
WSL    4.0      95.99      96.08      96.16      96.23      96.30      96.37
WSL    4.0      96.43      96.49      96.55      96.60      96.66      96.71
WSL    4.0      96.75      96.80      96.96      97.11      97.23      97.35
WSL    4.0      97.46      97.55      97.64      97.72      97.80      97.88
CAL1   4.0      95.00       5.54
VEL1   4.0                                                .0001 0.09 0.35 1.58
VEL1   4.0 2.45 2.00 1.95 1.65 1.30 1.06 0.72 0.35 0.12.0001
VEL1   4.0
XSEC   5.0       16.01.00      96.65     .00443
       5.0   .0100.0  3.3 97.9  6.8 97.7  8.4 97.0 22.2 96.7 24.6 97.2
       5.0 29.3 97.3 32.5 97.8 34.6 98.0 37.5 97.6 39.1 97.4 41.5 97.0
       5.0 42.5 97.0 43.5 97.0 44.5 97.0 45.5 97.0 46.5 97.1 47.5 97.1
       5.0 48.5 97.1 49.5 97.1 50.5 97.1 51.5 97.1 52.5 97.1 53.5 97.1
       5.0 54.5 97.0 55.5 97.0 56.5 97.0 60.2 97.4 65.1 97.4 66.6 97.8
       5.0 67.7 98.0 69.1 97.7 71.2 97.6 76.9 99.2 78.6100.1
NS     5.0  .10 4.00  .10 4.00 .035 4.00 .035 4.00 .035 4.50 .035 4.50
NS     5.0 .035 4.50 .035 4.50 .035 4.50  .04 4.50  .05 4.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     5.0  .00 0.00  .00 0.00  .00 0.00  .10 4.50  .10 4.00  .07 4.00
NS     5.0  .07 4.00  .07 4.00  .05 4.00  .05 4.50  .05 4.00
WSL    5.0      97.36      97.54      97.68      97.80      97.90      97.98
WSL    5.0      98.07      98.14      98.21      98.28      98.34      98.40
WSL    5.0      98.46      98.52      98.58      98.63      98.68      98.73
WSL    5.0      98.78      98.83      99.01      99.18      99.34      99.49
WSL    5.0      99.63      99.77      99.90     100.03     100.15     100.28
CAL1   5.0      97.38       5.54
VEL1   5.0                                                          .0001 0.25
VEL1   5.0 1.42 1.35 1.43 1.40 1.50 1.25 1.40 1.22 1.17 1.28 1.44 1.42
VEL1   5.0 1.18 0.89 0.55.0001
XSEC   6.0        4.01.00      97.64     .00381
       6.0   .0100.0  2.7 99.6  6.6 99.6 17.6100.0 32.9 99.4 43.9 98.8
       6.0 47.1 98.9 51.7 98.4 54.8 98.2 55.5 97.9 56.5 97.9 57.5 97.8
       6.0 58.5 97.8 59.5 97.7 60.5 97.6 61.5 97.7 62.5 97.8 63.5 97.8
       6.0 64.5 97.8 65.5 97.9 66.5 97.9 67.5 97.9 68.5 98.1 69.5 98.0
       6.0 70.5 98.0 71.5 98.2 82.0 98.4 83.5 99.1 90.7100.0104.4101.3
NS     6.0  .08 4.00  .08 4.00  .08 4.00  .08 4.00  .06 4.00  .08 4.00
NS     6.0 .045 4.00 .045 4.00 .045 4.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     6.0  .00 0.00  .05 4.50  .05 4.50  .05 4.00  .07 4.00  .10 4.00
WSL    6.0      98.13      98.29      98.39      98.48      98.55      98.61
WSL    6.0      98.67      98.73      98.78      98.82      98.87      98.91
WSL    6.0      98.95      98.99      99.03      99.06      99.10      99.13
WSL    6.0      99.16      99.20      99.31      99.42      99.51      99.60
WSL    6.0      99.68      99.76      99.83      99.90      99.96     100.02
CAL1   6.0      98.15       5.54
VEL1   6.0                                                .0001 0.50 0.91 0.71
VEL1   6.0 0.68 1.50 1.98 1.82 0.99 1.64 1.10 1.25 1.10 0.74 0.35 0.56
VEL1   6.0 0.02.0001
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Table IV.4 (continued)

```
XSEC   7.0      13.01.00      95.33     .00557
       7.0   .0100.0 11.0 97.2 14.8 97.2 17.8 97.5 22.1 97.0 28.2 96.2
       7.0 43.1 95.8 45.1 95.9 46.4 95.6 47.5 95.5 48.5 95.5 49.5 95.5
       7.0 50.5 95.4 51.5 95.4 52.5 95.4 53.5 95.3 54.5 95.3 55.5 95.3
       7.0 56.5 95.3 57.5 95.3 58.5 95.4 59.5 95.4 61.8 95.6 63.4 96.1
       7.0 65.5 95.7 66.3 96.1 71.8 96.2 73.6 96.1 77.4 96.2 80.8 96.9
       7.0 85.2 96.5 89.4 96.8 93.6 98.5
NS     7.0  .06 4.00 .045 4.50 .045 4.00  .07 4.00  .07 4.00  .04 4.50
NS     7.0 .035 4.50  .10 4.00  .10 4.50  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     7.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .10 4.50  .10 4.00
NS     7.0  .10 4.00  .10 4.50  .04 4.50  .04 4.50  .04 4.50  .04 4.50
NS     7.0  .10 4.50  .04 4.50  .04 4.00
WSL    7.0     95.62     95.73     95.82     95.90     95.96     96.01
WSL    7.0     96.06     96.10     96.14     96.18     96.21     96.24
WSL    7.0     96.27     96.29     96.32     96.35     96.37     96.39
WSL    7.0     96.41     96.43     96.51     96.59     96.65     96.72
WSL    7.0     96.78     96.83     96.88     96.93     96.98     97.03
CAL1   7.0     95.63      5.54
VEL1   7.0                                          .0001 0.18 0.37 0.68
VEL1   7.0 0.78 1.20 1.00 1.36 1.22 1.06 0.58 1.10 0.42.0001.0001
VEL1   7.0
XSEC   8.0      13.01.00      95.74     .00424
       8.0   .0100.0  4.6 97.6  7.1 97.0 11.1 96.8 15.0 96.4 15.7 96.2
       8.0 16.5 95.9 17.0 95.9 17.5 95.9 18.0 95.9 18.5 95.8 19.0 95.7
       8.0 19.5 95.8 20.0 95.8 20.5 95.8 21.0 95.8 21.5 95.9 22.0 95.9
       8.0 22.5 96.0 23.0 96.1 23.5 96.1 24.0 96.1 26.2 96.2 37.8 96.4
       8.0 38.6 96.4 39.0 96.7 39.7 96.5 42.9 96.4 47.5 97.7 50.0 99.1
NS     8.0 .045 4.50 .045 4.50  .04 4.50  .04 4.50  .04 4.50  .04 4.60
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     8.0  .10 4.50  .10 4.50  .10 4.50  .10 4.50  .10 4.50  .05 4.50
WSL    8.0     96.19     96.33     96.42     96.48     96.54     96.59
WSL    8.0     96.63     96.67     96.71     96.75     96.78     96.81
WSL    8.0     96.84     96.87     96.90     96.93     96.95     96.98
WSL    8.0     97.00     97.03     97.12     97.20     97.28     97.35
WSL    8.0     97.42     97.48     97.55     97.61     97.67     97.72
CAL1   8.0     96.21      5.54
VEL1   8.0                          .0001 0.46 0.83 1.05 1.10 1.16 1.46
VEL1   8.0 1.75 2.20 1.79 1.70 1.50 1.25 0.93 0.54 0.41 0.21.0001
VEL1   8.0
XSEC   9.0      13.01.00      95.66     .00021
       9.0   .0100.0  6.8 97.8  8.6 97.3 14.6 96.8 17.0 97.2 20.5 96.9
       9.0 21.6 96.3 24.2 96.6 27.0 97.3 29.7 97.1 31.9 96.6 35.0 95.9
       9.0 36.0 96.0 36.5 96.0 37.0 95.9 37.5 96.0 38.0 95.9 38.5 95.9
       9.0 39.0 95.9 39.5 95.9 40.0 95.8 40.5 95.7 41.0 95.7 41.5 95.7
       9.0 42.0 95.7 42.5 95.7 43.0 95.7 43.5 95.7 44.0 95.7 44.5 95.7
       9.0 45.5 95.7 46.5 95.8 47.5 95.7 48.5 95.7 49.5 95.7 50.5 95.7
       9.0 54.1 96.6 55.4 96.9 57.1 97.0 60.6 97.4 64.0 97.2 68.0 97.6
       9.0 71.3 97.5 74.7 97.1 78.9 97.3 84.1 97.9108.2 97.8
NS     9.0  .10 4.50  .07 4.50  .07 4.00  .07 4.00  .07 4.00  .07 4.00
NS     9.0  .07 4.00  .07 4.50  .05 4.50  .06 4.00  .06 4.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS     9.0  .10 4.00  .06 4.50  .06 4.00  .06 4.00  .05 4.00  .04 4.00
NS     9.0  .04 4.50  .04 4.50  .05 4.50  .04 4.00 .045 4.50
WSL    9.0     96.57     96.90     97.15     97.33     97.48     97.60
WSL    9.0     97.71     97.81     97.91     97.99     98.06     98.14
WSL    9.0     98.20     98.27     98.33     98.39     98.45     98.51
WSL    9.0     98.56     98.62     98.82     99.00     99.18     99.34
WSL    9.0     99.50     99.65     99.79     99.93    100.07    100.20
CAL1   9.0     96.61      5.54
```

Table IV.4 (continued)

```
VEL1   9.0                                                        .0001 0.20
VEL1   9.0 0.70 0.90 0.90 1.12 1.15 1.18 1.13 1.19 1.18 1.00 0.92 0.83
VEL1   9.0 0.93 1.05 1.11 1.11 1.15 1.07 0.90 0.64 0.36 0.13 0.07.0001
VEL1   9.0.0001
XSEC  10.0       11.0 .00      95.66     .00021
      10.0   .0100.0  6.8 97.8  8.6 97.3 14.6 96.8 17.0 97.2 20.5 96.9
      10.0 21.6 96.3 24.2 96.6 27.0 97.3 29.7 97.1 31.9 96.6 35.0 95.9
      10.0 36.0 96.0 36.5 96.0 37.0 95.9 37.5 96.0 38.0 95.9 38.5 95.9
      10.0 39.0 95.9 39.5 95.9 40.0 95.8 40.5 95.7 41.0 95.7 41.5 95.7
      10.0 42.0 95.7 42.5 95.7 43.0 95.7 43.5 95.7 44.0 95.7 44.5 95.7
      10.0 45.5 95.7 46.5 95.8 47.5 95.7 48.5 95.7 49.5 95.7 50.5 95.7
      10.0 54.1 96.6 55.4 96.9 57.1 97.0 60.6 97.4 64.0 97.2 68.0 97.6
      10.0 71.3 97.5 74.7 97.1 78.9 97.3 84.1 97.9108.2 97.8
NS    10.0  .00 4.50  .00 4.50  .00 4.00  .00 4.00  .00 4.00  .00 4.00
NS    10.0  .00 4.00  .00 4.50  .00 4.50  .00 4.00  .00 4.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00  .00 0.00
NS    10.0  .00 4.00  .00 4.50  .00 4.00  .00 4.00  .00 4.00  .00 4.00
NS    10.0  .00 4.50  .00 4.50  .00 4.50  .00 4.00  .00 4.50
WSL   10.0     96.57     96.90     97.15     97.33     97.48     97.60
WSL   10.0     97.71     97.81     97.91     97.99     98.06     98.14
WSL   10.0     98.20     98.27     98.33     98.39     98.45     98.51
WSL   10.0     98.56     98.62     98.82     99.00     99.18     99.34
WSL   10.0     99.50     99.65     99.79     99.93    100.07    100.20
CAL1  10.0     96.61      5.54
VEL1  10.0                                                        .0001 0.20
VEL1  10.0 0.70 0.90 0.90 1.12 1.15 1.18 1.13 1.19 1.18 1.00 0.92 0.83
VEL1  10.0 0.93 1.05 1.11 1.11 1.15 1.07 0.90 0.64 0.36 0.13 0.07.0001
VEL1  10.0.0001
ENDJ
```

APPENDIX V

Suitability Index Curve I.D. Numbers,
S.I. Curve Coordinates of the IFIM FISHCRV file,
observed frequency utilization and suitability index curves
for each species and life stage utilized in the IFIM analysis.

Table V.1 S.I. curve ID numbers and number of depth and velocity points for each species and life stage used in the IFIM analyses.

ID NUMBER	SPECIES	LIFE STAGE
10001	LONGFIN DACE	ADULT
10002	LONGFIN DACE	FRY/JUV
10101	SONORAN SUCKER	ADULT
10201	ROUNDTAIL CHUB	ADULT
10202	ROUNDTAIL CHUB	JUVENILE
10203	ROUNDTAIL CHUB	FRY
10301	SPIKEDACE	ADULT
10302	SPIKEDACE	JUVENILE
10303	SPIKEDACE	FRY
10401	MOUNTAIN SUCKER	ADULT
10402	MOUNTAIN SUCKER	FRY/JUV
10501	SPECKLED DACE	ADULT
10502	SPECKLED DACE	FRY/JUV
10601	LOACH MINNOW	ADULT
10602	LOACH MINNOW	FRY/JUV

Table V.2 Aravaipa Creek TNC S.I. curve sets in IFIM FISHCRV format.

H	10001	93 98	0	0 LONGFIN DACE							ADULT		90/06/01
V	10001	.00	.32	.01	.40	.05	.42	.09	.44	.12	.47	.16	.49
V	10001	.20	.51	.27	.56	.31	.59	.35	.61	.39	.64	.43	.67
V	10001	.46	.69	.50	.71	.54	.74	.58	.76	.61	.79	.65	.81
V	10001	.69	.83	.73	.85	.77	.87	.80	.89	.84	.91	.88	.92
V	10001	.92	.94	.95	.95	.99	.96	1.03	.97	1.07	.98	1.11	.99
V	10001	1.14	.99	1.18	1.00	1.22	1.00	1.26	1.00	1.33	1.00	1.37	.99
V	10001	1.41	.98	1.45	.97	1.48	.96	1.52	.95	1.56	.94	1.60	.93
V	10001	1.63	.91	1.67	.89	1.71	.87	1.75	.85	1.79	.83	1.82	.81
V	10001	1.86	.79	1.90	.77	1.94	.74	1.97	.72	2.01	.69	2.05	.67
V	10001	2.09	.64	2.13	.62	2.16	.59	2.20	.57	2.24	.54	2.28	.52
V	10001	2.31	.49	2.35	.47	2.39	.45	2.43	.42	2.47	.40	2.50	.38
V	10001	2.54	.36	2.58	.33	2.62	.31	2.65	.29	2.69	.28	2.73	.26
V	10001	2.77	.24	2.81	.22	2.84	.21	2.88	.19	2.92	.18	2.96	.16
V	10001	2.99	.15	3.07	.13	3.11	.12	3.15	.11	3.18	.10	3.22	.09
V	10001	3.30	.08	3.33	.07	3.37	.06	3.40	.05	3.44	.04	3.47	.03
V	10001	3.54	.01	3.57	.00	100.00	.00						
D	10001	.00	.00	.01	.02	.02	.04	.04	.05	.05	.06	.06	.07
D	10001	.08	.08	.09	.09	.10	.10	.12	.12	.13	.13	.14	.14
D	10001	.16	.16	.17	.18	.18	.20	.20	.22	.21	.24	.22	.26
D	10001	.24	.29	.25	.31	.26	.34	.28	.37	.29	.39	.30	.42
D	10001	.32	.46	.33	.49	.34	.52	.36	.55	.37	.59	.38	.62
D	10001	.40	.65	.41	.69	.42	.72	.44	.75	.45	.78	.46	.81
D	10001	.48	.84	.49	.86	.50	.89	.52	.91	.53	.93	.54	.95
D	10001	.56	.97	.57	.98	.58	.99	.60	1.00	.61	1.00	.62	1.00
D	10001	.64	1.00	.65	.99	.66	.98	.68	.97	.69	.96	.70	.94
D	10001	.72	.92	.73	.90	.74	.88	.76	.85	.77	.83	.78	.80
D	10001	.80	.77	.81	.74	.82	.71	.84	.67	.85	.64	.86	.61
D	10001	.88	.57	.89	.54	.90	.51	.92	.48	.93	.44	.94	.41
D	10001	.96	.38	.97	.35	.98	.33	1.00	.30	1.01	.28	1.02	.25
D	10001	1.04	.23	1.05	.21	1.06	.19	1.08	.17	1.09	.15	1.10	.14
D	10001	1.12	.12	1.13	.11	1.14	.10	1.16	.09	1.17	.08	1.18	.07
D	10001	1.20	.06	1.21	.05	1.23	.04	1.24	.03	1.25	.02	1.26	.01
D	10001	1.28	.00	100.00	.00								

Table V.2 (continued)

```
H  10002 94 15  0  0 LONGFIN DACE                                FRY/JUV    90/06/01
V  10002   .00   .80   .01   .82   .04   .84   .08   .86   .11   .88   .14   .89
V  10002   .18   .91   .21   .92   .24   .94   .28   .95   .31   .96   .34   .97
V  10002   .38   .98   .41   .99   .44   .99   .48  1.00   .51  1.00   .54  1.00
V  10002   .58  1.00   .61  1.00   .64  1.00   .68   .99   .71   .98   .74   .98
V  10002   .78   .97   .81   .96   .84   .95   .88   .94   .91   .92   .94   .91
V  10002   .98   .89  1.01   .87  1.04   .86  1.08   .84  1.11   .82  1.14   .80
V  10002  1.18   .78  1.21   .75  1.24   .73  1.28   .71  1.31   .69  1.34   .66
V  10002  1.38   .64  1.41   .62  1.44   .59  1.48   .57  1.51   .55  1.54   .53
V  10002  1.58   .50  1.61   .48  1.64   .46  1.68   .44  1.71   .41  1.74   .39
V  10002  1.78   .37  1.81   .35  1.84   .33  1.88   .32  1.91   .30  1.94   .28
V  10002  1.98   .26  2.01   .25  2.04   .23  2.08   .22  2.11   .20  2.14   .19
V  10002  2.18   .18  2.21   .16  2.24   .15  2.28   .14  2.31   .13  2.34   .12
V  10002  2.38   .11  2.41   .10  2.44   .09  2.48   .09  2.51   .08  2.54   .07
V  10002  2.58   .07  2.61   .06  2.64   .06  2.68   .05  2.71   .05  2.74   .04
V  10002  2.78   .04  2.81   .03  2.84   .03  2.88   .03  2.91   .03  2.94   .02
V  10002  2.98   .02  3.00   .01  3.10   .00100.00   .00
D  10002   .00   .00   .20   .89   .40  1.00   .60   .97   .80   .58  1.00   .47
D  10002  1.20   .29  1.40   .23  1.60   .18  1.80   .09  2.00   .07  2.20   .06
D  10002  2.40   .01  2.50   .00100.00   .00
H  10101 14  9  0  0 SONORAN SUCKER                              ADULT      90/06/01
V  10101   .00   .90   .05   .96   .20  1.00   .40   .95   .50   .34   .60   .25
V  10101  1.00   .12  1.60   .09  2.00   .07  2.40   .05  2.80   .03  3.20   .01
V  10101  3.60   .00100.00   .00
D  10101   .00   .00   .10   .00   .30   .15   .50   .30   .60   .50   .64   .85
D  10101   .80   .98   .90  1.00100.00  1.00
H  10201  5  4  0  0 ROUNDTAIL CHUB                              ADULT      90/06/01
V  10201   .00  1.00  1.20  1.00  2.45  1.00  3.75   .00100.00   .00
D  10201   .00   .00   .35   .00  1.30  1.00100.00  1.00
H  10202  4  4  0  0 ROUNDTAIL CHUB                              JUVENILE   90/06/01
V  10202   .00  1.00  2.50  1.00  3.60   .00100.00   .00
D  10202   .00   .00   .35   .00   .60  1.00100.00  1.00
H  10203  4  4  0  0 ROUNDTAIL CHUB                              FRY        90/06/01
V  10203   .00  1.00  1.60  1.00  2.60   .00100.00   .00
D  10203   .00   .00   .20   .00   .55  1.00100.00100.00
```

Table V.2 (continued)

```
H  10301 95 11  0  0 SPIKEDACE                                    ADULT      90/06/01
V  10301   .00   .10   .01   .12   .05   .15   .09   .17   .13   .19   .17   .21
V  10301   .21   .23   .25   .25   .29   .27   .33   .30   .37   .32   .41   .35
V  10301   .45   .38   .49   .41   .53   .44   .57   .47   .61   .50   .65   .53
V  10301   .69   .56   .73   .60   .77   .63   .81   .66   .85   .69   .89   .73
V  10301   .93   .76   .97   .79  1.01   .82  1.05   .84  1.09   .87  1.13   .89
V  10301  1.17   .92  1.21   .94  1.25   .95  1.29   .97  1.33   .98  1.37   .99
V  10301  1.41  1.00  1.45  1.00  1.49  1.00  1.53  1.00  1.57   .99  1.61   .98
V  10301  1.65   .97  1.69   .96  1.73   .94  1.77   .92  1.81   .90  1.85   .88
V  10301  1.89   .85  1.93   .83  1.97   .80  2.01   .77  2.05   .74  2.09   .71
V  10301  2.13   .67  2.17   .64  2.21   .61  2.25   .57  2.29   .54  2.33   .51
V  10301  2.37   .48  2.41   .45  2.45   .42  2.49   .39  2.53   .36  2.57   .33
V  10301  2.61   .30  2.65   .28  2.69   .26  2.73   .23  2.77   .21  2.81   .19
V  10301  2.85   .17  2.89   .16  2.93   .14  2.97   .13  3.01   .11  3.05   .10
V  10301  3.09   .09  3.13   .08  3.17   .07  3.21   .06  3.25   .05  3.29   .05
V  10301  3.33   .04  3.37   .04  3.41   .03  3.45   .03  3.49   .02  3.53   .02
V  10301  3.57   .02  3.61   .01  3.65   .01  3.69   .00100.00   .00
D  10301   .00   .00   .20   .10   .40   .26   .60  1.00   .80  1.00  1.00   .61
D  10301  1.20   .45  1.40   .13  1.60   .03  1.80   .00100.00   .00
H  10302 93 95  0  0 SPIKEDACE                                    JUVENILE   90/06/01
V  10302   .00   .20   .01   .22   .04   .24   .08   .26   .11   .28   .14   .31
V  10302   .18   .33   .21   .36   .24   .39   .28   .42   .31   .45   .34   .48
V  10302   .38   .51   .41   .54   .44   .57   .48   .60   .51   .64   .54   .67
V  10302   .58   .70   .61   .73   .64   .76   .68   .79   .71   .82   .74   .84
V  10302   .78   .87   .81   .89   .84   .92   .88   .93   .91   .95   .94   .97
V  10302   .98   .98  1.01   .99  1.04   .99  1.08  1.00  1.11  1.00  1.14  1.00
V  10302  1.18   .99  1.21   .99  1.24   .98  1.28   .96  1.31   .95  1.34   .93
V  10302  1.38   .91  1.41   .89  1.44   .87  1.48   .84  1.51   .81  1.54   .79
V  10302  1.58   .76  1.61   .73  1.64   .70  1.68   .66  1.71   .63  1.74   .60
V  10302  1.78   .57  1.81   .54  1.84   .50  1.88   .47  1.91   .44  1.94   .41
V  10302  1.98   .38  2.01   .36  2.04   .33  2.08   .30  2.11   .28  2.14   .26
V  10302  2.18   .23  2.21   .21  2.24   .19  2.28   .18  2.31   .16  2.34   .14
V  10302  2.38   .13  2.41   .12  2.44   .10  2.48   .09  2.51   .08  2.54   .07
V  10302  2.58   .06  2.61   .06  2.64   .05  2.68   .04  2.71   .04  2.74   .03
V  10302  2.78   .03  2.81   .03  2.84   .02  2.88   .02  2.91   .02  2.94   .01
V  10302  2.98   .01  3.00   .00100.00   .00
D  10302   .00   .00   .01   .00   .03   .00   .05   .00   .06   .00   .08   .00
D  10302   .10   .00   .12   .00   .13   .01   .15   .01   .17   .01   .19   .01
D  10302   .21   .01   .22   .02   .24   .02   .26   .03   .28   .03   .29   .04
D  10302   .31   .05   .33   .06   .35   .07   .37   .08   .38   .09   .40   .11
D  10302   .42   .13   .44   .15   .45   .17   .47   .20   .49   .22   .51   .25
D  10302   .53   .29   .54   .32   .56   .36   .58   .40   .60   .44   .61   .48
D  10302   .63   .52   .65   .57   .67   .61   .69   .66   .70   .70   .72   .75
D  10302   .74   .79   .76   .83   .77   .86   .79   .90   .81   .93   .83   .95
D  10302   .85   .97   .86   .99   .88  1.00   .90  1.00   .92  1.00   .93   .99
D  10302   .95   .98   .97   .96   .99   .94  1.01   .92  1.02   .88  1.04   .85
D  10302  1.06   .81  1.08   .77  1.09   .73  1.11   .69  1.13   .64  1.15   .60
D  10302  1.17   .55  1.18   .51  1.20   .46  1.22   .42  1.24   .38  1.25   .34
D  10302  1.27   .31  1.29   .27  1.31   .24  1.33   .21  1.34   .19  1.36   .16
D  10302  1.38   .14  1.40   .12  1.41   .10  1.43   .09  1.45   .07  1.47   .06
D  10302  1.49   .05  1.50   .04  1.52   .04  1.54   .03  1.56   .02  1.57   .02
D  10302  1.59   .02  1.62   .01  1.64   .01  1.67   .00100.00   .00
```

Table V.2 (continued)

H	10303	94 16	0	0 SPIKEDACE						FRY		90/06/01	
V	10303	.00	.04	.01	.05	.03	.06	.06	.06	.08	.07	.11	.08
V	10303	.13	.09	.16	.11	.18	.12	.21	.14	.23	.15	.25	.17
V	10303	.28	.19	.30	.21	.33	.23	.35	.26	.38	.28	.40	.31
V	10303	.43	.34	.45	.37	.47	.40	.50	.43	.52	.47	.55	.50
V	10303	.57	.53	.60	.57	.62	.60	.65	.64	.67	.68	.69	.71
V	10303	.72	.74	.74	.78	.77	.81	.79	.84	.82	.87	.84	.89
V	10303	.87	.92	.89	.94	.91	.96	.94	.97	.96	.98	.99	.99
V	10303	1.01	1.00	1.04	1.00	1.06	1.00	1.09	.99	1.11	.99	1.13	.97
V	10303	1.16	.96	1.18	.94	1.21	.92	1.23	.90	1.26	.87	1.28	.85
V	10303	1.31	.82	1.33	.79	1.35	.75	1.38	.72	1.40	.69	1.43	.65
V	10303	1.45	.62	1.48	.58	1.50	.54	1.53	.51	1.55	.48	1.57	.44
V	10303	1.60	.41	1.62	.38	1.65	.35	1.67	.32	1.70	.29	1.72	.27
V	10303	1.75	.24	1.77	.22	1.79	.20	1.82	.18	1.84	.16	1.87	.14
V	10303	1.89	.13	1.92	.11	1.94	.10	1.97	.09	1.99	.08	2.01	.07
V	10303	2.04	.06	2.06	.05	2.09	.04	2.11	.04	2.14	.03	2.16	.03
V	10303	2.19	.02	2.21	.01	2.24	.00	100.00	.00				
D	10303	.00	.00	.20	.11	.40	1.00	.60	.85	.80	.53	1.00	.41
D	10303	1.20	.21	1.40	.13	1.60	.07	1.80	.05	2.00	.04	2.20	.03
D	10303	2.40	.02	2.60	.01	2.80	.00	100.00	.00				

Table V.2 (continued)

H	10401	92	94	0	0	MOUNTAIN SUCKER					ADULT		90/06/01	
V	10401		.00	.05	.01	.05	.05	.05	.09	.05	.13	.06	.17	.07
V	10401		.21	.07	.25	.08	.29	.08	.33	.09	.37	.10	.41	.11
V	10401		.45	.12	.49	.13	.53	.14	.57	.15	.61	.16	.65	.17
V	10401		.69	.18	.73	.20	.77	.21	.81	.22	.85	.24	.89	.25
V	10401		.93	.27	.97	.29	1.01	.30	1.05	.32	1.09	.34	1.13	.36
V	10401		1.17	.38	1.21	.40	1.25	.42	1.29	.44	1.33	.46	1.37	.48
V	10401		1.41	.51	1.45	.53	1.49	.55	1.53	.57	1.57	.60	1.61	.62
V	10401		1.65	.64	1.69	.67	1.73	.69	1.77	.71	1.81	.73	1.85	.75
V	10401		1.89	.77	1.93	.80	1.97	.82	2.01	.83	2.05	.85	2.09	.87
V	10401		2.13	.89	2.17	.90	2.21	.92	2.25	.93	2.29	.94	2.33	.96
V	10401		2.37	.97	2.41	.98	2.45	.98	2.49	.99	2.53	.99	2.57	1.00
V	10401		2.61	1.00	2.65	1.00	2.69	1.00	2.73	1.00	2.77	1.00	2.81	1.00
V	10401		2.85	1.00	2.89	1.00	2.93	1.00	2.97	1.00	3.01	1.00	3.05	1.00
V	10401		3.09	1.00	3.13	1.00	3.17	1.00	3.21	1.00	3.25	1.00	3.29	1.00
V	10401		3.33	1.00	3.37	1.00	3.41	1.00	3.45	1.00	3.49	1.00	3.53	1.00
V	10401		3.57	1.00	100.00	.00								
D	10401		.00	.00	.01	.00	.03	.00	.05	.00	.06	.00	.08	.00
D	10401		.10	.00	.12	.00	.13	.00	.15	.01	.17	.01	.19	.01
D	10401		.21	.01	.22	.01	.24	.02	.26	.02	.28	.02	.29	.03
D	10401		.31	.04	.33	.04	.35	.05	.37	.06	.38	.07	.40	.09
D	10401		.42	.10	.44	.12	.45	.14	.47	.16	.49	.18	.51	.20
D	10401		.53	.23	.54	.26	.56	.30	.58	.33	.60	.37	.61	.41
D	10401		.63	.45	.65	.49	.67	.53	.69	.58	.70	.62	.72	.67
D	10401		.74	.71	.76	.75	.77	.79	.79	.83	.81	.87	.83	.90
D	10401		.85	.93	.86	.95	.88	.97	.90	.99	.92	1.00	.93	1.00
D	10401		.95	1.00	.97	.99	.99	.98	1.01	.97	1.02	.94	1.04	.92
D	10401		1.06	.89	1.08	.86	1.09	.82	1.11	.78	1.13	.74	1.15	.70
D	10401		1.17	.65	1.18	.61	1.20	.56	1.22	.52	1.24	.48	1.25	.43
D	10401		1.27	.39	1.29	.36	1.31	.32	1.33	.29	1.34	.25	1.36	.22
D	10401		1.38	.20	1.40	.17	1.41	.15	1.43	.13	1.45	.11	1.47	.09
D	10401		1.49	.08	1.50	.07	1.52	.06	1.54	.05	1.56	.04	1.57	.03
D	10401		1.59	.02	1.61	.01	1.62	.00	100.00	.00				

Table V.2 (continued)

```
H  10402 99 95  0  0 MOUNTAIN SUCKER                          FRY/JUV    90/06/01
V  10402   .00   .05   .01   .06   .06   .07   .10   .07   .15   .08   .20   .09
V  10402   .24   .10   .29   .11   .34   .12   .38   .13   .43   .15   .48   .16
V  10402   .52   .17   .57   .19   .62   .20   .66   .22   .71   .24   .76   .26
V  10402   .80   .28   .85   .30   .90   .32   .94   .34   .99   .37  1.04   .39
V  10402  1.08   .42  1.13   .44  1.18   .47  1.22   .49  1.27   .52  1.32   .55
V  10402  1.36   .57  1.41   .60  1.46   .63  1.50   .66  1.55   .68  1.60   .71
V  10402  1.64   .74  1.69   .76  1.74   .79  1.78   .81  1.83   .84  1.88   .86
V  10402  1.92   .88  1.97   .90  2.02   .92  2.06   .93  2.11   .95  2.16   .96
V  10402  2.20   .97  2.25   .98  2.30   .99  2.34  1.00  2.39  1.00  2.44  1.00
V  10402  2.48  1.00  2.53  1.00  2.58   .99  2.62   .99  2.67   .98  2.72   .97
V  10402  2.76   .95  2.86   .92  2.90   .91  2.95   .89  3.00   .87  3.04   .84
V  10402  3.14   .80  3.18   .77  3.23   .75  3.28   .72  3.32   .69  3.37   .67
V  10402  3.42   .64  3.46   .61  3.51   .58  3.56   .56  3.60   .53  3.65   .50
V  10402  3.74   .45  3.79   .42  3.88   .38  3.93   .35  3.98   .33  4.02   .31
V  10402  4.07   .29  4.12   .27  4.16   .25  4.25   .21  4.30   .19  4.34   .17
V  10402  4.39   .15  4.43   .13  4.52   .09  4.57   .07  4.61   .05  4.66   .03
V  10402  4.70   .01  4.80   .00100.00   .00
D  10402   .00   .00   .01   .00   .03   .00   .04   .01   .06   .01   .08   .01
D  10402   .09   .01   .11   .01   .13   .01   .14   .02   .16   .02   .18   .03
D  10402   .19   .03   .21   .04   .23   .04   .24   .05   .26   .06   .28   .07
D  10402   .29   .08   .31   .10   .33   .11   .34   .13   .36   .15   .38   .17
D  10402   .39   .19   .41   .22   .43   .24   .44   .27   .46   .30   .48   .33
D  10402   .49   .37   .51   .40   .53   .44   .54   .48   .56   .52   .58   .56
D  10402   .59   .60   .61   .64   .63   .68   .64   .72   .66   .76   .68   .80
D  10402   .69   .83   .71   .87   .73   .90   .74   .92   .76   .95   .78   .97
D  10402   .79   .98   .81   .99   .83  1.00   .84  1.00   .86  1.00   .88   .99
D  10402   .89   .98   .91   .96   .93   .94   .94   .92   .96   .89   .98   .86
D  10402   .99   .83  1.01   .79  1.03   .76  1.04   .72  1.06   .68  1.08   .64
D  10402  1.09   .60  1.11   .56  1.13   .52  1.14   .48  1.16   .44  1.18   .40
D  10402  1.19   .36  1.21   .33  1.23   .30  1.24   .27  1.26   .24  1.28   .21
D  10402  1.29   .19  1.31   .17  1.33   .15  1.34   .13  1.36   .11  1.38   .10
D  10402  1.39   .08  1.41   .07  1.43   .06  1.44   .05  1.46   .04  1.48   .04
D  10402  1.49   .03  1.50   .02  1.60   .01  1.70   .00100.00   .00
H  10501  5  5  0  0 SPECKLED DACE                              ADULT      90/06/01
V  10501   .00   .50   .30  1.00  2.50  1.00  3.75   .00100.00   .00
D  10501   .00   .00   .30  1.00  1.75  1.00  3.00   .00100.00   .00
H  10502  6  5  0  0 SPECKLED DACE                              FRY/JUV    90/06/01
V  10502   .00   .12   .45  1.00  1.85  1.00  2.45   .18  3.25   .00100.00   .00
D  10502   .00   .00   .50  1.00  1.70  1.00  3.30   .00100.00   .00
```

Table V.2 (continued)

H	10601	97	9	0	0	LOACH MINNOW					ADULT		90/06/01	
V	10601		.00	.00	.01	.01	.05	.02	.09	.02	.13	.02	.17	.03
V	10601		.21	.03	.25	.04	.29	.04	.33	.05	.37	.05	.41	.06
V	10601		.45	.07	.49	.08	.53	.09	.57	.10	.61	.12	.65	.13
V	10601		.69	.14	.73	.16	.77	.18	.81	.20	.85	.22	.89	.24
V	10601		.93	.26	.97	.29	1.01	.31	1.05	.34	1.09	.37	1.13	.40
V	10601		1.17	.43	1.21	.46	1.25	.50	1.29	.53	1.33	.56	1.37	.60
V	10601		1.41	.63	1.45	.66	1.49	.70	1.53	.73	1.57	.76	1.61	.79
V	10601		1.65	.82	1.69	.85	1.73	.88	1.77	.90	1.81	.92	1.85	.94
V	10601		1.89	.96	1.93	.97	1.97	.98	2.01	.99	2.05	1.00	2.09	1.00
V	10601		2.13	1.00	2.17	1.00	2.21	.99	2.25	.98	2.29	.97	2.33	.95
V	10601		2.37	.93	2.41	.91	2.45	.89	2.49	.86	2.53	.84	2.57	.81
V	10601		2.61	.78	2.65	.75	2.69	.71	2.73	.68	2.77	.65	2.81	.61
V	10601		2.85	.58	2.89	.54	2.93	.51	2.97	.48	3.01	.45	3.05	.42
V	10601		3.09	.39	3.13	.36	3.17	.33	3.21	.30	3.25	.28	3.29	.25
V	10601		3.33	.23	3.37	.21	3.41	.19	3.45	.17	3.49	.15	3.53	.14
V	10601		3.57	.12	3.61	.10	3.65	.07	3.69	.05	3.73	.02	3.77	.00
V	10601		100.00	.00										
D	10601		.00	.00	.20	.00	.40	.24	.60	1.00	.80	1.00	1.00	.68
D	10601		1.20	.12	1.40	.00	100.00	.00						

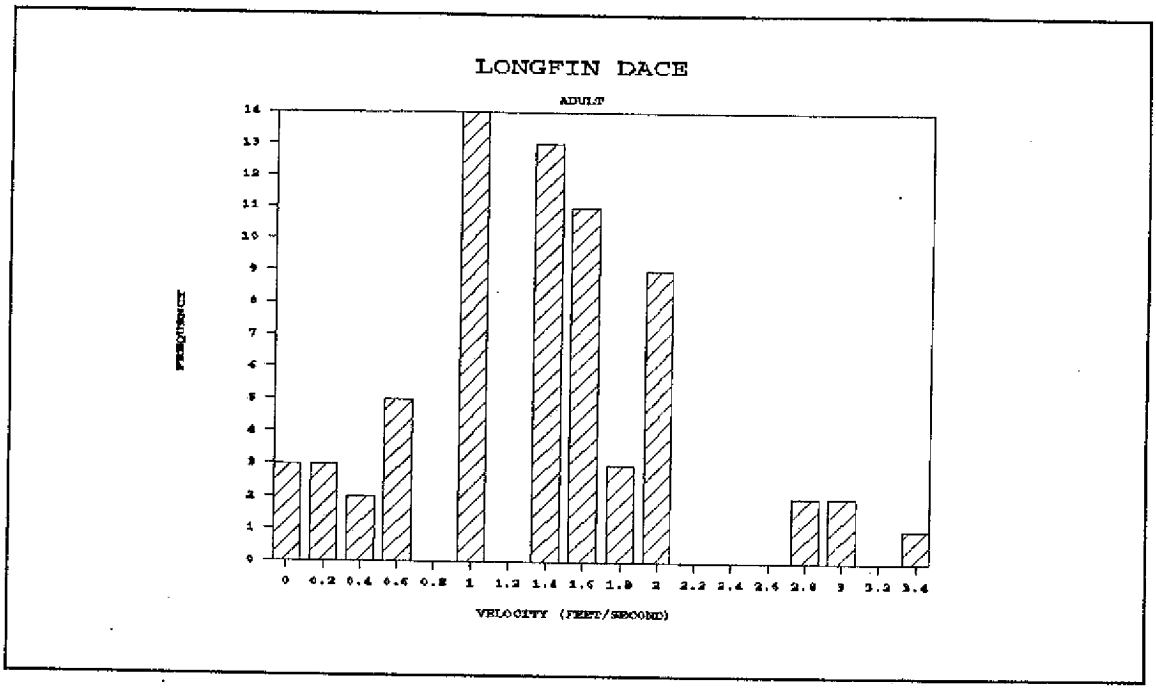

Figure V.2a Observed velocity utilization of adult Longfin Dace in Aravaipa Creek.

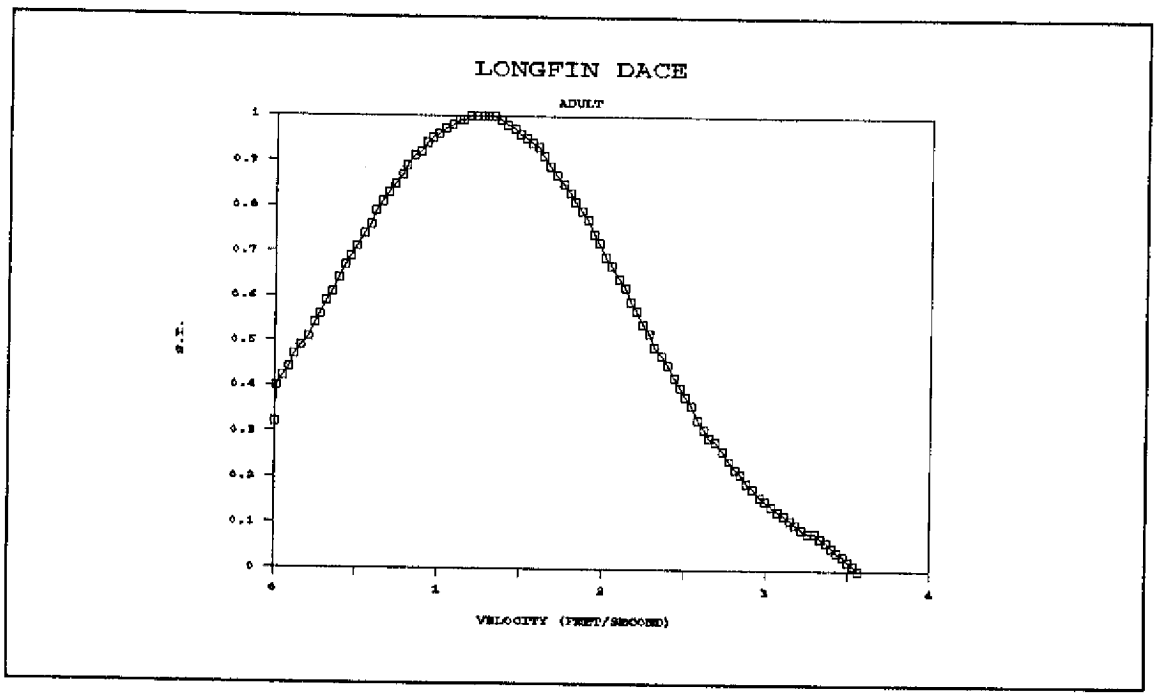

Figure V.2b Velocity Suitability Index Curve for adult Longfin Dace in Aravaipa Creek.

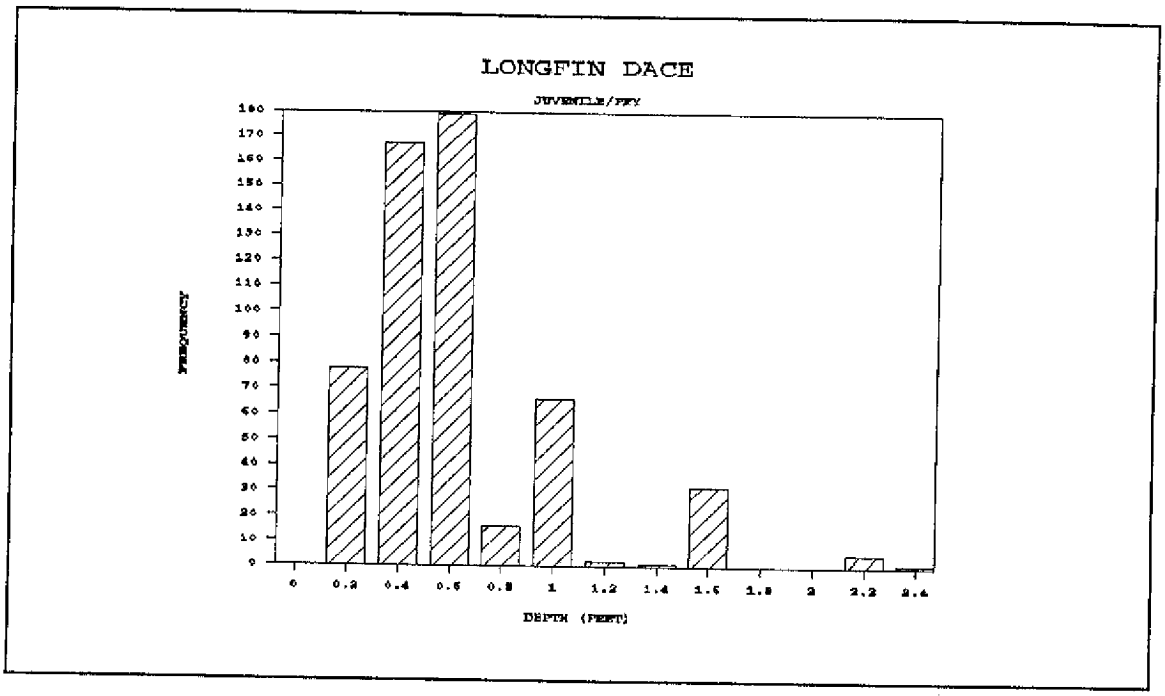

Figure V.3a Observed depth utilization of fry/juvenile Longfin Dace in Aravaipa Creek.

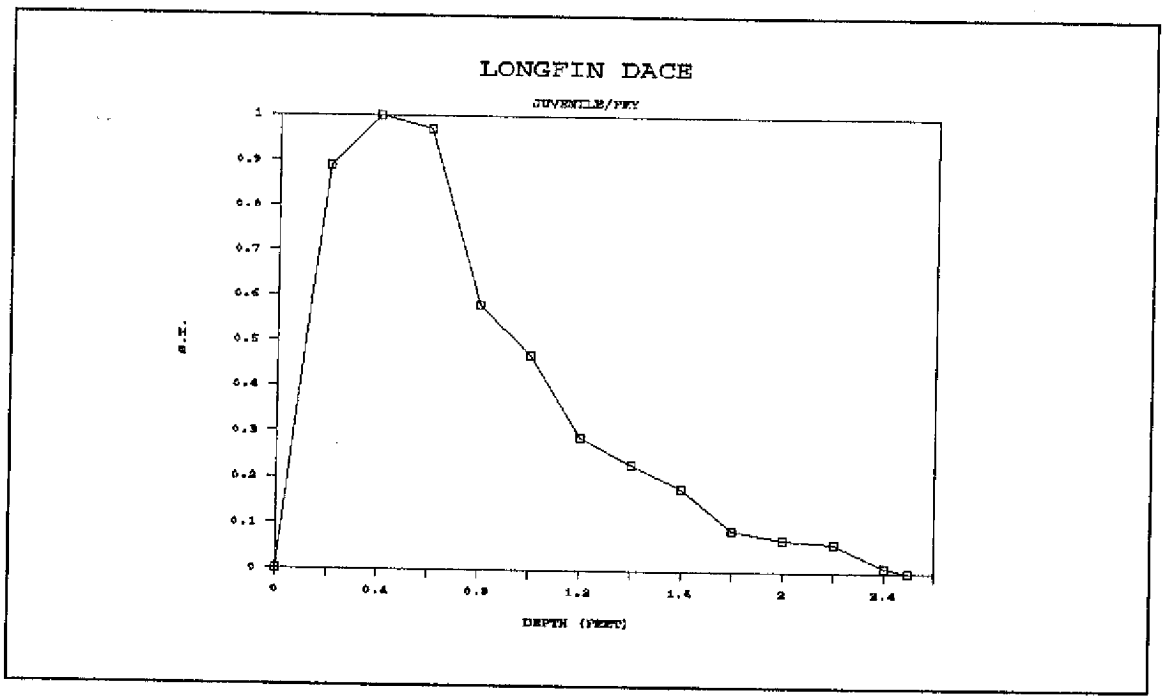

Figure V.3b Depth Suitability Index Curve for fry/juvenile Longfin Dace in Aravaipa Creek.

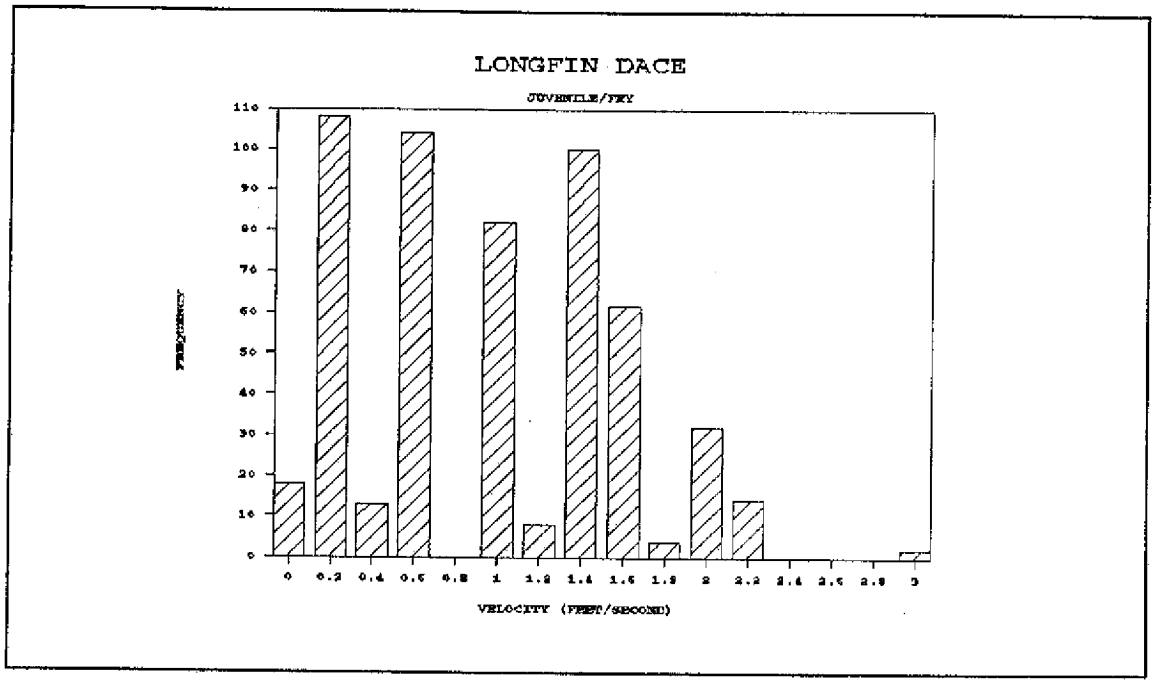

Figure V.4a Observed velocity utilization of fry/juvenile Longfin Dace in Aravaipa Creek.

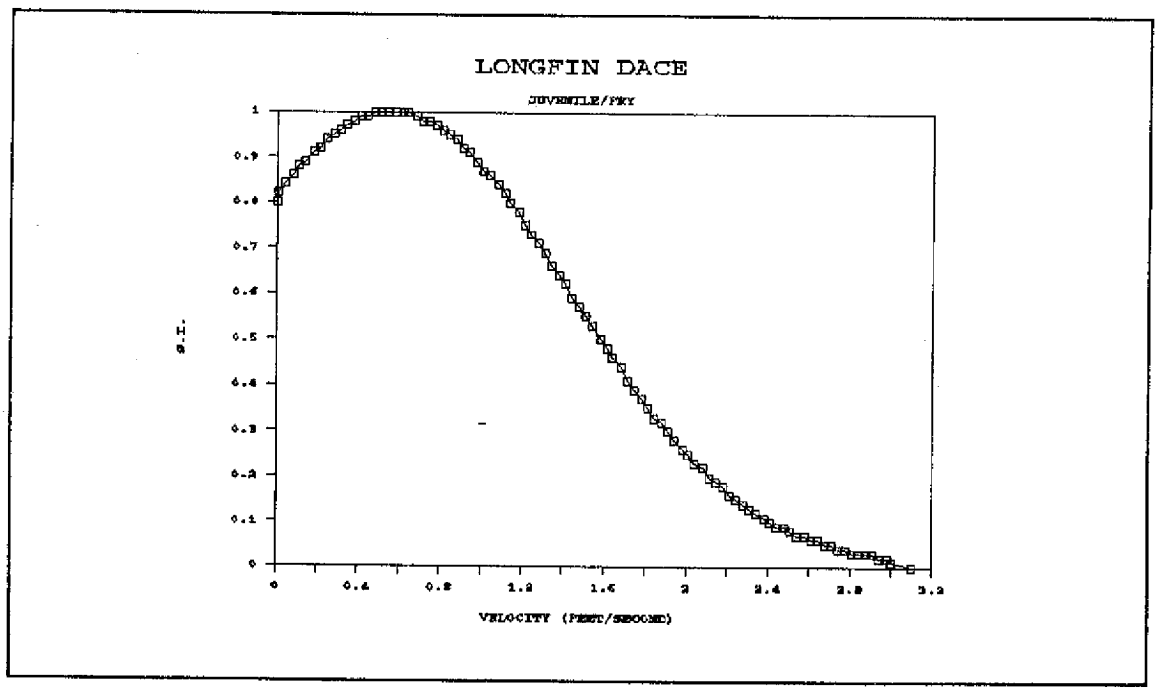

Figure V.4b Velocity Suitability Index Curve for fry/juvenile Longfin Dace in Aravaipa Creek.

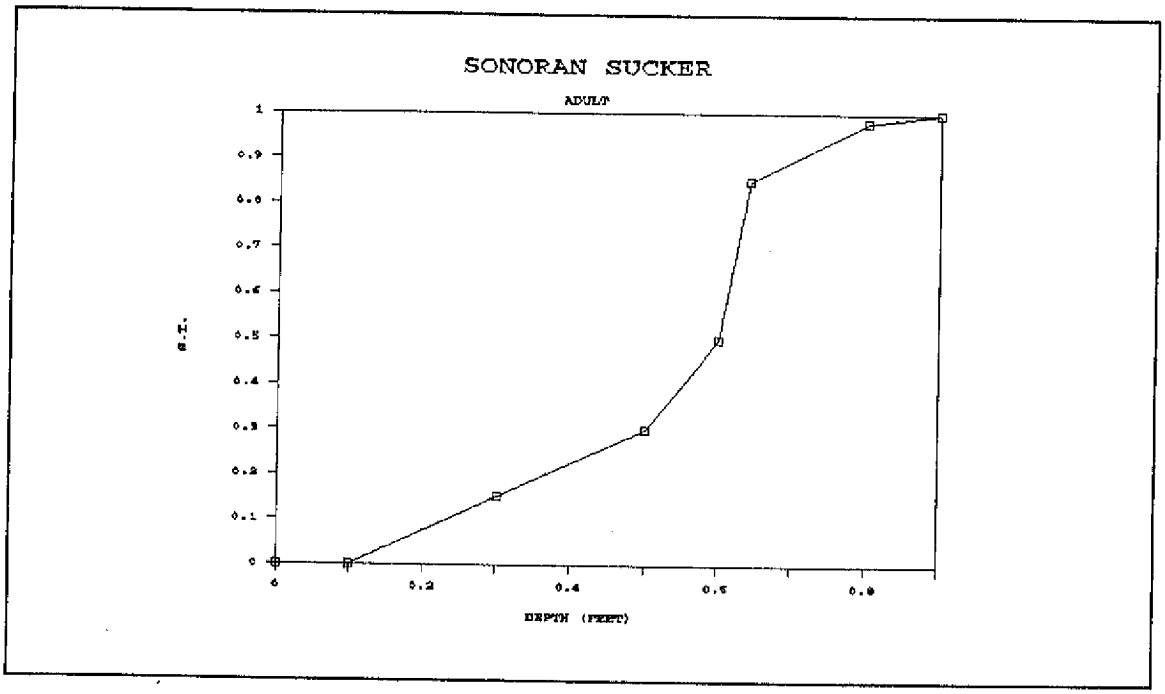

Figure V.5a Depth Suitability Index Curve for adult Sonoran Sucker in Aravaipa Creek taken from BLM (1988).

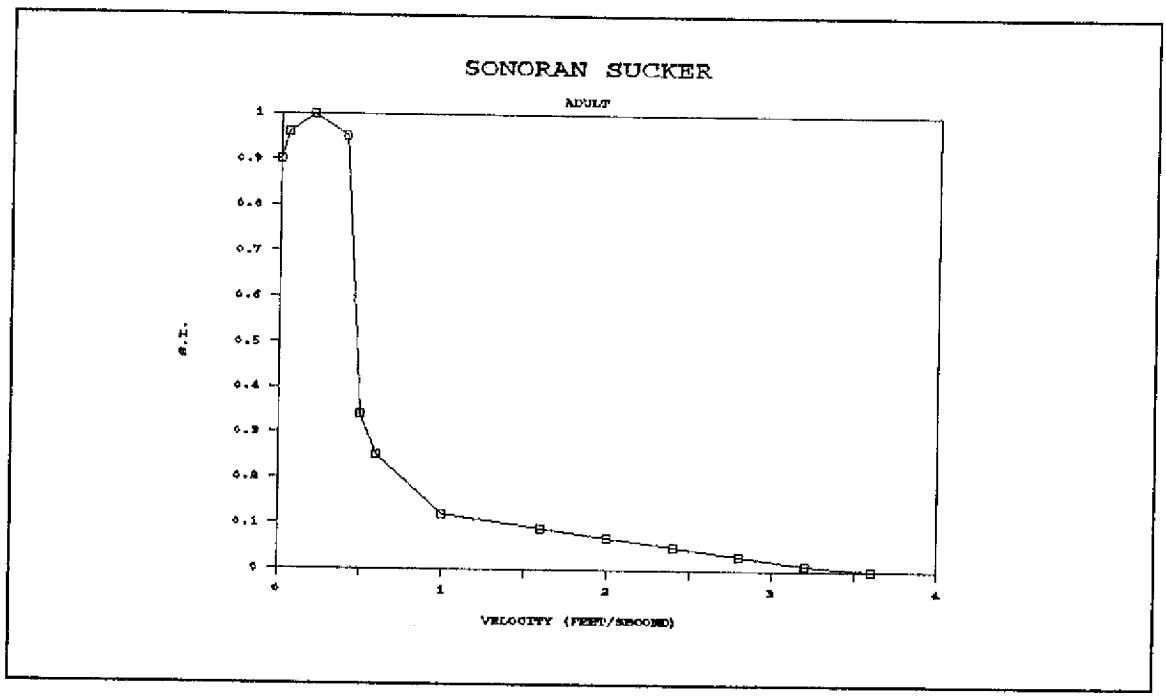

Figure V.5b Velocity Suitability Index Curve for adult Sonoran Sucker in Aravaipa Creek taken from BLM (1988).

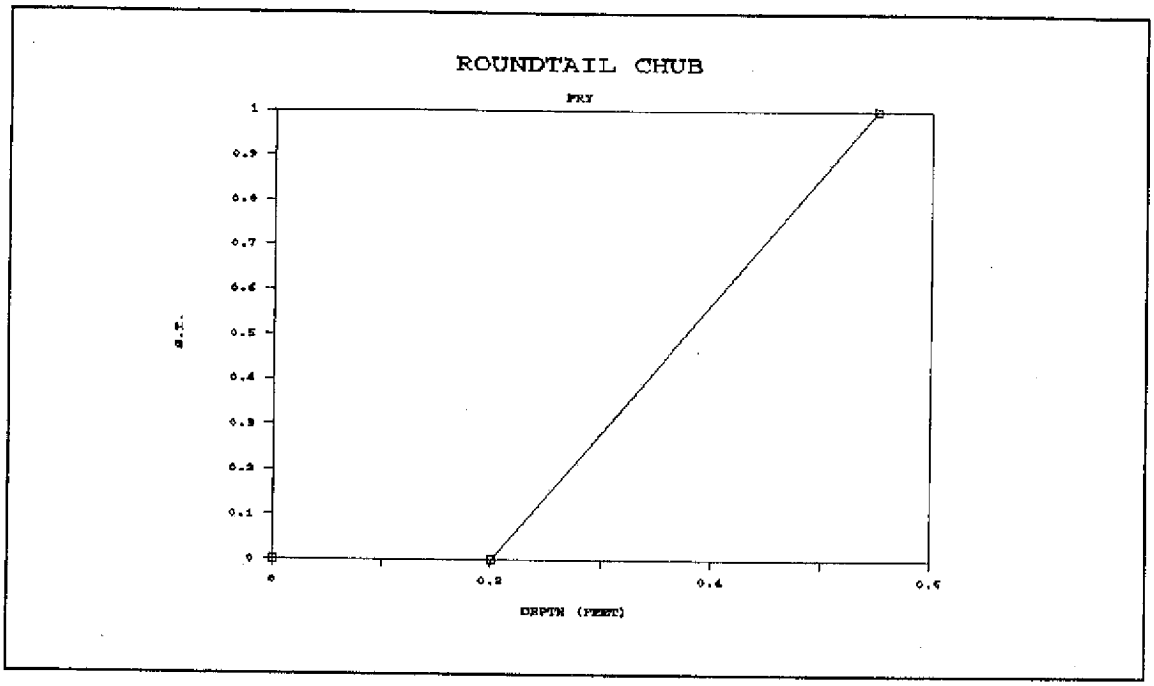

Figure V.8a Depth Suitability Index Curve for fry Roundtail Chub in the Virgin River taken from Hardy (1989).

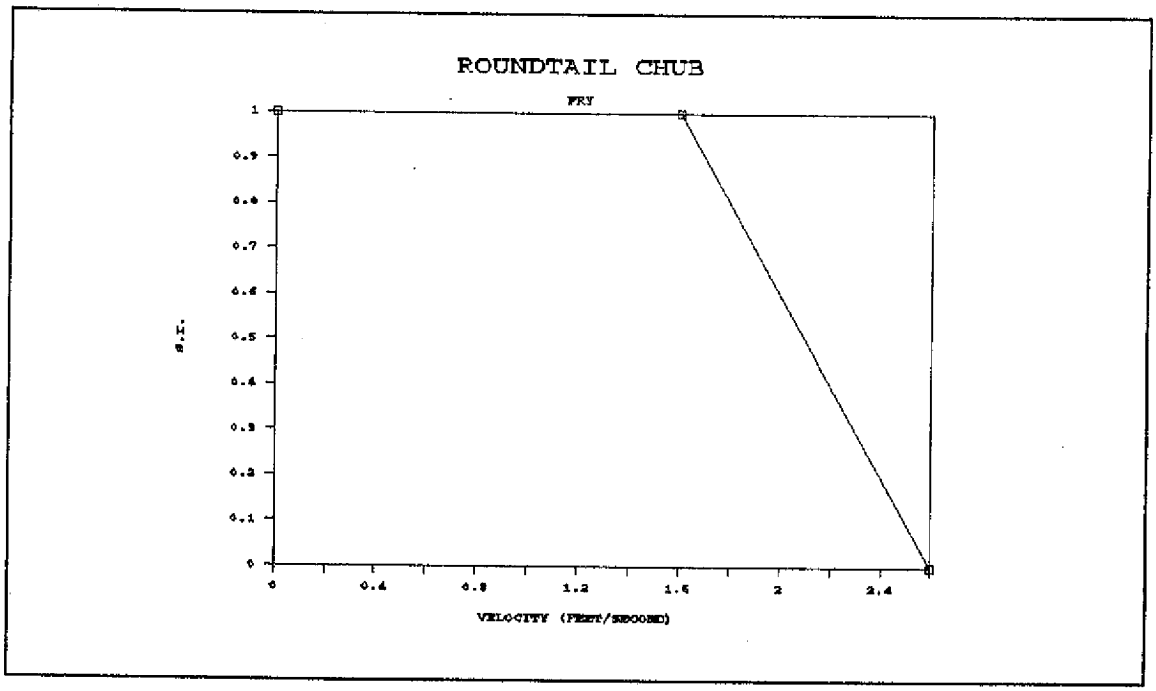

Figure V.8b Velocity Suitability Index Curve for fry Roundtail Chub in the Virgin River taken from Hardy (1989).

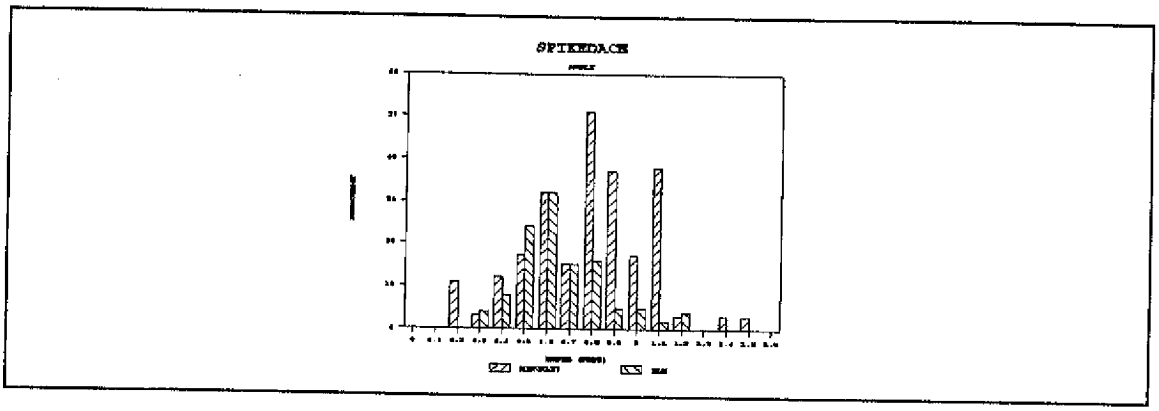

Figure V.9a Observed depth utilization of adult Spikedace in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

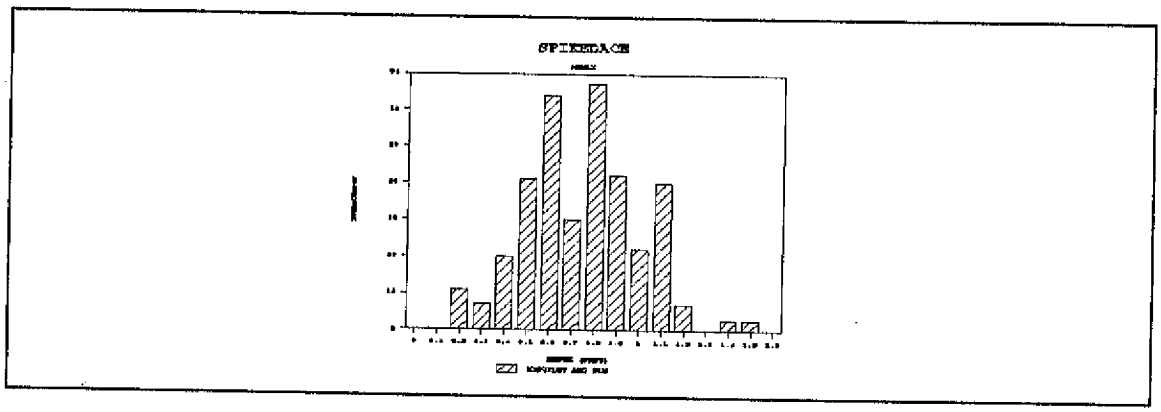

Figure V.9b Combined Observed depth utilization of adult Spikedace in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

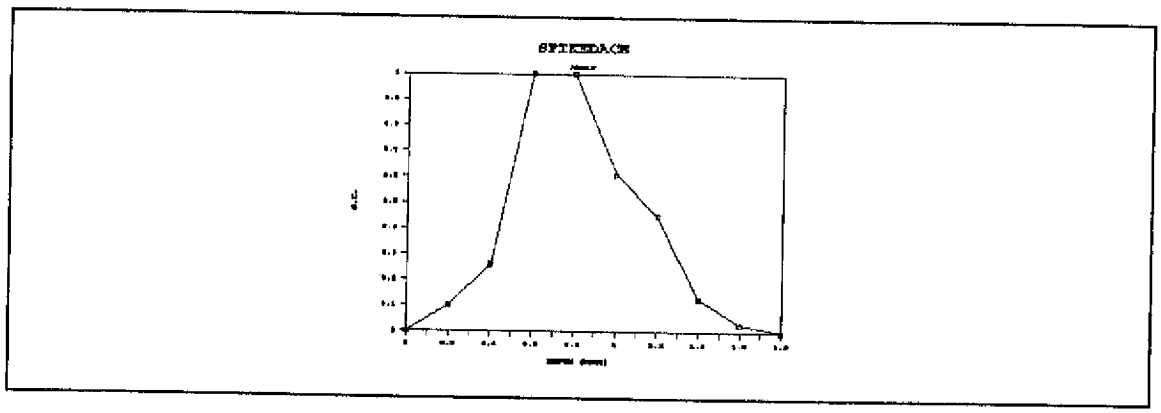

Figure V.9c Depth Suitability Index Curve for adult Spikedace in Aravaipa Creek.

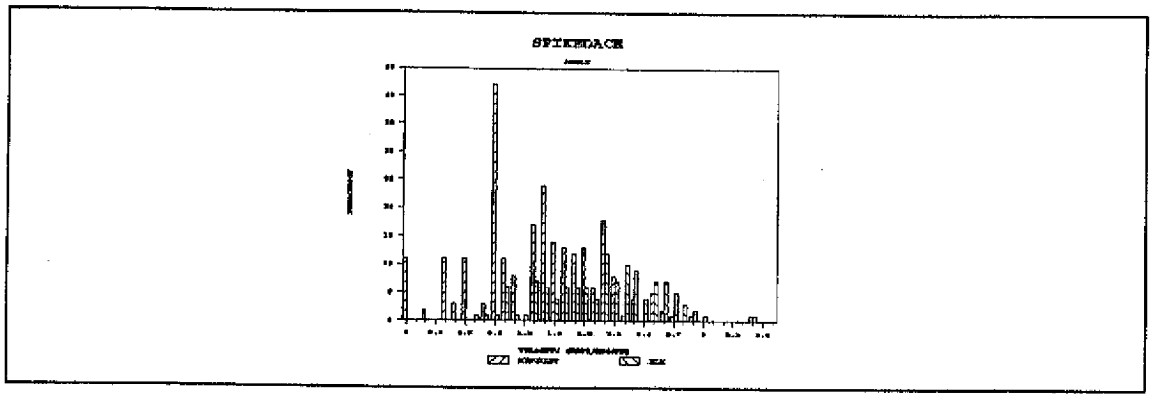

Figure V.10a Observed velocity utilization of adult Spikedace in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

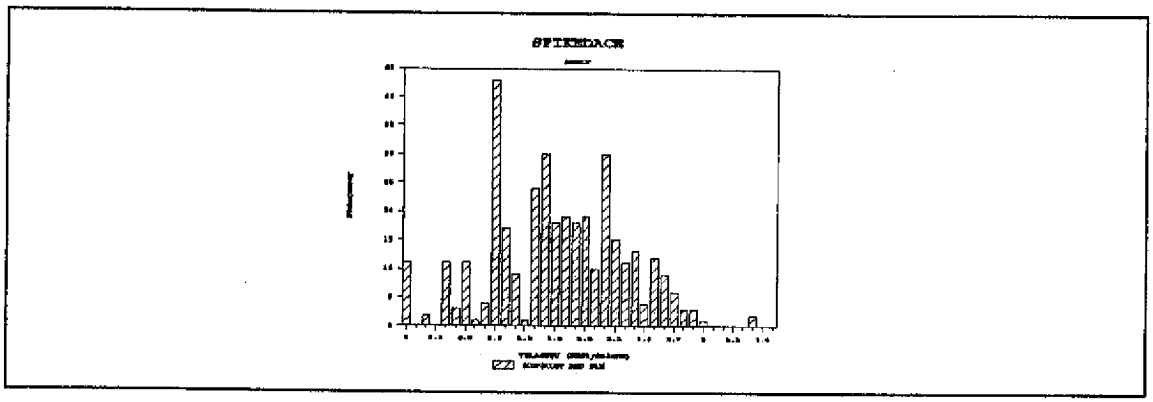

Figure V.10b Combined Observed velocity utilization of adult Spikedace in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

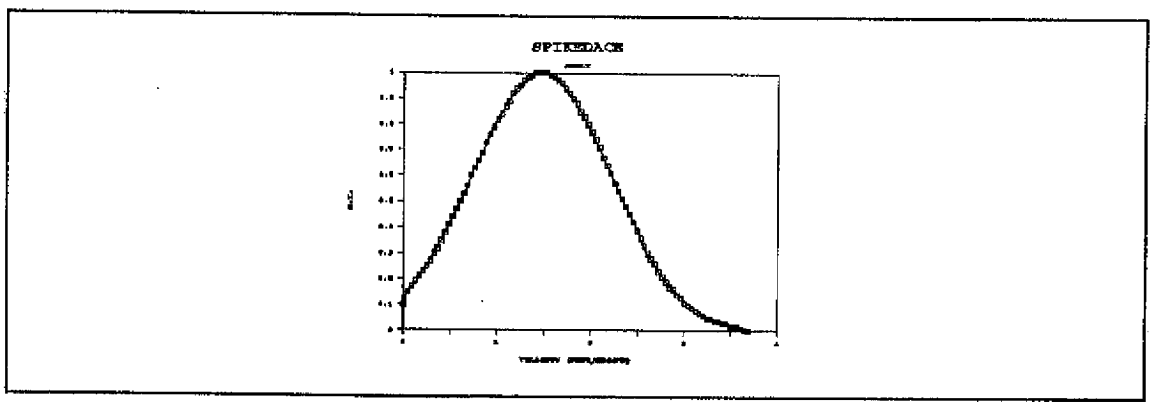

Figure V.10c Velocity Suitability Index Curve for adult Spikedace in Aravaipa Creek.

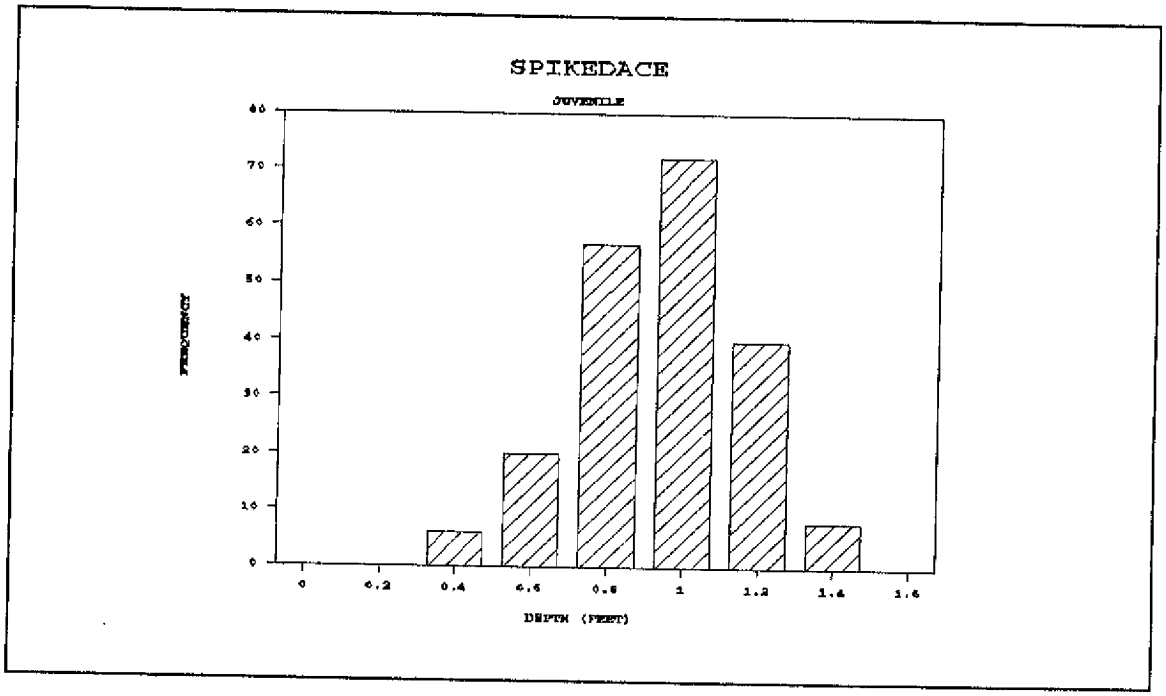

Figure V.11a Observed depth utilization of adult Spikedace in Aravaipa Creek.

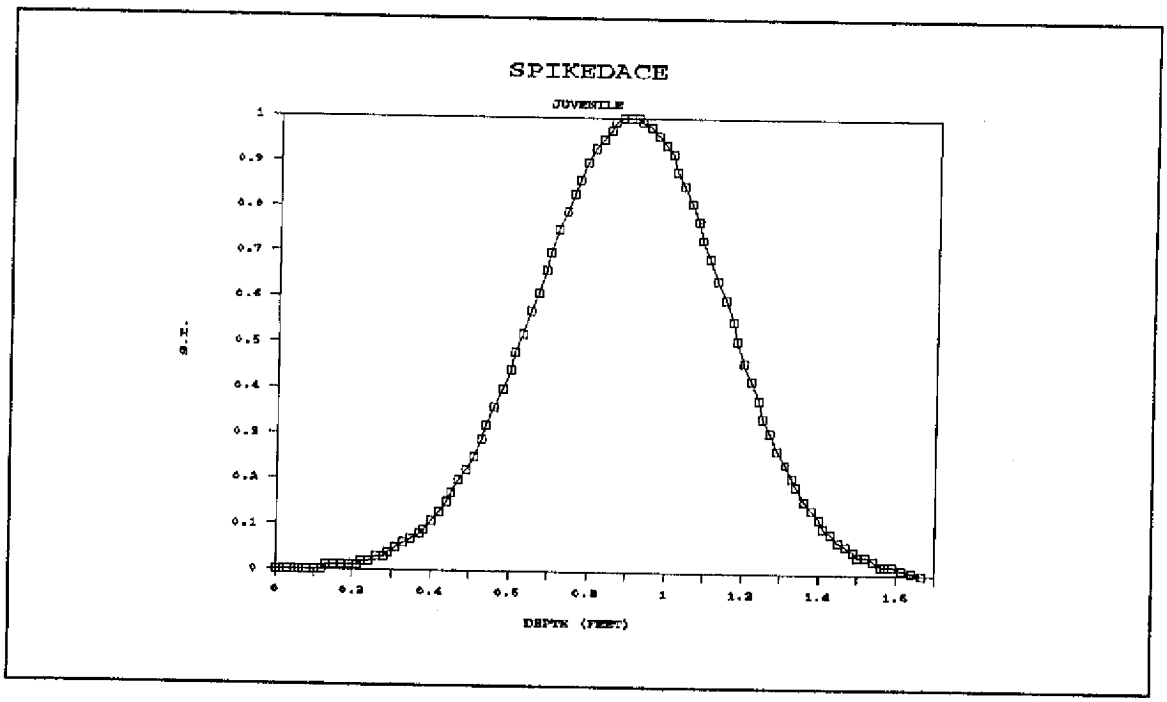

Figure V.11b Depth Suitability Index Curve for adult Spikedace in Aravaipa Creek.

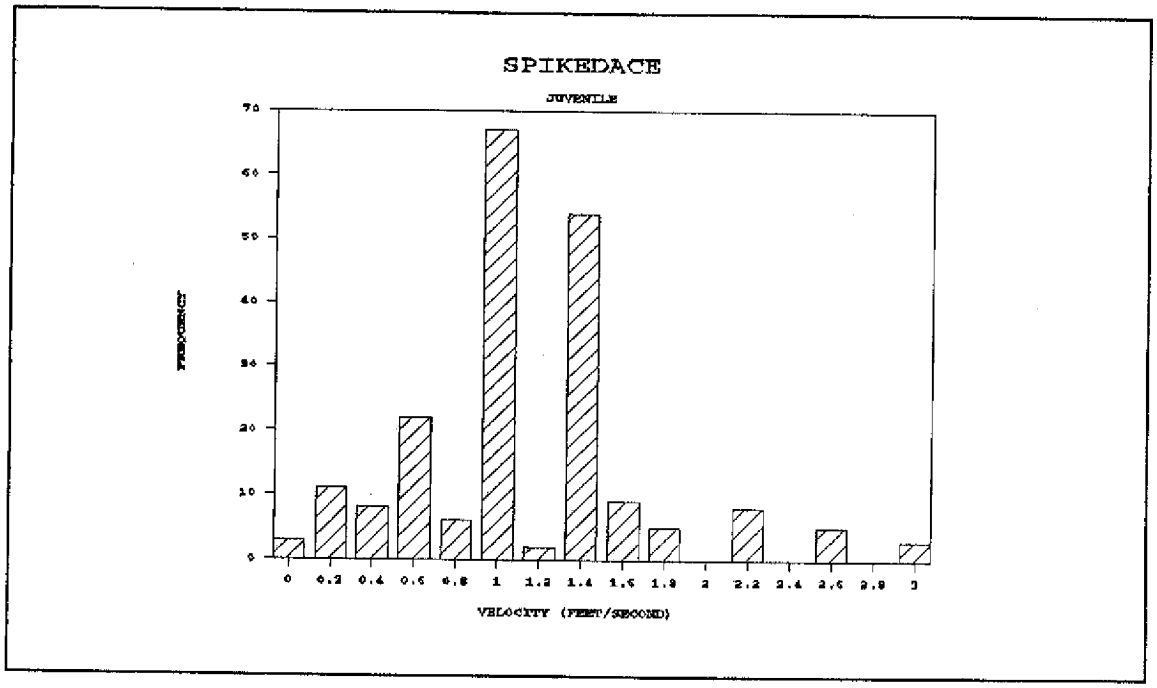

Figure V.12a Observed velocity utilization of juvenile Spikedace in Aravaipa Creek.

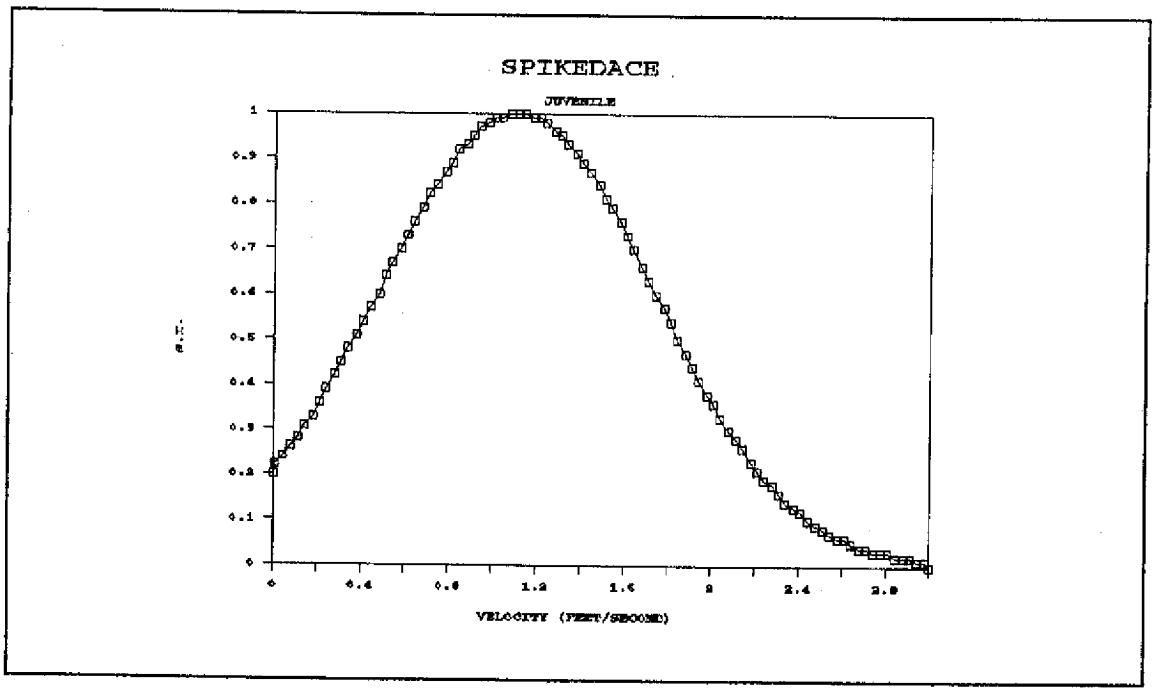

Figure V.12b Velocity Suitability Index Curve for juvenile Spikedace in Aravaipa Creek.

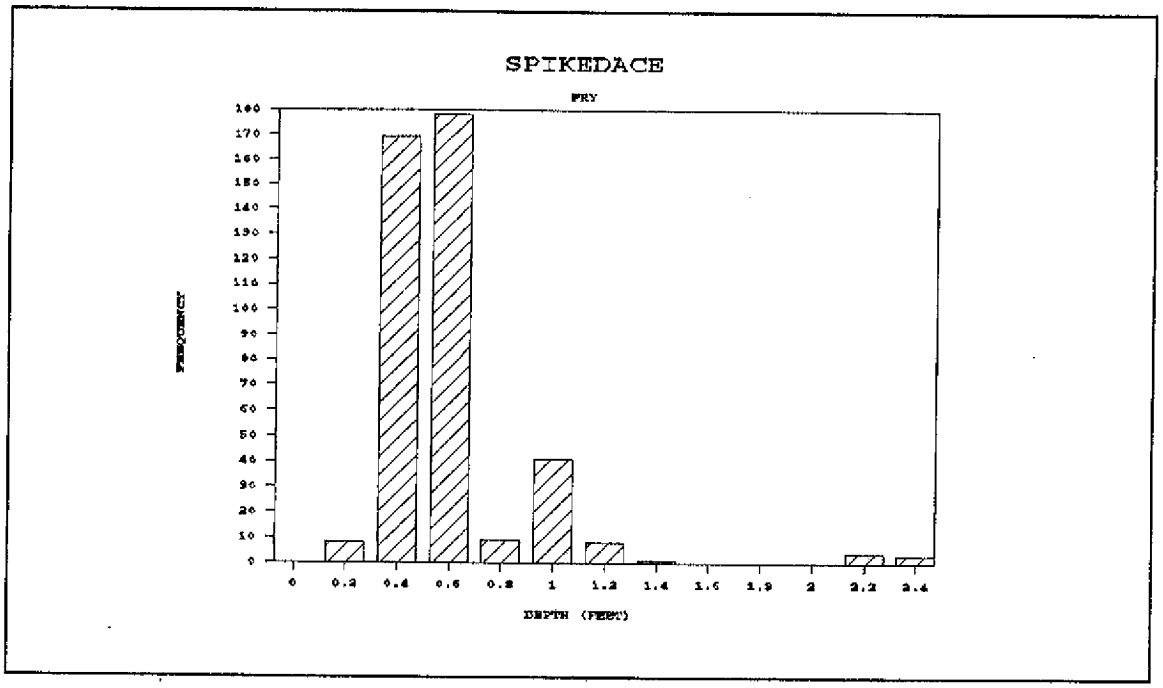

Figure V.13a Observed depth utilization of fry Spikedace in Aravaipa Creek.

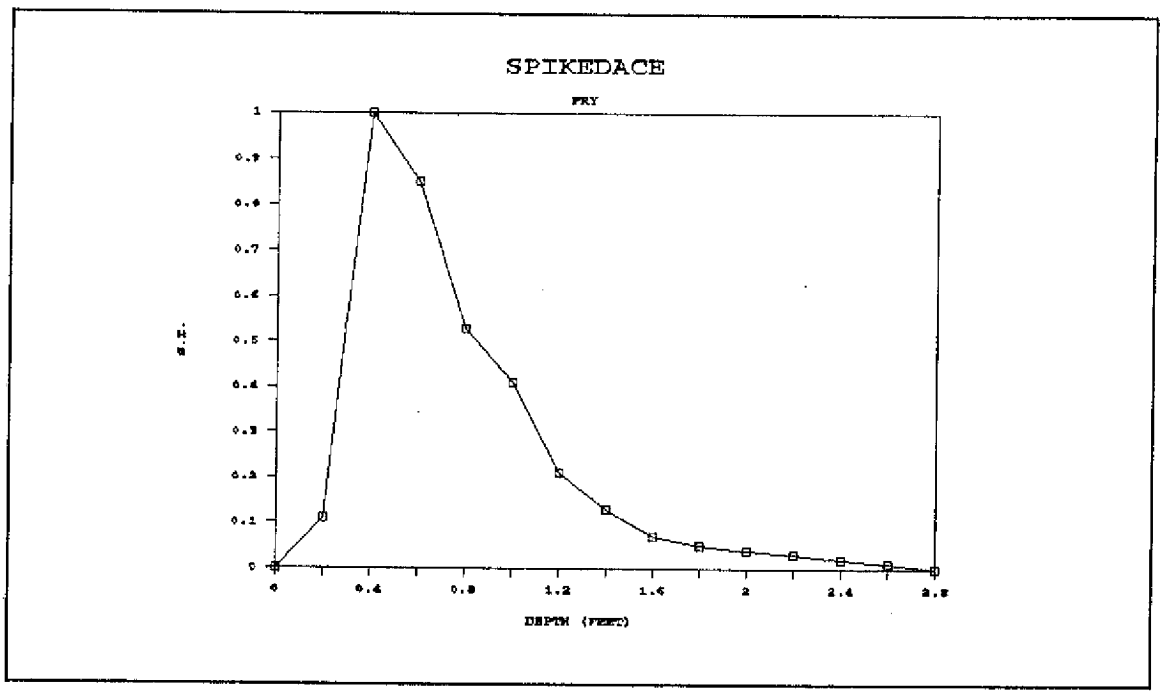

Figure V.13b Depth Suitability Index Curve for fry Spikedace in Aravaipa Creek.

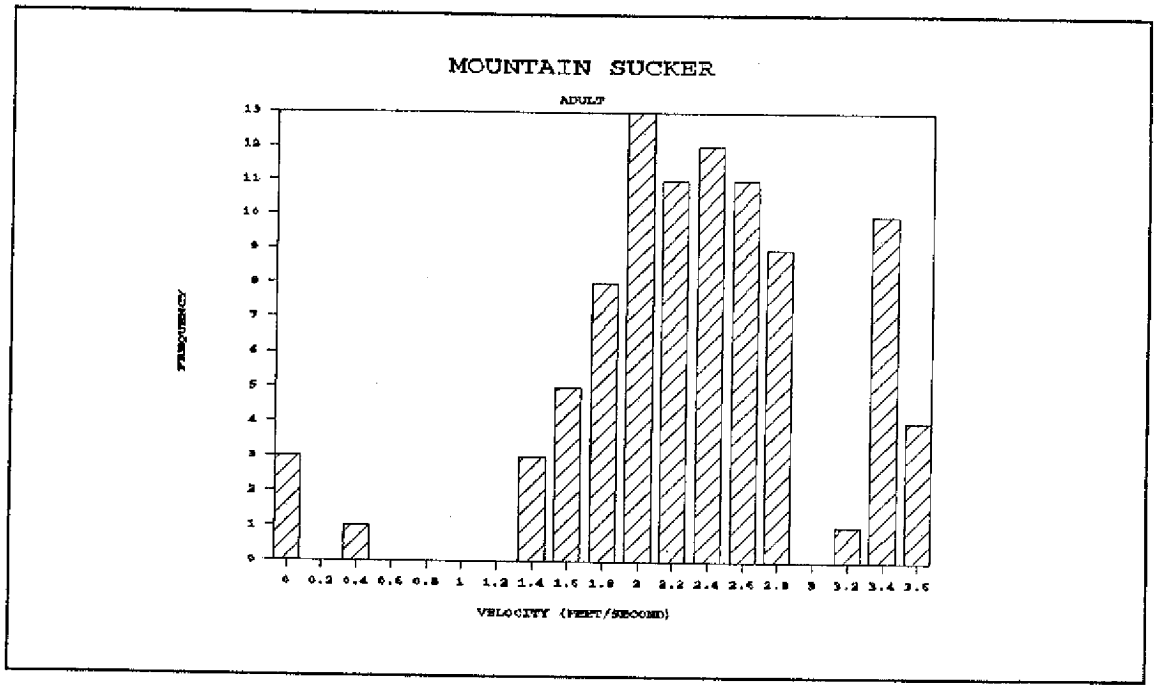

Figure V.16a Observed velocity utilization of adult Mountain Sucker in Aravaipa Creek.

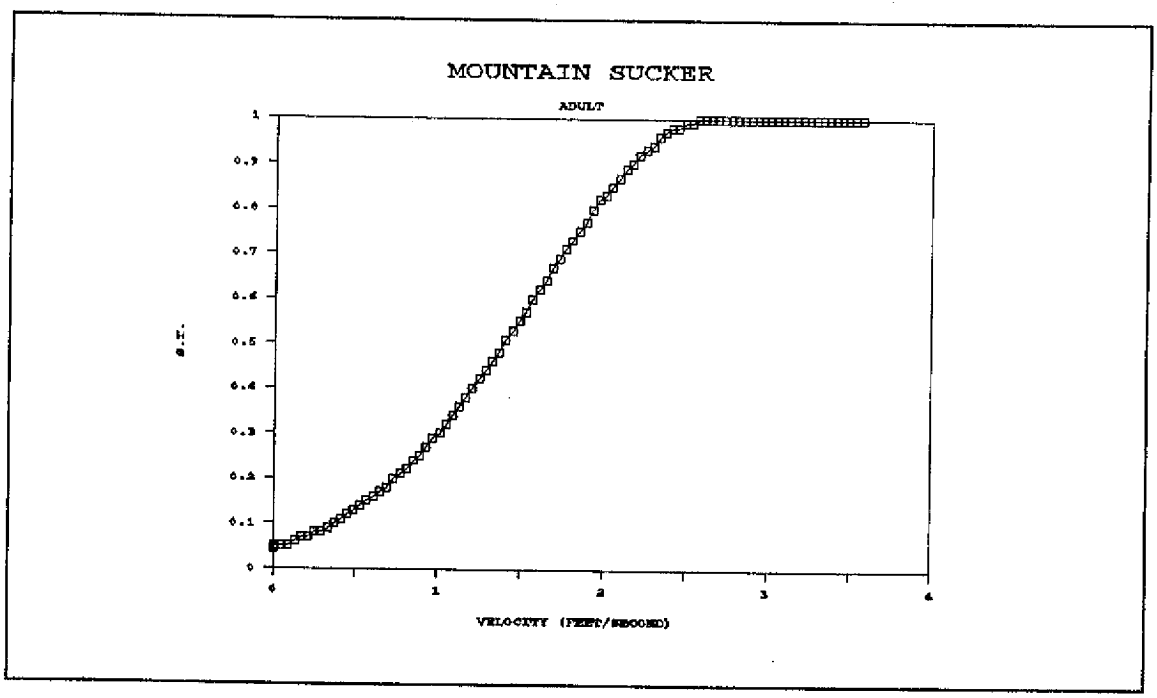

Figure V.16b Velocity Suitability Index Curve for adult Mountain Sucker in Aravaipa Creek.

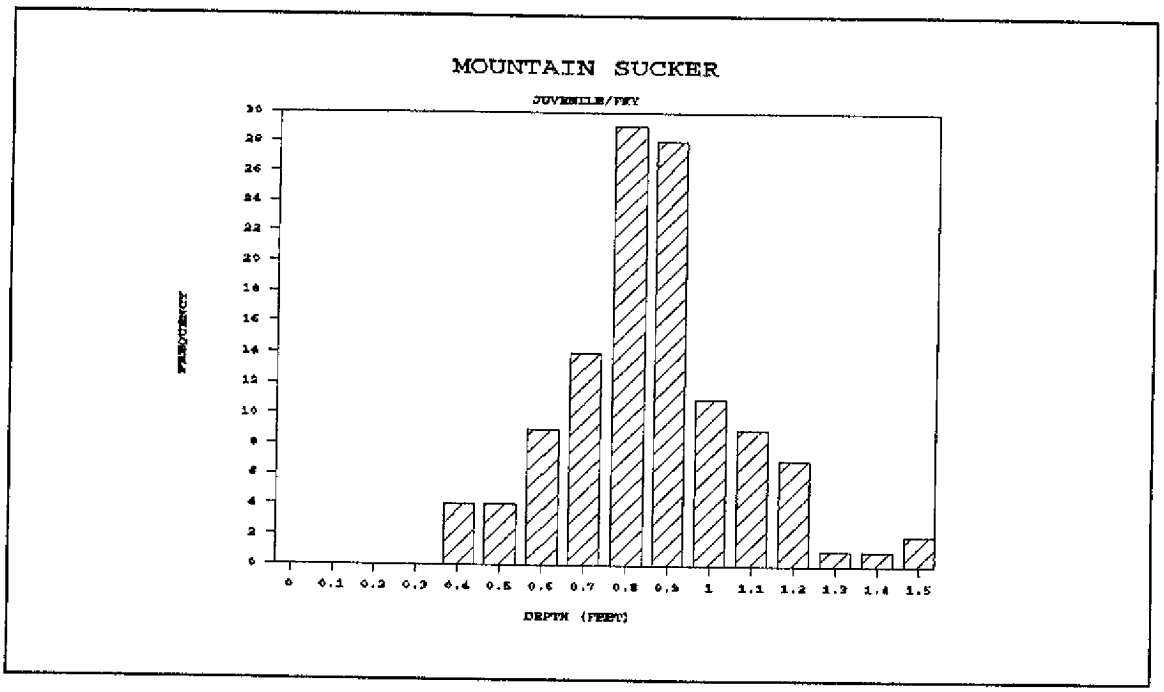

Figure V.17a Observed depth utilization of fry/juvenile Mountain Sucker in Aravaipa Creek.

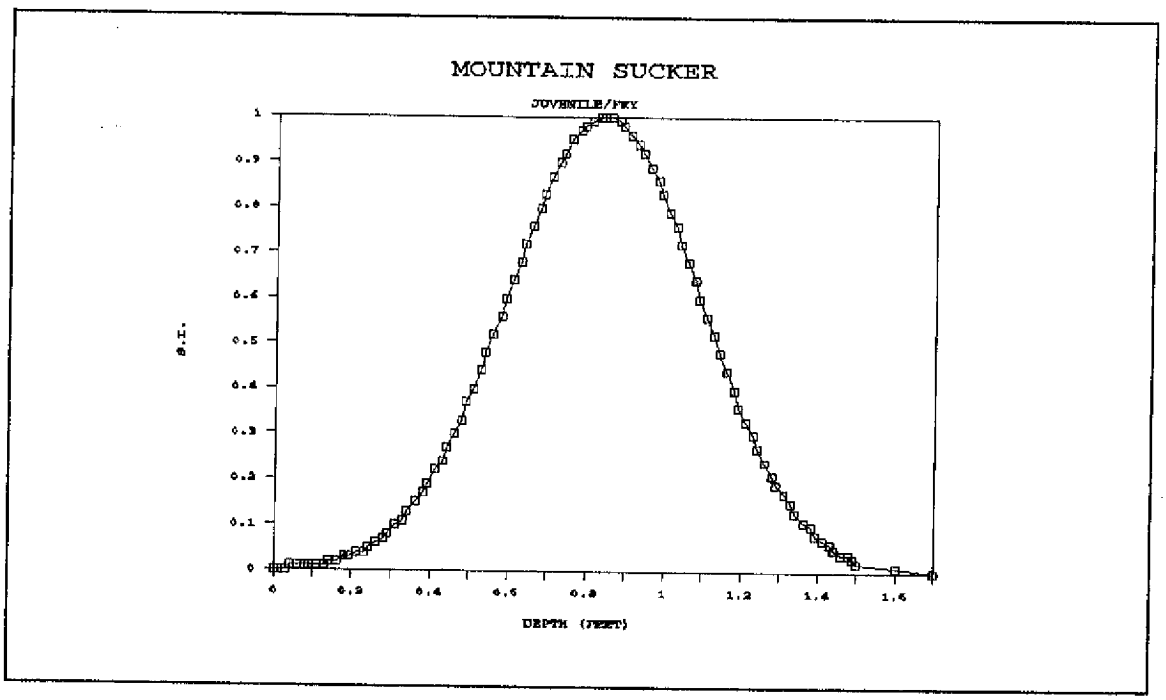

Figure V.17b Depth Suitability Index Curve for fry/juvenile Mountain Sucker in Aravaipa Creek.

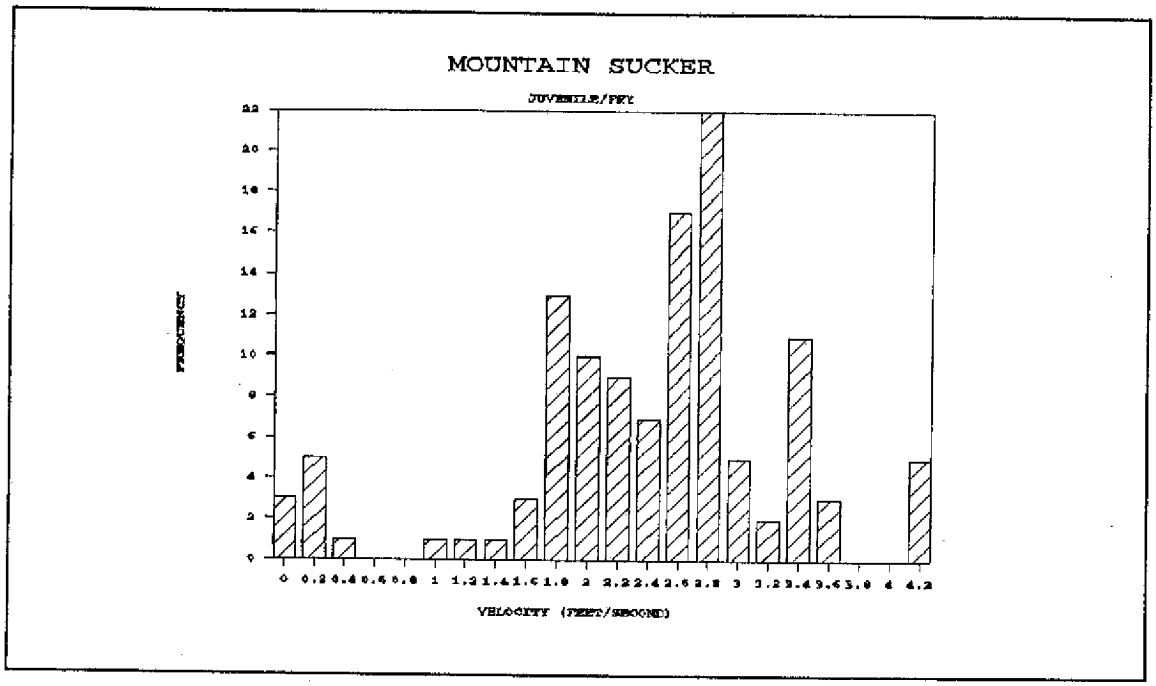

Figure V.18a Observed velocity utilization of fry/juvenile Mountain Sucker in Aravaipa Creek.

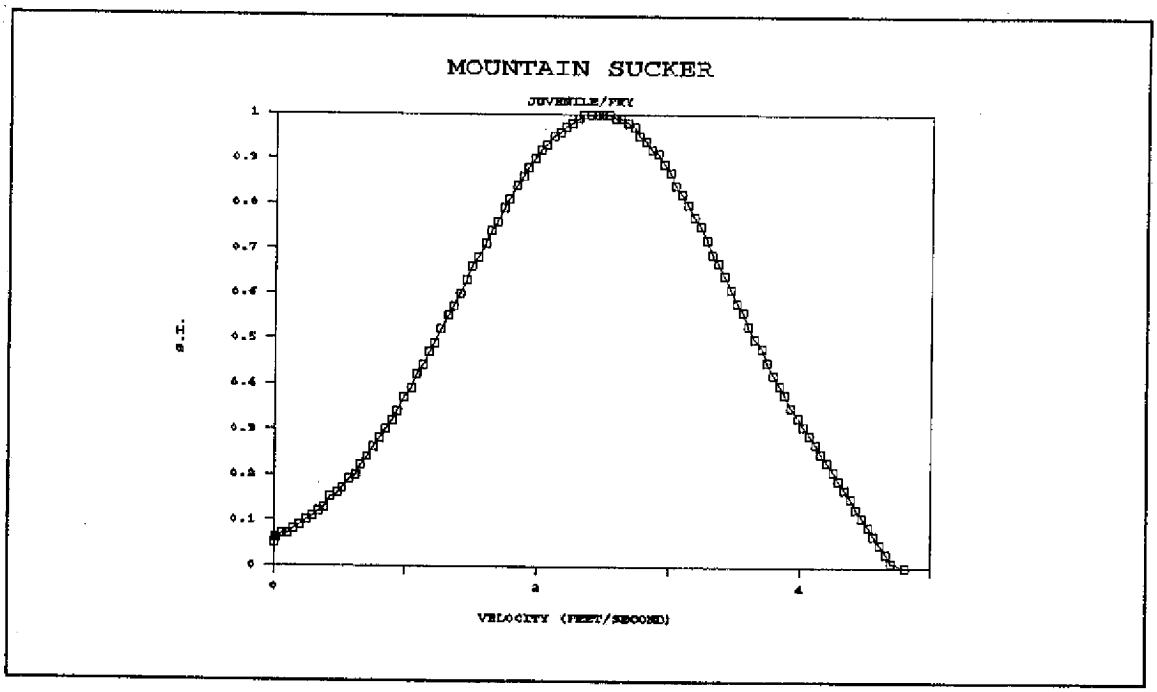

Figure V.18b Velocity Suitability Index Curve for fry/juvenile Mountain Sucker in Aravaipa Creek.

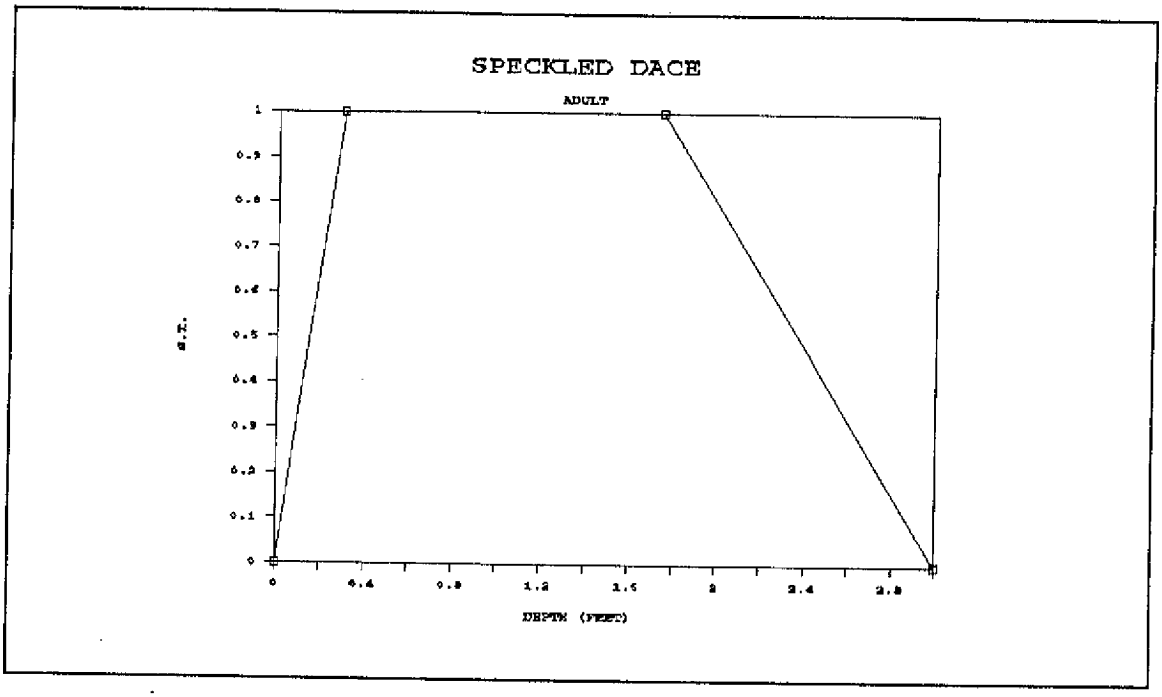

Figure V.19a Depth Suitability Index Curve for adult Speckled Dace in Aravaipa Creek taken from Hardy (1989).

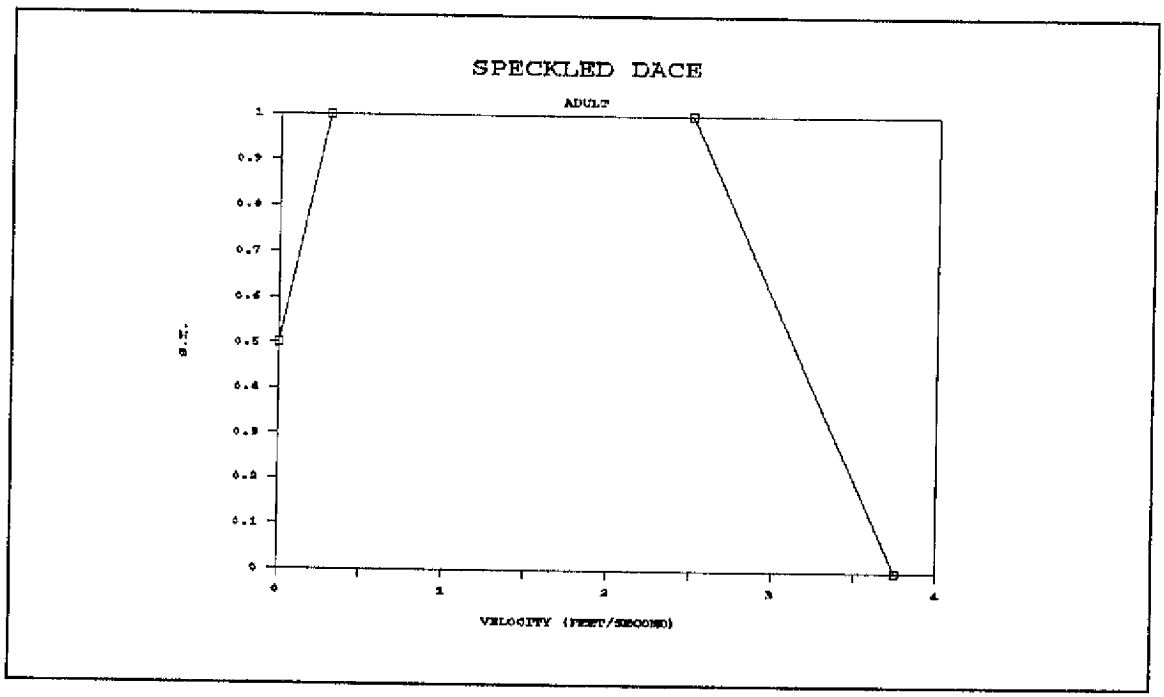

Figure V.19b Velocity Suitability Index Curve for adult Speckled Dace in Aravaipa Creek taken from Hardy (1989).

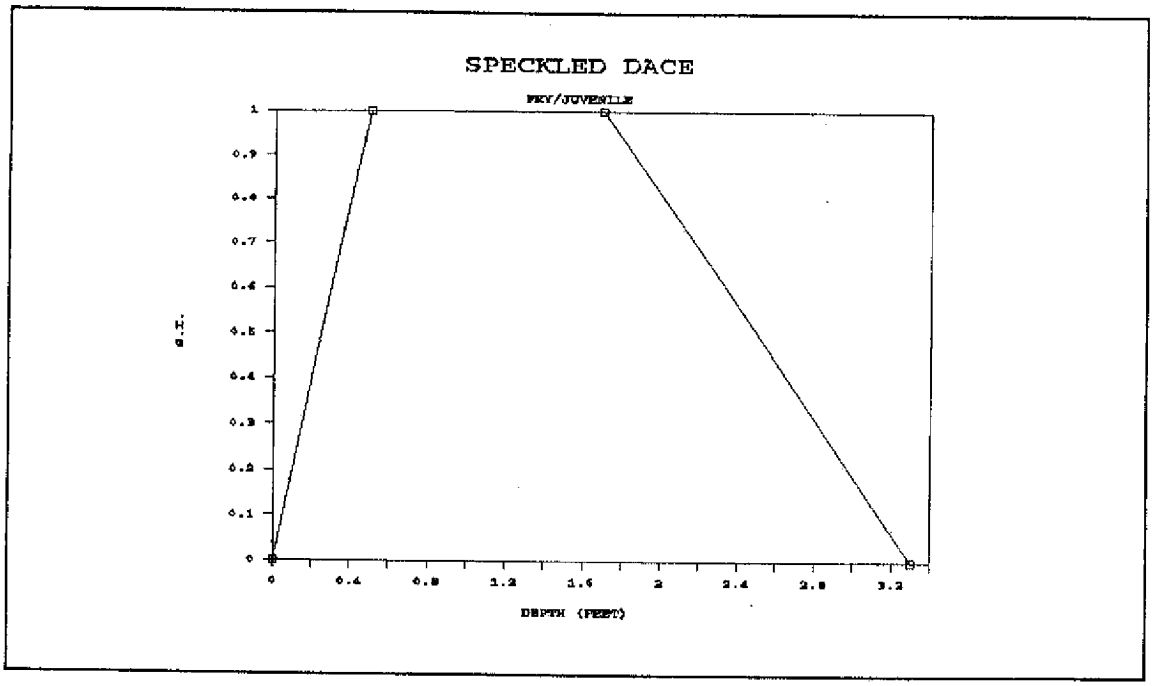

Figure V.20a Depth Suitability Index Curve for fry/juvenile Speckled Dace in Aravaipa Creek taken from Hardy (1989).

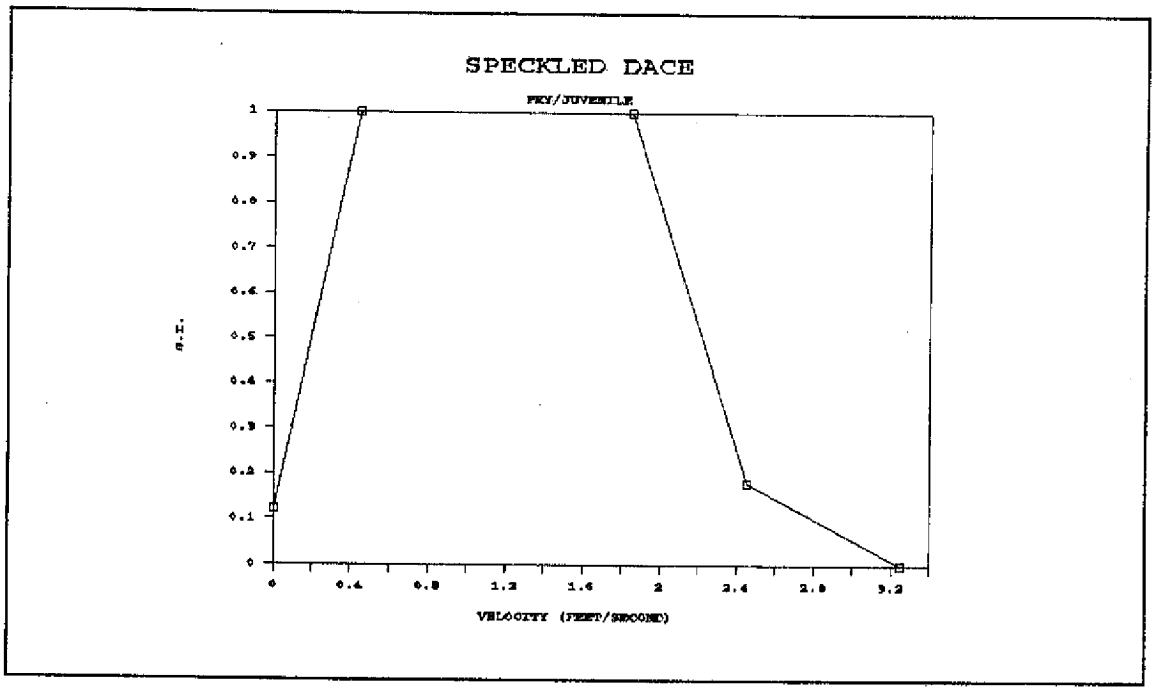

Figure V.20b Velocity Suitability Index Curve for fry/juvenile Speckled Dace in Aravaipa Creek taken from Hardy (1989).

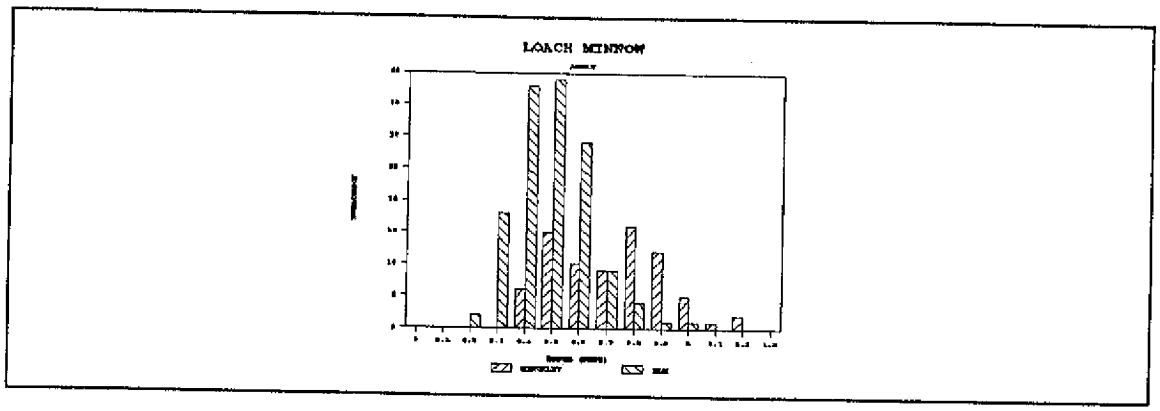

Figure V.21a Observed depth utilization of adult Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

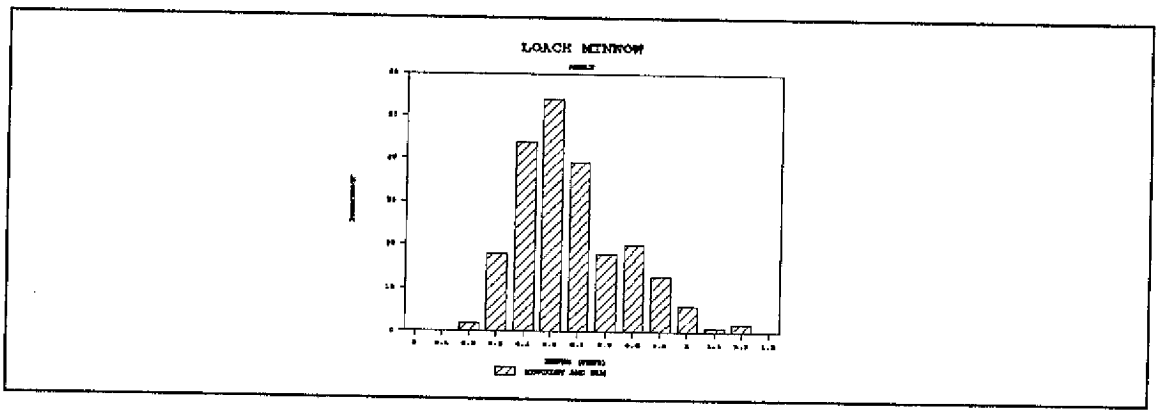

Figure V.21b Combined Observed depth utilization of adult Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

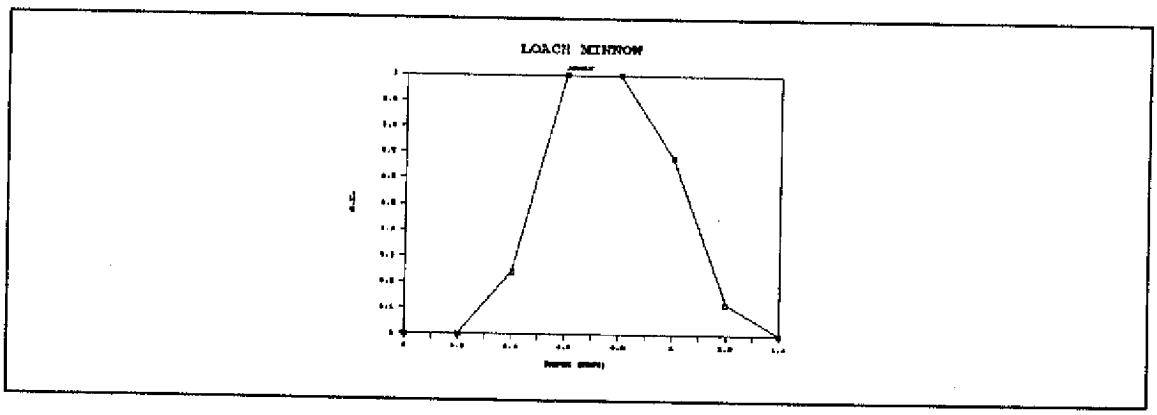

Figure V.21c Depth Suitability Index Curve for adult Loach Minnow in Aravaipa Creek.

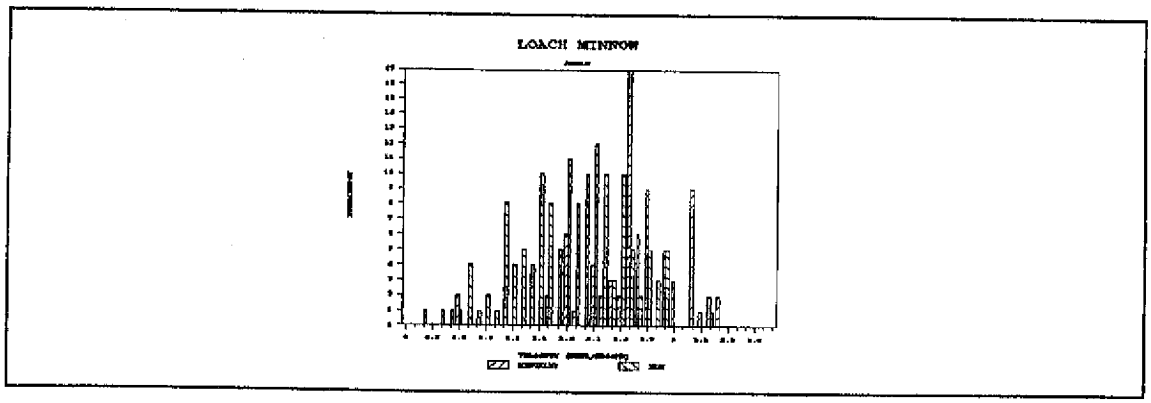

Figure V.22a Observed velocity utilization of adult Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

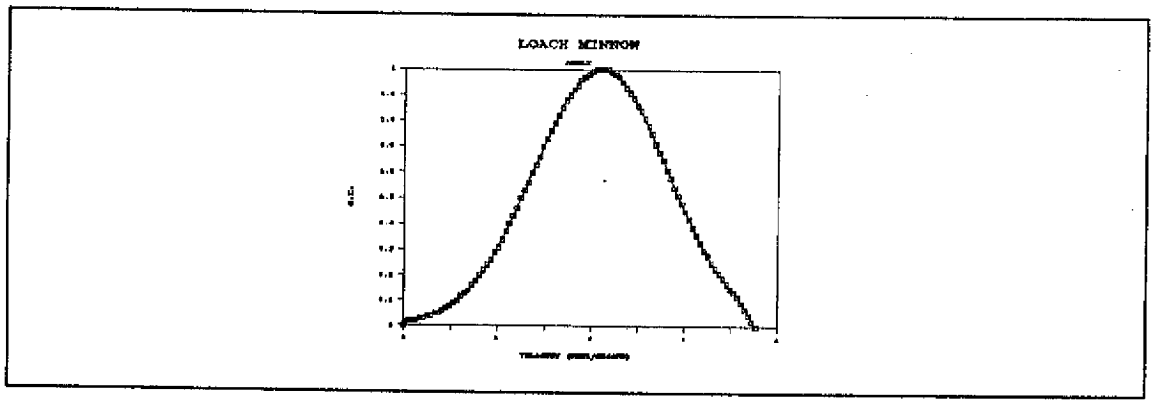

Figure V.22b Combined Observed velocity utilization of adult Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

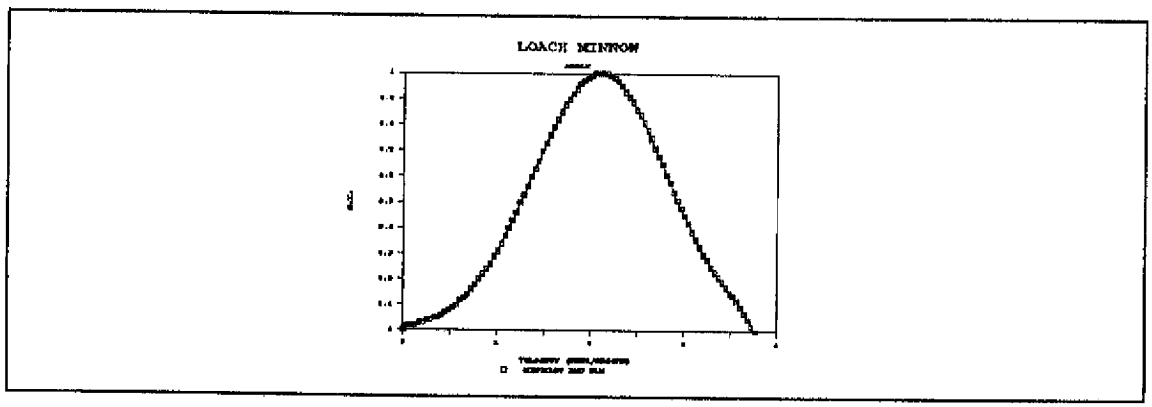

Figure V.22c Velocity Suitability Index Curve for adult Loach Minnow in Aravaipa Creek.

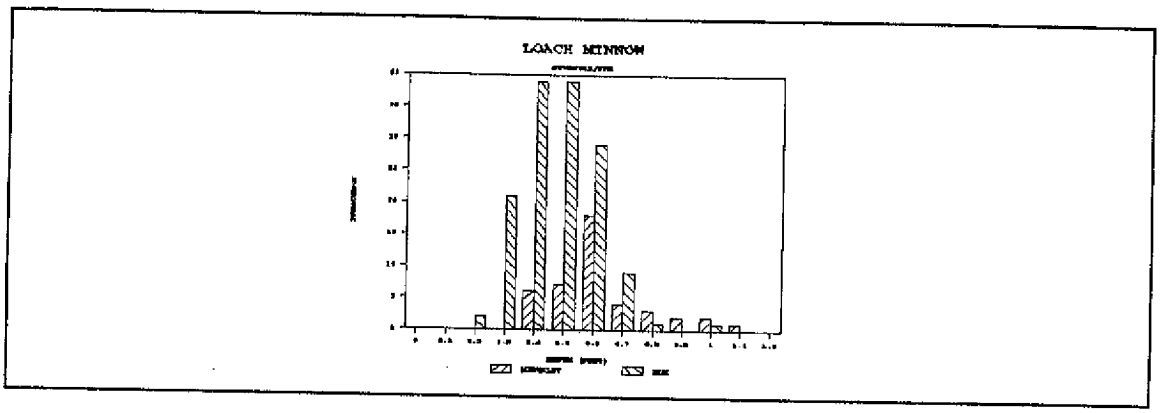

Figure V.23a Observed depth utilization of fry/juvenile Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

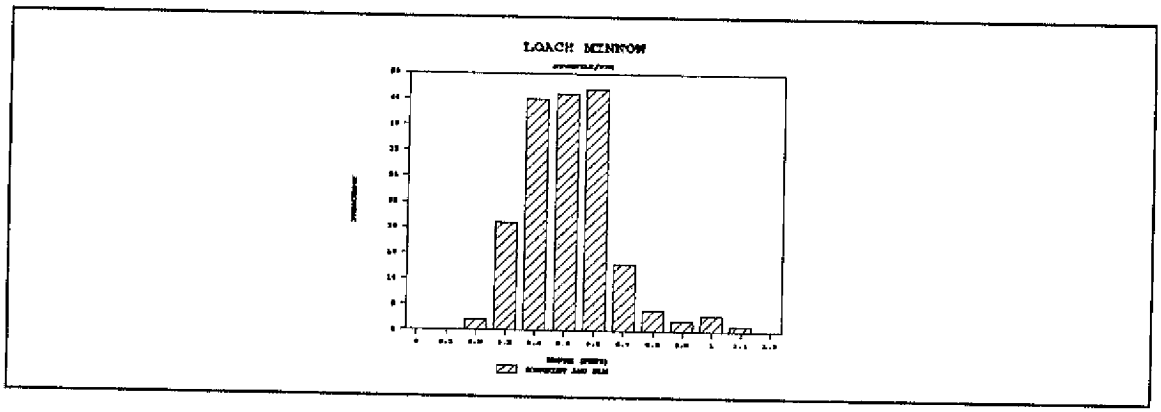

Figure V.23b Combined Observed depth utilization of fry/juvenile Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

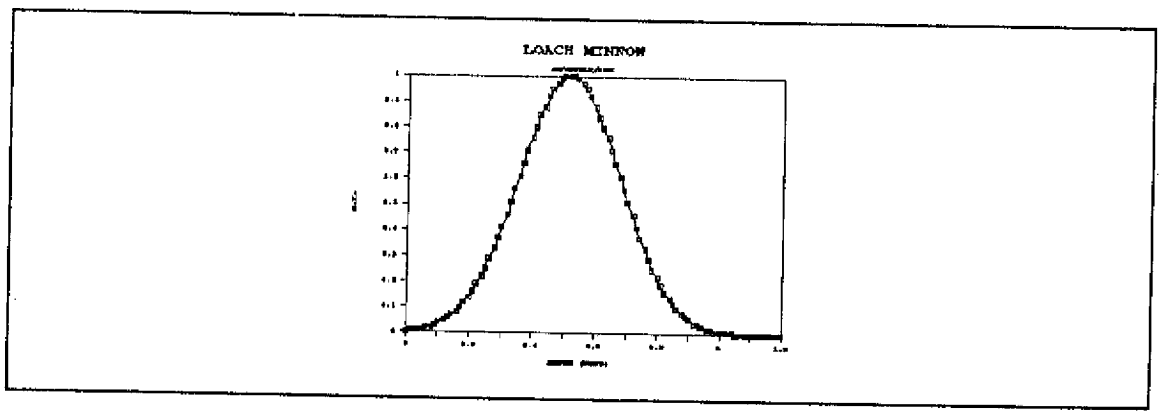

Figure V.23c Depth Suitability Index Curve for fry/juvenile Loach Minnow in Aravaipa Creek.

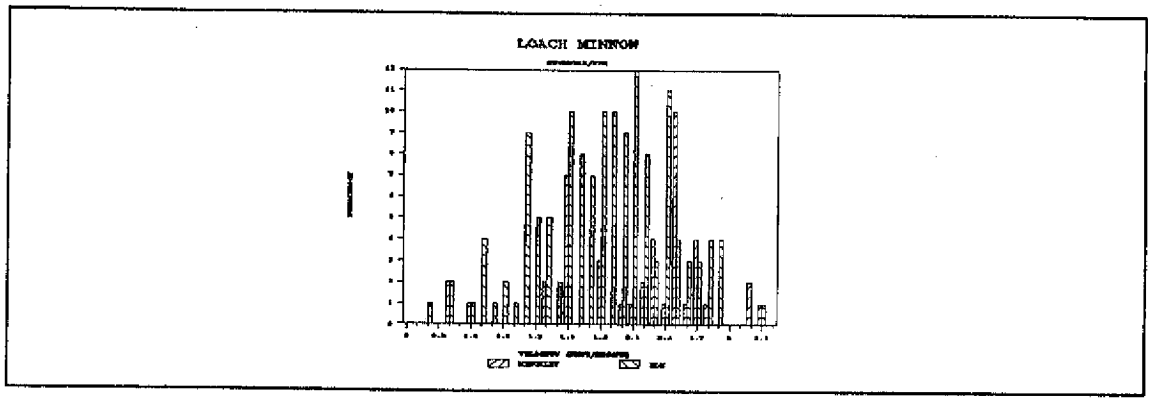

Figure V.24a Observed velocity utilization of fry/juvenile Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

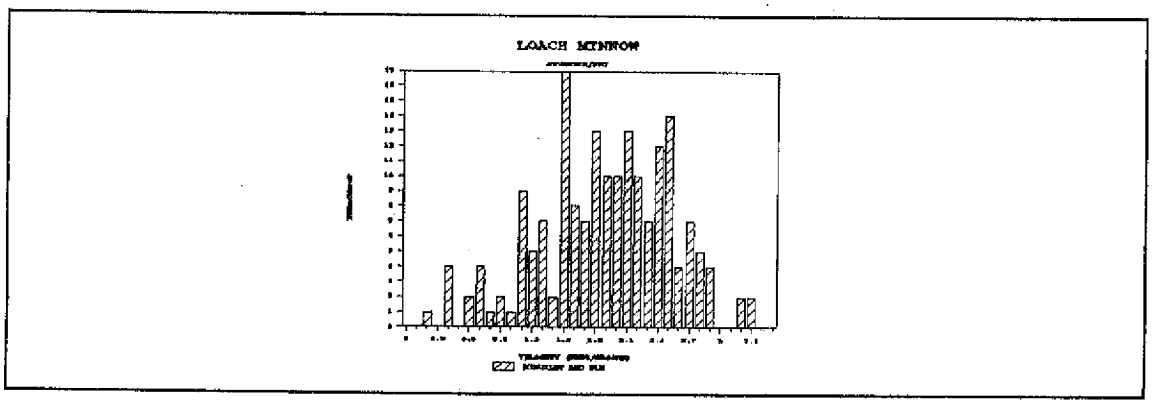

Figure V.24b Combined Observed velocity utilization of fry/juvenile Loach Minnow in Aravaipa Creek for data from Minckley (1990) and BLM (1988).

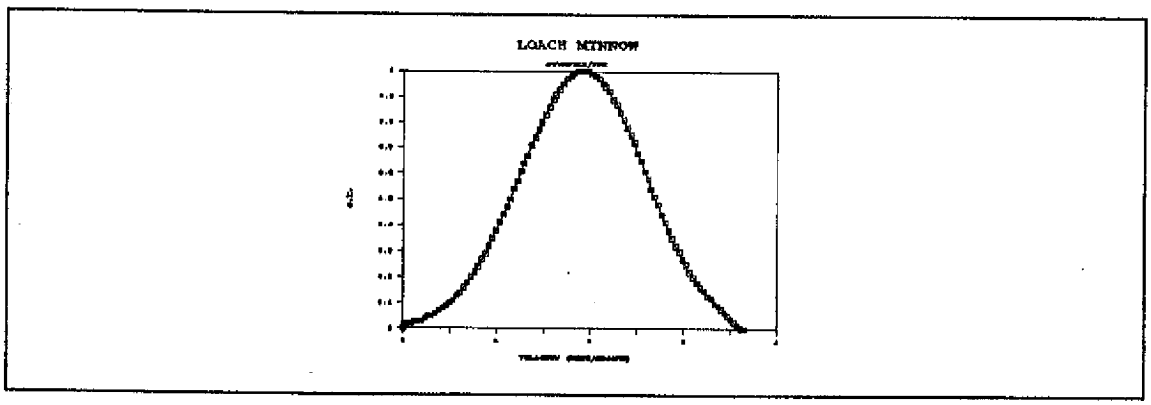

Figure V.24c Velocity Suitability Index Curve for fry/juvenile Loach Minnow in Aravaipa Creek.ation of adult Longfin Dace in Aravaipa Creek.

APPENDIX VI

Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for each species and life stage in Segment D.

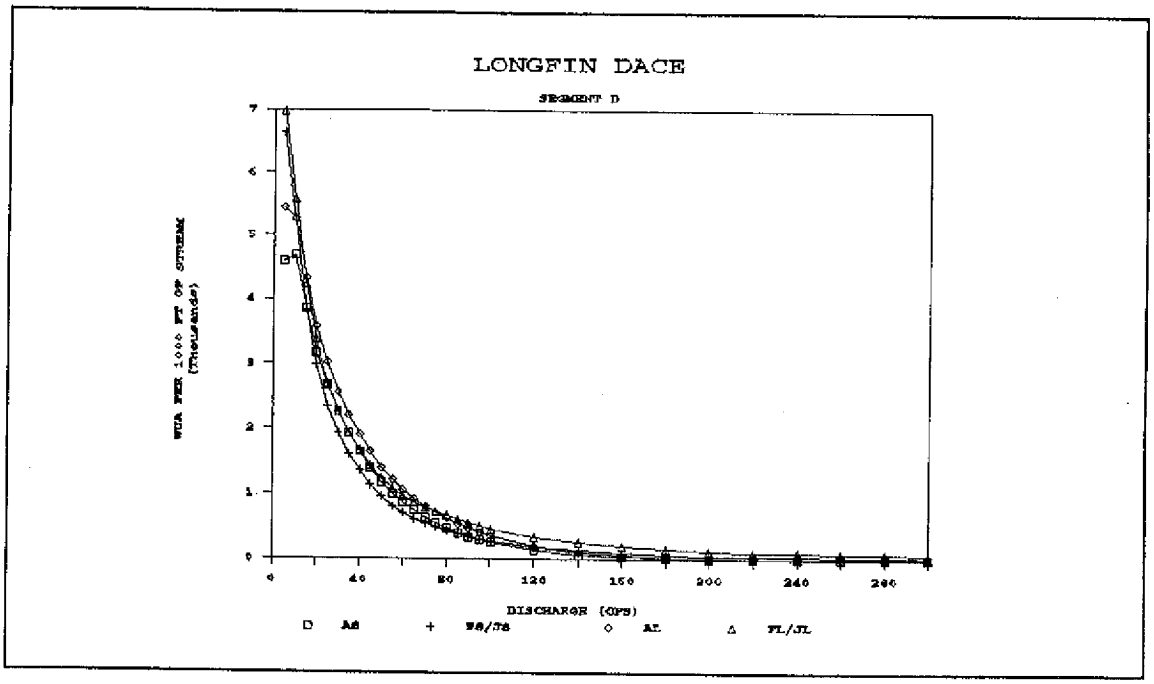

Figure VI.1 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Longfin Dace in Segment D. (AS = Adult Standard; FS/JS = Fry/Juvenile Standard; AL = Adult Limiting Factor; and FL/JL = Fry/Juvenile Limiting Factor).

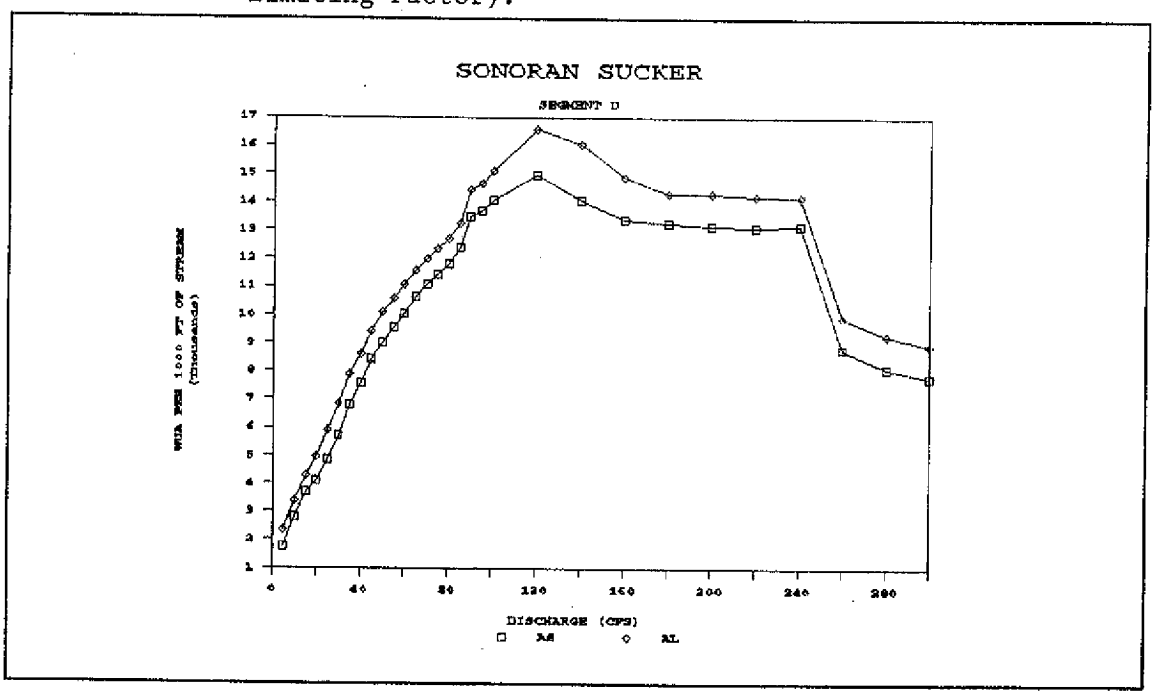

Figure VI.2 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Sonoran Sucker in Segment D. (AS = Adult Standard; and AL = Adult Limiting Factor).

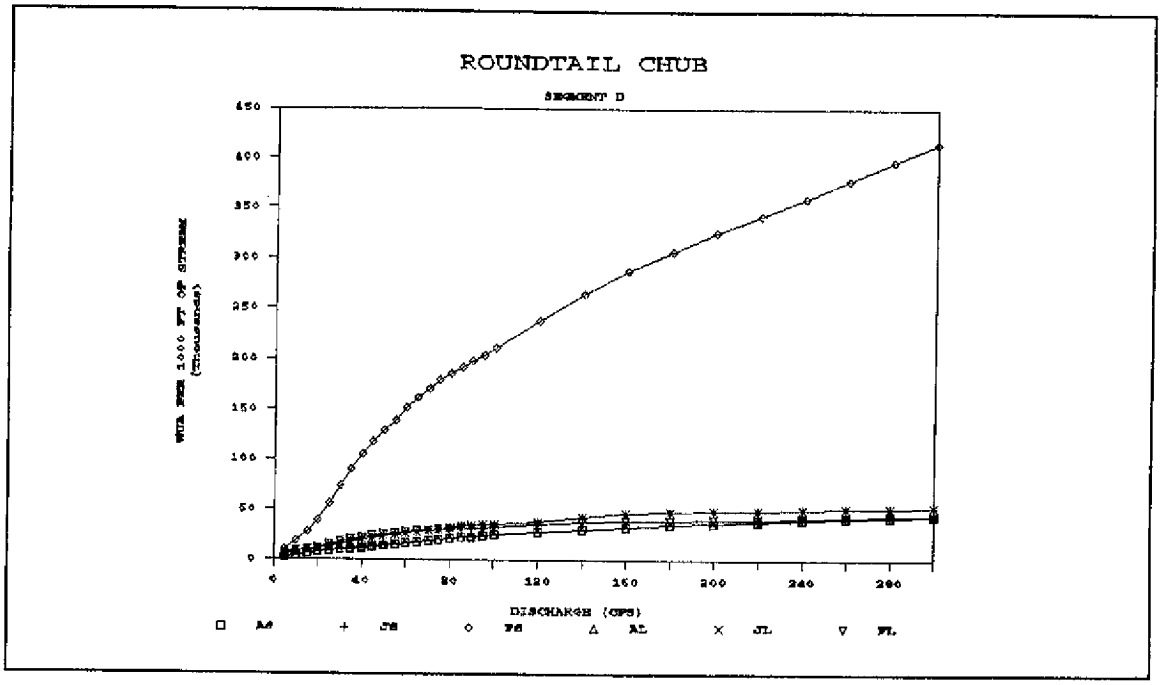

Figure VI.3 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Roundtail Chub in Segment D. (AS = Adult Standard; JS = Juvenile Standard; JF = Fry Standard; AL = Adult Limiting Factor; JL = Juvenile Limiting Factor; and FL = Fry Limiting Factor.

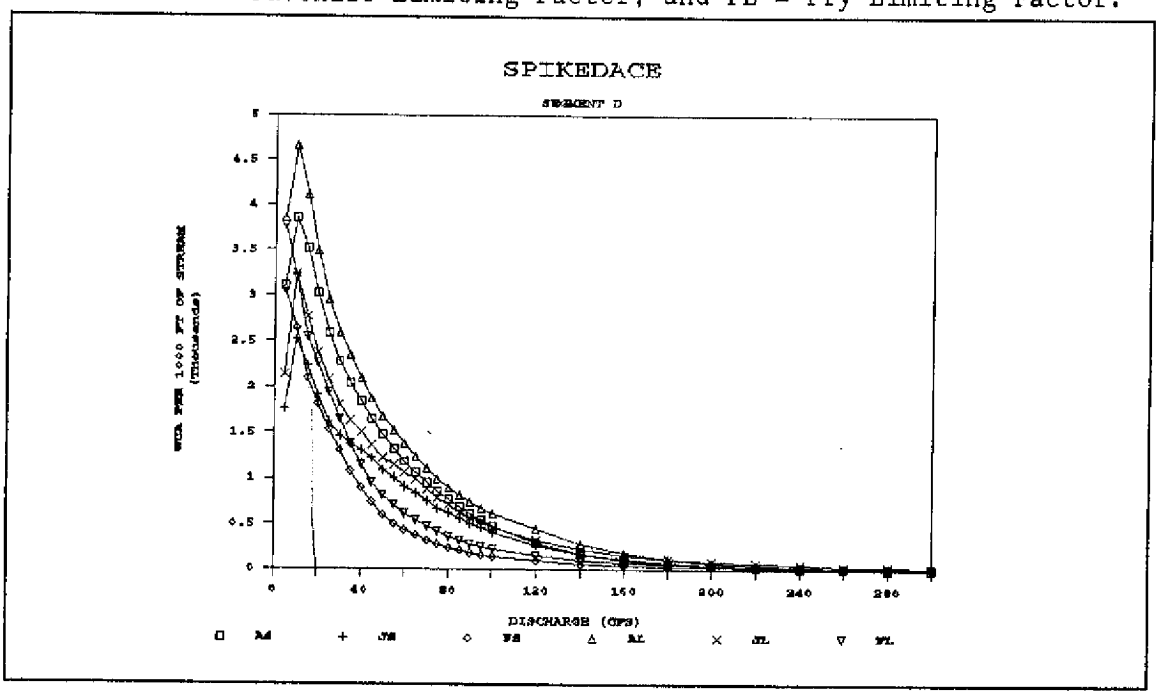

Figure VI.4 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Spikedace in Segment D. (AS = Adult Standard; JS = Juvenile Standard; FS = Fry Standard; AL = Adult Limiting Factor; JL = Juvenile Limiting Factor; and FL = Fry Limiting Factor.

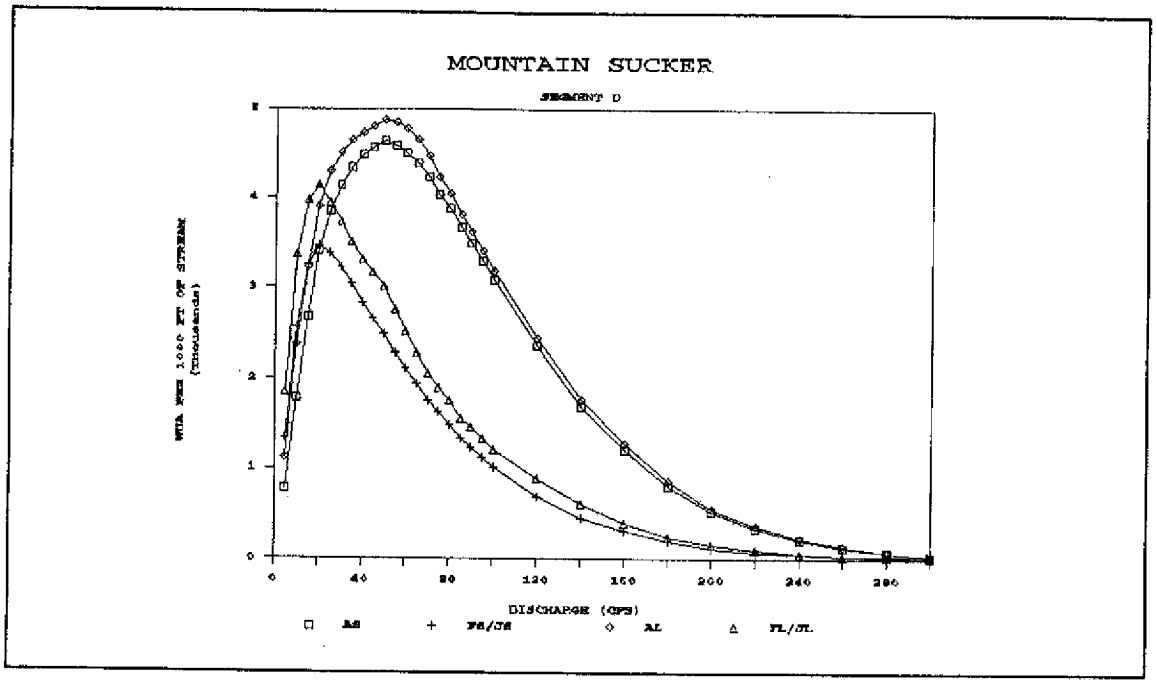

Figure VI.5 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Mountain Sucker in Segment D. (AS = Adult Standard; FS/JS = Fry/Juvenile Standard; AL = Adult Limiting Factor; and FL/JL = Fry/Juvenile Limiting Factor).

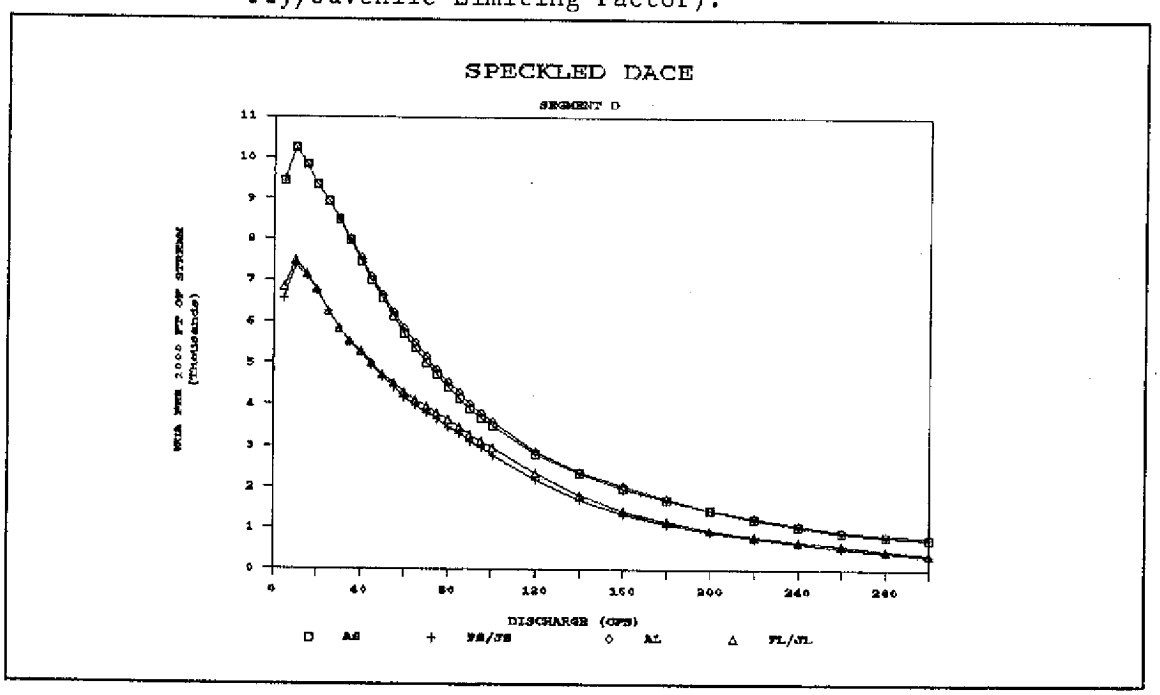

Figure VI.6 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Speckled Dace in Segment D. (AS = Adult Standard; FS/JS = Fry/Juvenile Standard; AL = Adult Limiting Factor; and FL/JL = Fry/Juvenile Limiting Factor).

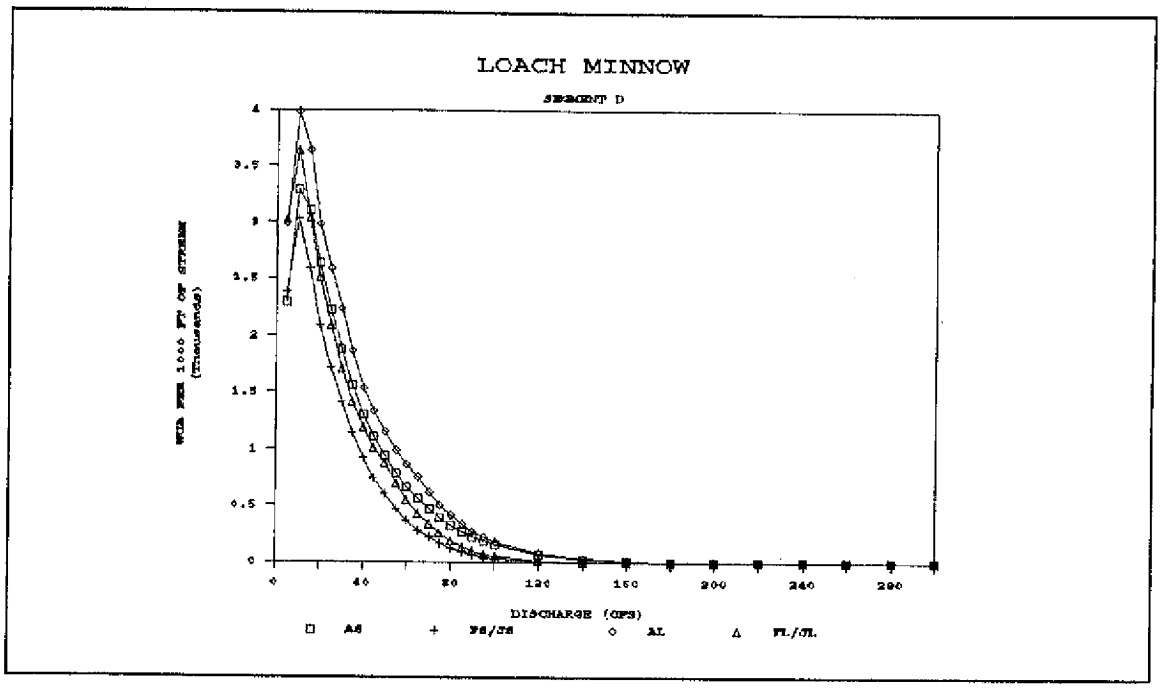

Figure VI.1 Comparisons between Weighted Usable Area derived from the standard and lowest limiting factor computation for Loach Minnow in Segment D. (AS = Adult Standard; FS/JS = Fry/Juvenile Standard; AL = Adult Limiting Factor; and FL/JL = Fry/Juvenile Limiting Factor).

APPENDIX VII

Weighted Usable Area per 1000 feet of stream as
a function of discharge for each life stage for each species.

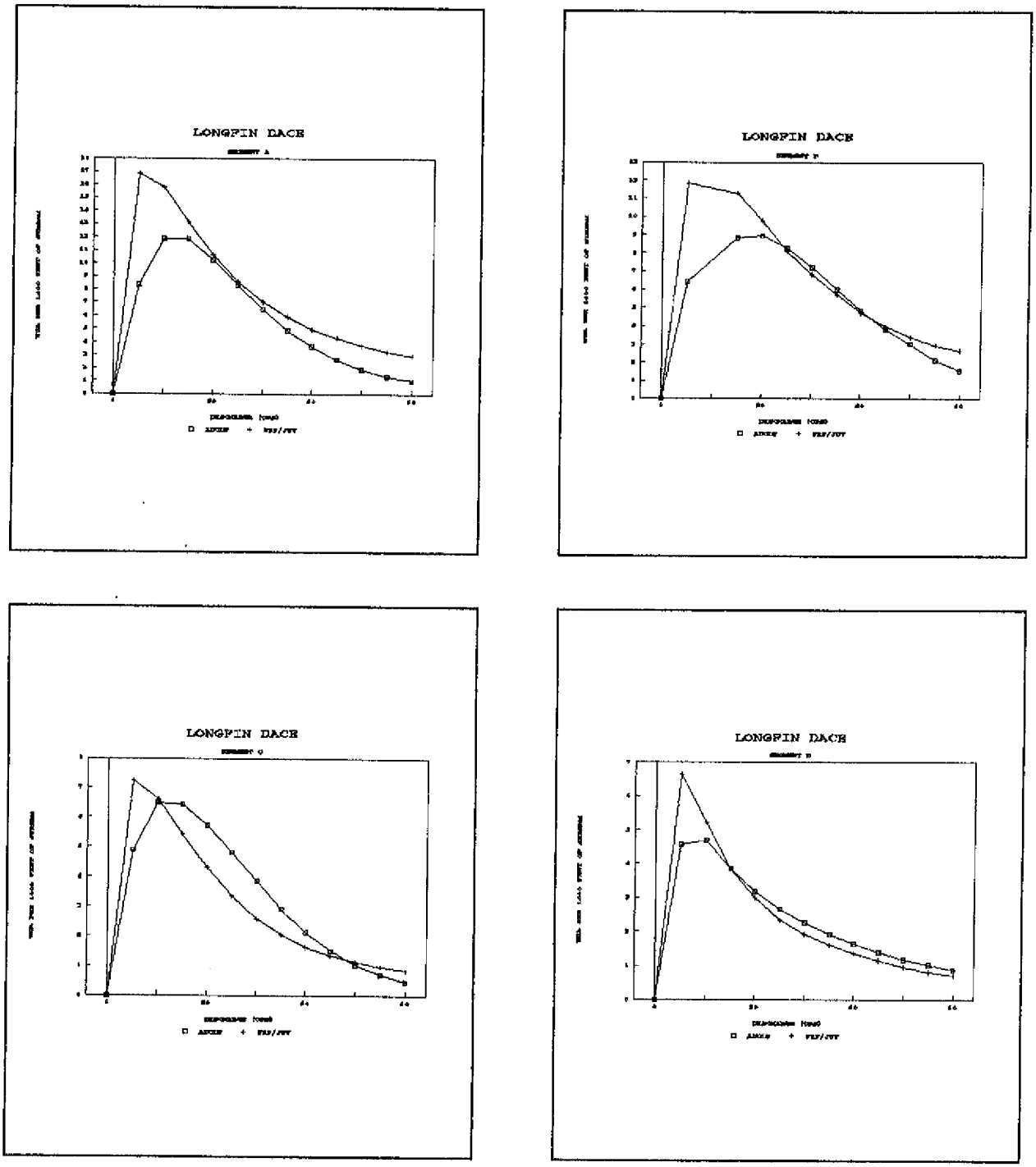

Figure VII.1 Weighted Usable Area (thousand square feet) per 1000 feet of stream as a function of discharge for each life stage of Longfin Dace (FRY/JUV = Fry and Juvenile combined).

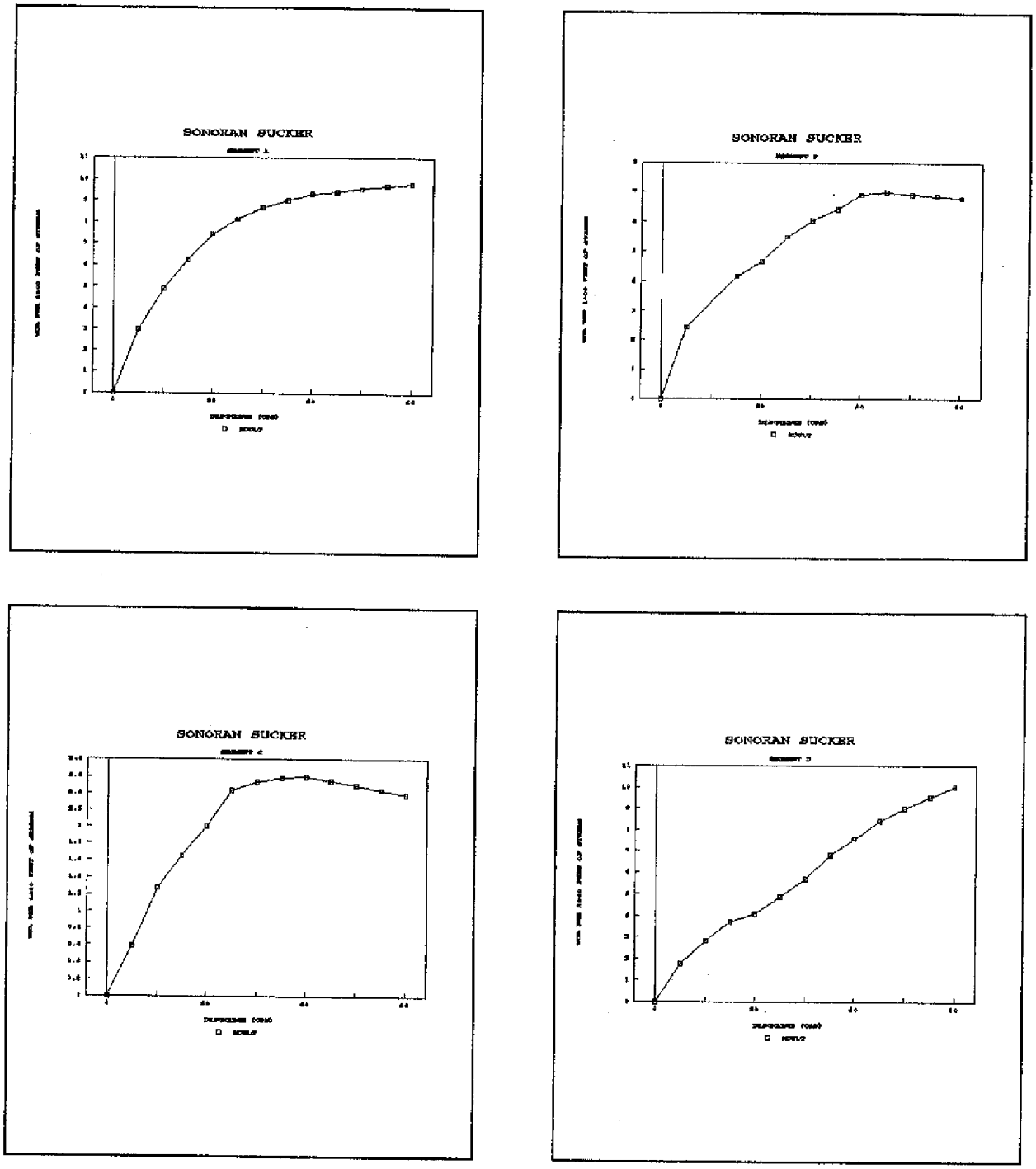

Figure VII.2 Weighted Usable Area (thousand square feet) per 1000 feet of stream as a function of discharge for each life stage of Sonoran Sucker.

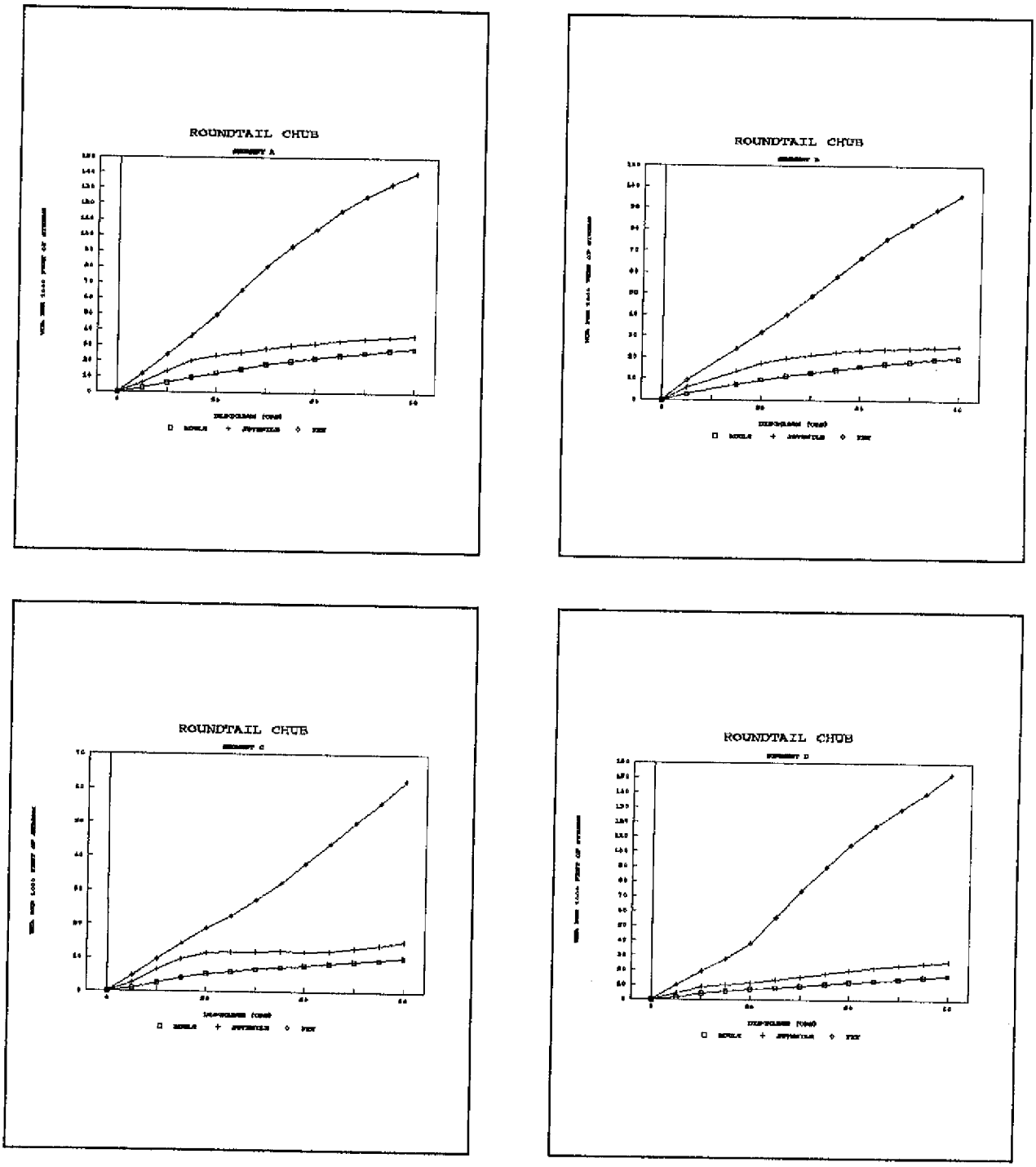

Figure VII.3 Weighted Usable Area (thousand square feet) per 1000 feet of stream as a function of discharge for each life stage of Roundtail Chub.

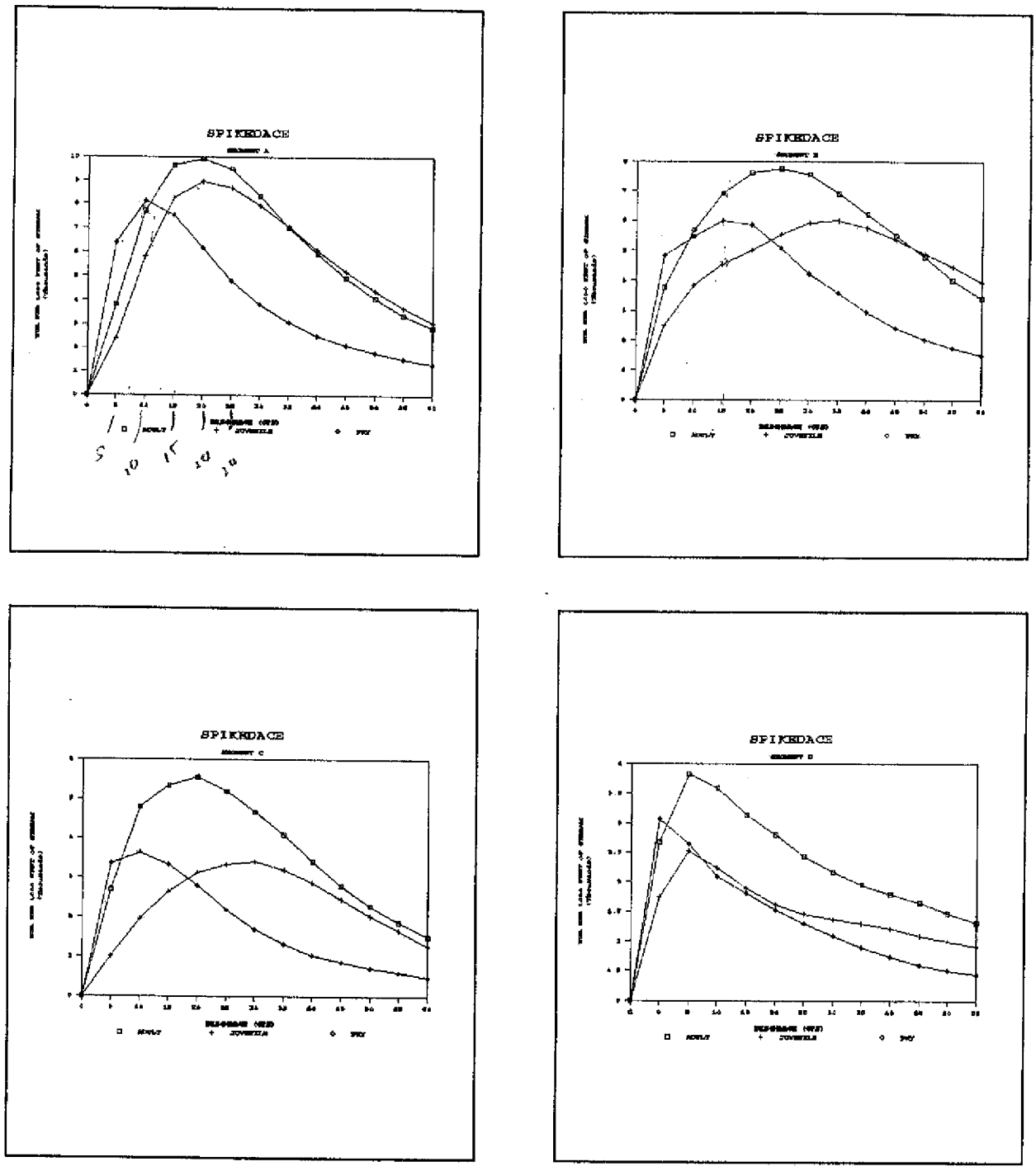

Figure VII.4 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage of Spikedace.

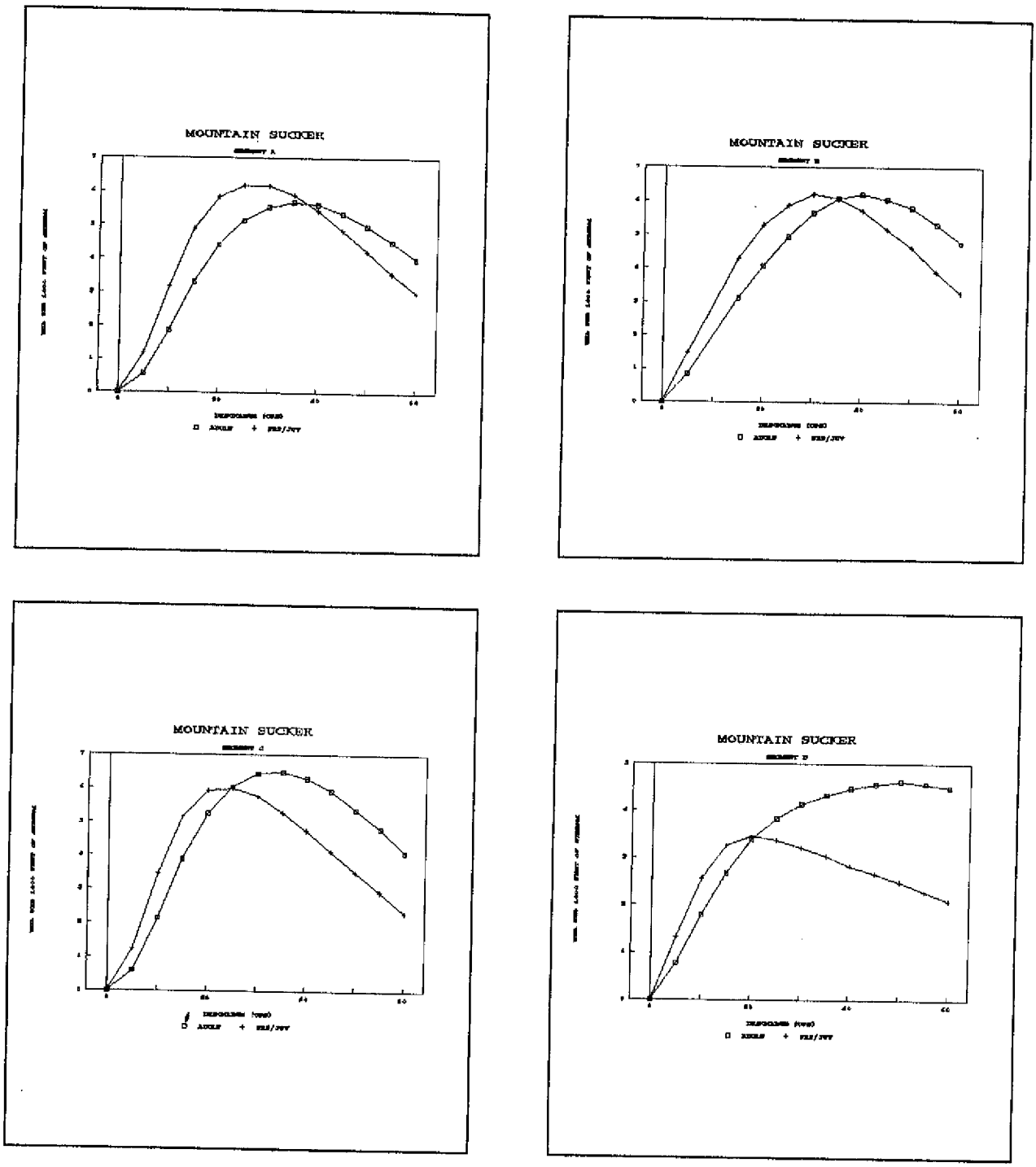

Figure VII.5 Weighted Usable Area (thousand square feet) per 1000 feet of stream as a function of discharge for each life stage of Mountain Sucker (FRY/JUV = Fry and Juvenile combined).

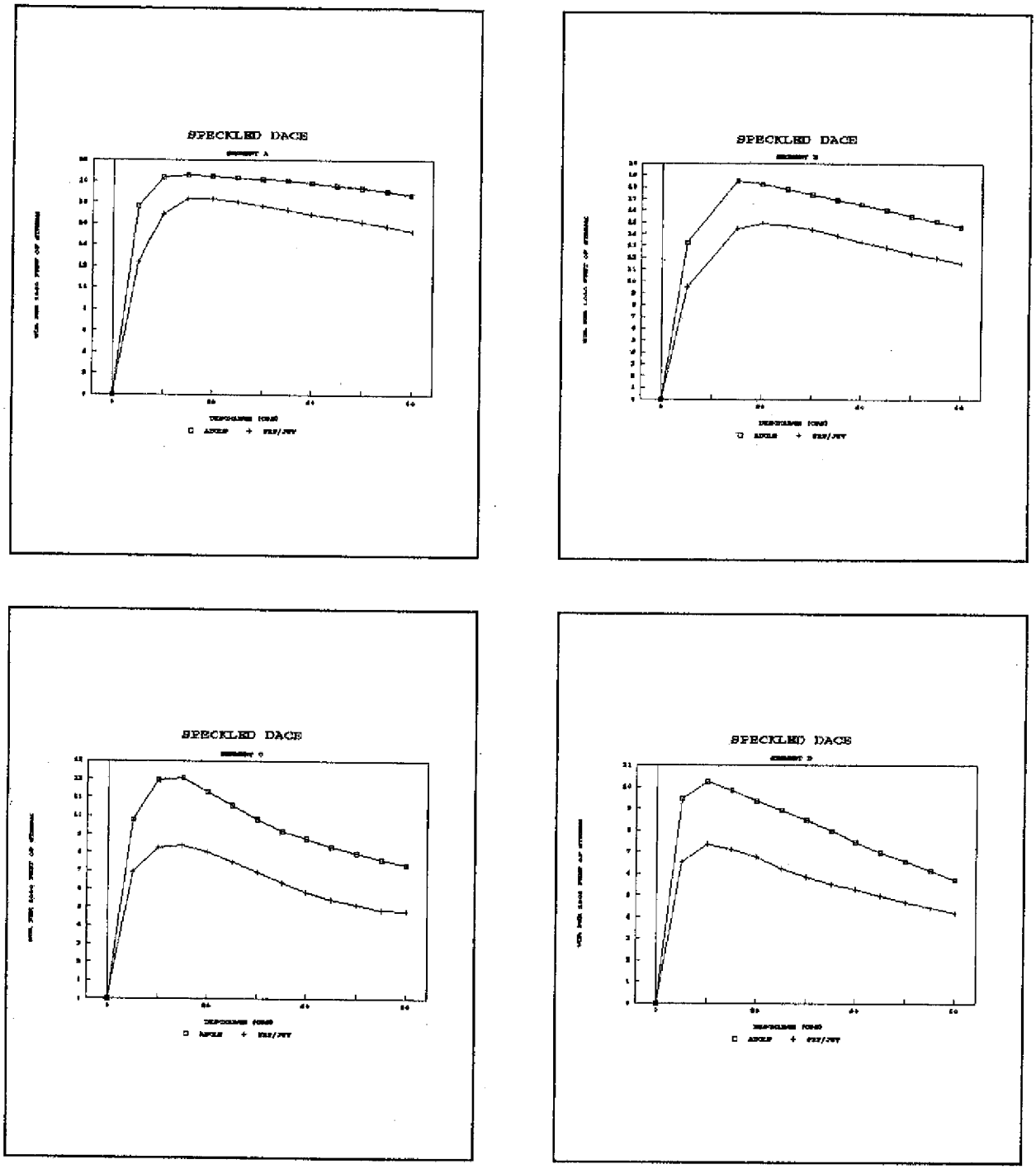

Figure VII.6 Weighted Usable Area (thousand square feet) per 1000 feet of stream as a function of discharge for each life stage of Speckled Dace (FRY/JUV = Fry and Juvenile combined).

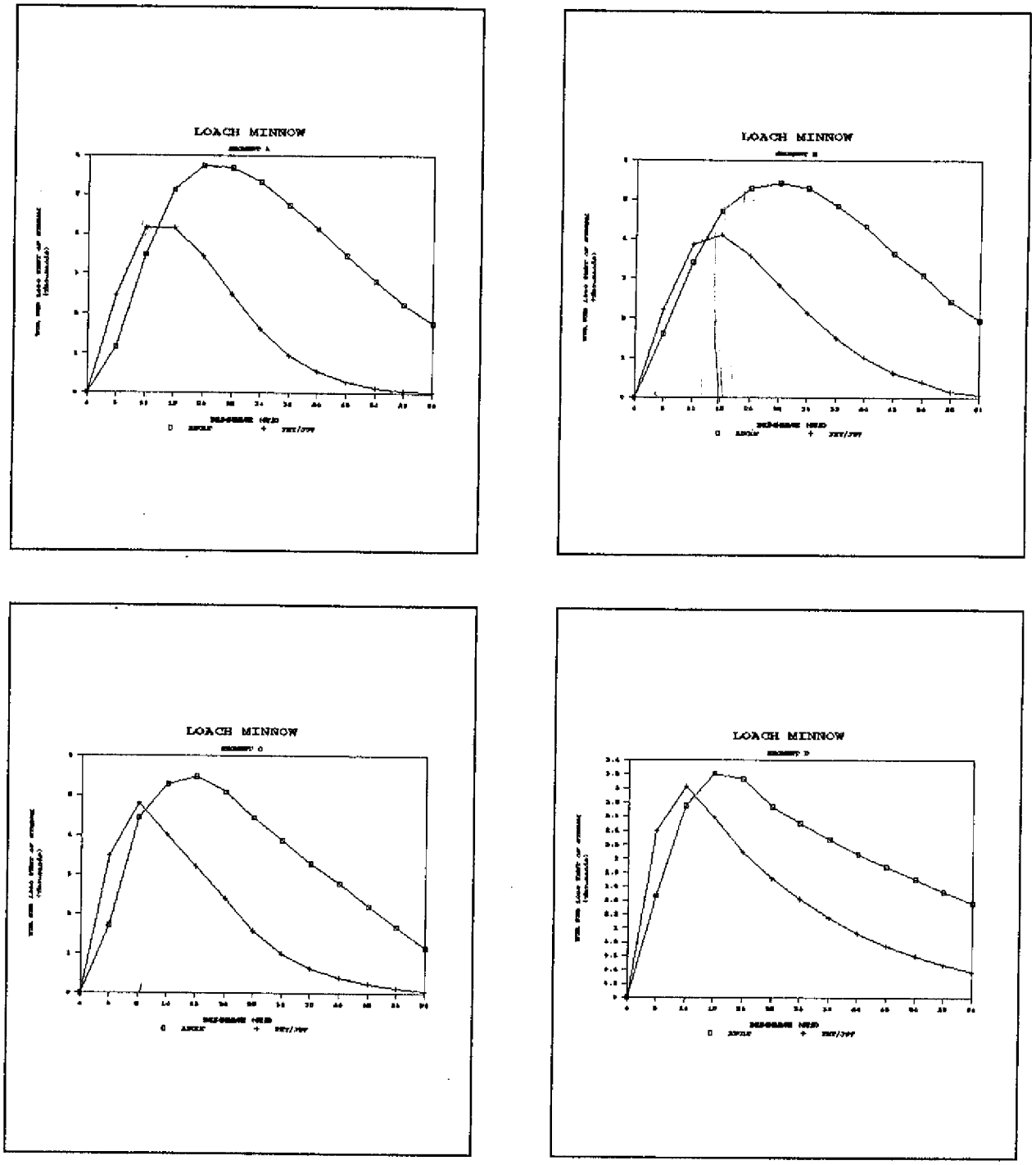

Figure VII.7 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage of Loach Minnow (FRY/JUV = Fry and Juvenile combined).

Table VII.1 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species in Segment A.

DISCHARGE	LD ADULT	LD FRY/JUV	SS ADULT	RC ADULT	RC JUV	RC FRY	SKD ADULT	SKD JUV	SKD FRY	MS ADULT	MS FRY/JUV	SPD ADULT	SPD FRY/JUV	LM ADULT	LM FRY/JUV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	8328	16815	2975	2426	6201	11238	3810	2357	6377	551	1175	17610	12371	1169	2468
10	11872	15726	4850	5724	13425	23847	7708	5802	8125	1837	3183	20397	16898	3475	4163
15	11835	13111	6220	9171	19558	35775	9638	8230	7552	3290	4870	20586	18282	5116	4144
20	10234	10652	7432	12165	23032	49104	9928	8953	6150	4400	5838	20454	18326	5748	3437
25	8314	8580	8113	14875	25142	65085	9496	8668	4794	5128	6193	20305	18012	5680	2474
30	6446	7047	8665	17607	27650	80101	8330	7929	3818	5518	6184	20163	17609	5318	1608
35	4899	5888	9006	19902	29859	92956	7015	7052	3087	5671	5911	20016	17254	4723	954
40	3680	4971	9291	21952	31330	103945	5946	6080	2522	5624	5440	19822	16850	4141	546
45	2667	4301	9404	23884	32838	115844	4939	5189	2096	5346	4845	19621	16520	3466	278
50	1931	3756	9580	25517	34402	124906	4109	4415	1785	4980	4217	19398	16173	2827	133
55	1384	3298	9697	26975	35517	132783	3402	3690	1529	4510	3584	19081	15768	2249	60
60	1004	2928	9784	28191	36228	139994	2862	3088	1327	4012	3016	18684	15317	1770	32

LD = Longfin Dace SS = Sonoran Sucker RC = Roundtail Chub SKD = Spikedace MS = Mountain Sucker SPD = Speckled Dace
LM = Loach Minnow

Table VII.2 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species in Segment B.

DISCHARGE	LD ADULT	LD FRY/JUV	SS ADULT	RC ADULT	RC JUV	RC FRY	SKD ADULT	SKD JUV	SKD FRY	MS ADULT	MS FRY/JUV	SPD ADULT	SPD FRY/JUV	LM ADULT	LM FRY/JUV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	6403	11823	2417	2696	5828	9359	3770	2487	4825	845	1485	13274	9499	1613	2226
10	8039	12529	3611	5055	9520	16309	5692	3847	5478	2049	3035	17430	12957	3416	3857
15	8819	11274	4153	7217	13343	23792	6927	4535	5988	3112	4278	18480	14429	4712	4111
20	8905	9729	4666	9443	17104	31660	7609	5021	5849	4069	5267	18200	14926	5300	3570
25	8236	8089	5492	11212	19376	39896	7757	5523	5067	4946	5868	17776	14673	5421	2817
30	7210	6788	6038	12819	21107	48847	7560	5917	4238	5649	6207	17353	14375	5282	2133
35	5998	5718	6431	14257	22400	57855	6916	5988	3585	6088	6099	16924	13836	4844	1510
40	4841	4743	6909	15787	23277	66585	6212	5752	2958	6198	5721	16520	13350	4322	1015
45	3813	3948	6996	17047	23682	75524	5494	5359	2424	6055	5171	16067	12875	3625	632
50	3019	3386	6923	18068	24186	82356	4793	4902	2051	5811	4628	15527	12352	3098	399
55	2133	2959	6873	19240	24786	89183	4012	4475	1751	5308	3925	15107	11997	2435	166
60	1564	2636	6797	20139	25526	95916	3415	3954	1525	4774	3306	14658	11574	1957	83

LD = Longfin Dace SS = Sonoran Sucker RC = Roundtail Chub SKD = Spikedace MS = Mountain Sucker SPD = Speckled Dace
LM = Loach Minnow

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Table VII.3 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species in Segment C.

DISCHARGE	LD ADULT	LD FRY/JUV	SS ADULT	RC ADULT	RC JUV	RC FRY	SKD ADULT	SKD JUV	SKD FRY	MS ADULT	MS FRY/JUV	SPD ADULT	SPD FRY/JUV	LM ADULT	LM FRY/JUV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4892	7231	594	778	2452	4615	2704	1006	3364	601	1234	9784	6918	1710	3491
10	6485	6611	1271	2363	6525	9663	4801	1951	3632	2136	3446	11919	8233	4442	4799
15	6445	5436	1664	3895	9464	14334	5340	2651	3336	3885	5143	12043	8351	5295	4013
20	5734	4304	2001	5118	11337	18723	5554	3132	2794	5249	5919	11312	7995	5462	3214
25	4818	3339	2432	5952	11795	22386	5198	3338	2180	6042	6000	10550	7467	5091	2401
30	3840	2585	2532	6617	11810	27032	4669	3397	1686	6441	5759	9796	6941	4453	1595
35	2910	2027	2577	7198	11906	32043	4096	3209	1320	6491	5285	9194	6359	3880	1008
40	2112	1620	2595	7731	11853	38018	3419	2875	1041	6289	4745	8745	5845	3313	639
45	1498	1352	2542	8236	12057	43816	2796	2469	859	5929	4146	8322	5432	2797	386
50	1021	1141	2497	8840	12869	49959	2284	2042	711	5385	3528	7957	5128	2229	230
55	687	971	2443	9407	13761	56014	1881	1656	592	4823	2934	7611	4843	1700	121
60	449	830	2384	10275	15185	62273	1496	1272	483	4120	2307	7298	4768	1168	62

LD = Longfin Dace SS = Sonoran Sucker RC = Roundtail Chub SKD = Spikedace MS = Mountain Sucker SPD = Speckled Dace
LM = Loach Minnow

Table VII.4 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species in Segment D.

DISCHARGE	LD ADULT	LD FRY/JUV	SS ADULT	RC ADULT	RC JUV	RC FRY	SKD ADULT	SKD JUV	SKD FRY	MS ADULT	MS FRY/JUV	SPD ADULT	SPD FRY/JUV	LM ADULT	LM FRY/JUV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4584	6643	1757	1660	4379	10153	2682	1751	3066	767	1330	9436	6544	1461	2389
10	4689	5220	2807	3921	8305	19210	3824	2515	2639	1788	2562	10237	7355	2755	3023
15	3853	3848	3697	5528	10012	27533	3594	2236	2095	2671	3250	9838	7096	3214	2585
20	3174	2994	4075	6761	11469	38376	3143	1910	1810	3395	3452	9344	6746	3136	2095
25	2670	2333	4851	8044	13319	55776	2797	1619	1533	3844	3371	8944	6247	2740	1716
30	2257	1918	5712	9261	15525	73245	2438	1460	1303	4137	3217	8464	5838	2503	1418
35	1923	1599	6810	10490	17620	89436	2161	1372	1085	4333	3037	7971	5516	2274	1146
40	1640	1347	7565	11726	19797	104307	1963	1306	894	4474	2833	7461	5240	2072	922
45	1390	1135	8423	12980	21562	117495	1802	1218	735	4561	2659	6983	4947	1881	745
50	1184	952	9031	14151	23273	128704	1653	1096	605	4625	2482	6545	4658	1714	601
55	1006	806	9562	15300	24848	139513	1485	1011	509	4568	2277	6128	4412	1526	471
60	860	698	10055	16514	26338	151889	1322	909	434	4485	2102	5717	4170	1365	374

LD = Longfin Dace SS = Sonoran Sucker RC = Roundtail Chub SKD = Spikedace MS = Mountain Sucker SPD = Speckled Dace
LM = Loach Minnow

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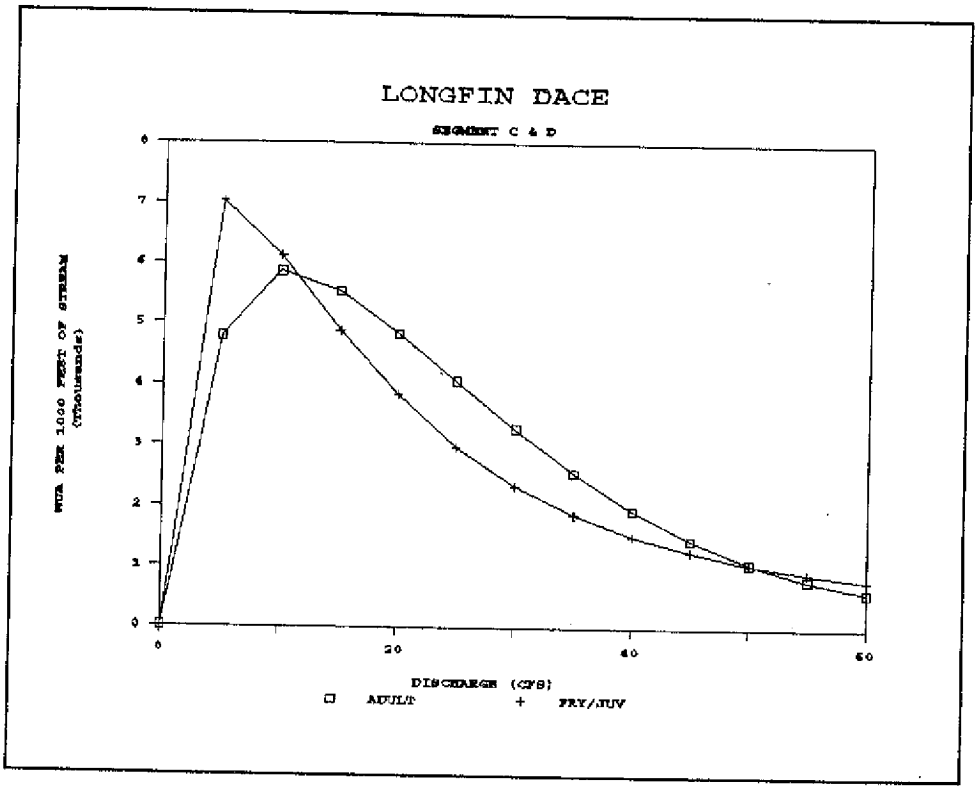
APPENDIX VIII

Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species for combined Segments C and D.



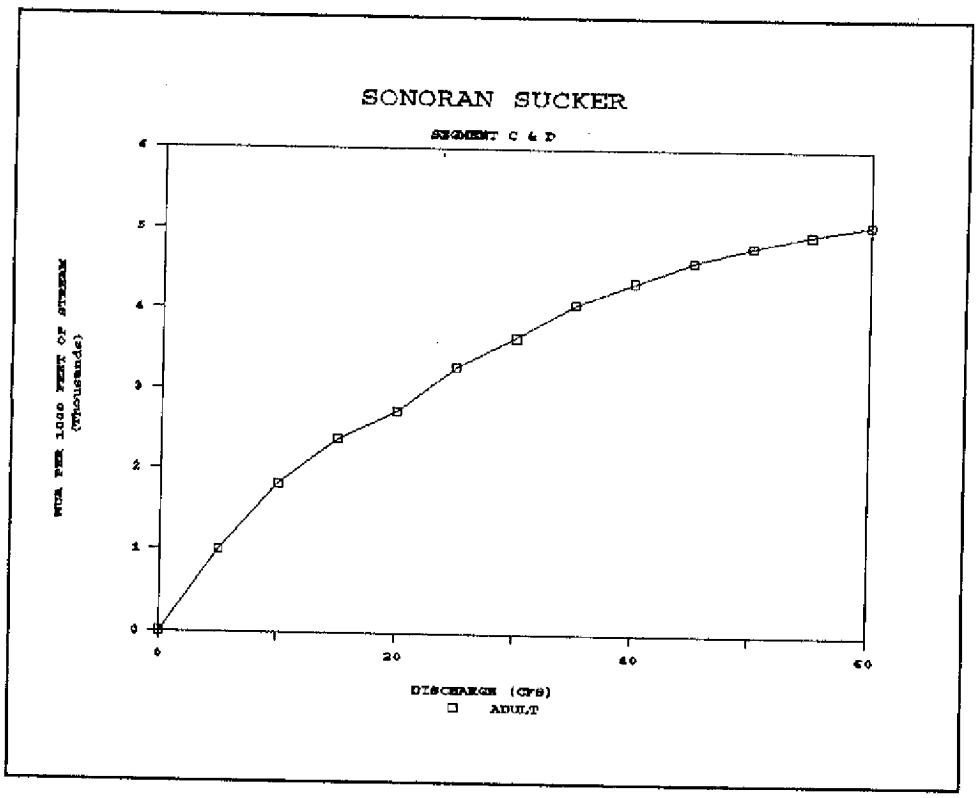
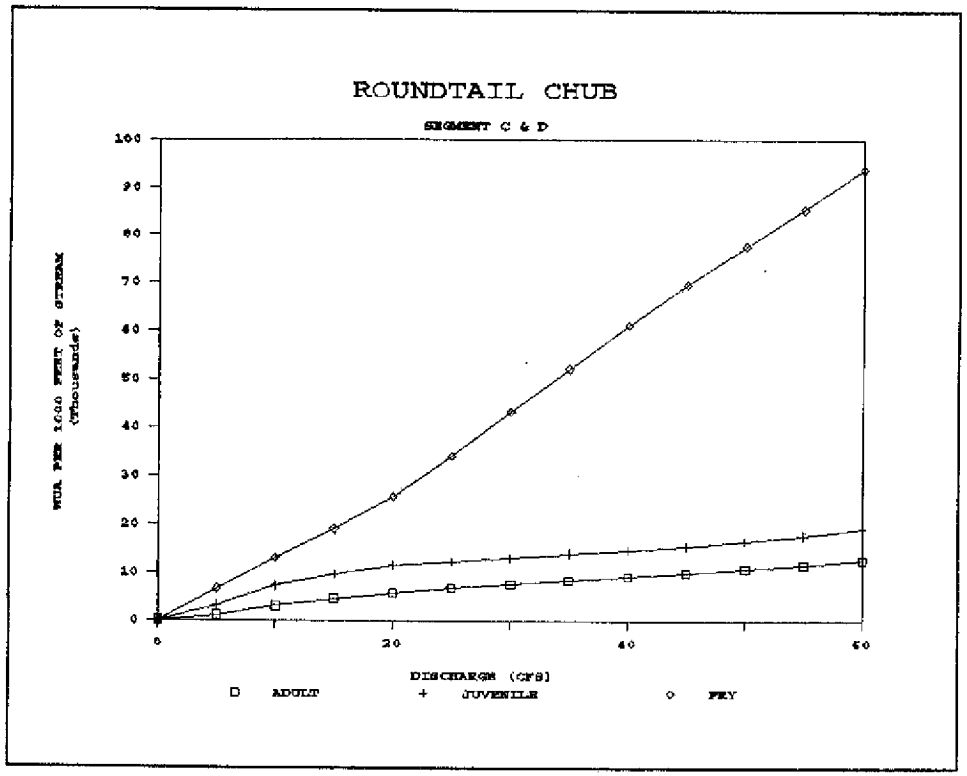


Figure VIII.1 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for Longfin Dace and Sonoran Sucker for combined Segments C and D.



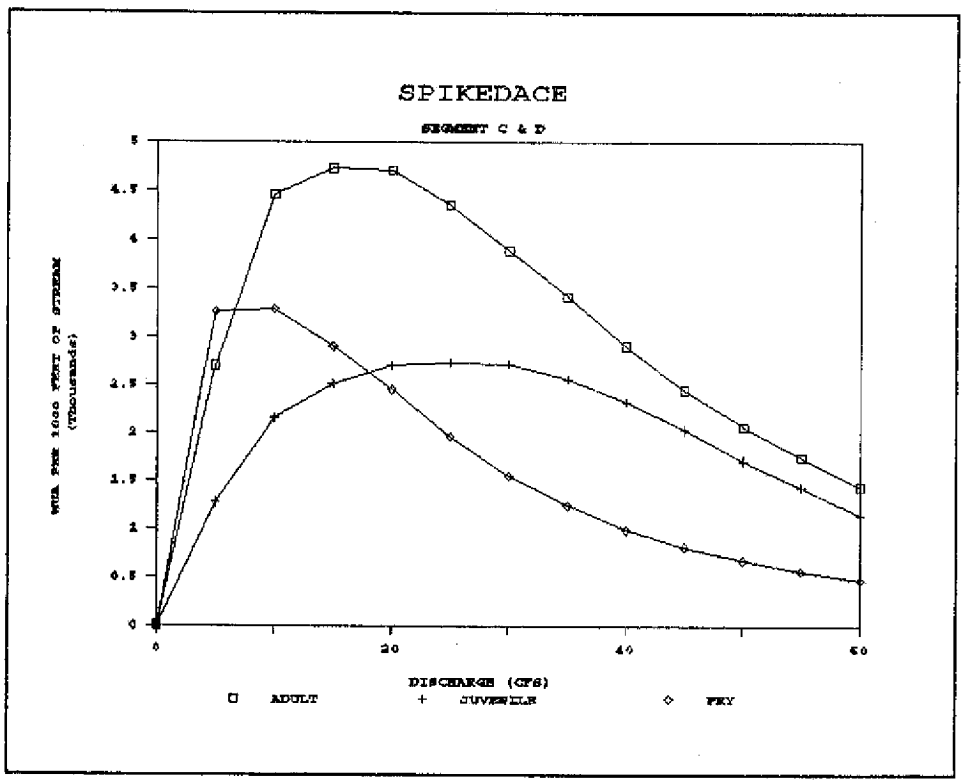
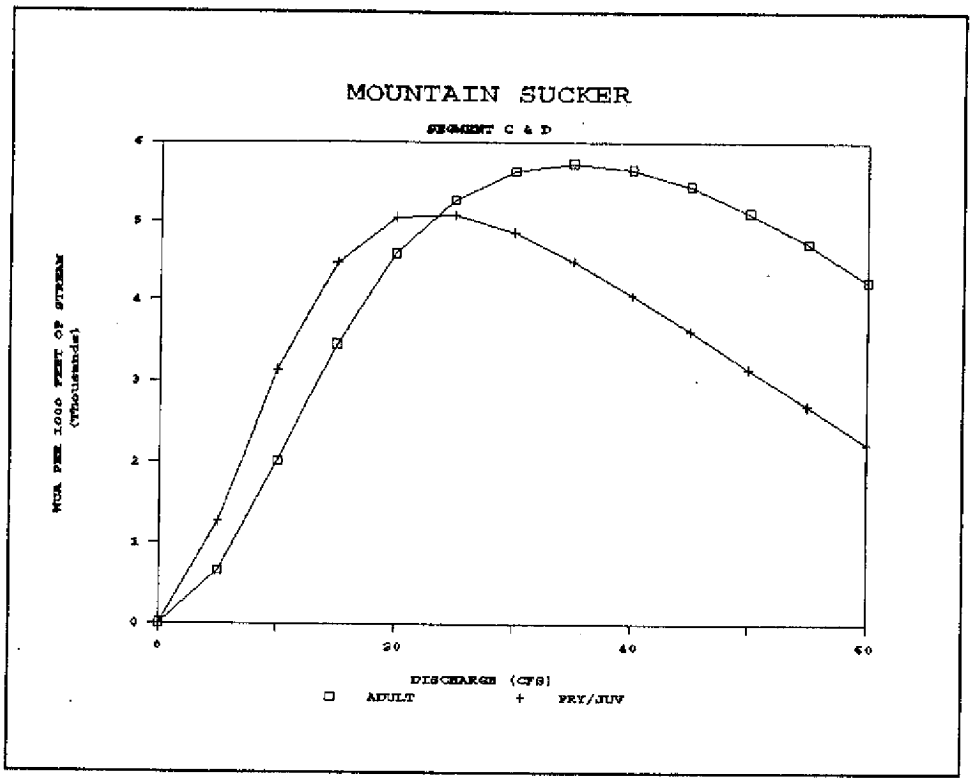


Figure VIII.2 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for Roundtail Chub and Spikedace for combined Segments C and D.



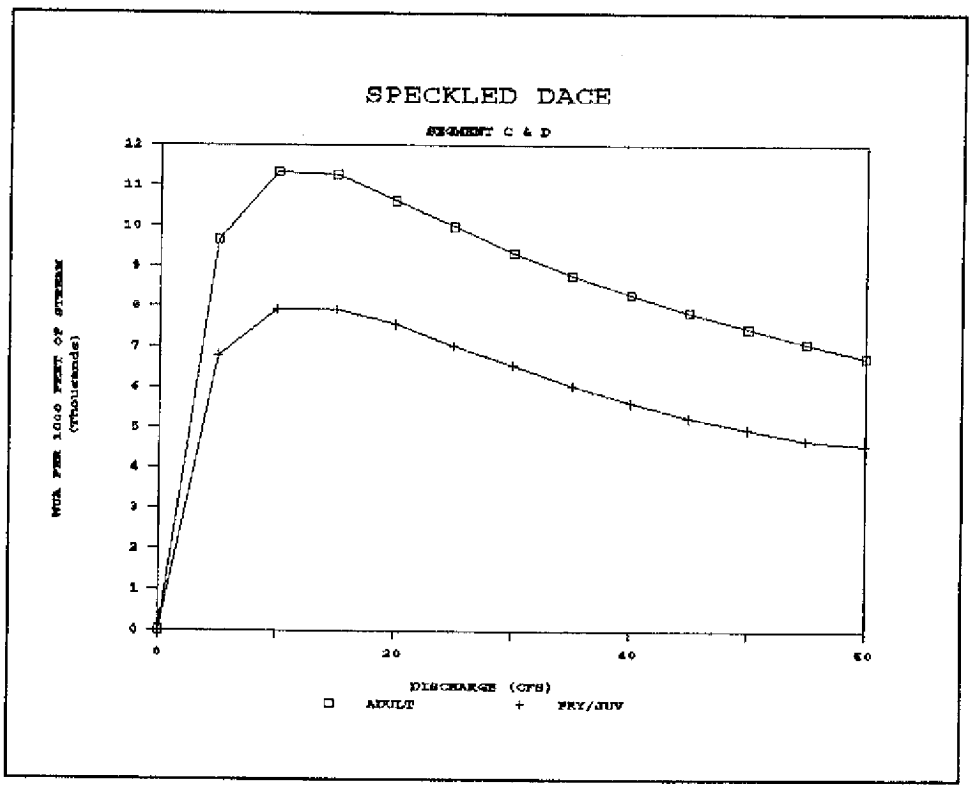


Figure VIII.3 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for Mountain Sucker and Speckled Dace for combined Segments C and D.

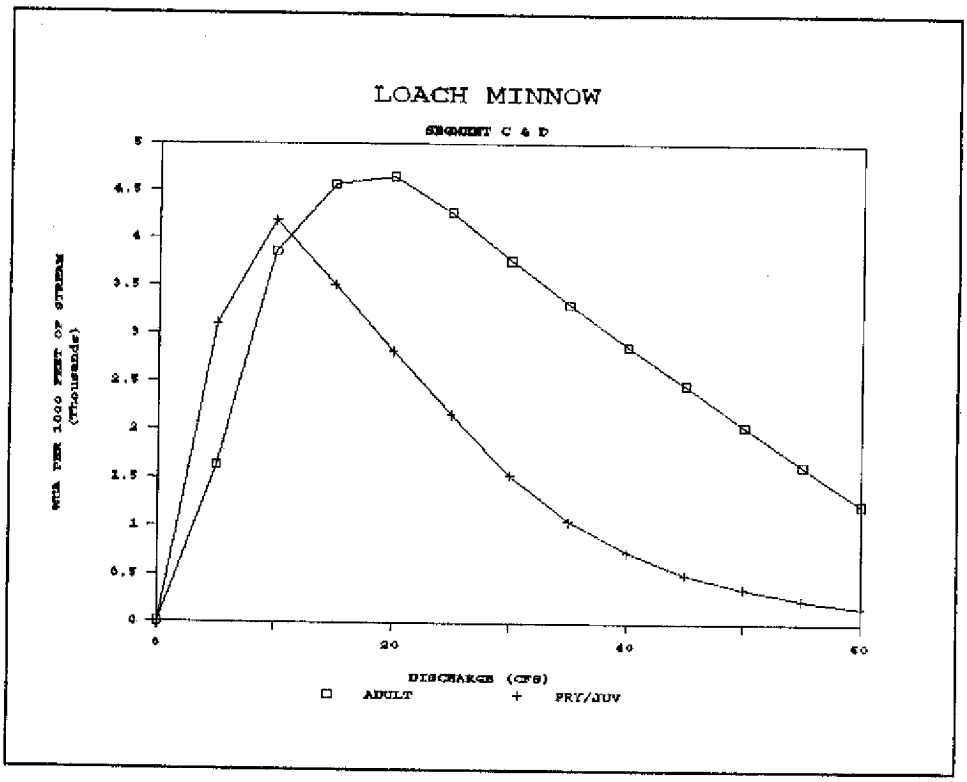


Figure VIII.4 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for Loach Minnow for combined Segments C and D.

Table VIII.1 Weighted Usable Area (square feet) per 1000 feet of stream as a function of discharge for each life stage for each species in Segments C and D combined.

DISCHARGE	LD ADULT	LD FRY/JUV	SS ADULT	RC ADULT	RC JUV	RC FRY	SKD ADULT	SKD JUV	SKD FRY	MS ADULT	MS FRY/JUV	SPD ADULT	SPD FRY/JUV	LM ADULT	LM FRY/JUV
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4784	7024	1003	1088	3130	6561	2696	1268	3259	659	1268	9662	6786	1623	3104
10	5854	6122	1811	2911	7151	13019	4458	2149	3283	2014	3135	11328	7924	3849	4175
15	5534	4878	2379	4469	9656	18973	4726	2505	2900	3458	4477	11268	7910	4564	3511
20	4834	3843	2730	5695	11383	25631	4706	2702	2449	4597	5052	10620	7556	4645	2821
25	4063	2985	3282	6687	12330	34122	4354	2734	1953	5269	5076	9985	7038	4265	2160
30	3283	2350	3650	7546	13116	43275	3885	2716	1552	5631	4866	9328	6554	3767	1533
35	2563	1876	4065	8355	13915	52216	3416	2563	1238	5733	4495	8764	6063	3316	1056
40	1946	1524	4342	9135	14645	61318	2907	2324	989	5651	4073	8294	5632	2877	738
45	1460	1276	4609	9903	15398	69713	2447	2029	815	5448	3623	7851	5262	2475	512
50	1078	1074	4794	10707	16526	77637	2063	1710	674	5118	3160	7461	4963	2048	360
55	799	913	4945	11478	17658	85363	1742	1429	563	4733	2703	7089	4692	1639	244
60	594	784	5080	12468	19105	93772	1435	1144	466	4248	2235	6742	4558	1237	171

LD = Longfin Dace SS = Sonoran Sucker RC = Roundtail Chub SKD = Spikedace MS = Mountain Sucker SPD = Speckled Dace
LM = Loach Minnow

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APPENDIX IX

Minimum, average, maximum and median monthly discharges for the period of record 1966 to 1988 for the USGS Westend gage, 1981 to 1989 for the BLM Westend gage, and Eastend gage.

Table IX.1 Minimum, average, maximum and median monthly discharges for the period of record (1966-1988) for the USGS Westend gage.

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1931	5	5.00	8.42	65.00	6.00
1931	6	5.00	9.57	90.00	7.00
1931	7	3.00	35.39	236.00	12.00
1931	8	6.00	48.16	446.00	20.00
1931	9	8.00	49.87	616.00	17.50
1931	10	9.00	28.61	504.00	12.00
1931	11	10.00	48.53	221.00	16.00
1931	12	17.00	82.26	1260.00	28.00
1932	1	20.00	25.32	35.00	23.00
1932	2	17.00	155.86	1940.00	34.00
1932	3	13.00	32.42	146.00	22.00
1932	4	14.00	18.00	27.00	18.00
1932	5	8.00	12.26	15.00	13.00
1932	6	6.00	9.27	14.00	9.00
1932	7	7.00	36.19	267.00	11.00
1932	8	4.00	26.74	213.00	16.00
1932	9	3.00	10.43	43.00	8.00
1932	10	12.00	15.55	24.00	15.00
1932	11	12.00	13.30	16.00	12.00
1932	12	14.00	28.00	264.00	19.00
1933	1	15.00	27.03	91.00	17.00
1933	2	20.00	25.64	53.00	22.00
1933	3	10.00	15.26	19.00	16.00
1933	4	8.00	12.93	17.00	13.50
1933	5	5.00	10.19	14.00	10.00
1933	6	4.00	8.57	16.00	8.00
1933	7	5.00	47.06	668.00	13.00
1933	8	3.00	9.74	89.00	5.00
1933	9	3.00	13.67	81.00	8.50
1933	10	7.00	21.45	141.00	13.00
1933	11	10.00	11.87	20.00	11.50
1933	12	10.00	11.65	13.00	12.00
1934	1	8.00	10.39	12.00	10.00
1934	2	9.00	11.29	16.00	10.50
1934	3	9.00	11.23	14.00	12.00
1934	4	7.00	8.67	12.00	9.00
1934	5	4.00	6.10	15.00	6.00
1934	6	3.00	5.17	9.00	5.00
1934	7	2.00	27.94	323.00	5.00
1934	8	4.00	42.55	251.00	11.00
1934	9	1.00	8.63	76.00	4.50
1934	10	6.00	8.39	12.00	8.00
1934	11	8.00	13.50	80.00	11.00
1934	12	7.00	20.65	138.00	17.00
1935	1	12.00	69.94	1250.00	31.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1935	2	9.00	186.25	1700.00	34.00
1935	3	18.00	118.97	516.00	33.00
1935	4	15.00	17.57	28.00	17.00
1935	5	5.00	10.61	16.00	10.00
1935	6	2.00	5.13	8.00	5.00
1935	7	1.00	7.06	111.00	3.00
1935	8	12.00	133.29	781.00	41.00
1935	9	9.00	35.07	249.00	21.50
1935	10	9.00	10.74	14.00	10.00
1935	11	6.00	18.47	102.00	14.00
1935	12	14.00	15.65	20.00	16.00
1936	1	14.00	34.94	330.00	15.00
1936	2	20.00	90.52	730.00	30.00
1936	3	12.00	29.19	112.00	21.00
1936	4	11.00	14.80	25.00	14.00
1936	5	6.00	8.23	11.00	8.00
1936	6	4.00	4.90	7.00	5.00
1936	7	3.00	36.03	430.00	12.00
1936	8	5.00	22.19	200.00	14.00
1936	9	4.00	37.80	170.00	16.50
1936	10	6.00	11.00	17.00	12.00
1936	11	10.00	12.50	24.00	11.50
1936	12	10.00	20.90	114.00	16.00
1937	1	17.00	70.29	427.00	37.00
1937	2	17.00	87.14	1060.00	21.00
1937	3	11.00	15.97	28.00	16.00
1937	4	6.00	11.20	13.00	12.00
1937	5	4.00	7.81	14.00	7.00
1937	6	3.00	4.20	7.00	4.00
1937	7	2.00	11.74	73.00	7.00
1937	8	5.00	26.97	171.00	13.00
1937	9	7.00	42.33	236.00	12.50
1937	10	5.00	7.61	9.00	8.00
1937	11	7.00	10.90	12.00	11.50
1937	12	11.00	14.35	19.00	14.00
1938	1	9.00	12.77	15.00	13.00
1938	2	12.00	17.50	43.00	15.00
1938	3	12.00	65.58	1280.00	16.00
1938	4	8.00	10.60	13.00	11.00
1938	5	5.00	6.42	9.00	6.00
1938	6	2.00	5.10	21.00	4.00
1938	7	6.00	16.71	121.00	9.00
1938	8	5.00	21.29	132.00	8.00
1938	9	2.00	15.30	189.00	4.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1938	10	4.00	6.19	7.00	7.00
1938	11	6.00	9.57	12.00	10.00
1938	12	9.00	15.45	92.00	12.00
1939	1	8.00	10.81	13.00	11.00
1939	2	10.00	17.68	27.00	17.00
1939	3	9.00	11.16	14.00	11.00
1939	4	7.00	9.10	13.00	9.00
1939	5	3.00	4.42	8.00	4.00
1939	6	1.00	1.90	3.00	2.00
1939	7	2.00	8.42	78.00	5.00
1939	8	4.00	47.81	597.00	11.00
1939	9	2.00	14.77	144.00	4.00
1939	10	2.00	31.19	772.00	6.00
1939	11	5.00	8.70	12.00	8.50
1939	12	9.00	14.00	38.00	11.00
1940	1	7.00	10.13	13.00	10.00
1940	2	7.00	44.66	650.00	13.00
1940	3	7.00	10.32	19.00	10.00
1940	4	5.00	7.30	9.00	7.00
1940	5	3.00	5.35	7.00	6.00
1940	6	3.00	40.10	480.00	3.00
1940	7	.80	8.38	83.00	3.00
1940	8	.40	39.25	286.00	2.00
1940	9	6.00	25.80	229.00	8.50
1940	10	5.00	6.65	16.00	7.00
1940	11	6.00	73.87	1530.00	10.00
1940	12	9.00	256.97	4060.00	17.00
1941	1	20.00	92.00	600.00	30.00
1941	2	30.00	177.71	1750.00	61.00
1941	3	33.00	192.10	2020.00	70.00
1941	4	27.00	37.93	83.00	33.50
1941	5	10.00	21.84	50.00	19.00
1941	6	8.00	10.63	13.00	10.50
1941	10	33.00	82.13	316.00	61.00
1941	11	21.00	38.73	408.00	23.00
1941	12	19.00	69.71	1080.00	33.00
1942	1	12.00	30.58	70.00	30.00
1942	2	18.00	47.14	778.00	20.00
1942	3	18.00	32.87	105.00	27.00
1942	4	15.00	25.43	48.00	25.00
1942	5	11.00	16.06	21.00	16.00
1942	6	7.40	9.04	11.00	8.95
1942	7	8.80	115.12	2910.00	15.00
1942	8	5.00	19.57	123.00	11.00
1942	9	5.70	44.36	343.00	20.50
1942	10	12.00	13.90	22.00	14.00
1942	11	11.00	13.07	16.00	13.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1942	12	19.00	22.94	34.00	22.00
1943	1	.00	.00	.00	.00
1943	2	.00	.00	.00	.00
1943	3	.00	.00	.00	.00
1943	4	.00	.00	.00	.00
1943	5	.00	.00	.00	.00
1943	6	.00	.00	.00	.00
1943	7	.00	.00	.00	.00
1943	8	.00	.00	.00	.00
1943	9	.00	.00	.00	.00
1965	10	.00	.00	.00	.00
1965	11	.00	.00	.00	.00
1965	12	.00	.00	.00	.00
1966	1	.00	.00	.00	.00
1966	2	.00	.00	.00	.00
1966	3	.00	.00	.00	.00
1966	4	.00	.00	.00	.00
1966	5	5.70	6.04	6.60	6.00
1966	6	3.90	7.10	34.00	5.85
1966	7	4.90	11.56	84.00	6.30
1966	8	3.30	34.82	261.00	18.00
1966	9	14.00	43.70	265.00	22.00
1966	10	8.00	13.87	30.00	13.00
1966	11	13.00	16.83	35.00	17.00
1966	12	10.00	16.29	20.00	17.00
1967	1	15.00	18.55	21.00	19.00
1967	2	11.00	15.86	19.00	16.00
1967	3	7.50	13.69	20.00	13.00
1967	4	8.20	12.27	17.00	12.00
1967	5	6.80	9.45	13.00	9.20
1967	6	2.80	5.58	8.60	5.35
1967	7	2.70	25.10	231.00	11.00
1967	8	3.60	17.49	65.00	13.00
1967	9	5.00	37.74	450.00	12.50
1967	10	8.60	14.41	43.00	10.00
1967	11	8.20	14.26	26.00	12.00
1967	12	13.00	205.52	2700.00	53.00
1968	1	11.00	15.42	45.00	13.00
1968	2	3.70	94.23	707.00	9.90
1968	3	3.70	66.63	522.00	28.00
1968	4	17.00	19.30	25.00	19.00
1968	5	14.00	16.48	20.00	17.00
1968	6	8.80	13.39	19.00	12.50
1968	7	5.60	19.01	141.00	13.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1968	8	4.00	25.35	96.00	15.00
1968	9	14.00	24.90	250.00	15.00
1968	10	9.60	12.07	16.00	12.00
1968	11	8.60	16.45	45.00	16.50
1968	12	14.00	40.94	396.00	15.00
1969	1	9.00	19.31	60.00	16.00
1969	2	9.00	14.14	34.00	11.00
1969	3	11.00	18.90	33.00	17.00
1969	4	9.70	12.56	16.00	12.00
1969	5	5.80	11.48	24.00	10.00
1969	6	4.40	6.08	8.00	5.85
1969	7	4.20	9.43	20.00	7.50
1969	8	8.30	23.39	211.00	14.00
1969	9	8.80	24.09	170.00	16.00
1969	10	7.60	9.17	14.00	9.00
1969	11	9.00	13.70	71.00	11.00
1969	12	12.00	15.94	22.00	17.00
1970	1	14.00	15.16	16.00	15.00
1970	2	11.00	12.64	15.00	12.50
1970	3	11.00	83.65	1020.00	15.00
1970	4	6.60	11.59	16.00	11.50
1970	5	5.00	8.58	14.00	8.60
1970	6	4.40	5.17	6.10	5.20
1970	7	3.60	8.23	61.00	5.00
1970	8	3.30	18.18	122.00	10.00
1970	9	3.00	26.68	388.00	9.10
1970	10	2.70	14.56	175.00	7.10
1970	11	8.30	10.48	12.00	11.00
1970	12	4.40	9.69	15.00	9.80
1971	1	7.20	10.16	15.00	10.00
1971	2	7.00	11.36	17.00	12.00
1971	3	6.90	9.52	12.00	9.20
1971	4	5.80	10.71	17.00	9.70
1971	5	3.80	6.77	11.00	6.50
1971	6	2.70	3.70	4.80	3.55
1971	7	2.20	13.28	136.00	2.50
1971	8	6.50	41.14	196.00	20.00
1971	9	1.80	21.70	143.00	8.35
1971	10	5.10	44.20	345.00	11.00
1971	11	13.00	26.00	233.00	15.00
1971	12	13.00	38.65	81.00	32.00
1972	1	12.00	15.65	23.00	15.00
1972	2	9.20	11.55	15.00	11.00
1972	3	6.80	11.79	15.00	12.00
1972	4	5.10	7.80	12.00	8.05

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1972	5	2.30	4.33	16.00	2.90
1972	6	4.00	16.93	99.00	10.50
1972	7	1.30	17.15	197.00	5.00
1972	8	.80	10.61	63.00	3.40
1972	9	8.00	55.20	331.00	20.00
1972	10	8.00	200.87	3740.00	22.00
1972	11	14.00	27.97	71.00	18.50
1972	12	7.60	30.17	224.00	15.00
1973	1	14.00	21.35	39.00	18.00
1973	2	17.00	98.50	890.00	21.00
1973	3	8.80	113.85	480.00	43.00
1973	4	17.00	41.33	265.00	26.50
1973	5	7.80	16.61	44.00	16.00
1973	6	8.30	24.92	149.00	15.50
1973	7	3.50	15.06	60.00	8.20
1973	8	6.30	11.95	29.00	10.00
1973	9	1.90	5.35	11.00	5.35
1973	10	7.50	12.02	17.00	12.00
1973	11	11.00	16.73	27.00	16.50
1973	12	16.00	19.32	22.00	20.00
1974	1	11.00	16.52	46.00	14.00
1974	2	15.00	16.96	20.00	17.00
1974	3	9.10	18.65	36.00	19.00
1974	4	7.60	11.16	19.00	10.00
1974	5	2.10	6.25	10.00	6.90
1974	6	1.90	3.64	6.10	3.25
1974	7	2.80	26.31	102.00	18.00
1974	8	4.80	27.19	340.00	9.60
1974	9	4.60	18.95	72.00	15.00
1974	10	5.90	24.39	129.00	9.20
1974	11	10.00	14.53	28.00	13.00
1974	12	9.40	13.30	15.00	14.00
1975	1	11.00	12.77	15.00	13.00
1975	2	13.00	14.75	17.00	15.00
1975	3	12.00	22.90	90.00	18.00
1975	4	8.40	16.86	69.00	12.50
1975	5	5.90	9.49	12.00	9.60
1975	6	2.20	3.55	5.30	3.40
1975	7	1.90	11.84	108.00	2.60
1975	8	3.30	7.81	23.00	5.90
1975	9	2.90	10.17	56.00	7.50
1975	10	5.90	7.78	9.90	7.50
1975	11	6.50	9.66	17.00	9.30
1975	12	11.00	12.48	14.00	13.00
1976	1	10.00	12.00	13.00	12.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1976	2	6.90	11.80	21.00	11.00
1976	3	5.50	9.49	13.00	10.00
1976	4	6.50	7.17	8.00	7.00
1976	5	3.50	5.98	9.00	5.30
1976	6	1.40	2.54	3.50	2.75
1976	7	1.30	12.15	115.00	2.50
1976	8	2.60	10.59	134.00	6.20
1976	9	5.30	13.77	70.00	7.70
1976	10	3.60	6.96	11.00	7.10
1976	11	5.70	8.70	11.00	8.70
1976	12	6.90	10.74	25.00	8.60
1977	1	10.00	17.06	62.00	14.00
1977	2	6.10	11.11	16.00	11.00
1977	3	6.70	10.04	25.00	10.00
1977	4	6.10	7.73	12.00	7.40
1977	5	3.70	5.24	7.80	5.00
1977	6	1.30	2.25	4.30	1.80
1977	7	1.20	13.76	153.00	4.60
1977	8	.90	14.79	98.00	2.00
1977	9	1.20	11.86	132.00	5.00
1977	10	1.20	8.52	52.00	5.50
1977	11	2.20	10.50	55.00	9.30
1977	12	7.80	10.50	39.00	8.70
1978	1	7.40	39.48	440.00	10.00
1978	2	10.00	77.50	300.00	49.50
1978	3	27.00	226.71	1660.00	65.00
1978	4	9.00	15.07	32.00	14.00
1978	5	4.70	13.25	28.00	13.00
1978	6	4.80	12.13	78.00	7.15
1978	7	5.60	17.11	76.00	9.50
1978	8	10.00	37.35	199.00	14.00
1978	9	3.70	13.13	118.00	9.60
1978	10	5.80	31.03	198.00	12.00
1978	11	17.00	91.13	1100.00	20.00
1978	12	21.00	473.71	6400.00	25.00
1979	1	20.00	230.13	1390.00	166.00
1979	2	42.00	133.75	552.00	107.50
1979	3	35.00	56.61	128.00	42.00
1979	4	38.00	47.13	71.00	45.00
1979	5	30.00	44.77	181.00	38.00
1979	6	17.00	25.13	41.00	25.00
1979	7	16.00	22.55	28.00	23.00
1979	8	16.00	28.13	155.00	22.00
1979	9	15.00	22.37	27.00	25.00
1979	10	22.00	25.87	50.00	25.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1979	11	25.00	27.40	31.00	27.00
1979	12	25.00	27.77	33.00	28.00
1980	1	26.00	45.52	218.00	28.00
1980	2	27.00	175.52	896.00	55.00
1980	3	32.00	54.84	263.00	38.00
1980	4	25.00	27.63	39.00	25.00
1980	5	16.00	21.16	25.00	21.00
1980	6	10.00	15.60	19.00	17.00
1980	7	12.00	18.19	27.00	17.00
1980	8	10.00	26.39	125.00	20.00
1980	9	13.00	19.47	50.00	18.50
1980	10	12.00	17.74	30.00	17.00
1980	11	16.00	19.67	21.00	20.00
1980	12	16.00	19.35	22.00	20.00
1981	1	19.00	19.74	22.00	20.00
1981	2	18.00	27.82	135.00	20.50
1981	3	16.00	45.06	276.00	18.00
1981	4	12.00	17.77	25.00	18.00
1981	5	10.00	16.23	39.00	15.00
1981	6	7.40	8.70	14.00	8.00
1981	7	6.50	20.81	63.00	13.00
1981	8	6.00	17.42	179.00	8.00
1981	9	6.00	14.15	59.00	10.00
1981	10	8.20	12.60	37.00	12.00
1981	11	6.30	12.37	35.00	11.00
1981	12	14.00	15.68	17.00	16.00
1982	1	17.00	48.87	349.00	25.00
1982	2	17.00	32.29	171.00	22.50
1982	3	16.00	29.10	110.00	25.00
1982	4	13.00	14.23	16.00	14.00
1982	5	7.00	10.86	20.00	12.00
1982	6	4.20	6.17	8.40	6.00
1982	7	3.60	7.57	39.00	6.00
1982	8	8.00	45.20	435.00	20.00
1982	9	5.20	26.70	202.00	9.40
1982	10	6.70	11.82	16.00	12.00
1982	11	9.60	18.92	45.00	18.00
1982	12	16.00	27.90	176.00	20.00
1983	1	16.00	73.97	1330.00	17.00
1983	2	26.00	214.68	1340.00	54.50
1983	3	32.00	310.65	2000.00	95.00
1983	4	24.00	35.63	51.00	35.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1983	5	11.00	18.90	26.00	20.00
1983	6	10.00	13.50	18.00	12.50
1983	7	10.00	21.19	63.00	20.00
1983	8	20.00	38.35	107.00	30.00
1983	9	24.00	52.50	537.00	29.00
1983	10	40.00	1097.74	16000.00	45.00
1983	11	35.00	50.33	100.00	47.50
1983	12	45.00	51.45	100.00	45.00
1984	1	42.00	51.19	64.00	50.00
1984	2	22.00	35.00	44.00	38.00
1984	3	22.00	30.03	39.00	30.00
1984	4	30.00	32.47	39.00	32.50
1984	5	29.00	30.94	34.00	30.00
1984	6	23.00	31.20	49.00	30.50
1984	7	25.00	90.52	226.00	75.00
1984	8	32.00	105.74	254.00	90.00
1984	9	33.00	55.83	87.00	56.00
1984	10	27.00	33.94	58.00	32.00
1984	11	27.00	39.07	115.00	30.00
1984	12	40.00	100.65	425.00	62.00
1985	1	55.00	106.00	309.00	70.00
1985	2	49.00	84.25	148.00	72.50
1985	3	43.00	51.32	70.00	49.00
1985	4	35.00	41.27	50.00	40.50
1985	5	31.00	33.00	36.00	33.00
1985	6	24.00	29.80	35.00	30.00
1985	7	22.00	27.77	88.00	26.00
1985	8	22.00	44.32	110.00	42.00
1985	9	21.00	25.23	49.00	22.50
1985	10	28.00	31.71	52.00	30.00
1985	11	28.00	43.97	236.00	30.00
1985	12	25.00	29.94	70.00	26.00
1986	1	23.00	25.77	30.00	26.00
1986	2	24.00	57.75	265.00	39.00
1986	3	23.00	144.13	589.00	80.00
1986	4	25.00	29.03	45.00	27.00
1986	5	23.00	25.65	28.00	26.00
1986	6	18.00	19.53	22.00	19.00
1986	7	16.00	26.94	166.00	21.00
1986	8	16.00	24.61	88.00	19.00
1986	9	19.00	31.03	177.00	21.50
1986	10	22.00	41.45	467.00	24.00
1986	11	21.00	25.17	33.00	24.00
1986	12	23.00	50.68	309.00	34.00
1987	1	26.00	30.10	46.00	30.00
1987	2	23.00	51.32	271.00	28.50
1987	3	22.00	61.42	200.00	42.00

Table IX.1 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1987	4	22.00	29.57	48.00	27.00
1987	5	24.00	25.68	28.00	26.00
1987	6	14.00	19.40	54.00	15.00
1987	7	12.00	20.97	50.00	22.00
1987	8	14.00	21.45	30.00	22.00
1987	9	20.00	24.40	35.00	24.50
1987	10	14.00	17.94	31.00	18.00
1987	11	18.00	20.60	30.00	20.00
1987	12	22.00	30.39	59.00	28.00
1988	1	20.00	27.87	96.00	23.00
1988	2	23.00	31.62	84.00	25.00
1988	3	19.00	23.06	28.00	23.00
1988	4	17.00	19.97	30.00	19.00
1988	5	13.00	15.42	25.00	15.00
1988	6	12.00	14.93	24.00	13.00
1988	7	11.00	32.61	182.00	19.00
1988	8	12.00	44.84	101.00	42.00
1988	9	15.00	19.53	53.00	15.00

Table IX.2 Minimum, average, maximum and median monthly discharges for the period of record (1981-1989) for the BLM Westend gage.

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1981	10	.00	.00	.00	.00
1981	11	.00	.00	.00	.00
1981	12	27.70	32.89	34.80	33.50
1982	1	29.80	32.91	36.00	33.50
1982	2	28.50	32.25	89.20	29.80
1982	3	19.40	50.09	248.00	26.10
1982	4	14.20	20.76	26.90	20.50
1982	5	12.30	14.96	22.90	14.60
1982	6	9.30	11.10	12.30	11.10
1982	7	11.20	24.51	79.60	20.50
1982	8	10.60	16.13	31.00	13.50
1982	9	13.10	18.39	50.90	15.85
1982	10	13.10	16.60	36.00	15.00
1982	11	10.80	16.59	55.80	15.00
1982	12	15.60	16.74	17.80	16.60
1983	1	16.60	31.81	54.20	26.90
1983	2	20.40	29.78	77.10	26.50
1983	3	19.40	33.63	160.00	23.70
1983	4	17.80	20.98	24.50	20.50
1983	5	10.80	15.26	27.70	15.60
1983	6	8.30	9.70	11.20	9.60
1983	7	7.40	9.35	31.00	8.60
1983	8	10.80	23.17	146.00	11.10
1983	9	11.20	23.79	127.40	16.10
1983	10	11.60	14.47	16.10	14.60
1983	11	14.60	18.19	28.50	17.50
1983	12	18.80	25.73	50.90	23.70
1984	1	20.50	26.23	104.00	22.90
1984	2	26.90	28.35	33.50	27.70
1984	3	26.90	73.97	266.00	41.80
1984	4	24.50	39.55	50.90	41.00
1984	5	16.10	23.68	29.80	24.50
1984	6	10.30	20.56	27.70	21.30
1984	7	.00	.00	.00	.00
1984	8	.00	.00	.00	.00
1984	9	.00	.00	.00	.00
1984	10	.00	.00	.00	.00
1984	11	.00	.00	.00	.00
1984	12	.00	.00	.00	.00
1985	1	.00	.00	.00	.00
1985	2	.00	.00	.00	.00
1985	3	.00	.00	.00	.00
1985	4	.00	.00	.00	.00
1985	5	29.60	31.80	34.70	31.20
1985	6	26.30	30.00	37.00	29.60

Table IX.2 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1985	7	18.00	46.36	158.00	35.90
1985	8	27.20	52.00	127.00	43.35
1985	9	31.20	43.22	137.00	35.90
1985	10	25.00	29.12	34.70	28.00
1985	11	23.80	31.06	59.00	31.20
1985	12	31.20	59.82	165.00	43.90
1986	1	28.80	60.73	208.00	39.30
1986	2	50.60	70.81	177.90	56.20
1986	3	41.60	54.32	70.40	53.40
1986	4	41.60	45.44	50.60	45.00
1986	5	34.70	38.06	43.90	37.00
1986	6	27.20	32.29	37.00	34.70
1986	7	22.60	26.72	86.80	25.00
1986	8	23.20	30.60	54.80	26.40
1986	9	23.80	27.72	42.80	25.60
1986	10	6.40	33.85	64.70	32.80
1986	11	24.40	40.53	190.80	29.60
1986	12	27.20	33.21	56.20	32.80
1987	1	23.80	27.29	36.40	26.40
1987	2	28.80	40.94	97.30	35.90
1987	3	27.20	37.12	72.30	31.20
1987	4	26.40	28.74	36.30	27.80
1987	5	21.40	23.51	27.10	22.40
1987	6	20.30	21.06	21.70	21.00
1987	7	20.70	31.13	241.40	21.70
1987	8	21.00	28.17	98.20	23.50
1987	9	22.70	25.81	42.60	24.90
1987	10	22.40	29.06	79.00	25.60
1987	11	22.70	25.06	32.10	24.55
1987	12	22.40	35.45	141.40	29.30
1988	1	22.40	26.01	46.80	24.90
1988	2	22.40	32.85	207.80	25.60
1988	3	27.80	65.61	241.40	40.50
1988	4	22.40	28.24	59.00	25.60
1988	5	20.70	22.35	25.60	22.10
1988	6	19.30	21.09	34.20	20.50
1988	7	18.20	19.39	29.30	18.80
1988	8	20.00	22.47	27.80	21.40
1988	9	19.10	20.31	25.60	20.30
1988	10	19.30	21.96	24.90	22.40
1988	11	22.70	25.40	48.90	24.55
1988	12	21.40	26.52	87.00	24.20
1989	1	21.40	30.17	155.80	25.25
1989	2	22.10	30.96	163.00	24.20
1989	3	20.30	21.78	22.40	22.10
1989	4	19.00	20.90	27.10	20.50

Table IX.2 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1989	5	.00	.00	.00	.00
1989	6	.00	.00	.00	.00
1989	7	.00	.00	.00	.00
1989	8	.00	.00	.00	.00
1989	9	.00	.00	.00	.00

Table IX.3 Minimum, average, maximum and median monthly discharges for the period of record (1981-1989) for the Eastend gage.

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1981	10	.00	.00	.00	.00
1981	11	.00	.00	.00	.00
1981	12	25.30	28.78	30.10	29.20
1982	1	26.70	28.80	30.90	29.20
1982	2	25.80	28.36	67.10	26.70
1982	3	19.60	40.50	175.10	24.20
1982	4	16.10	20.54	24.70	20.40
1982	5	14.80	16.61	22.00	16.40
1982	6	12.80	13.97	14.80	13.95
1982	7	14.00	23.09	60.60	20.40
1982	8	13.60	17.40	27.50	15.60
1982	9	15.30	18.92	41.00	17.20
1982	10	15.30	17.71	30.90	16.60
1982	11	13.80	17.72	44.40	16.60
1982	12	17.00	17.79	18.50	17.70
1983	1	17.70	28.03	43.30	24.70
1983	2	20.30	26.68	58.90	24.45
1983	3	19.60	29.29	115.20	22.50
1983	4	18.50	20.69	23.10	20.40
1983	5	13.80	16.80	25.30	17.00
1983	6	12.10	13.03	14.00	13.00
1983	7	11.50	12.80	27.50	12.30
1983	8	13.80	22.18	105.70	13.95
1983	9	14.00	22.61	93.10	17.40
1983	10	14.30	16.27	17.40	16.40
1983	11	16.40	18.78	25.80	18.30
1983	12	19.20	23.91	41.00	22.50
1984	1	20.40	24.27	77.20	22.00
1984	2	24.70	25.72	29.20	25.30
1984	3	24.70	56.73	187.30	34.85
1984	4	23.10	33.32	41.00	34.30
1984	5	17.40	22.54	26.70	23.10
1984	6	13.40	20.40	25.30	20.90
1984	7	.00	.00	.00	.00
1984	8	.00	.00	.00	.00
1984	9	.00	.00	.00	.00
1984	10	.00	.00	.00	.00
1984	11	.00	.00	.00	.00
1984	12	.00	.00	.00	.00
1985	1	.00	.00	.00	.00
1985	2	.00	.00	.00	.00
1985	3	.00	.00	.00	.00
1985	4	.00	.00	.00	.00
1985	5	26.60	28.03	30.00	27.60
1985	6	24.30	26.84	31.60	26.60

Table IX.3 (continued)

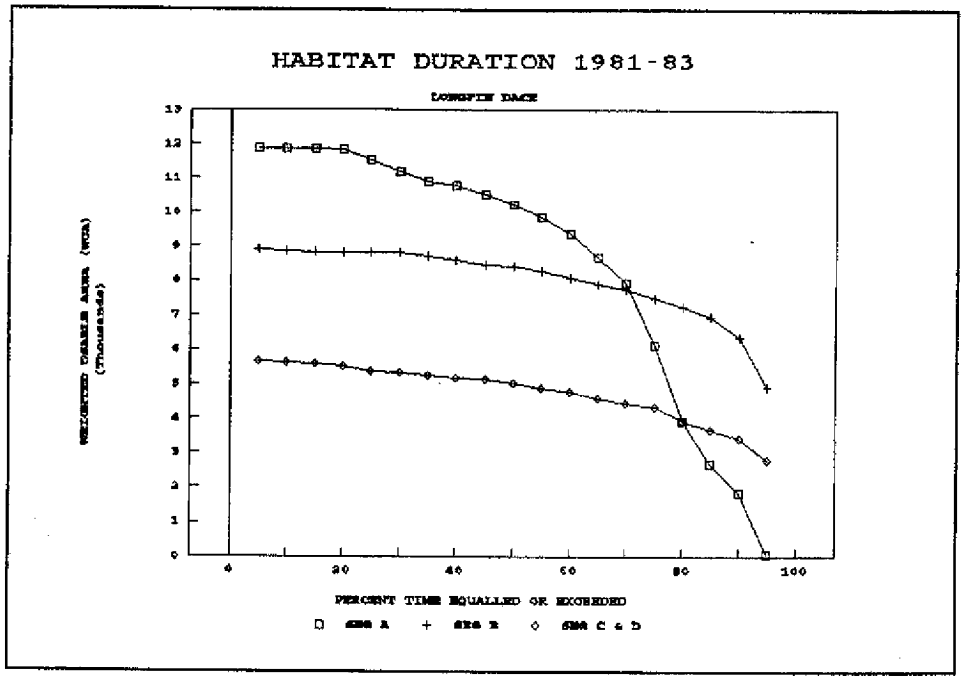
Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1985	7	18.70	37.95	113.90	30.80
1985	8	24.90	41.79	92.80	35.90
1985	9	27.60	35.82	99.60	30.80
1985	10	23.40	26.23	30.00	25.50
1985	11	22.60	27.53	46.50	27.60
1985	12	27.60	47.09	118.60	36.30
1986	1	26.00	47.73	147.90	33.20
1986	2	40.80	54.55	127.40	44.60
1986	3	34.70	43.35	54.30	42.70
1986	4	34.70	37.32	40.80	37.00
1986	5	30.00	32.30	36.30	31.60
1986	6	24.90	28.36	31.60	30.00
1986	7	21.80	24.58	65.50	23.40
1986	8	22.20	27.23	43.70	24.40
1986	9	22.60	25.26	35.50	23.80
1986	10	10.80	29.43	50.40	28.70
1986	11	23.00	33.98	136.20	26.60
1986	12	24.90	29.00	44.60	28.70
1987	1	22.60	24.99	31.20	24.40
1987	2	26.00	34.27	72.60	30.80
1987	3	24.90	31.66	55.60	27.60
1987	4	24.40	25.99	31.10	25.30
1987	5	21.00	22.44	24.90	21.70
1987	6	20.20	20.75	21.20	20.70
1987	7	20.50	27.62	170.60	21.20
1987	8	20.70	25.60	73.20	22.40
1987	9	21.90	23.99	35.40	23.40
1987	10	21.70	26.20	60.20	23.80
1987	11	21.90	23.48	28.30	23.15
1987	12	21.70	30.56	102.60	26.40
1988	1	21.70	24.13	38.30	23.40
1988	2	21.70	28.77	147.70	23.80
1988	3	25.30	51.06	170.60	34.00
1988	4	21.70	25.63	46.50	23.80
1988	5	20.50	21.65	23.80	21.50
1988	6	19.60	20.79	29.70	20.35
1988	7	18.80	19.61	26.40	19.20
1988	8	20.00	21.72	25.30	21.00
1988	9	19.40	20.25	23.80	20.20
1988	10	19.60	21.38	23.40	21.70
1988	11	21.90	23.72	39.70	23.15
1988	12	21.00	24.48	65.60	22.90
1989	1	21.00	26.95	112.40	23.60
1989	2	21.50	27.50	117.30	22.90
1989	3	20.20	21.27	21.70	21.50
1989	4	19.40	20.65	24.90	20.35
1989	5	.00	.00	.00	.00

Table IX.3 (continued)

Year	Month	Minimum Flow (cfs)	Average Flow (cfs)	Maximum Flow (cfs)	Median Flow (cfs)
1989	6	.00	.00	.00	.00
1989	7	.00	.00	.00	.00
1989	8	.00	.00	.00	.00
1989	9	.00	.00	.00	.00

APPENDIX X

Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adults of each species in Segments A, B, and C & D combined.



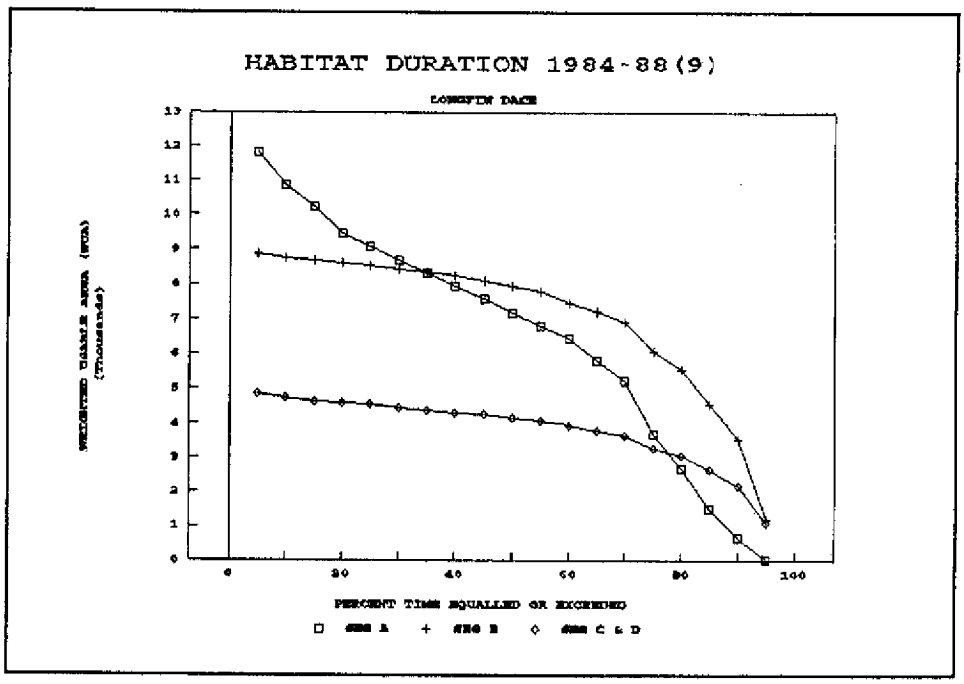
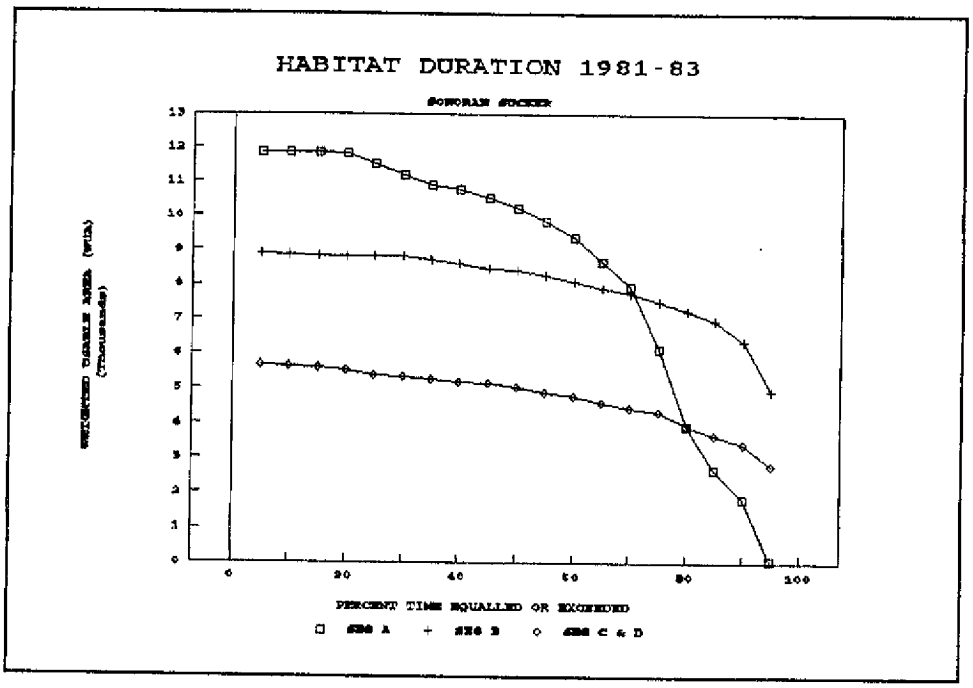


Figure X.1 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Longfin Dace in Segments A, B and C & D combined.



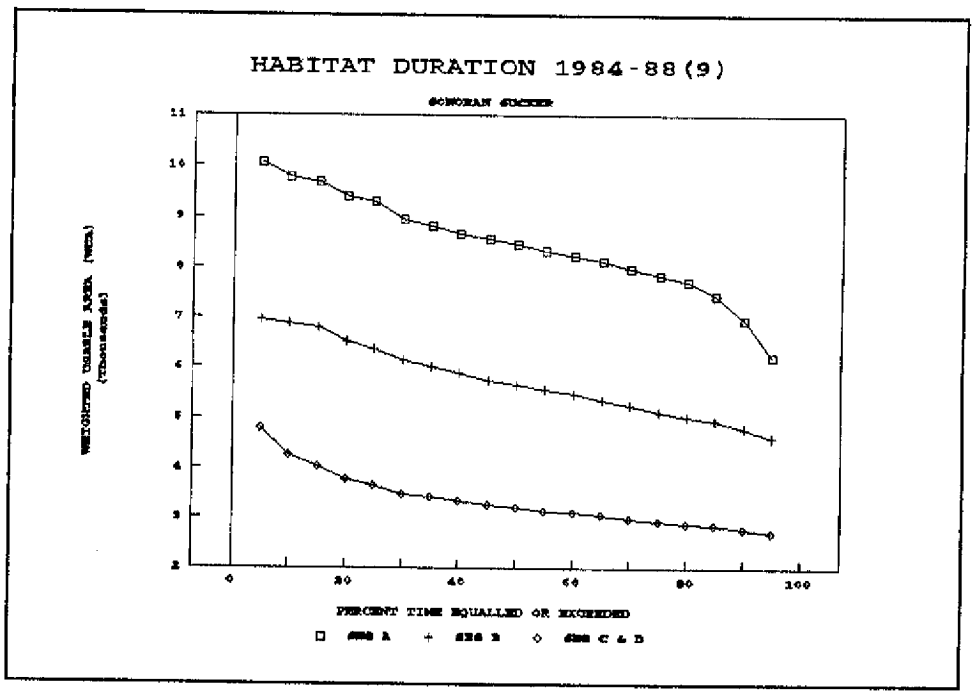
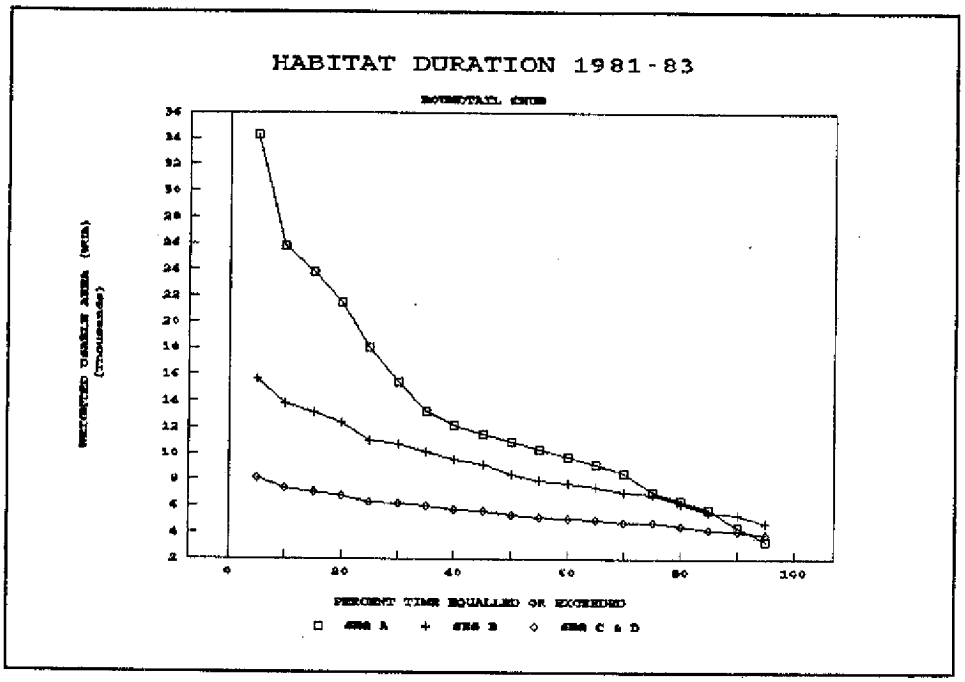


Figure X.2 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Sonoran Sucker in Segments A, B and C & D combined.



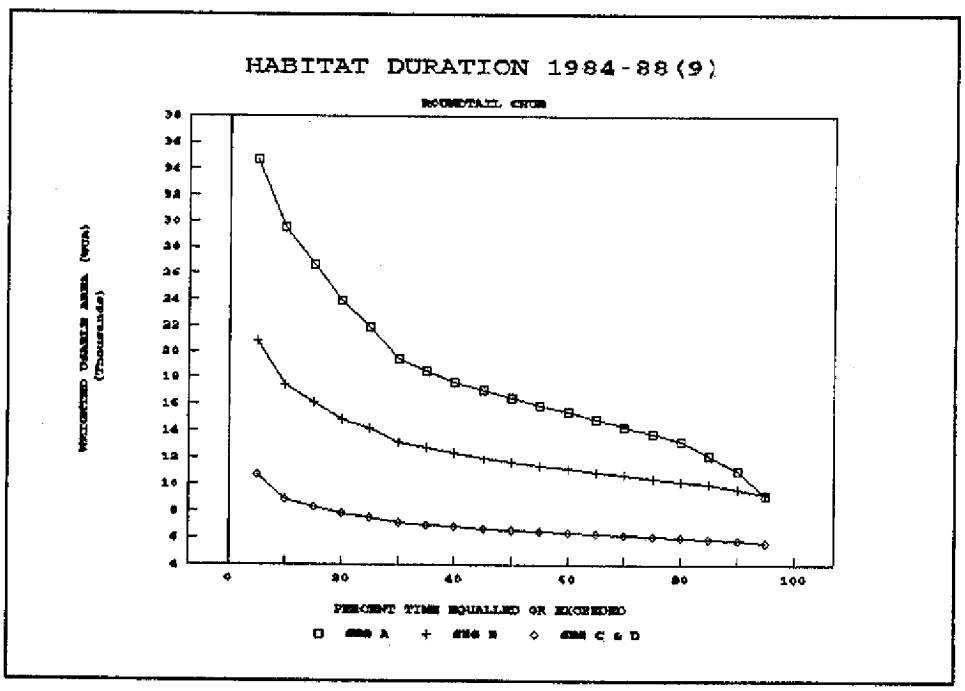
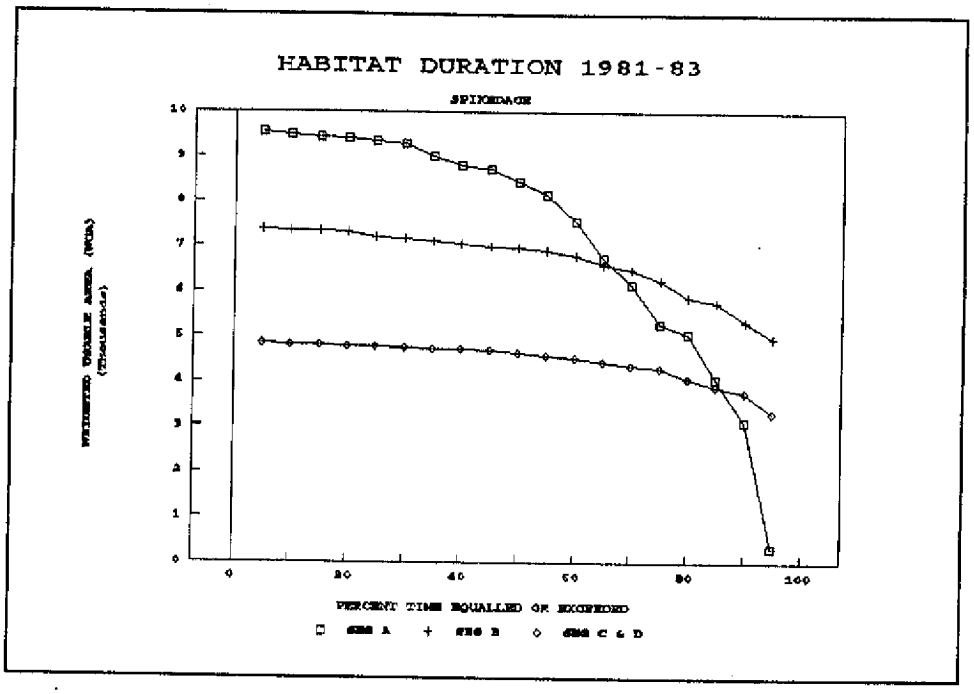


Figure X.3 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Rountail Chub in Segments A, B and C & D combined.



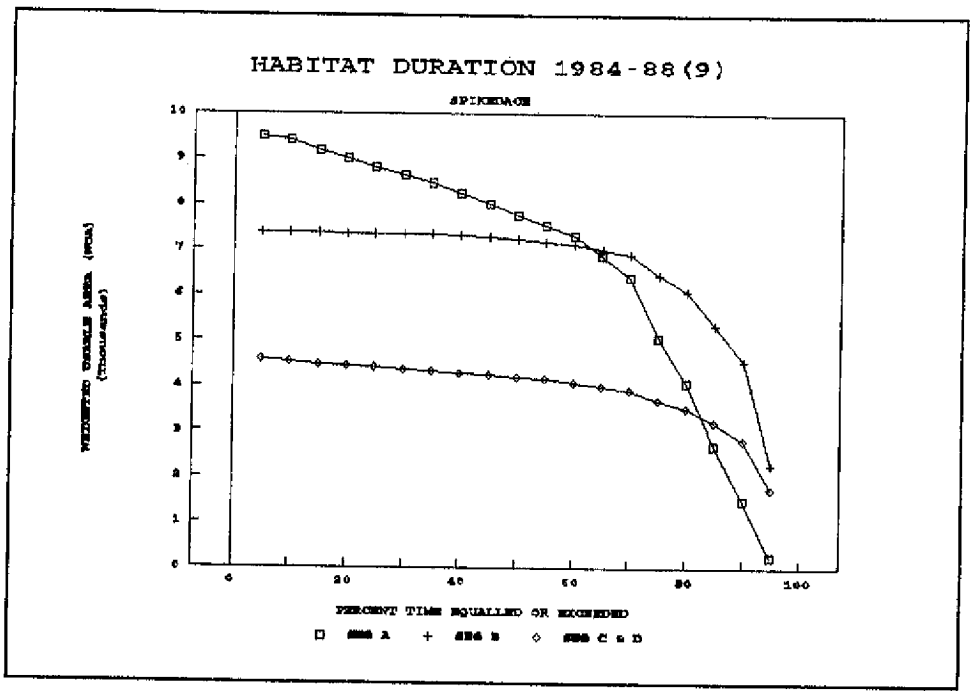
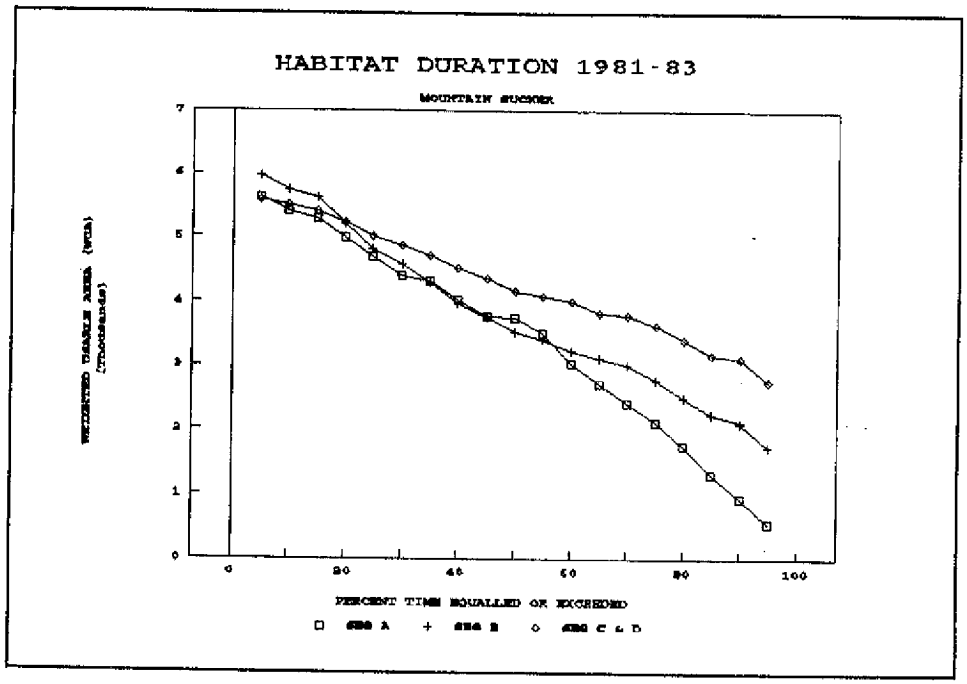


Figure X.4 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Spikedace in Segments A, B and C & D combined.



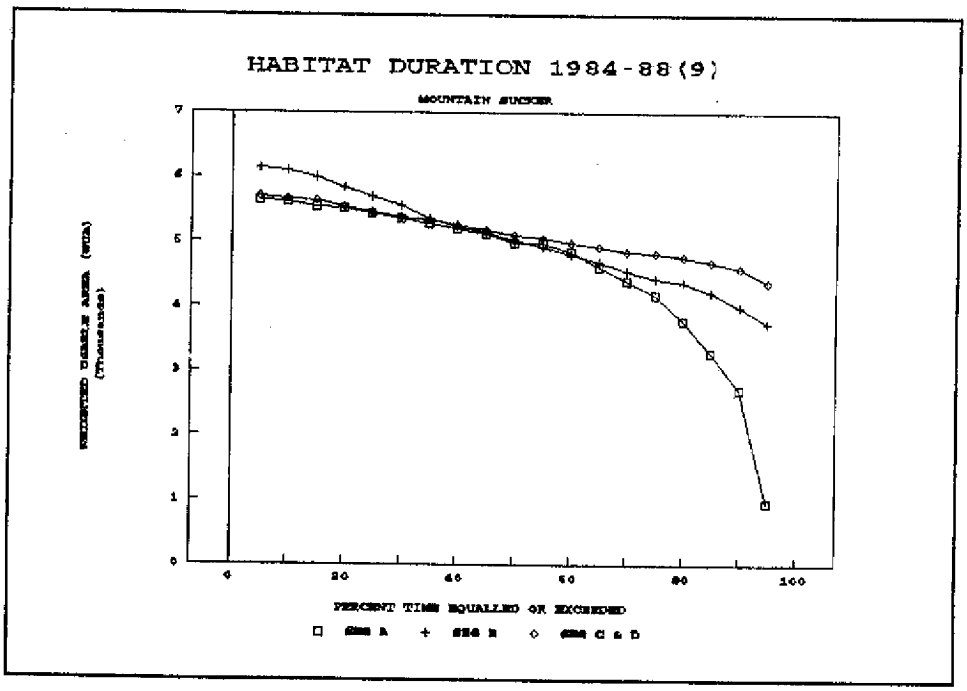
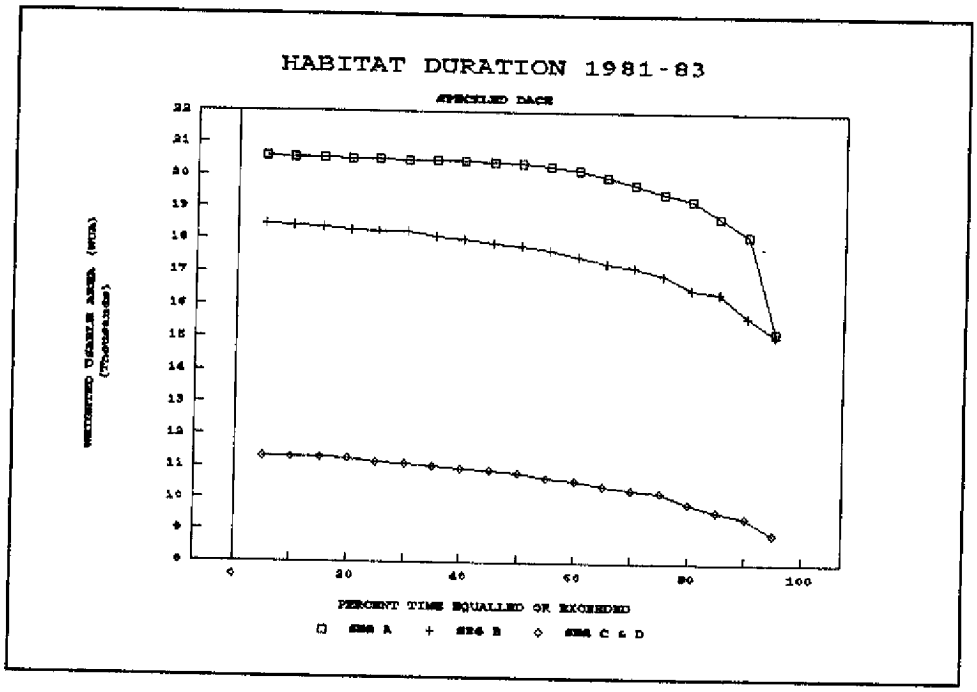


Figure X.5 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Mountain Sucker in Segments A, B and C & D combined.



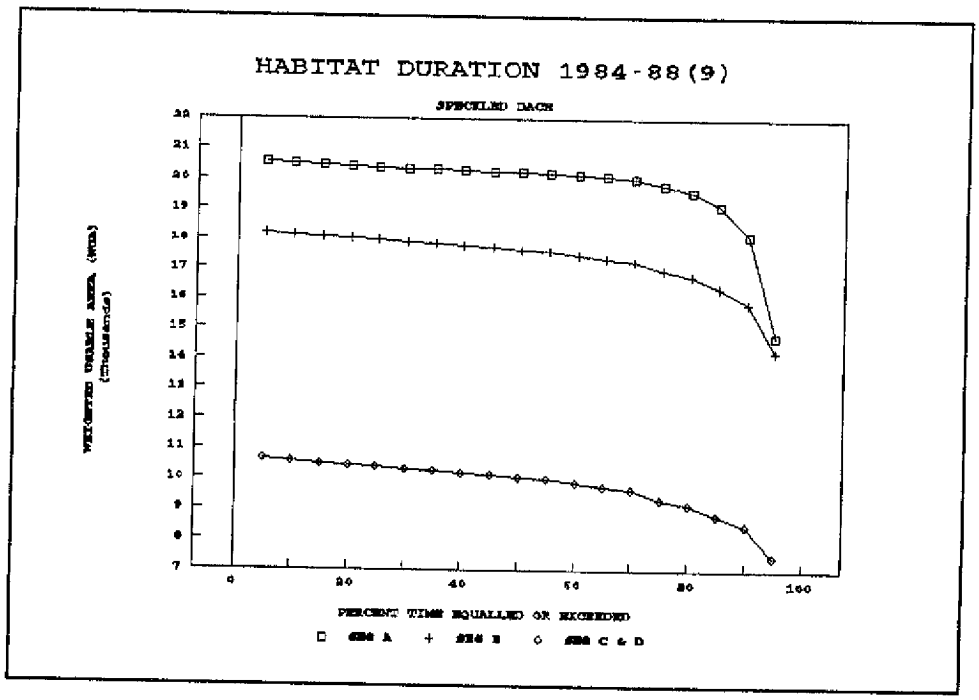
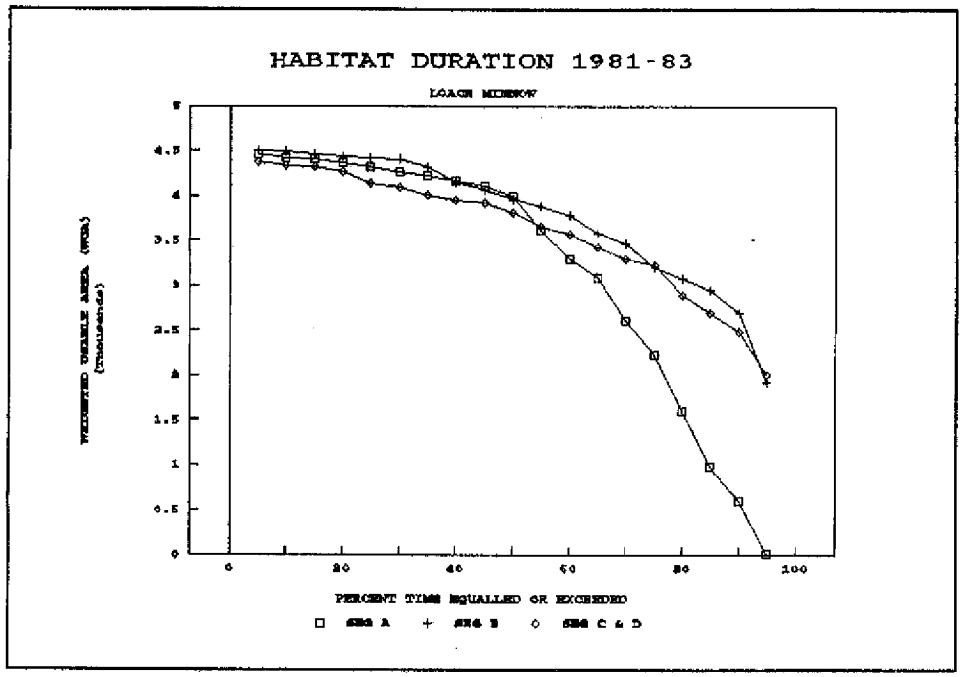


Figure X.6 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Speckled Dace in Segments A, B and C & D combined.



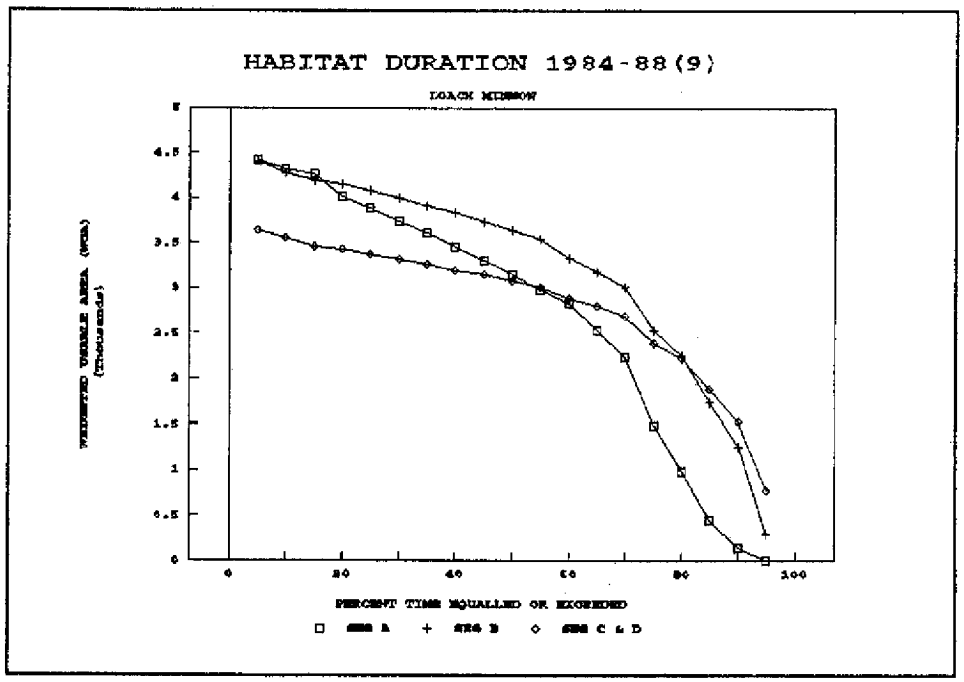


Figure X.7 Annual Habitat Durations for the period of records 1981-1983 and 1984-1988(9) for the adult Loach Minnow in Segments A, B and C & D combined.

APPENDIX XI

Memorandum regarding regression relationships for Westend and Eastend sites at Aravaipa Canyon

MEMORANDUM

TO: Tom Collazo
cc: Mark Heitlinger, Robert Wigington
FROM: Brian Richter
DATE: May 13, 1990
RE: Regression relationships for West End and East End sites at Aravaipa Canyon
attachments: data for West End (BLM), East End, Schoolhouse; memo from 4/3/90

COMPARISON OF WEST AND EAST END DATA

I have analyzed some linear regression relationships between the West End streamgage data (daily means from BLM records) with corresponding instantaneous (current meter) measurements from the East End, for the dates on which both East and West End data are available. Based upon paired measurements from 126 dates, the regression relationship (r^2 = .62) is:

$$(\text{East End}) = 6.43 + 0.68\ (\text{West End})$$

Here is a tabular illustration of this relationship:

West End (measured)	East End (predicted)
10 cfs	13.2 cfs
20 cfs	20.0 cfs
30 cfs	26.8 cfs
40 cfs	33.6 cfs

This relationship suggests an interesting phenomenon; at the lower flow values (around 10 cfs), the East End seems to show slightly higher values than the West End. However, at higher flows (30-40 cfs), the West End shows higher values than the East End. This could be interpreted by saying that during the Winter and Spring, the creek experiences gains from springflows along its length through the canyon. Also, when the larger and longer duration storms pass over Aravaipa Canyon (during the Winter and Spring), more drainage area is contributing to the West End and therefore West End flows can be expected to be higher than at the East End.

During the low flow season of Summer, however, the water generated from the upper valley (and whatever additional springflow is contributed within the canyon) is partially

consumed by evapotranspirative losses before reaching the West End. This results in a net loss in transport from East End to West End. These findings are supported by two other pieces of evidence: 1) Ellingson (1980) estimated that an annual average of 3 cfs is lost to evapotranspiration between the two ends - most of this would of course be attributable to the summer months; and 2) a comparison of median flows estimated for both the West and East Ends (ref: memo B. Richter 4/3/90) suggests that flows are 2.8 cfs higher at the West End during February but 0.9 cfs lower at West End in August - this could be interpreted as a 3.7 cfs (2.8 + 0.9) loss attributable to evapotranspiration during August.

Here's a look at how the median flows would look for East End, comparing the medians of instantaneous measurements taken at the East End versus medians predicted from the regression relationship with the West End data (regression equation was applied to West End medians for each month - see memo 4/3/90):

	OCT	NOV	DEC	JAN	FEB	MAR
Instant.	24.4	28.7	26.1	25.2	25.9	30.6
Predict.	22.7	23.0	24.9	24.4	25.9	27.1

	APR	MAY	JUN	JUL	AUG	SEP
Instant.	27.5	21.8	21.3	20.9	25.1	22.8
Predict.	23.8	21.9	20.5	21.2	22.9	21.7

COMPARISON OF EAST END WITH SCHOOLHOUSE DATA

I've also taken a look at how the East End instantaneous measurements relate to the upstream Schoolhouse instantaneous data. From 80 measurement pairs (taken within a day of each other at the two sites), a strong relationship ($r^2 = .90$) is identified:

$$(\text{Schoolhouse}) = -0.46 + 0.85\ (\text{East End})$$

Here is a tabular illustration of this relationship:

East End (measured)	Schoolhouse (predicted)
10 cfs	8.0 cfs
20 cfs	16.5 cfs
30 cfs	25.0 cfs
40 cfs	33.5 cfs

Here's a look at how the median flows would look for the Schoolhouse site, comparing the medians of instantaneous measurements taken at Schoolhouse versus medians predicted from the regression relationship with the East End instantaneous data:

	OCT	NOV	DEC	JAN	FEB	MAR
Instant.	23.0	19.7	22.7	21.0	21.0	22.6
Predict.	20.3	23.9	21.7	21.0	21.6	25.6

	APR	MAY	JUN	JUL	AUG	SEP
Instant.	22.8	18.5	21.0	19.1	19.6	20.4
Predict.	22.9	18.1	17.6	17.3	20.9	18.9

ESAMPLOW DATA FOR WEST ARAVAIPA
RAVAIPA CANYON PRESERVE
HE ARIZONA NATURE CONSERVANCY

ISCHARGE (CFS) FOR WATER YEAR DECEMBER 1980 TO SEPTEMBER 1981

AY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1				33.5	29.8	28.5	19.4	22.9	12.3	12.3	31.0	13.1	1
2				33.5	29.8	110.8	20.5	19.4	12.0	11.6	21.3	13.5	2
3				33.5	31.0	204.0	24.5	18.3	10.6	11.2	20.5	13.5	3
4				32.5	29.8	248.0	23.7	16.6	10.3	11.2	20.5	14.6	4
5				34.8	29.8	103.6	23.7	16.6	9.8	11.2	20.0	15.0	5
6				34.8	31.0	--- -	22.9	16.6	9.8	11.2	21.3	28.5	6
7				36.0	31.0	146.0	23.7	16.1	11.0	11.6	19.4	17.2	7
8				36.0	31.0	55.8	23.7	16.1	12.0	39.7	15.6	16.6	8
9				36.0	31.0	44.3	24.5	16.1	12.0	12.7	16.1	16.6	9
10				36.0	89.2	36.0	24.5	15.0	12.0	12.7		16.1	10
11				34.8	36.0	27.7	23.7	14.6	10.8	29.8		15.6	11
12			27.7	34.8	32.2	28.5	24.5	13.1	10.6	46.0		15.0	12
13			33.5	33.5	31.0	31.0	24.5	12.3	10.8	20.5		15.0	13
14			31.0	33.5	29.8	28.5	23.7	12.7	11.2	18.8		15.0	14
15			32.2	33.5	29.8	26.1	22.9	12.3	10.8	20.0		15.0	15
16			33.5	32.2	29.8	26.1	26.9	13.9	10.8	20.0		15.0	16
17			33.5	32.2	29.8	26.1	22.9	14.2	11.0	22.1		50.9	17
18			33.5	32.2	29.8	25.3	20.5	14.6	11.2	20.5		17.8	18
19			33.5	33.5	29.8	25.3	20.0	14.6	11.6	19.4		17.2	19
20			33.5	33.5	29.8	26.9	19.4	14.6	12.0	22.9		15.6	20
21			33.5	31.0	28.5	26.1	19.4	14.6	12.0	20.5		15.6	21
22			33.5	31.0	28.5	25.3	19.4	14.6	11.6	44.3	10.6	33.5	22
23			33.5	32.2	28.5	25.3	18.8	14.2	10.3	23.7	11.0	37.2	23
24			32.2	29.8	28.5	24.5	18.3	14.2	10.0	22.9	13.1	17.2	24
25			32.2	29.8	28.5	24.5	15.6	14.2	9.3	42.6	13.5	16.1	25
26			33.5	31.0	31.0	24.5	14.6	13.5	10.8	23.7	11.0	16.1	26
27			32.2	31.0	28.5	22.1	14.6	13.5	11.2	24.5	10.8	16.1	27
28			33.5	31.0	29.8	20.0	14.6	13.5	11.2	22.9	12.7	16.6	28
29			33.5	32.2		20.5	14.2	13.1	11.6	20.5	12.7	13.5	29
30			33.5	31.0		22.1	15.6	12.7	12.3	49.2	12.7	13.1	30
31			34.8	29.8		19.4	18.3			78.6	12.7		31

:\PRESERVE\HYDRO>

ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	13.9	13.9	17.8	16.6	24.5	24.5	21.3	17.8	11.2	8.8	14.2	17.8	1
2	36.0	14.2	17.2	31.2	23.7	23.7	22.1	17.8	11.2	8.6	11.2	17.8	2
3	27.7	14.6	16.6	50.9	22.9	23.7	23.7	17.8	11.0	8.6	11.2	18.3	3
4	19.4	14.2	16.6	26.9	22.1	23.7	23.7	27.7	11.2	8.6	11.0	18.3	4
5	19.4	13.5	15.6	23.7	21.3	22.9	24.5	23.7	11.2	8.6	11.0	18.3	5
6	18.8	10.8	16.1	54.2	21.3	22.9	24.5	19.4	11.0	8.2	11.2	18.3	6
7	18.3	11.0	16.1	---	21.3	22.1	24.5	18.3	10.8	8.5	10.8	18.3	7
8	18.3	12.0	16.1	50.9	22.1	22.1	23.7	17.2	9.8	7.9	10.8	19.4	8
9	17.8	14.2	16.6	37.2	22.9	22.1	22.9	17.2	9.1	7.9	11.0	18.3	9
10	17.2	14.2	16.6	31.0	23.7	21.3	23.7	17.2	8.8	7.7	10.8	96.4	10
11	16.6	14.6	17.2	29.8	20.4	21.3	23.7	16.1	8.6	8.1	18.8	60.0	11
12	16.1	15.6	17.2	---	77.1	22.9	22.9	16.6	8.5	8.1	146.0	127.4	12
13	16.1	15.6	17.2		41.0	160.0	20.5	16.6	9.3	8.1	---	22.1	13
14	15.0	15.6	17.2		32.2	77.1	20.5	15.6	10.3	8.0		17.2	14
15	15.0	15.6	17.8		28.5	69.8	19.4	15.6	10.0	7.6		16.1	15
16	15.6	15.0	17.2		27.7	38.5	20.0	15.6	10.0	7.4		16.1	16
17	15.6	14.6	17.2		26.9	29.8	20.0	14.6	9.5	8.0		16.1	17
18	14.6	13.9	16.6		47.6	41.0	20.5	14.6	8.5	11.0		15.0	18
19	14.6	14.6	17.2		44.3	57.5	20.5	14.2	8.3	9.3		12.3	19
20	14.2	15.0	16.6		36.0	41.0	19.4	13.1	8.5	8.8		12.0	20
21	13.5	15.6	16.6		32.2	29.8	19.4	12.3	9.5	9.0		14.2	21
22	13.5	16.1	16.6		29.8	26.9	19.4	12.0	9.8	9.0		12.0	22
23	13.5	16.1	16.6		26.9	23.7	19.4	11.2	9.6	9.0		11.2	23
24	13.5	16.1	16.6		26.1	20.0	19.4	11.0	9.6	9.0		11.2	24
25	13.5	16.1	16.6		32.2	19.4	18.8	11.0	9.6	9.3		14.2	25
26	13.1	17.2	16.6		27.7	22.1	18.3	10.8	9.6	9.3		14.6	26
27	13.1	17.2	16.6	23.7	26.1	28.5	18.3	11.0	9.3	9.3		14.6	27
28	13.5	17.2	16.1	22.9	25.3	19.4	18.3	11.2	8.8	9.0		15.0	28
29	13.9	55.8	16.6	25.3		22.1	18.3	12.0	9.1	9.3		15.6	29
30		27.7	16.6	26.9		22.1	17.8	12.0	9.3	8.8		15.6	30
31			16.6	25.9		20.5		12.0		31.0			31

SRP12678

STREAMFLOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	15.6	16.6	22.4	23.7	-- -	26.9	50.9	25.3	27.7	-- -	-- -	-- -	1
2	15.6	16.6	29.8	23.7		27.7	44.3	29.8	25.3				2
3	15.0	16.1	22.9	23.7		34.8	47.6	26.9	24.5				3
4	14.6	15.6	21.3	23.7		-- -	44.3	29.8	23.7				4
5	14.6	14.6	20.5	22.9			41.0	26.1	19.4				5
6	14.6	15.6	20.0	22.9			39.7	18.3	25.3				6
7	14.2	16.6	19.4	22.9		132.0	42.6	22.9	23.7				7
8	14.2	16.6	18.8	22.9		69.8	41.0	26.1	22.1				8
9	14.6	17.2	19.4	22.1		46.0	41.0	25.3	23.7				9
10	14.2	17.8	49.2	22.1		39.7	42.6	23.7	22.9				10
11	13.9	21.3	50.9	21.3		39.7	39.7	24.5	27.7				11
12	12.7	16.1	27.7	20.5		38.5	46.0	24.5	23.7				12
13	11.6	15.6	24.5	20.5		39.7	49.2	25.3	20.5				13
14	12.7	15.6	24.5	20.5		41.0	41.0	26.1					14
15	12.3	15.6	24.5	20.5		41.0	41.0	28.5	16.6				15
16	13.5	16.6	24.5	20.5		41.0	41.0	28.5	20.0				16
17	14.2	23.7	23.7	26.1		42.6	42.6	24.5	15.0				17
18	14.2	28.5	23.7	22.1	33.5	198.0	44.3	23.7	16.6				18
19	14.6	19.4	23.7	21.3	29.8	-- -	44.3	21.3	18.3				19
20	14.6	18.3	23.7	34.8	27.7		42.6	24.5	20.5				20
21	14.6	18.3	22.9	26.1	28.5		38.5	24.5	22.1				21
22	15.0	17.8	23.7	23.7	27.7		37.2	22.1	20.0				22
23	15.0	17.2	31.0	22.9	27.7		33.5	18.3	19.4				23
24	14.6	17.8	39.7	22.9	27.7		31.0	18.3	22.9				24
25	15.0	18.3	26.1	22.9	27.7		32.2	22.1	23.7				25
26	15.0	19.4	23.7	22.1	27.7		31.0	18.3	21.3				26
27	15.0	18.8	22.9	21.3	26.9	266.0	31.0	17.8	17.8				27
28	15.6	19.4	22.1	36.0	26.9	122.7	29.8	16.1	10.8				28
29	15.6	19.4	22.9	104.0		85.6	31.0	21.3	10.3				29
30	15.6	25.3	23.7	--- -		74.6	24.5	24.5	10.8				30
31	16.1		23.7			72.2		25.3					31

SRP12679

SRP12680

TRE LOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR MAY 1984 TO SEPTEMBER 1984

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1								34.7	30.4	26.4	37.0	39.3	1
2								33.6	29.6	35.9	28.0	54.8	2
3								33.6	30.4	35.9	27.2	35.9	3
4								32.8	29.6	19.6	27.2	34.7	4
5								32.8	30.4	18.0	74.2	32.0	5
6								32.8	30.4	21.4	41.6	32.0	6
7								32.8	30.4	22.6	49.2	32.0	7
8								32.8	30.4	19.6	53.4	32.0	8
9								32.0	29.6	18.8	42.8	31.2	9
10								32.0	29.6	45.0	43.9	49.2	10
11								31.2	28.8	31.2	127.0	137.0	11
12								31.2	28.8	31.2	84.6	64.7	12
13								30.4	28.8	39.3	57.6	40.5	13
14								29.6	28.8	46.4	80.2	37.0	14
15								32.0	28.8	40.5	64.7	32.0	15
16								32.8	29.6	54.8	49.2	-- -	16
17								32.0	29.6	80.2	91.2		17
18								31.2	29.6	158.0	68.5		18
19								31.2	29.6	100.0	-- -		19
20								31.2	29.6	59.0	84.6		20
21								31.2	29.6	-- -	31.2		21
22								31.2	28.8	74.2	33.6		22
23								31.2	28.8	93.4	72.3		23
24								31.2	28.8	45.0	56.2		24
25								31.2	37.0	29.6	32.8		25
26								31.2	35.9	31.2	39.3	41.6	26
27								31.2	33.6	30.4	28.0	40.5	27
28								31.2	30.4	32.0	39.3	38.2	28
29								31.2	28.0	78.0	29.6	34.7	29
30								31.2	26.3	42.8	29.6	33.6	30
31								31.2		30.4	35.9	34.7	31

STREAMFLOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	34.7	30.4	35.9	70.4	109.0	70.4	45.0	43.9	34.7	26.4	37.0	23.8	1
2	34.7	31.2	31.2	53.4	89.0	68.5	46.4	43.9	35.9	26.4	49.2	23.8	2
3	34.7	32.0	34.7	45.0	100.0	64.7	49.2	43.9	35.9	25.6	47.8	24.4	3
4	33.6	31.2	45.0	39.3	177.9	62.8	45.0	43.9	37.0	25.6	37.0	25.0	4
5	32.8	31.2	38.2	39.3	-- -	57.6	45.0	43.9	37.0	25.0	-- -	24.4	5
6	31.2	32.0	40.5	39.3		57.6	45.0	41.6	35.9	24.4	-	25.0	6
7	29.6	32.8	43.9	39.3		56.2	45.0	41.6	35.9	24.4		26.4	7
8	28.8	35.9	35.9	177.9		56.2	46.4	40.5	35.9	23.8		25.6	8
9	27.2	34.7	-- -	208.0		54.8	46.4	39.3	35.9	22.6	23.8	26.4	9
10	25.6	34.7		84.6		53.4	46.4	38.2	34.7	22.6	23.2	26.4	10
11	25.0	32.0		53.4		53.4	46.4	38.2	34.7	22.6	46.4	28.0	11
12	26.4	26.4		45.0		56.2	47.8	37.0	34.7	24.4	25.6	28.0	12
13	28.0	25.6		38.2		53.4	47.8	38.2	-- -	23.2	25.0	26.4	13
14	27.2	25.0		35.9	64.7	52.0	46.4	37.0		23.2	25.0	25.6	14
15	27.2	24.4		37.0	62.8	64.7	46.4	38.2		22.6	25.0	26.4	15
16	26.4	25.0		32.8	53.4	62.8	45.0	37.0		23.2	25.0	25.6	16
17	26.4	25.0		32.8	50.6	56.2	45.0	35.9		23.2	25.0	25.6	17
18	27.2	24.4		32.0	50.6	54.8	46.4	35.9		23.8	26.4	40.5	18
19	28.0	24.4		31.2	53.4	54.8	42.8	35.9		24.4	30.4	30.4	19
20	29.6	23.8	80.2	30.4	52.0	53.4	41.6	35.9		25.6	54.8	27.2	20
21	30.4	23.8	137.0	29.6	50.6	50.6	43.9	35.9		25.0	32.8	25.6	21
22	30.4	25.6	64.7	28.8	53.4	52.0	43.9	37.0		28.8	28.0	25.6	22
23	28.0	28.8	49.2	31.2	68.5	49.2	43.9	35.9	27.2	26.4	26.4	25.6	23
24	27.2	23.8	47.8	60.9	62.8	47.8	42.8	35.9	27.2	25.6	25.6	25.6	24
25	28.0	39.3	38.2	42.8	56.2	47.8	42.8	34.7	27.2	25.0	28.8	25.0	25
26	30.4	59.0	40.5	169.3	56.2	47.8	46.4	34.7	27.2	25.0	30.4	25.6	26
27	30.4	38.2	-- -	-- -	56.2	43.9	50.6	34.7	27.2	25.6	28.8	25.6	27
28	28.0	38.2			78.0	41.6	47.8	34.7	27.2	26.4	25.6	42.8	28
29	27.2	37.0		112.0		47.8	42.8	34.7	27.2	25.6	25.0	40.5	29
30	28.8	35.9	165.0	-- -		46.4	42.8	35.9	27.2	25.0	24.4	34.7	30
31	29.6		89.0			45.0		35.9		86.8	23.8		31

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STREAMFLOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	46.4	29.6	56.2	28.8	35.9	31.2	36.3	27.1	21.7	21.7	21.0		1
2	35.9	29.6	41.6	28.8	33.6	31.2	36.3	26.4	21.4	21.7	24.9		2
3	35.9	29.6	35.9	29.6	28.8	30.4	34.2	26.4	21.0	22.7	25.6		3
4	35.9	28.8	34.7	36.4	32.0	30.4	32.1	25.6	21.0	24.9	22.4		4
5	34.7	28.8	33.6	31.2	32.0	29.6	32.1	26.4	21.0	23.5	22.1		5
6	34.7	28.0	32.8	30.4	31.2	29.6	29.3	26.4	20.7	22.4	22.7		6
7	35.9	27.2	32.8	29.6	40.5	28.0	30.0	26.4	20.7	22.4	24.9	23.5	7
8	34.7	25.6	32.8	29.6	40.5	28.0	28.6	26.4	21.0	24.2	22.7	24.9	8
9	38.2	25.0	33.6	28.0		27.2	28.6	25.6	21.0	24.2	23.5	27.1	9
10	50.6	25.0	34.7	28.0	86.8	28.8	28.6	24.9	21.4	21.7	24.2	26.4	10
11	64.7	24.4	35.9	28.0	50.6		27.8	24.2	21.4	21.4	23.5	26.4	11
12	37.0	28.8	38.2	27.2	41.6		27.1	23.5	21.0	20.7	24.2	26.4	12
13	34.7	27.2	35.9	27.2	38.2		27.1	23.5	21.0	20.7	22.4	25.6	13
14	32.8	26.4	37.0	26.4	37.0		27.1	22.7	21.0		44.7	25.6	14
15	31.2	27.2	35.9	26.4	35.9		27.1	22.7	21.0		27.1	26.4	15
16	33.6	28.8	34.7	25.6	97.3	72.3	27.1	22.4	21.0		24.2	24.9	16
17	42.8	29.6	33.6	25.0	70.4		26.4	22.4	21.4		27.8	23.5	17
18	33.6	29.6	32.8	24.4	43.9		27.1	22.4	21.4		23.5	23.5	18
19	31.2	30.4	32.8	23.8	38.2		27.1	22.1	20.7		22.4	23.5	19
20	30.4	31.2	31.2	23.8	35.9		27.1	21.7	20.7	21.0	22.1	22.7	20
21	28.8	32.0	31.2	24.4	33.6		27.1	21.7	20.3	22.1	22.1	22.7	21
22	28.8	31.2	30.4	25.0	32.0		27.8	22.1	20.7	26.4	22.4	22.7	22
23	29.6	31.2	29.6	25.6	32.0		27.8	22.1	21.0	241.4	22.1	30.0	23
24	29.6	32.0	28.0	26.4	32.0	55.0	27.8	21.7	21.4	24.9	24.2		24
25	29.6	59.0	28.0	26.4	31.2	46.8	27.8	21.7	21.0	22.4	24.2	42.6	25
26	30.4	190.8	27.2	26.4	32.0	44.7	27.8	21.7	21.0	21.7	22.7	27.1	26
27	31.2	66.6	27.2	26.4	31.2	38.4	27.8	21.7	21.0	21.4	59.0	25.6	27
28	31.2	40.5	27.2	27.2	31.2	38.4	27.1	21.7	21.0	21.4	25.6	24.9	28
29	32.0	34.7	28.0	26.4		38.4	27.1	21.4	21.4	21.4	98.2	24.2	29
30	32.0	137.0	28.0	26.4		38.4	27.1	21.7	21.4	21.0	34.2	23.5	30
31	31.2		28.0	27.2		38.4		22.1		21.0	22.7		31

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STREAMFLOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	22.7	23.5	22.7	26.4	27.8	241.4	28.6	25.6	20.7	19.3	27.1	20.7	1
2	22.4	29.3	22.4	25.6	24.9	141.4	28.6	24.9	20.7	19.3	26.4	20.7	2
3	22.7	27.1	22.4	24.9	24.9	83.0	27.8	24.2	20.7	19.1	26.4	20.7	3
4	22.7	24.9	22.7	24.9	24.2	87.0	42.6	23.5	20.7	19.1	27.8	21.7	4
5	24.2	23.5	22.7	29.3	24.2	174.2	46.8	22.7	20.7	19.1	27.8	21.7	5
6	24.2	22.7	65.7	26.4	23.5	119.8	59.0	22.7	27.1	19.1	23.5	21.4	6
7	24.9	27.1		26.4	22.4	79.0	44.7	22.1	34.2	19.1	22.1	21.7	7
8	24.9	23.5		25.6	23.5	46.8	30.0	21.7	22.7	19.0	21.7	20.3	8
9	25.6	22.7	141.4	24.9	24.2	40.5	28.6	22.1	22.4	18.8	21.4	20.0	9
10	36.3	23.5	51.0	24.9	24.9		27.8	21.7	21.7	18.7	22.7	19.6	10
11	79.0	22.7	38.4	24.9	25.6		25.6	21.7	21.7	18.5	26.4	19.6	11
12		23.5	34.2	24.2	25.6	134.2	24.9	22.1	21.4	18.5	22.1	19.3	12
13		22.7	29.3	24.9	26.4	59.0	24.9	22.1	21.4	18.5	21.4	19.3	13
14	60.8	23.5	29.3	24.2	26.4	40.5	23.5	22.1	21.0	19.0	21.0	19.3	14
15	36.3	24.2	29.3	24.9	26.4	51.0	22.7	22.7	20.7	18.8	20.7	19.3	15
16	29.3	25.6	29.3	27.1	27.1		22.4	22.7	20.3	19.1	20.3	19.1	16
17	28.6	25.6	44.7	27.1	26.4		22.4	22.1	19.6	18.8	20.3	19.1	17
18	27.8	25.6	44.7	25.6	25.6	67.0	22.4	22.4	19.6	18.5	20.0	19.6	18
19	27.1	32.1	36.3	25.6	25.6	44.7	22.7	22.4	19.6	18.5	20.0	19.3	19
20	27.1	27.8	32.1	25.6	25.6	34.2	23.5	24.2	20.0	18.5	20.3	19.1	20
21	26.4	27.8	29.3	24.9	24.9	30.0	22.7	23.5	20.0	18.4	22.7	19.3	21
22	26.4	27.1	29.3	24.2	24.2	36.3	23.5	22.7	19.6	18.4	21.4	19.6	22
23	25.6	26.4	23.6	24.2	26.4	32.1	23.5	22.4	19.6	18.2	21.4	20.7	23
24	25.6	25.6	28.6	23.5		29.3	24.2	21.4	19.3	18.4	21.7	20.7	24
25	25.6	24.9	27.8	22.7		28.6	24.9	21.7	19.6	18.8	22.1	20.7	25
26	25.6	24.9	27.8	22.7		29.3	25.6	21.4	19.6	18.4	21.4	20.3	26
27	24.9	24.2	27.1	22.7		27.8	25.6	21.4	19.3	18.4	21.4	20.3	27
28	24.9	23.5	27.1	22.4	207.8	28.6	26.4	20.7	19.6	19.3	21.4	20.3	28
29	24.2	23.5	27.1	22.4		28.6	25.6	20.7	19.6	23.5	21.4	20.3	29
30	23.5	22.7	26.4	36.3		28.6	25.6	20.7	19.6	29.3	21.4	25.6	30
31	23.5			46.8		28.6		20.7		22.7	21.0		31

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STREAMFLOW DATA FOR WEST ARAVAIPA
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1987 TO APRIL 1988

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DAY
1	20.7	48.9	24.2	21.4	24.9	22.4	20.3						1
2	20.0	29.3	23.5	21.4	24.9	22.2	20.3						2
3	19.3	25.6	23.5	21.7	25.6	22.1	19.6						3
4	19.3	24.9	24.9	22.1	25.6	21.7	19.6						4
5	19.3	24.2	24.2	22.1	163.0	21.7	19.3						5
6	19.6	24.2	24.2	22.4	87.0	21.7	19.1						6
7	19.3	24.2	24.2	22.4	32.4	22.1	19.3						7
8	20.0	23.5	24.9	22.4	27.1	22.1	19.3						8
9	20.3	23.5	24.2	22.7	24.9	22.1	19.1						9
10	20.3	22.7	24.2	22.7	24.2	22.1	19.0						10
11	20.3	23.5	24.2	23.5	22.7	22.1	19.1						11
12	20.7	23.5	24.2	24.2	22.4	22.1	19.1						12
13	22.1	23.5	24.9	24.9	22.4	22.1	19.1						13
14	22.4	24.2	24.2	25.6	22.1	22.1	20.7						14
15	22.4	24.2	24.2	25.6	22.1	22.1	20.0						15
16	22.4	24.9	23.5	25.6	22.4	22.1	21.7						16
17	22.7	24.9	29.3	26.4	22.4	22.1	21.0						17
18	22.7	24.9	87.0		22.4	22.1	21.0						18
19	22.7	24.9	36.3	155.8	22.7	22.1	20.7						19
20	22.4	24.9	32.1	51.0	23.5	22.1	20.3						20
21	22.7	24.9	24.9	38.4	24.2	22.1	21.4						21
22	23.5	24.9	22.1	30.0	24.2	21.7	25.6						22
23	24.9	25.6	22.1	28.6	24.2	21.7	23.5						23
24	24.2	25.6	25.6	26.4	24.2	21.4	22.1						24
25	24.2	24.9	24.2	25.6	24.2	21.4	21.7						25
26	23.5	24.9	22.7	25.6	24.2	21.4	21.4						26
27	23.5	24.2	22.1	24.9	22.7	21.4	21.4						27
28	23.5	24.2	21.7	25.6	22.7	21.0	22.4						28
29	23.5	24.2	21.7	24.9	22.4	21.0	22.7						29
30	23.5	24.2	21.7	25.6		20.7	27.1						30
31	24.9		21.4	25.6		20.3							31

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[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]												
[illegible]												
[illegible]							36.7					
[illegible]												
[illegible]												
[illegible]												
[illegible]												
[illegible]												
[illegible]												
[illegible]												
[illegible]								28.1				
[illegible]											23	
[illegible]												
[illegible]									29.5			
[illegible]						33.2						
[illegible]												
[illegible]												29.8
[illegible]										20.9		
[illegible]												
[illegible]						31.2						
[illegible]												
[illegible]												
[illegible]							34.3					
[illegible]												
[illegible]												
[illegible]												
[illegible]									33			
[illegible]												
[illegible]												
[illegible]								29.4				
[illegible]												

[illegible]

[illegible]

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2							36.7					
3												
4												
5												
6												
7												
8												
9												
10								28.1				
11										23		
12												
13									29.5			
14						33.2						
15												
16											29.8	
17												
18										20.9		
19												
20						31.2						
21												
22												
23							34.3					
24												
25												
26												
27									33			
28												
29												
30								29.4				
31												

MEAN
46.7.

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	[illegible]	[illegible]	[illegible]
1												
2												
3												
4												
5												
6												26
7												
8												
9												
10												
11												
12												
13												
14												
15												
16										21.4		
17												
18										13.5		
19												
20									21.6			
21												
22												
23										20.3		
24		24										
25												
26												
27									18.6			
28												
29												
30										14.3		
31												

STREAMFLOW DATA FOR HAVASUPAI CREEK - EAST END COLORADO RIVER MEASUREMENTS
HAVASUPAI CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3												
4												
5												
6											26	
7												
8												
9												
10												
11												
12												
13												
14												
15										21.4		
16												
17										13.5		
18												
19												
20									21.6			
21												
22										20.3		
23	24											
24												
25												
26									18.6			
27												
28												
29										14.3		
30												
31												

TOTAL
MEAN

STREAMFLOW DATA FOR ARAVAIPA CREEK - PAST AND CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2									16.2			
3												
4												
5												
6												
7												
8										14.1		
9												
10						23.1						
11												
12												
13												
14												
15												
16												
17												
18												
19			21.3									
20												
21												
22												
23												
24	14.7											
25												
26												
27												
28												
29												
30												
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2									16.8			
3												
4												
5												
6												
7												
8										14.1		
9												
10						23.1						
11												
12												
13												
14												
15												
16												
17												
18												
19			21.3									
20												
21												
22												
23												
24	14.7											
25												
26												
27												
28												
29												
30												
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST FK CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2						17.5						
3												
4											17.0	
5									11.9			
6												
7										6.8		
8												
9												
10									9.2			
11												
12												
13						18.7						
14								14				
15												
16				20.5								
17												
18												
19												
20												
21										10.3		
22												
23	14.6											7.3
24			16.1		18.8			10.1				
25												
26												
27												
28							12.3					
29				17.3								
30												
31			15.5									
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2						17.5						
3											17.3	
4									11.9			
5												
6										6.8		
7												
8												
9									9.2			
10												
11												
12						16.7						
13								15				
14												
15				20.5								
16												
17												
18												
19												
20										10.8		
21												
22												7.8
23	14.6											
24			16.1		16.8			10.1				
25												
26												
27							12.3					
28												
29				17.3								
30												
31			15.5									
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2			14.9									
3												
4				16.5								
5		9.2							16.5			
6												
7												
8							26.7					
9	12.6											
10											21.9	
11					21.2							
12												
13										20.6		
14												
15					26.2							26.7
16												
17								16.6				
18			9.9						17.9			
19	10.2											
20												
21												
22				10.1								
23										27.5		
24												
25												
26												
27												
28					17.2							
29												
30							17		10		35.2	
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2			14.9									
3												
4				16.5					18.5			
5		9.2										
6												
7												
8							26.7					
9	12.6										21.9	
10												
11					21.2							
12										20.8		
13												
14												20.7
15					26.2							
16								16.6				
17									17.9			
18			9.9									
19	10.2											
20												
21												
22				10.1						27.5		
23												
24												
25												
26												
27												
28					17.2							
29							17		10		35.2	
30												
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAPAHOE CREEK - EAST END CURRENT METER REQUIREMENTS
ARAPAHOE CANYON PRESERVE
THE MILLION NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3												
4							27.5					
5										28.7	30.4	
6												
7			43.7									
8												
9												
10				31								
11												
12			34.5						30.1			
13												
14												27
15								23.1				
16												
17		33.4								26.7		
18	40						34.3					
19												
20												
21												
22		28.7		33.1								
23									25.3			
24												
25		30.5									33.5	
26												
27					37.9							
28												
29												
30												
31							39.7					

MEAN
[illegible]

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3							27.3					
4										26.7	34.6	
5												
6												
7			43.7									
8												
9												
10				31								
11									37.2			
12			34.6									
13												27
14								33.1				
15												
16										26.7		
17		33.4					36.3					
18	40											
19												
20												
21												
22		28.7		32.1					18.3			
23												
24											19.3	
25		30.3										
26												
27					37.9							
28												
29												
30							39.7					
31												

MEAN
41.77

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER REGULATORS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1994 TO SEPTEMBER 1995

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	30.7											
2		30.4										
3									38.1			
4												
5												
6								37.7				
7												
8							37.8					
9												[illegible]
10			29.2									
11						42.4						
12					32.2							
13											[illegible]	
14												
15												
16	29.3	27.9								29.4		
17									31.3			
18												
19												
20		30						31.4				
21												
22			47			42.1	40.2					
23												[illegible]
24												
25												
26					32.6						32.5	
27												
28												
29												
30									29.2			
31												

*END
[illegible],

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	30.7											
2		30.4										
3									35.1			
4												
5												
6								37.7				
7												
8							37.8					
9												27.6
10			29.2									
11						42.4						
12					62.4						33.8	
13												
14												
15										29.5		
16	29.3	27.9										
17									31.3			
18												
19												
20		39						35.4				
21												
22			47			42.1	40.2					
23												27.2
24												
25												
26					52.6						31.8	
27												
28												
29												
30									29.2			
31												
MEAN												
AC.FT.												

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1												[illegible]
2			[illegible]						[illegible]			
3												
4		[illegible]						[illegible]			[illegible]	
5												
6												
7	[illegible]											
8							[illegible]					
9												
10						[illegible]						
11					[illegible]							
12												
13				[illegible]								
14												
15												[illegible]
16			[illegible]						[illegible]			
17												
18		[illegible]									[illegible]	
19								[illegible]				
20							[illegible]					
21	[illegible]									[illegible]		
22												
23												
24					[illegible]							
25												
26												
27				[illegible]								
28												
29										[illegible]		[illegible]
30			[illegible]						[illegible]			
31												

[illegible]

[illegible]

STREAMFLOW DATA FOR HAVAPAI CREEK - EAST END CURRENT METER MEASUREMENTS
HAVAPAI CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												35.6
2			31.6						25.9			
3												
4		29.9						26			24	
5												
6												
7	28.2											
8							29.5					
9												
10						24.4						
11					29.3							
12												
13				29.3								
14												
15												23.3
16			28.3						24.9			
17												
18		28.7									29.4	
19								25.8				
20							27.6					
21	29.3									22.9		
22												
23												
24					27.7							
25												
26												
27				27.1								
28												
29										31.3		24.2
30			26.4						20			
31												

MEAN
AC.FT.

[illegible]

[illegible] NATURE [illegible]

[illegible] FOR WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1			13.2		25.9							
2												
3						34.5						
4												
5												1[illegible]
6												
7				25.6								
8												
9										27.2		
10												
11			45.4									
12									22.8			
13												
14		15.1										
15												
16				21.5								
17								21.1				
18												
19	25.3											
20							25.1					
21												
22												21.1
23			26.7									
24												
25						30.5						
26												
27											21.7	
28												
29												
30												
31					23.4					21.[illegible]		
32												
33			26.7						21			
34												
35		15.1										
36								17.3				
37												
38	24.8						22.6					
39												
40			25.7									21.4
41												
42						22.1						
43												
44											1[illegible]	
45												
46												
47												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1			23.8		25.9							
2						30.6						
3											25	
4												
5				25.6								
6										20.2		
7												
8			48.4						22.5			
9												
10		25.5										
11				25.5				21.3				
12												
13	35.3						26.2					
14												21.8
15			26.7									
16						30.5						
17											22.7	
18												
19												
20					25.9					21.7		
21												
22			26.7						21			
23												
24		28.1										
25								25.5				
26												
27	24.8						23.6					
28												21.6
29			25.7									
30						25.2						
31											21.5	
MEAN												
AC.FT.												

[illegible] DATA FOR ANALYSIS PERIOD - [illegible] WATER MEASUREMENTS

[illegible]

[illegible] METERS DISCHARGED

[illegible] FOR WATER YEAR OCTOBER 1987 TO SEPTEMBER 1989

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	[illegible]	[illegible]	[illegible]
1					20.3							
2												
3												
4				22.7			19.6	15				
5												
6												
7			22									
8												
9												
10		22.3										
11												
12	21.6											
13												
14										13.1		
15									16.7			
16					21.2							
17												
18												15
19								16.4				
20				24.8			17.6					
21												
22			24.1									
23												
24		21.7										
25												
26												
27												
28												
29	23.2				22.5							
30												
31										18.1		
32												
33								14.3				
34												
35												

MEAN
[illegible]

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END CURRENT METER MEASUREMENTS
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					20.6							
2												
3												
4				22.7			19.6	18				
5												
6												
7			22									
8												
9												
10		22.2										
11												
12	21.6											
13										15.1		
14									16.3			
15					21.5							
16												
17												18
18								16.4				
19				24.8			19.8					
20												
21			24.1									
22												
23		21.2										
24												
25												
26												
27												
28	23.2				21.9							
29									16.1			
30												
31								14.3				
MEAN												
AC.FT.												

| | | |

[illegible]

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	[illegible]	AUG	SEP
1												
2					9.4			9.4				
3												
4												
5												
6							18.6				23.1	
7												
8												
9										12.1		
10												
11									8.5			
12												
13												
14												
15												
16												
17												
18												
19												
20								14.6				
21												
22												
23												
24												
25										12.9		
26									12.6			
27												12.7
28											14	
29												
30												
31												

MEAN

[illegible]

16.6

16.9

16.4

[illegible]

[illegible]

THE ARIZONA NATURE CONSERVANCY

[illegible] FOR WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3												
4												
5												
6		16.6										
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22			16.9									
23												
24												
25												
26												
27		16.4										
28												
29												
30												
31												

[illegible]

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3									29.5			
4												
5												
6												
7												
8							35					
9												
10												26.3
11												
12												
13											28.3	
14												
15												
16										27		
17												
18									28.7			
19												
20												
21								29.8				
22												
23							34.7					
24												26.2
25												
26												
27											25.7	
28												
29												
30										26.9		
31									28.5			
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2												
3									29.5			
4												
5												
6												
7												
8							35					
9												26.3
10												
11												
12											28.3	
13												
14												
15										27		
16												
17									28.7			
18												
19												
20								29.8				
21												
22							34.7					
23												26.2
24												
25												
26											25.7	
27												
28												
29										26.9		
30									28.5			
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
2			24.2									22.5
3									21.4			
4		23.9										
5								22.6			19	
6												
7	26.1											
8							23.8					
9												
10												
11						21.4						
12					22.2							
13												
14				21.6								
15												
16												20.1
17			24.4						21.5			
18												
19		22.8									20.6	
20								20.7				
21	25.1						23.5					
22										21.4		
23												
24												
25					21	28.3						
26												
27												
28				21								
29												
30												20.4
31			22.7						20.6			
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												22.5
2			24.2						21.4			
3												
4		23.9						22.6			19	
5												
6												
7	26.1						23.8					
8												
9												
10						21.4						
11					22.2							
12												
13				21.6								
14												
15												20.1
16			24.4						21.5			
17												
18		22.8									20.6	
19								20.7				
20							23.5					
21	25.1									21.4		
22												
23												
24					21	28.3						
25												
26												
27				21								
28												
29												20.4
30			22.7						20.6			
31												
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					21.5							
2						22.6						
3												
4											17.9	
5				21.5								
6												
7										19.1		
8			44.8									
9									19.9			
10		20.9										
11												
12								18.2				
13	27.8											
14							22					
15												19.3
16					21.4	23.4						
17												
18											19.6	
19				20.9								
20												
21										18.5		
22			20.7									
23									18.7			
24		21.3										
25								18.7				
26												
27	20.8						19.8					
28												
29												18.9
30						21.2						
31											19.4	
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					21.5							
2						22.6						
3											17.9	
4												
5				21.5								
6										19.1		
7												
8			44.8						19.9			
9												
10		20.9										
11								18.2				
12												
13	27.8						22					
14												19.3
15												
16					21.4	23.4						
17											19.6	
18												
19				20.9								
20										18.5		
21												
22			20.7						18.7			
23												
24		21.3										
25								18.7				
26												
27	20.8						19.8					
28												18.9
29												
30						21.2						
31											19.4	
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					16.5							
2												
3												
4				17.3			15.2	15.2				
5												
6												
7			18.3									
8												
9												
10		18.1										
11												
12	17.7											
13												
14										12.9		
15					17.4				13			
16												
17												
18								13.9				
19				18.8			15.1					
20												
21			18.5									
22												
23		18.5										
24												
25												
26												
27												
28	18				17.6							
29												
30									13.4			
31								13.9				
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					16.5							
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4				17.3			15.2	15.2				
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12	17.7											
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15					17.4							
16												
17												
18								13.9				
19				18.8			15.1					
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28	18				17.6							
29									13.4			
30												
31								13.9				
MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
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27		12										
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MEAN												
AC.FT.												

STREAMFLOW DATA FOR ARAVAIPA CREEK - EAST END SCHOOLHOUSE SITE
ARAVAIPA CANYON PRESERVE
THE ARIZONA NATURE CONSERVANCY

DISCHARGE (CFS) FOR WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												
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MEAN												
AC.FT.												