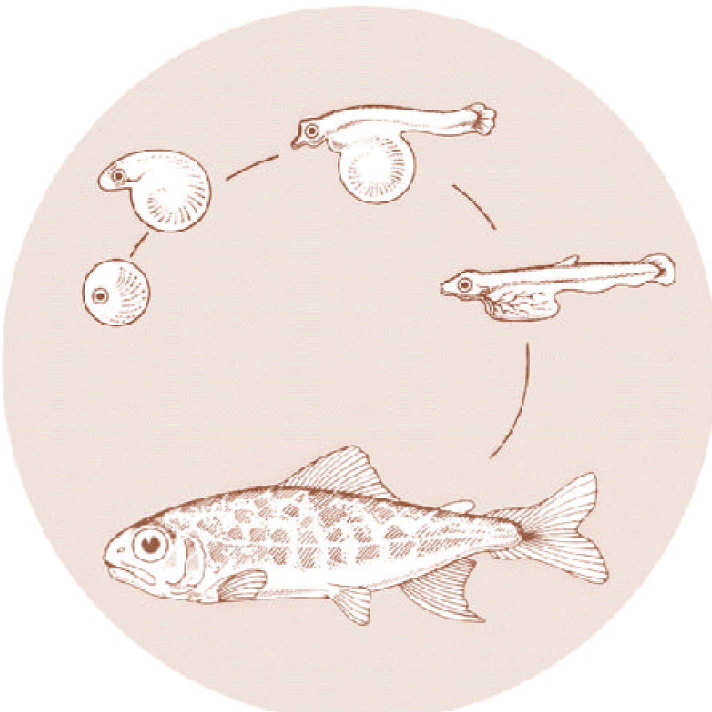
August 1981

# INSTREAM FLOW STUDY OF SHITIKE CREEK



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UNITED STATES DEPARTMENT OF THE INTERIOR

Fisheries Assistance Office
U.S. Fish and Wildlife Service
Vancouver, Washington

# INSTREAM FLOW STUDY

# OF

# SHITIKE CREEK

Prepared by: Brian C. Cates

Fishery Management Biologist

A Cooperative Study by:

U.S. Fish and Wildlife Service

and

Columbia River Inter-Tribal Fish Commission

AUGUST, 1981

(Funded by the Bonneville Power Administration)

## ACKNOWLEDGMENTS

This project could not have been completed without the assistance of the FAO-Vancouver computer staff. Dan Zielinski worked many long hours collecting the field data and contributed many useful ideas. Dell Simmons and Bob Hannah spent many long hours analyzing and making sense out of the field data. They not only completed the computer analysis but provided other technical assistance. They and other members of the FAO staff reviewed the manuscript and their recornnendations were incorporated in the final paper.

# INTRODUCTION

The anadromous fish runs into the Deschutes River and its tributaries have historically been of great importance to the Indian people of eastern Oregon. The Confederated Tribes of the Warm Springs Indian Reservation are especially concerned about the anadromous fish runs entering the waters of the Reservation and are interested in the enhancement and protection of this resource. Because of this concern the U.S. Fish and Wildlife Service (USFWS) and the Columbia River Inter-Tribal Fish Commission (CRITFC) requested funding from the Bonneville Power Administration (BPA) to conduct an instream flow study on the Warm Springs Indian Reservation. The object of the study is to determine the suitability of the area for different anadromous fish species, and to serve as a guide for the determination of methods of enhancing the desired runs. Funding was received in October 1979. Field work began in November 1979 and continued through August 1980. Then study was conducted by the USFWS Fisheries Assistance Office-Vancouver (FAO) and consisted of the analysis of available habitat under varying instream flow regimes using the incremental methodology developed by the USFWS Instream Flow Group (IFG) in Fort Collins, Colorado. This report describes available anadromous fish habitat in Shitike Creek under varying flow conditions.

# SITE SELECTION

The initial step in the selection of the study areas was the stratification of the stream into large homogenous sections. This delineation of homogenous sections was accomplished according to IFG instructions by using such factors as topography, geology, gradient, stream flow, biological communities, and certain man-made conditions such as channelization. This task was completed by using a combination of maps, a tour of the area, and consultations with Tribal Natural Resources personnel.

Once the homogenous sections were established, each section was surveyed visually to obtain general information on habitat types and determine accessibility to field crews. A concensus of opinion was then used to select the study reach that best represented the stream section. The typical study reach contained two riffle-pool, or meander crossing meander-pool sequences and averaged ten to fourteen times the average channel width, as recommended by the IFG (Bovee and Milhous, 1978).

One representative reach was established in each homogenous section. Table 1 describes the homogenous sections and locates the study reaches. Figure 1 shows the location of the study reaches within the Shitike Creek system.

On each study reach transects were positioned across the stream to describe habitat types. Whenever possible the downstream transect, as specified by the IFG methodology, was placed on a hydraulic control. Between six and eight transects were placed in each reach depending on its complexity.

Table 1. Representative Section Boundaries and Study Reach Locations.

| Representative Section Boundaries | Study Reach Location | Stream Characteristics |
|---|---|---|
| Mouth of Shitike Creek to 1.0 miles above point where road P-670 meets creek. Length 9.7 miles. | S-l<br>Just above USGS gaging station at bridge crossing 2.3 miles upstream from Tenino Creek. | Moderate stream gradient in winding canyon. |
| From point 1.0 miles above road P-670 to mouth of unnamed creek 3.5 miles below road P-200 crossing. Length 10.0 miles. | s-2<br>Immediatey upstream from road P-320 crossing (Upper Crossing). | High stream gradient in narrow forested canyon. |
| Mouth of unnamed creek 3.5 miles below P-ZOO crossing (Peters Pasture) to mouth of tributary creek 1.5 miles above P-ZOO crossing. Length 5 miles. | s-3<br>.2 miles below P-200 crossing (Peters Pasture). | Moderate stream gradient in forested canyon. |

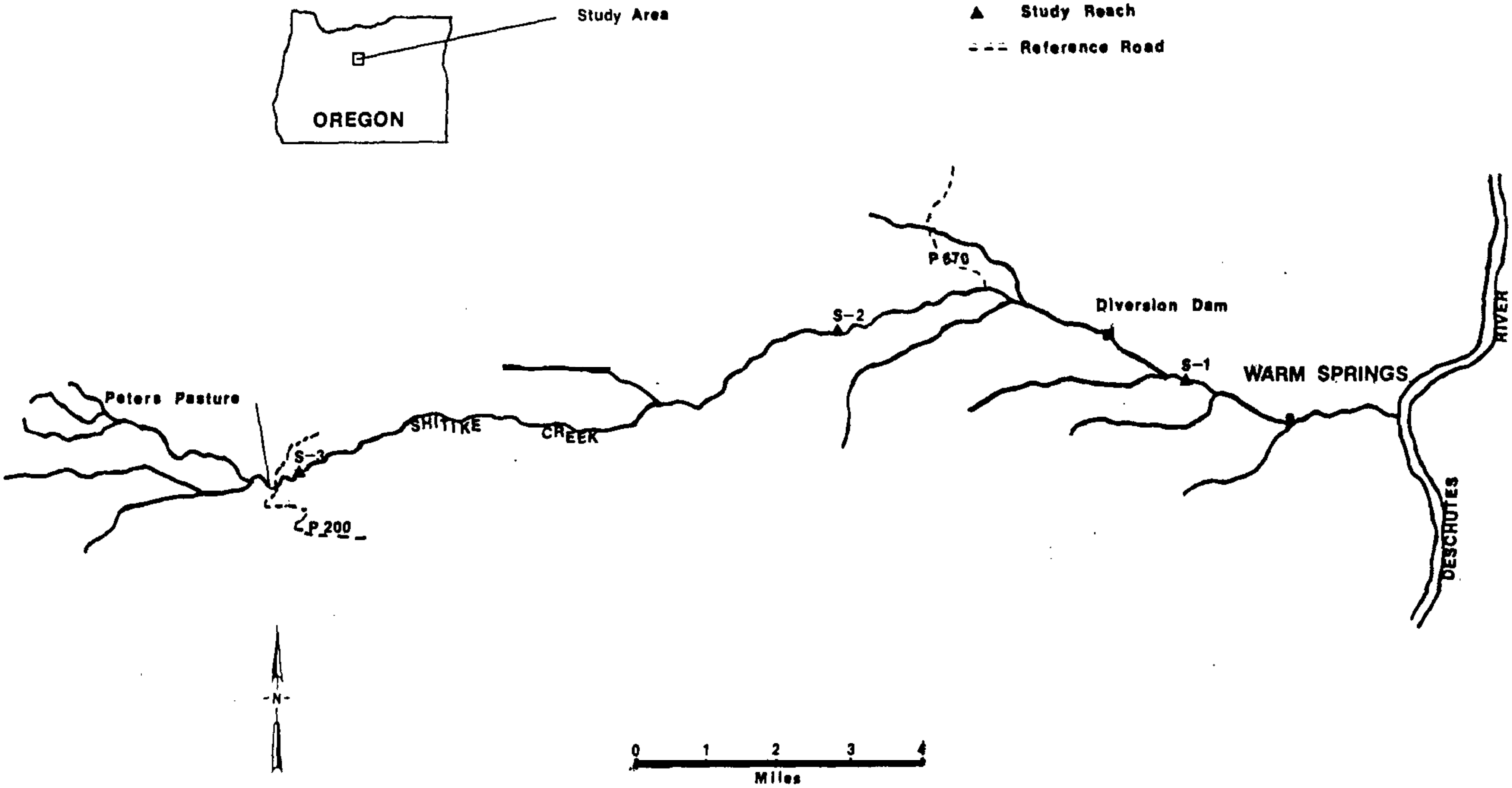



Figure 1. Shitike Creek drainage and study reach locations.

## DATA COLLECTION

As suggested by IFG, stream parameters were measured at three separate flows. Using the three-point rating curve approach increases the reliability of velocity and water surface elevation predictions made from the data. The three-point approach also allows for measurement of statistical error in fitting the instream flow model. High, medium and low flow measurements were made at each reach. This generally allowed a useful range of extrapolation of 0.4 times the minimum discharge measured to 2.5 times the maximum discharge measured.

The actual field measurements were made according to the methods described by Bovee and Milhous (1978). The elevation of the ground and headstakes marking the transect ends and the distance between the transects was obtained prior to the collection of flow measurements. For each flow measured, the water surface elevation was determined by measuring the difference in elevation between the headstake and the water surface at each transect. A tagline was stretched across the stream at each transect to measure the distance between each velocity measuring point and the bank headstake. Measurements of depth, velocity and substrate were taken along each transect at the predetermined points. The number of measurement points on a transect varied but was usually between 20 and 30. Discharges were measured at one transect per reach. IFG recommends that at least 20 measurement points be placed on the discharge transect to assure that no more than five percent of the stream discharge was represented by any one data point. The velocity at each point was measured using a Marsh-McBirney electronic flow meter. For depths of less than 2.5 feet, one measurement of velocity, taken at six tenths of the depth from the surface, was used to determine the mean column velocity. For depths greater than 2.5 feet, two measurements of velocity were taken, one at two tenths and one at eight tenths of the depth from the surface. The two velocity measurements were then averaged to obtain the mean velocity. The streambed elevation was determined by subtracting the water depth from the water surface elevation.

Substrate was examined and characterized, based on a modified Wentworth scale. This scale, based on particle size, assigns a numerical rating between one and eight to substrate type (Table 2).

Table 2. Substrate Classification Based Upon Modified Wentworth Scale.

| Substrate Index | Material | Size Range (mm) |
|---|---|---|
| 8 | Bedrock | -- |
| 7 | Boulder | >305 |
| 6 | Cobble | 75 - 305 |
| 5 | Gravel | 5 - 75 |
| 4 | Sand | .125 - 5 |
| 3 | Silt | ,062 - .125 |
| 2 | Clay | <.062 |
| 1 | Plant Detritus | |

The high and medium discharge measurements on Shitike Creek were taken during March and April 1980. Low flow measurements were taken in October 1979 for the lowest reach (S-1) and in August 1980 for the upper two reaches.

## COMPUTER ANALYSIS

The IFG process of evaluating instream flow requirements for any species of fish is composed of two segments: hydraulic simulation, and habitat evaluation. Hydraulic simulation estimates the relationship of one or more sets of measured flow related parameters, to stream discharge. Habitat evaluation estimates the total available habitat, by species and life history stage, based on the results of hydraulic simulation.

Fisheries Assistance Office staff, simulated eight or nine discharges for each river reach, using the IFG's rating curve hydraulic simulation model (IFG4). FAO-Vancouver computer terminals, linked to the University of Washington computer facilities, were utilized for the data analysis.

Calibration of the hydraulic simulation model was performed using an allowable error criterion of one plus or minus 10% in the velocity adjustment factors, for all simulated discharges.

After completion of hydraulic simulation, the resultant prediction of hydraulic conditions were interfaced with the habitat (IFG3) program to obtain estimates of available habitat at various stream discharges. Probability of use curves for depth, velocity, and substrate make up the core of the IFG's Habitat model (Figure 2).

The probability of use curves were developed by IFG, based on the best available information for each species. Frequency of occurrence was related to increments of depth, velocity, and substrate. Probability of use was then equated with frequency of occurrence. The point with the greatest frequency of occurrence was assigned 1.0 probability of use. Where frequency of use equaled zero, probability of use was assigned zero. Intermediate values were assigned on a linear scale basis. When frequency of occurrence data was not available literature was searched by IFG to develop curves based on such things as range and optimum conditions (where a species may be found), parameter overlaps (presence-absence information), and indirect parameter analyses. Bovee (1977) describes in detail how each of these methods are used to construct probability curves and the reliability of each curve.

In order to estimate the composite probability of use, the IFG3 program cross-multiplies the individual probabilities drawn from the depth, velocity and substrate curves. The program applies this process to data collected from each point across all transects. The next step expands the habitat rating given to the individual data points to the total habitat contained within the study reach. Transects are divided into segments centered about a data point. For the transects forming the upper and lower boundaries of a reach, the length of the segments extend

# FALL CHINOOK

## SPAWNING

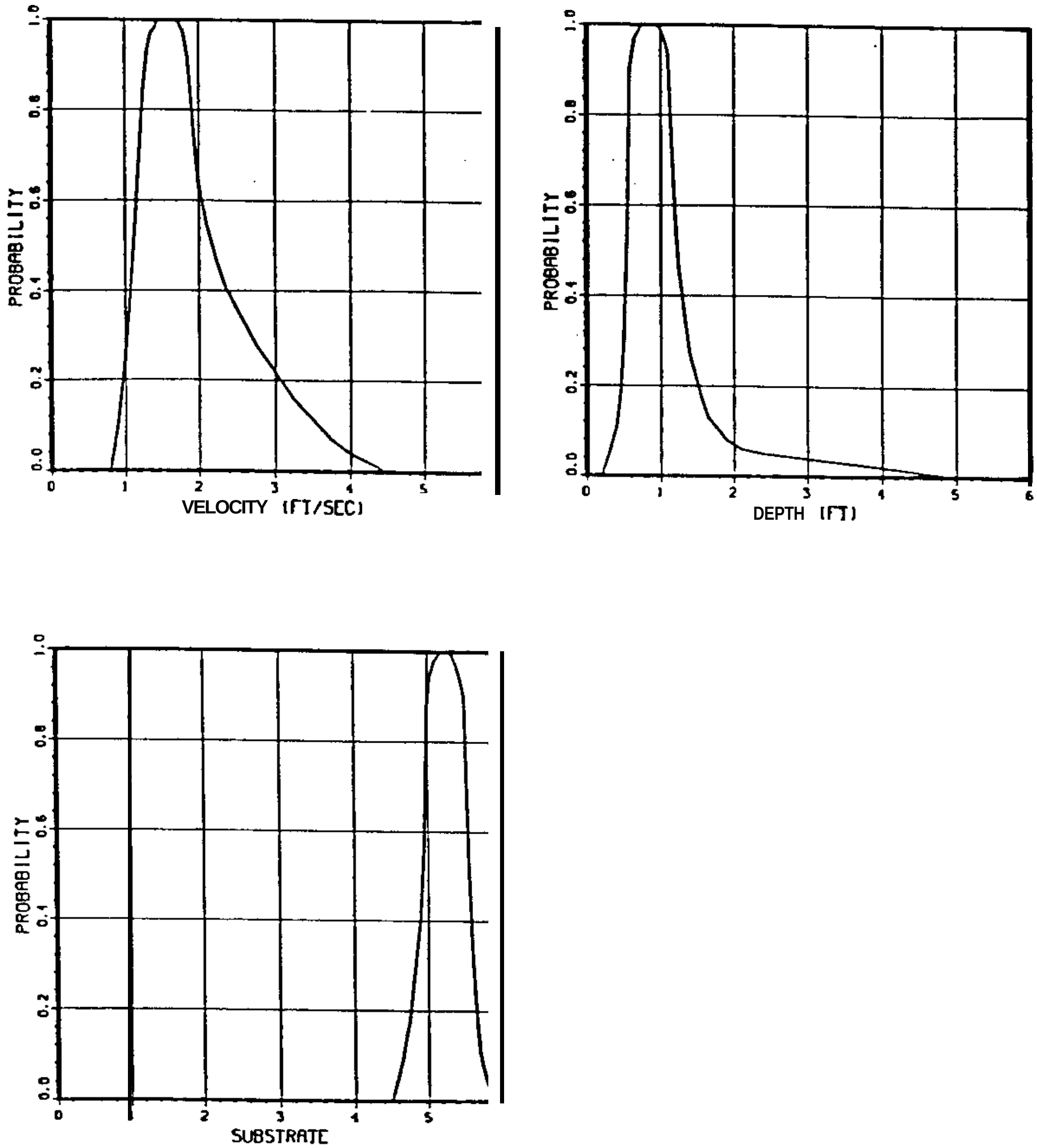



Figure 2: Probability of Use Curves.

from the transect to a line one-half the distance to the next transect. Segments of the inside transects extend one-half the distance from the transect in each direction. The entire area of each segment is given a habitat value the same as its central data point located on this transect (Figure 3).

To compute available habitat, the area of the segment containing the data point is multiplied by the composite probability of use. This results in an estimate of available habitat expressed as weighted usable area. One unit of weighted usable area is equivalent to a unit of optimum habitat. The IFG3 program standardizes the measure of available habitat by expressing it in square feet of weighted usable area per 1,000 lineal feet of stream.

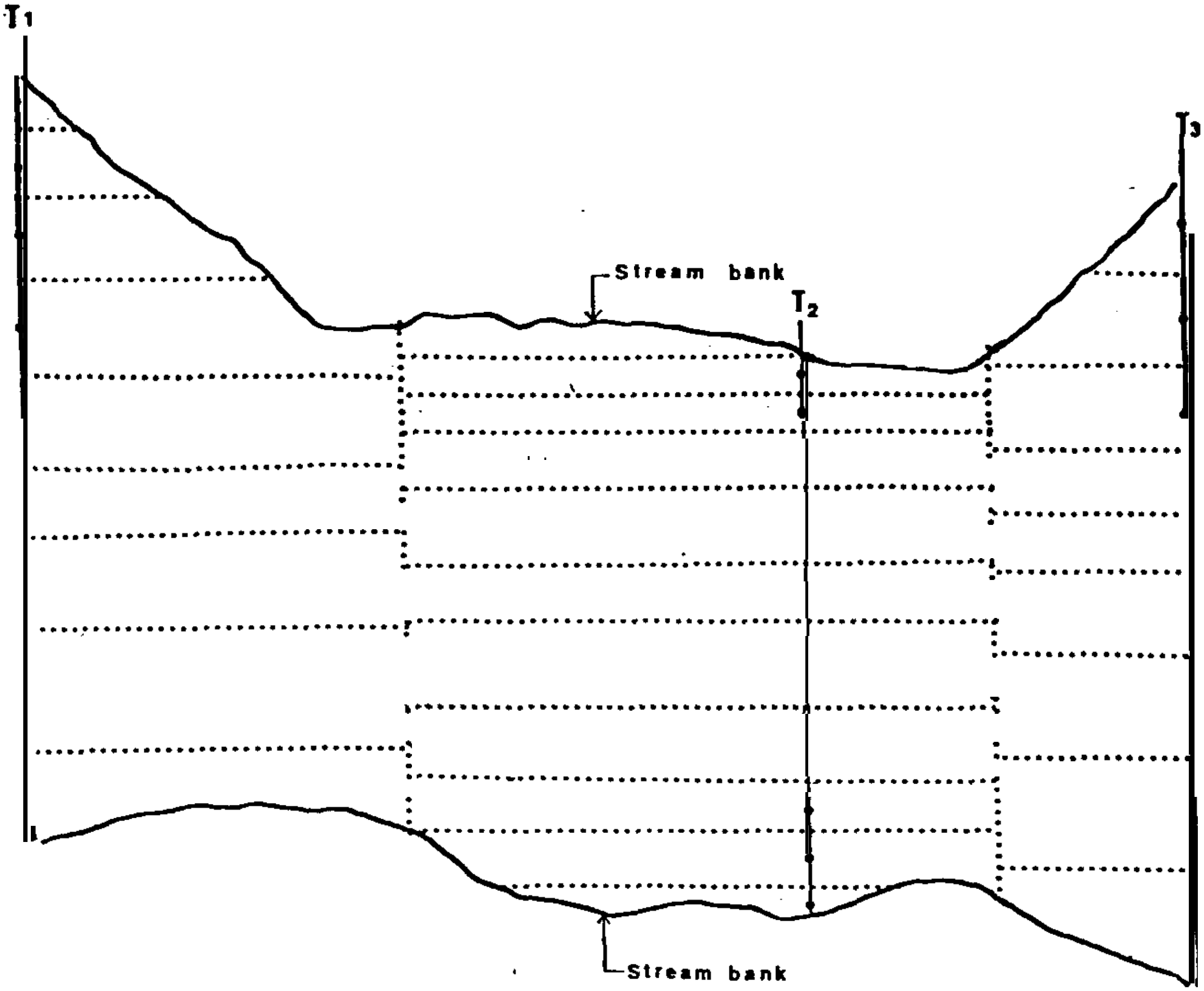
## FACTORS EFFECTING PREDICTION OF HABITAT

Anadromous fish production is greatly influenced by water temperature. IFG has developed a probability of use curve for temperature as it relates to the various anadromous species. Figure 4 illustrates the probability of use curve for temperature as it effects juvenile steel-head rearing. This curve indicates that at temperatures higher than 24.4'C (76'F) the probability of use for juvenile steelhead rearing drops to zero. Maximum daily water temperature in lower Shitike Creek approaches 21.1*C (70'F) during the Sumner months. The temperatures in the upper reaches of Shitike Creek are much cooler and remain in the 40°-50'F range much of the year. Maximum daily temperature during late summer in the Peter's Pasture area generally ranges between 50' and 55'F. Water temperatures and flows in this section of creek don't fluctuate greatly due to the late snowmelt from the steep north facing slopes of the upper canyon. Fish growth is probably slow in the upper drainage due to the cold water temperatures much of the year.

The probability of use curves developed by IFG are based on the hydraulic prediction of mean column velocity. At high flows the mean column velocity can be significantly higher than velocities occurring near the streambed where juvenile salmonids would be expected to occur. In this case the model probably underestimates the actual available habitat at high flows. This would be especially pronounced in areas where the mean water column velocities exceed the tolerance range identified in the probability of use curves.

The IFG velocity model also tapers off all velocity curves so as to end at the origin. Interpretation of this would suggest that salmonids do not utilize zero velocity areas. It has been amply demonstrated that salmonids will utilize these areas to some extent. The model does not take this-into account and as a result will slightly underestimate available habitat.

Instream and overhead cover are additional factors that influence the suitability of streams for anadromous fish. While cover analysis would provide additional input into the model it is felt that in the case of the Shitike Creek system, cover is not among the most critical factors influencing anadromous fish production.




TI-Transect
• – Data measurement point
. ··–1/2 Distance between Transect or
Data measurement point

Figure 3: Example of the Division of a Study Reach into Segments to Estimate Habitat Value.

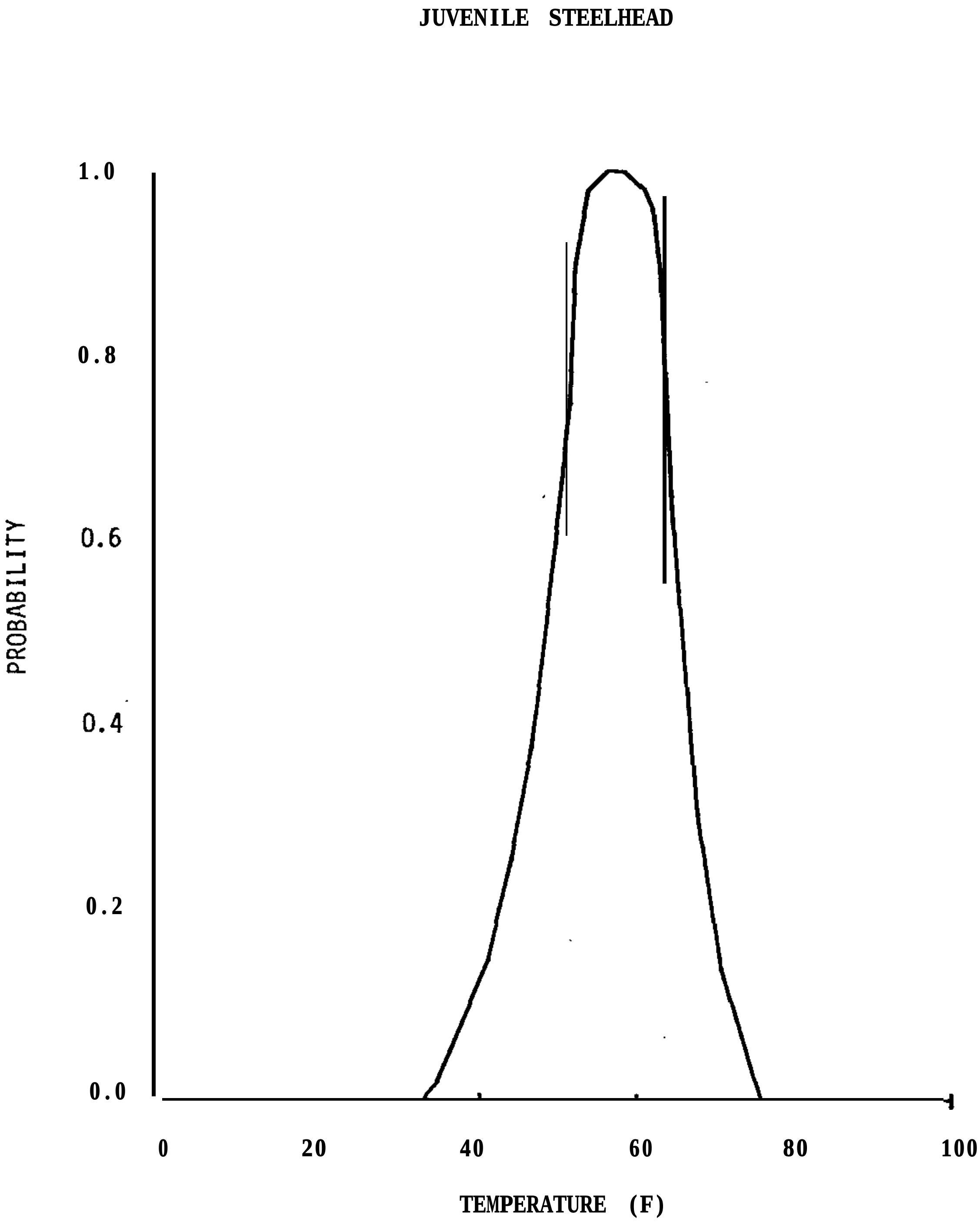



Figure 4 : Probability of Use Curve for Temperature.

Evidence, acknowledged by IFG (Bovee, 1978). indicates that depth probability of use curves do not tail off for fry and juvenile steelhead at depths greater than 1.5 feet (juvenile curve) and 0.5 feet (fry curve) utilized in the present model. It is reasonable to assume that this same lack of tailing off would also occur in depth probability of use curves for other anadromous salmonid fry and juveniles. Fish and Wildlife Service personnel in the Arcata Fisheries Assistance Office evaluated several stream sections with and without the tailing effect of the probability of use curves. The tests showed insignificant differences in prediction of available habitat throughout the ranges tested (Anonymous. 1981 Instream Flow Study of the Umatilla River). Consequently, although the curves used in this study for juvenile and fry may not reflect true behavior at these life stages, we do not feel their use significantly effected the results of the study.

## OUTPUT

For each study reach, the amount of available habitat for the range of flows modeled is provided in graphic and tabular form by species and life history stage.

Mean monthly discharges in the Shitike Creek system were obtained from the U.S. Geological Survey at a point just below study reach S-l. Discharge records have been recorded there since October 1974. Flow records are not available for other areas in the system, but the discharges in the upper drainage probably don't vary as much as those at S-1, because of the constant flow of the various feeder springs and the delayed snowmelt. The lower portion of the drainage is influenced to a greater extent by the discharge of intermittent streams.

Steelhead and spring chinook salmon are the only anadromous fish utilizing the Shitike Creek system at the present time, however the potential habitat for coho and fall chinook was also investigated in this report. The discharges which would allow maximum habitat for each specie were compared with the habitat occurring at the actual mean monthly discharges at study reach S-l. Only discharges which provide maximum habitat are provided for the other reaches, since actual mean discharges were not available.

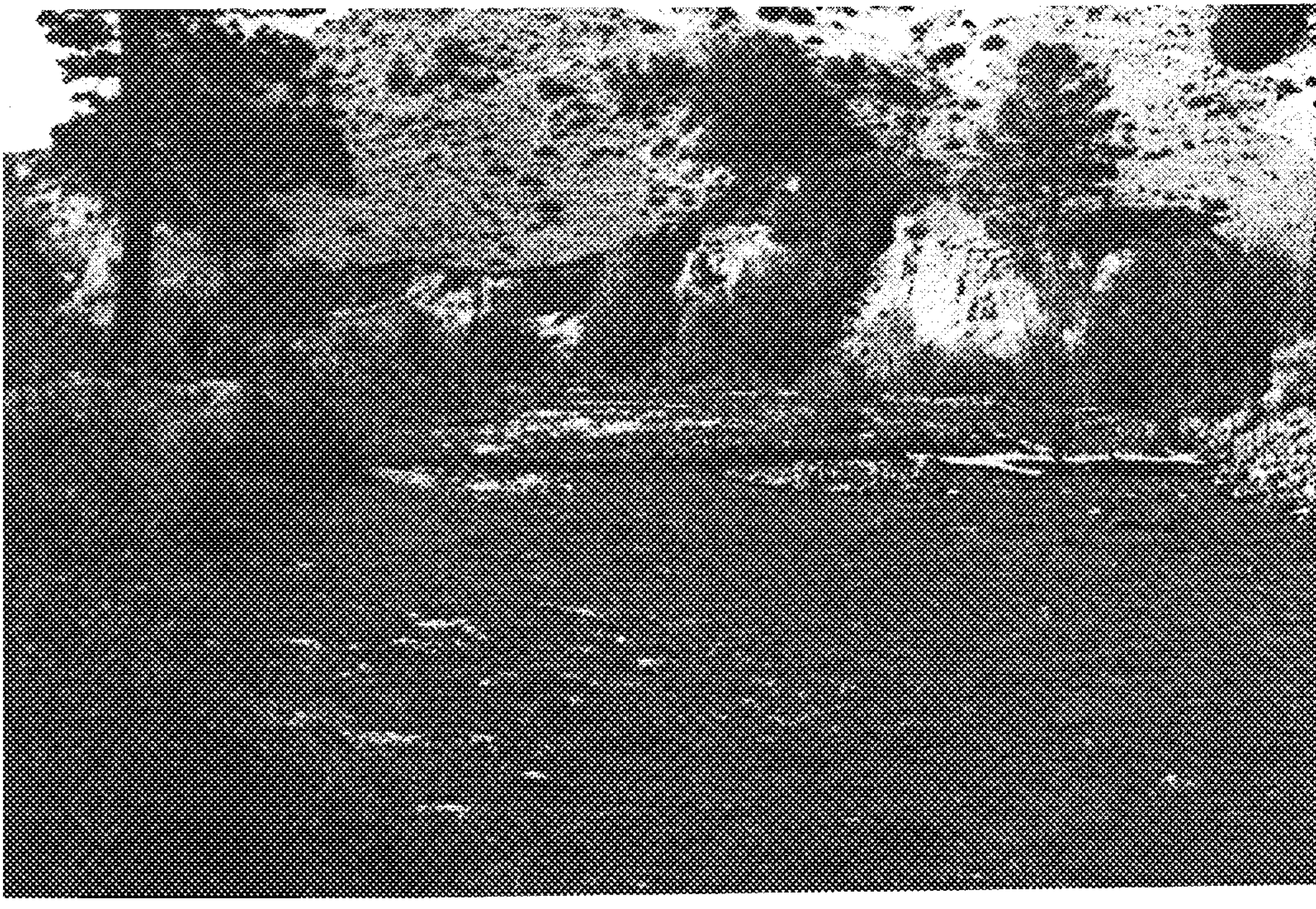
When two or more life history stages of a species are concurrently using the river, the life history stage requiring the greater discharge was utilized to identify the flow that provides the maximum habitat.

Probability of use curves were not available for summer steelhead which are present in the Shitike system. Curves for winter steelhead were utilized for the purposes of this report. Past observations in Shitike Creek indicate that most summer steelhead probably do not enter the stream until February, and continue arriving until May. Adult steelhead do not appear to be holding for any prolonged length of time prior to spawning.

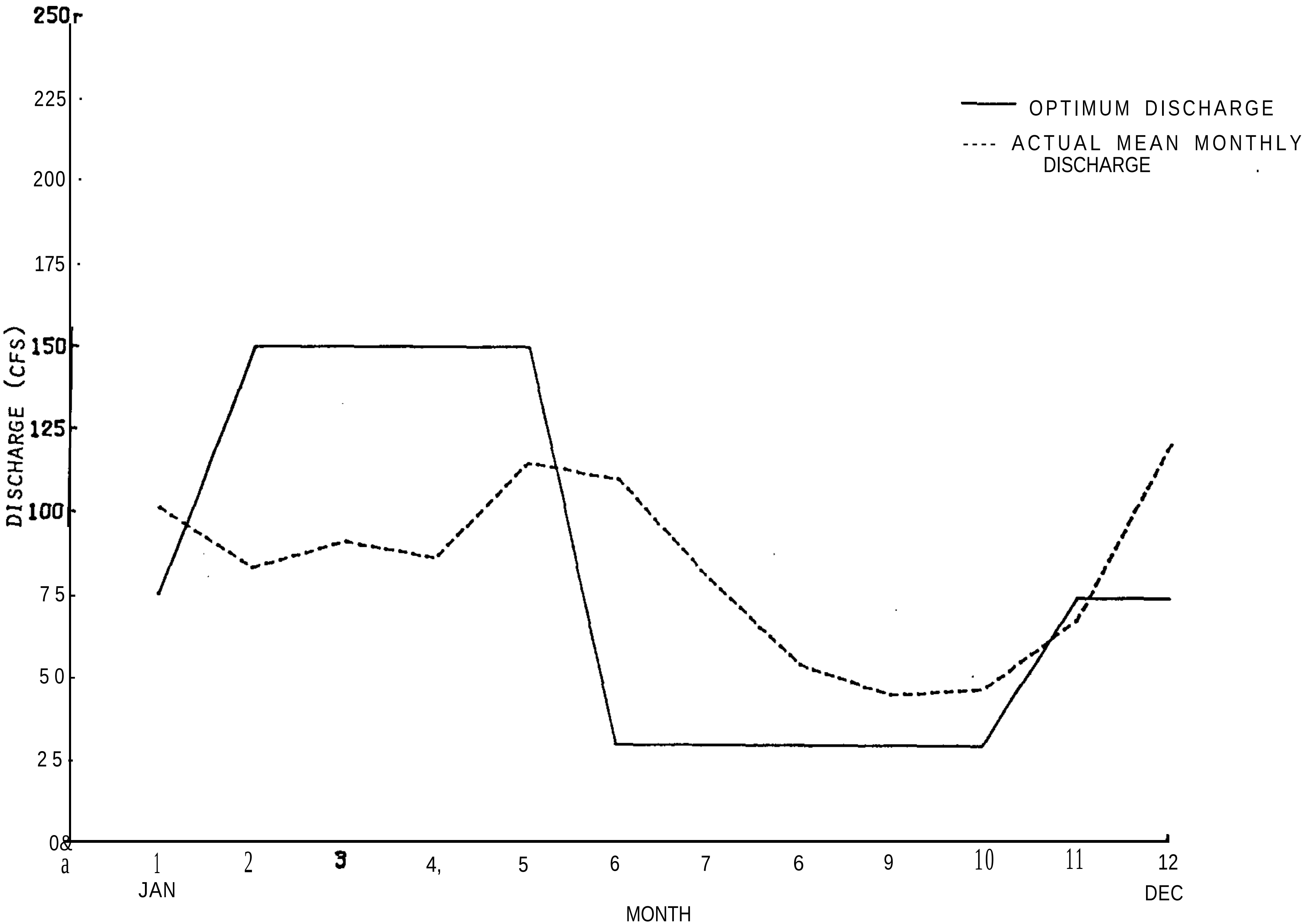
In several instances, available habitat was increasing at the end of the range of discharges that could be modeled within the 10% velocity adjustment factor. Optimum discharge in these instances was selected as the last discharge modeled.

By comparing the figures and tables in each section, the user of this report can determine the extent or degree of impact an altered flow regime would have on anadromous fish habitat. In addition it will give an indication of the suitability of the system to each particular species. As a result of this study, the resource manager will have a tool that will assist in comparing various water management alternatives for Shitike Creek and their effect on the anadromous fish resource.

The following section provides the habitat data for each study reach beginning near the mouth of Shitike Creek and proceeding upstream.

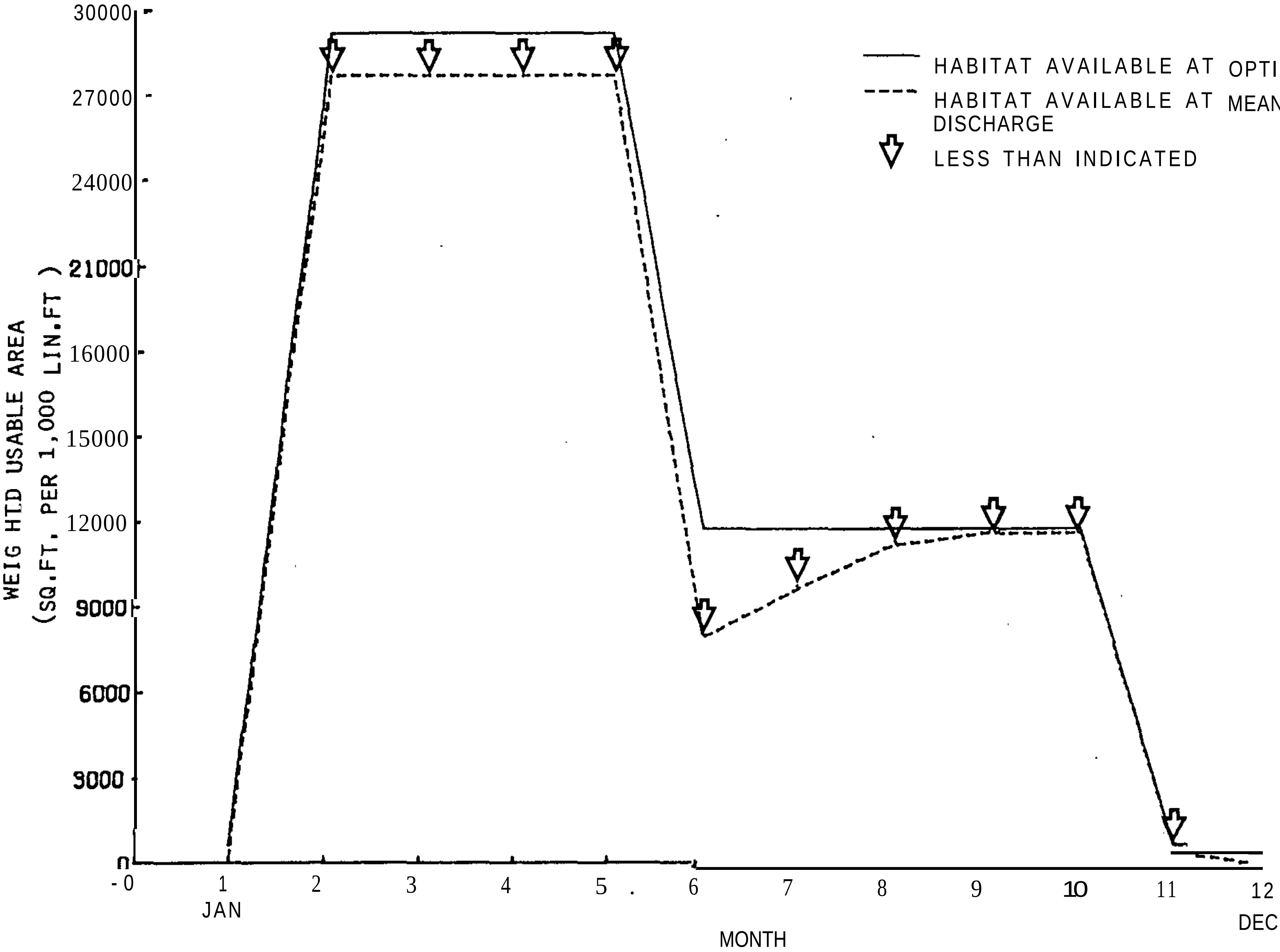


**Shitike Creek (S-1)**



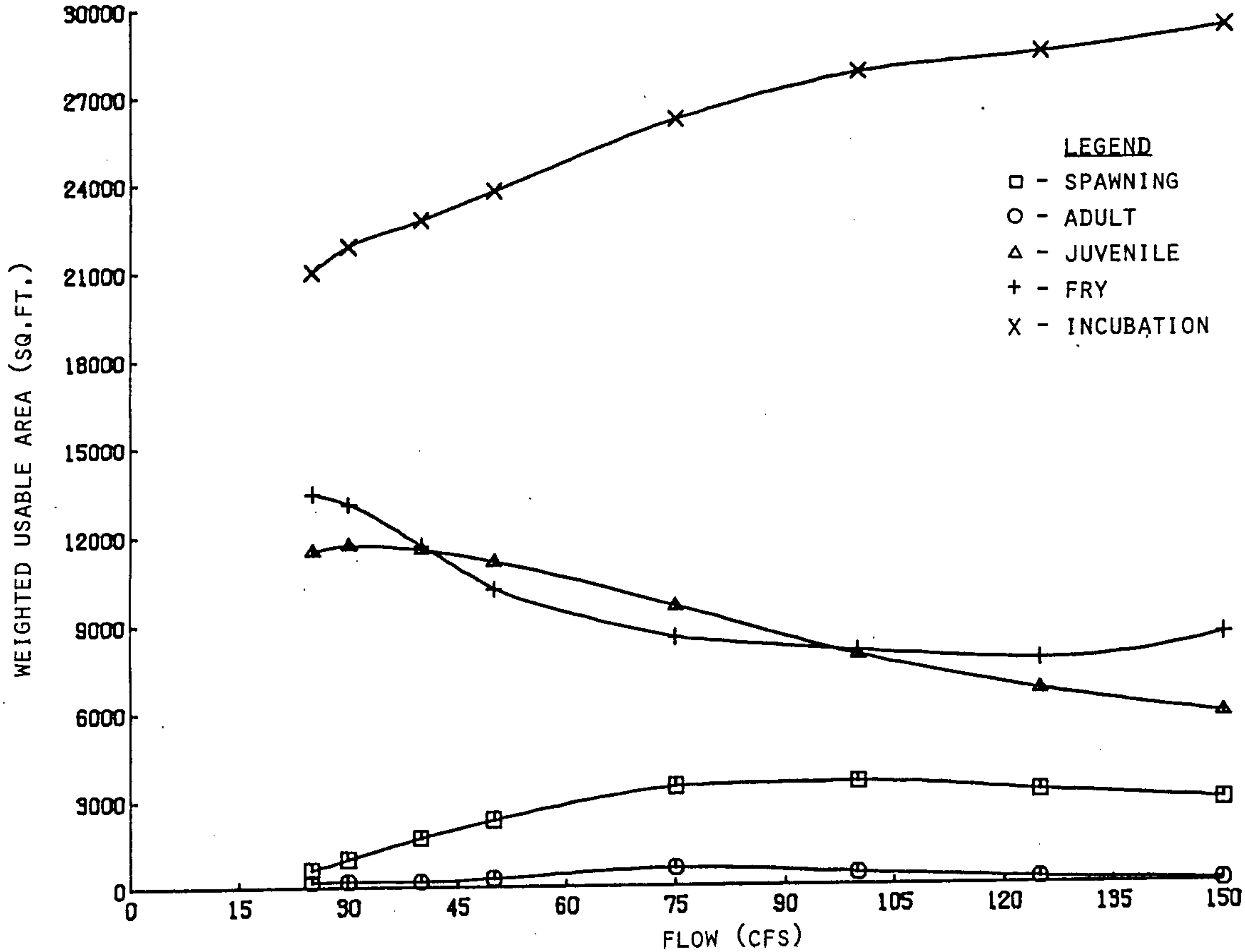

SHITIKE CREEK S-1

OPTIMUM DISCHARGE FOR STEELHEAD



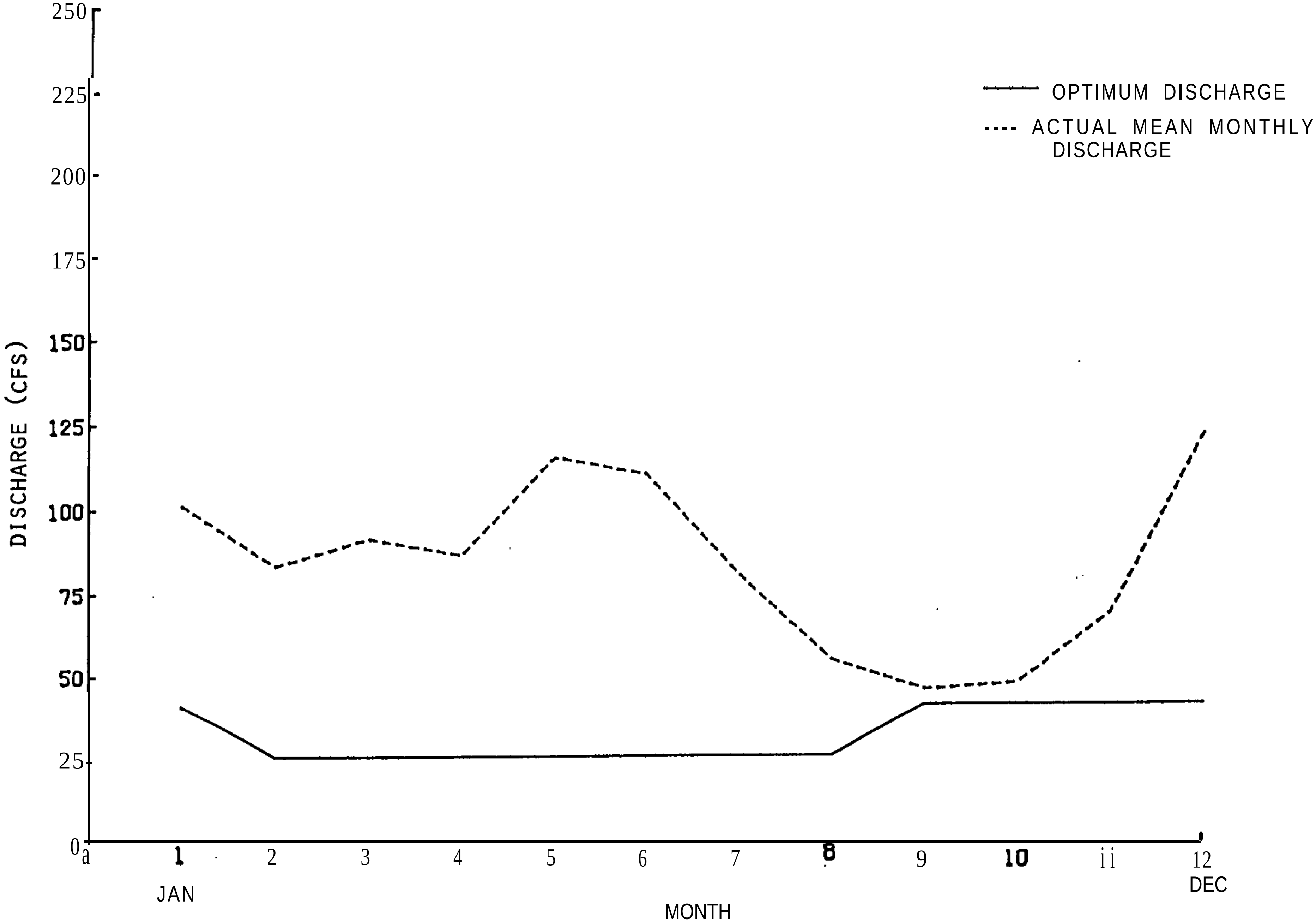

.SHITIKE CREEK S-1

ANNUAL STEELHEAD HABITAT FOR SELECTED LIFESTAGES



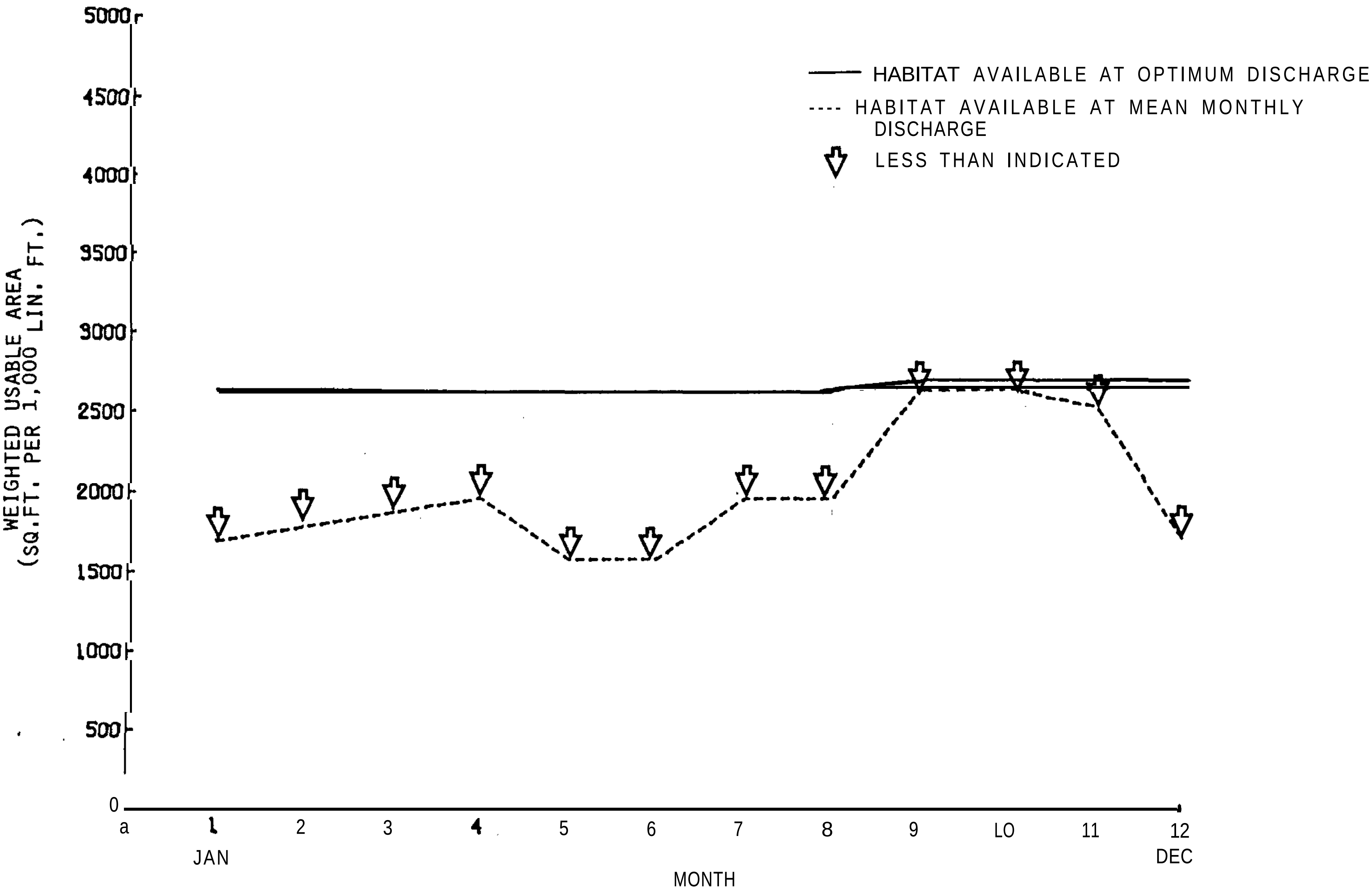

SHITIKE CREEK S-1

STEELHEAD (CLEARWATER, S = .004)



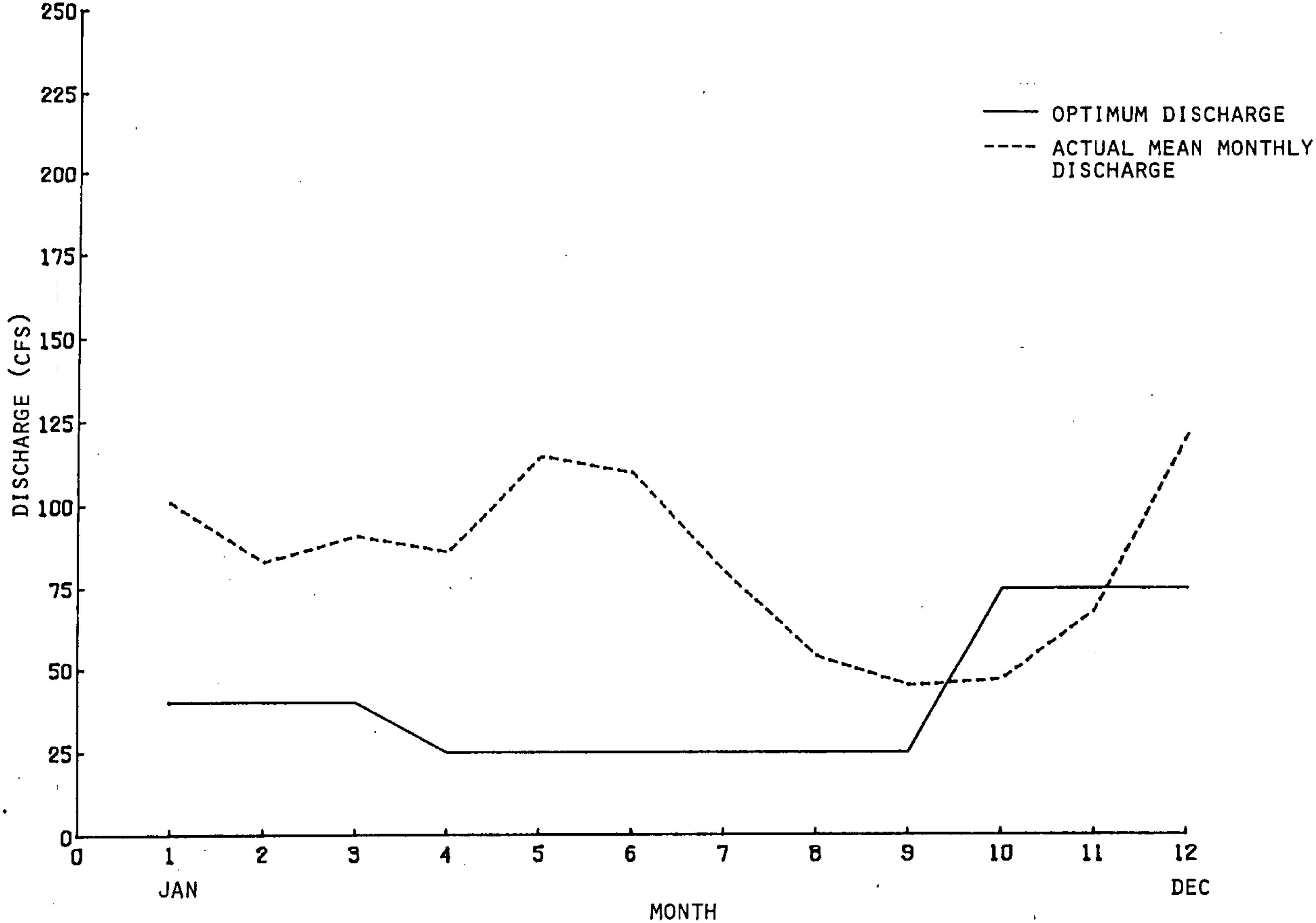

SHITIKE CREEK S-1

OPTIMUM DISCHARGE FOR SPRING CHINOOK



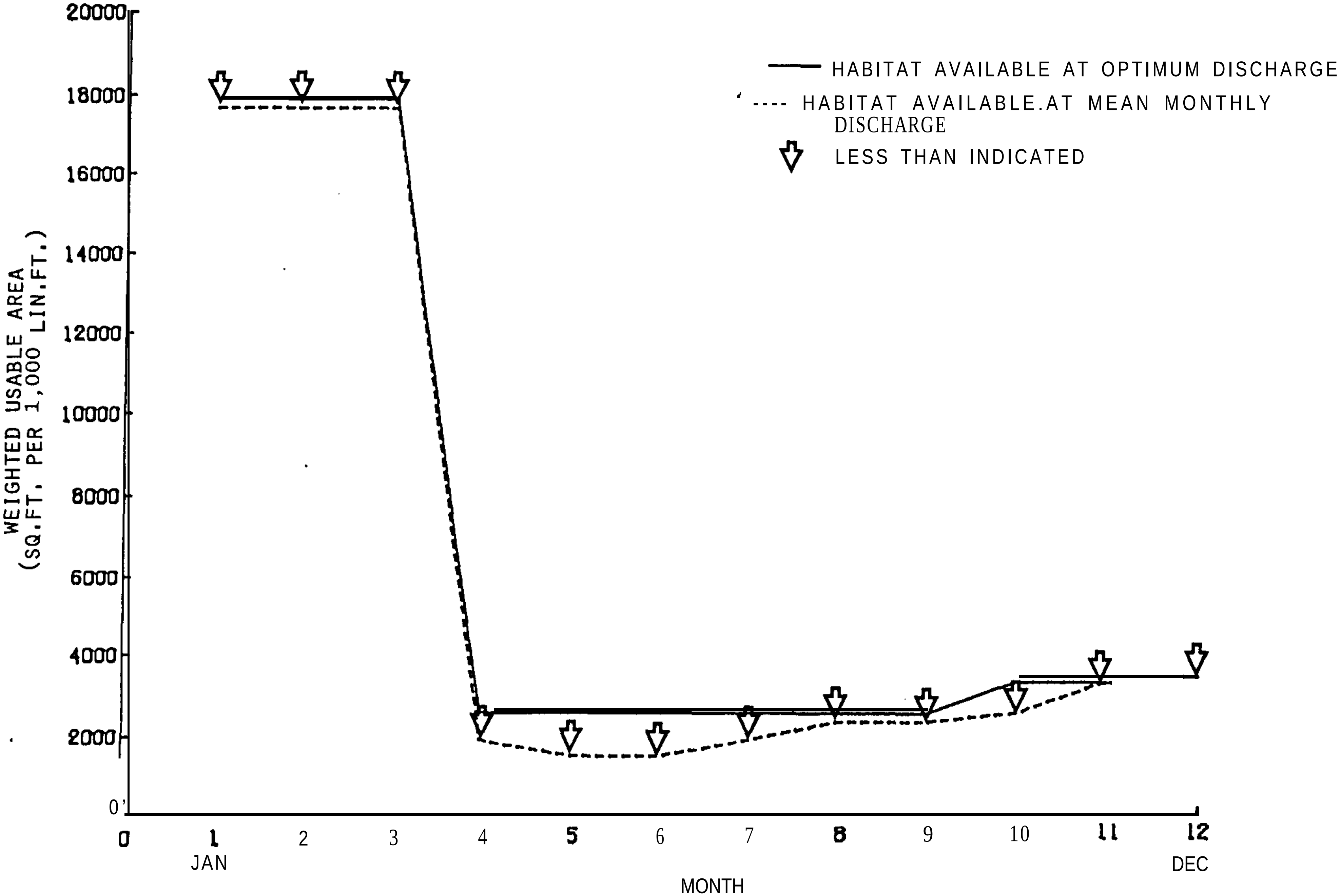

SHITIKE CREEK S-l

ANNUAL SPRING CHINOOK HABITAT FOR SELECTED LIFESTAGES



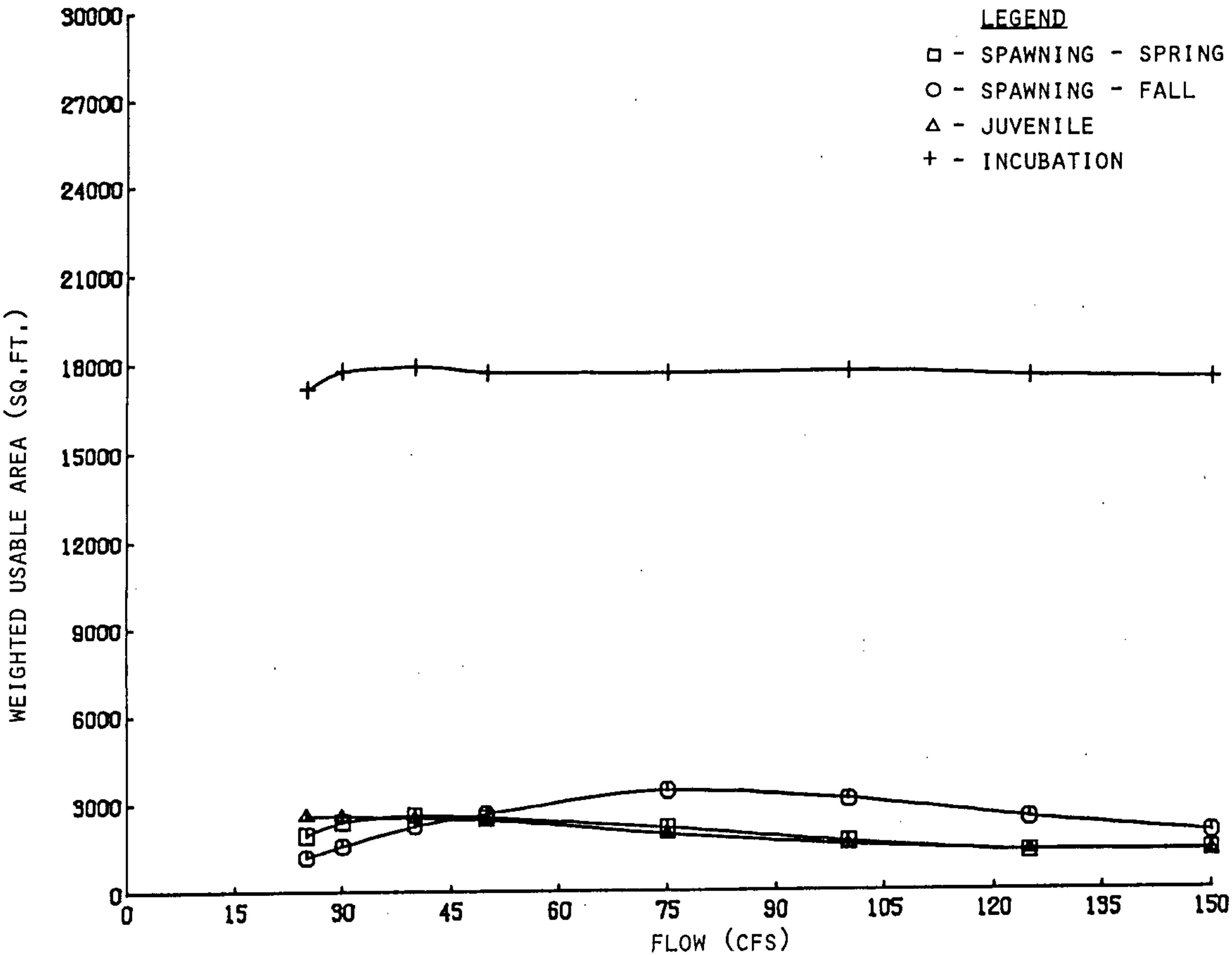

SHITIKE CREEK S-1

OPTIMUM DISCHARGE FOR FALL CHINOOK



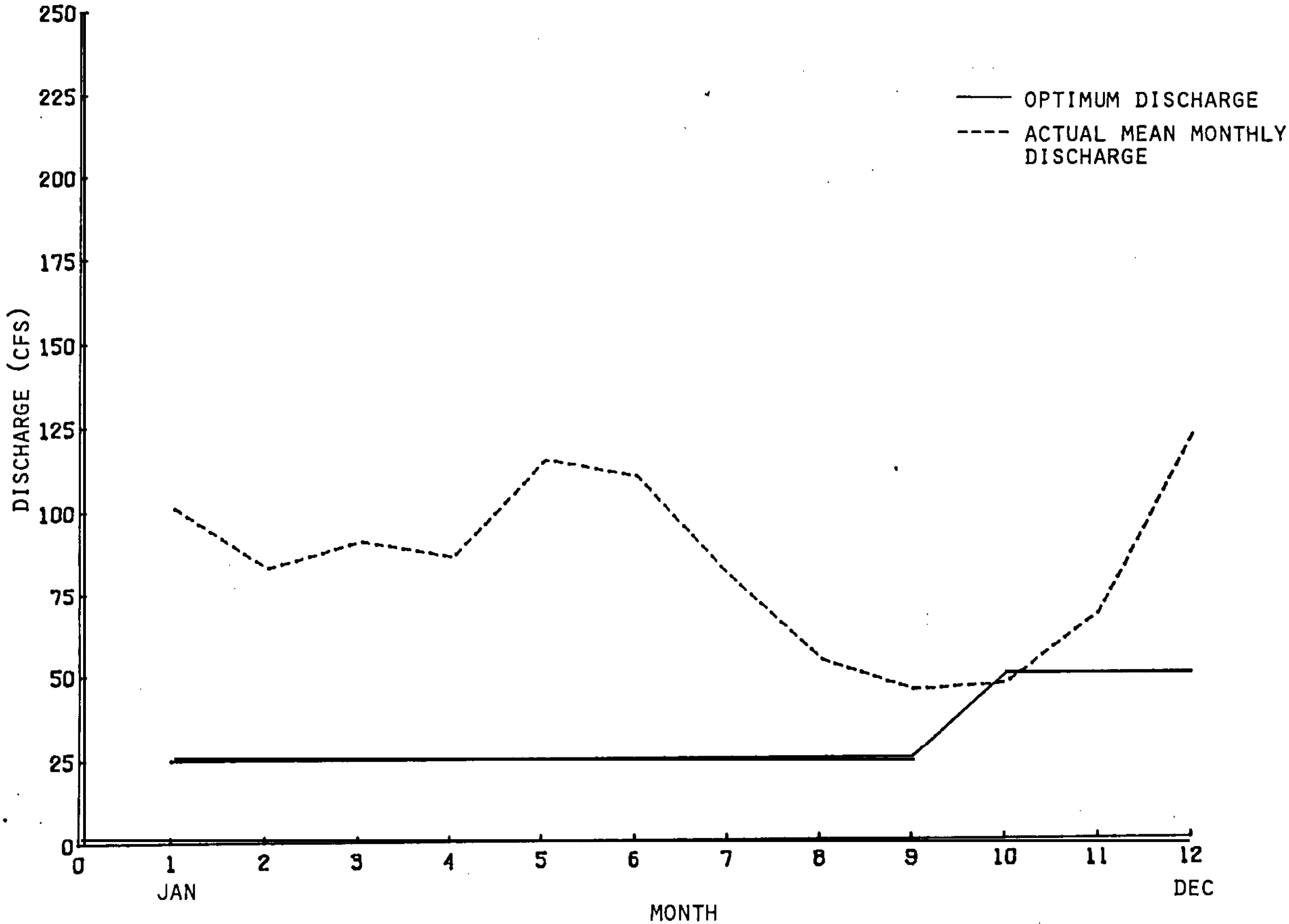

SHITIKE CREEK S-1

ANNUAL FALL CHINOOK HABITAT FOR SELECTED LIFESTAGES



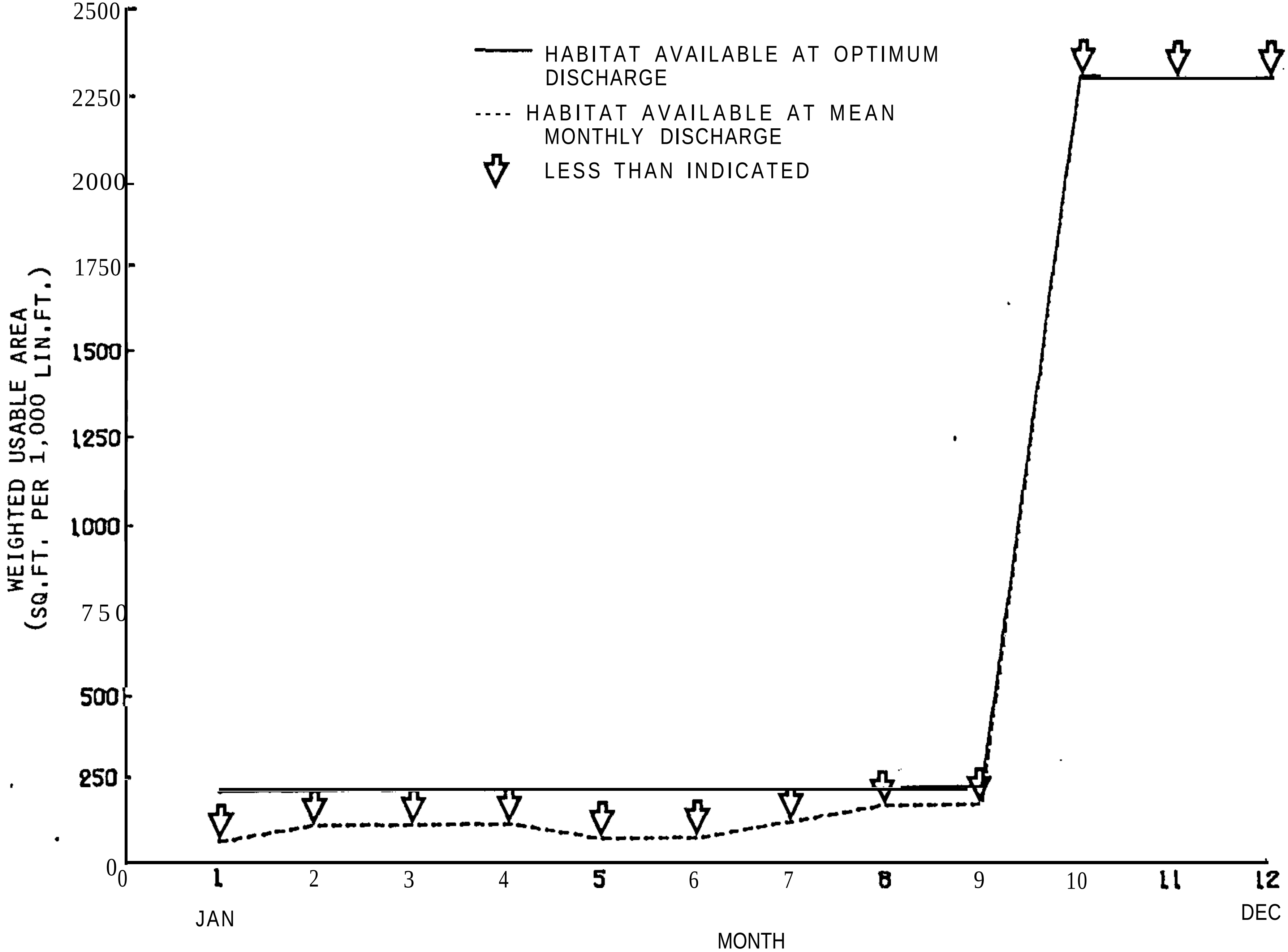

SHITIKE CREEK S-1

CHINOOK SALMON (CLEARWATER, S = .004)



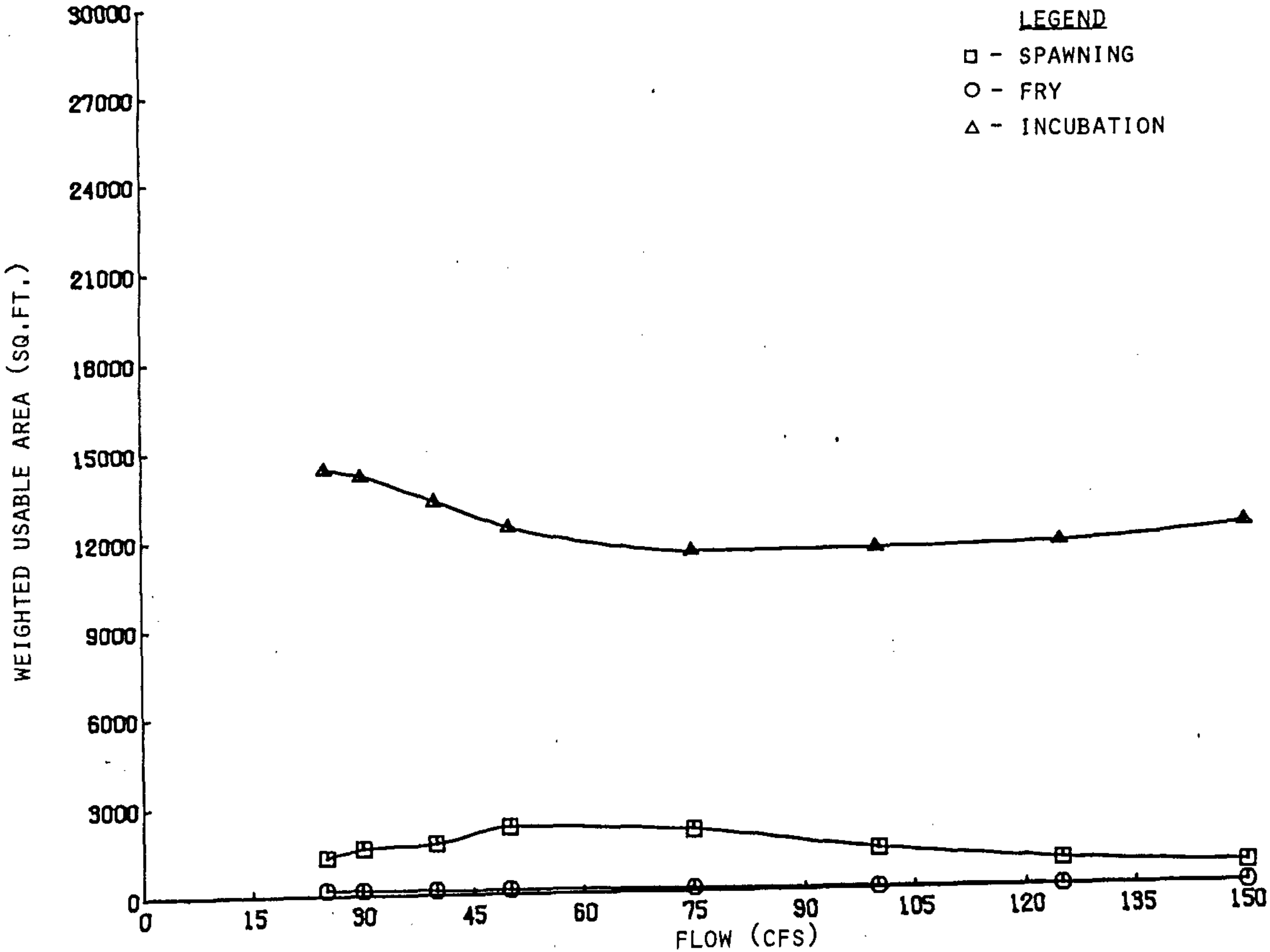

SHITIKE CREEK S-1

OPTIMUM DISCHARGE FOR COHO




SHITIKE CREEK S-1

ANNUAL COHO HABITAT FOR SELECTED LIFESTAGES




SHITIKE CREEK S-1

COHO SALMON (CLEARWATER, S = .004)

## SHITIKE CREEK (S-1)

## DISCHARGE (CFS) VS. AVAILABLE HABITAT AREA (SQ.FT.) PER 1000 FEET OF STREAM

### STEELHEAD

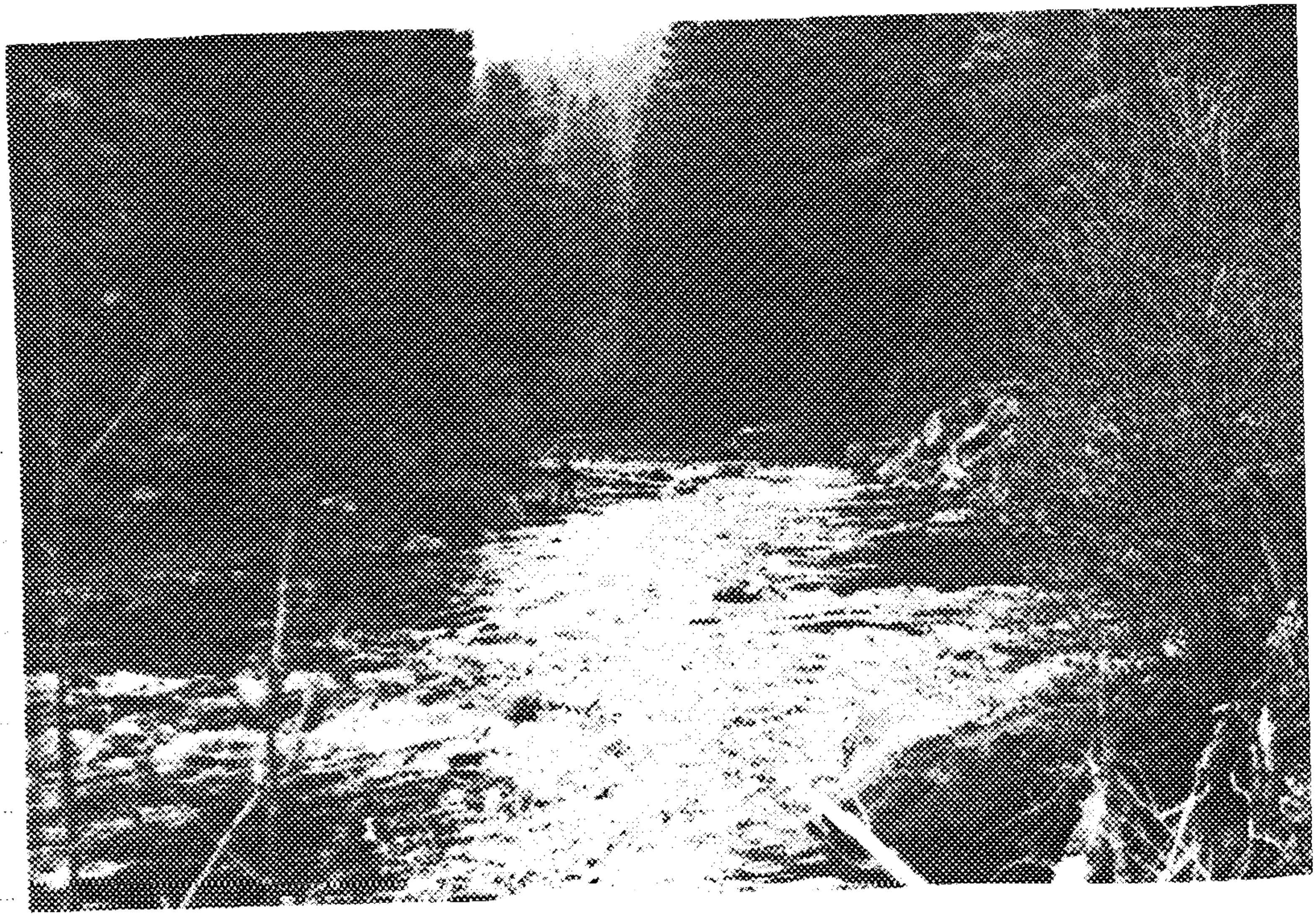
| DISCHARGE | SPAWNING | ADULT | JUVENILE | FRY | INCUBATION |
|---|---|---|---|---|---|
| 25 | 637 | 212 | 11534 | 13470 | 21028 |
| 30 | 1004 | 218 | 11734 | 13108 | 21894 |
| 40 | 1734 | 313 | 11575 | 11703 | 22779 |
| 50 | 2341 | 312 | 11143 | 10233 | 23767 |
| 75 | 3438 | 642 | 9605 | 8553 | 26179 |
| 100 | 3559 | 425 | 7901 | 8044 | 27750 |
| 125 | 3222 | 213 | 6675 | 7735 | 28389 |
| 150 | 2882 | 115 | 5805 | 8549 | 29229 |

### CHINOOK SALMON

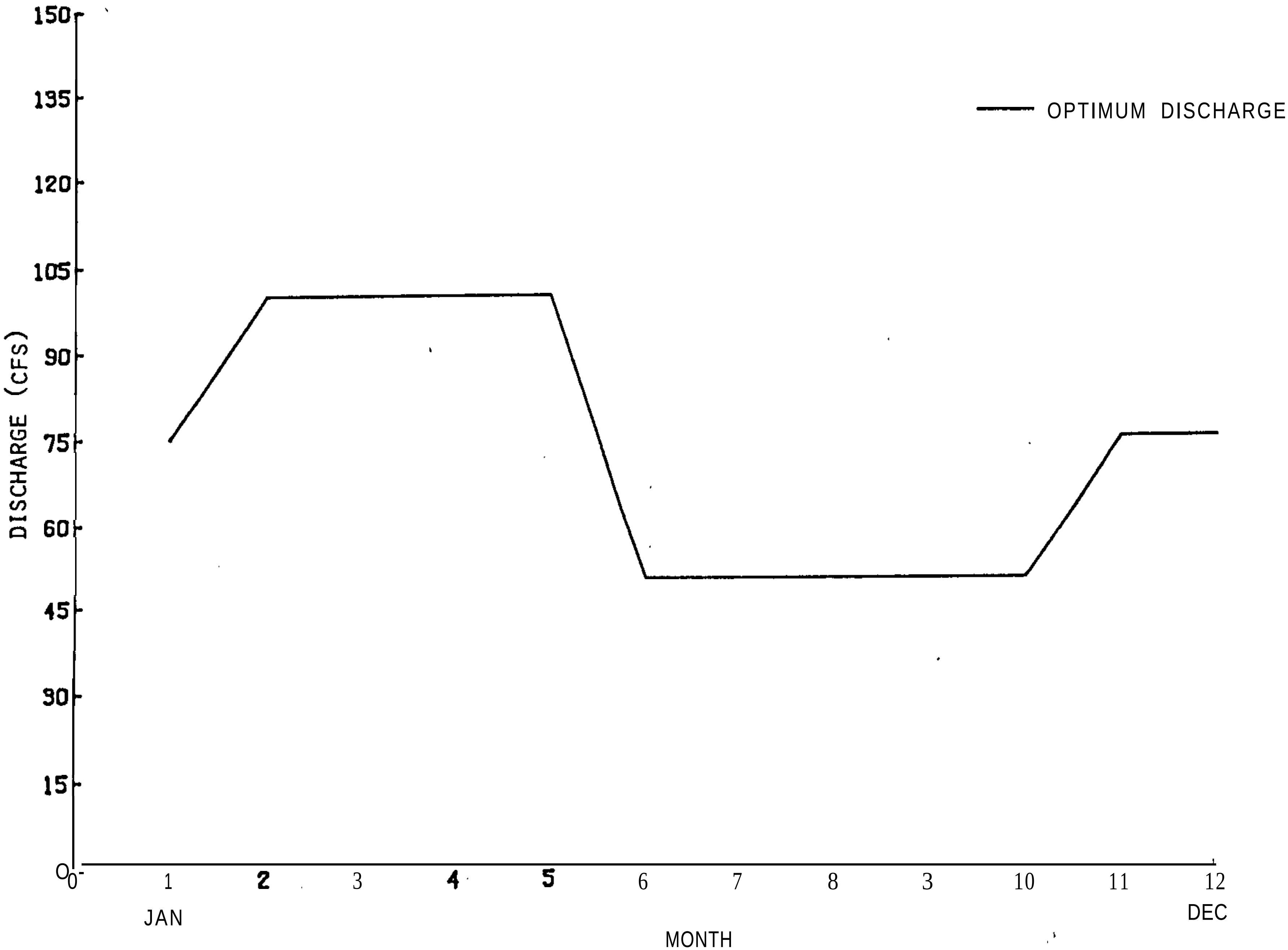
| DISCHARGE | SPAWNING-SPRING | SPAWNING-FALL | JUVENILE | INCUBATION |
|---|---|---|---|---|
| 25 | 1986 | 1219 | 2624 | 17190 |
| 30 | 2420 | 1615 | 2608 | 17783 |
| 40 | 2642 | 2282 | 2528 | 17923 |
| 50 | 2528 | 2672 | 2443 | 17702 |
| 75 | 2174 | 3438 | 1965 | 17656 |
| 100 | 1700 | 3127 | 1581 | 17712 |
| 125 | 1350 | 2472 | 1352 | 17502 |
| 150 | 1364 | 1981 | 1324 | 17398 |

### COHO SALMON

| DISCHARGE | SPAWNING | FRY | INCUBATION |
|---|---|---|---|
| 25 | 1329 | 220 | 14416 |
| 30 | 1617 | 201 | 14180 |
| 40 | 1763 | 184 | 13296 |
| 50 | 2291 | 169 | 12381 |
| 75 | 2085 | 122 | 11488 |
| 100 | 1373 | 73 | 11512 |
| 125 | 912 | 53 | 11628 |
| 150 | 695 | 43 | 12162 |

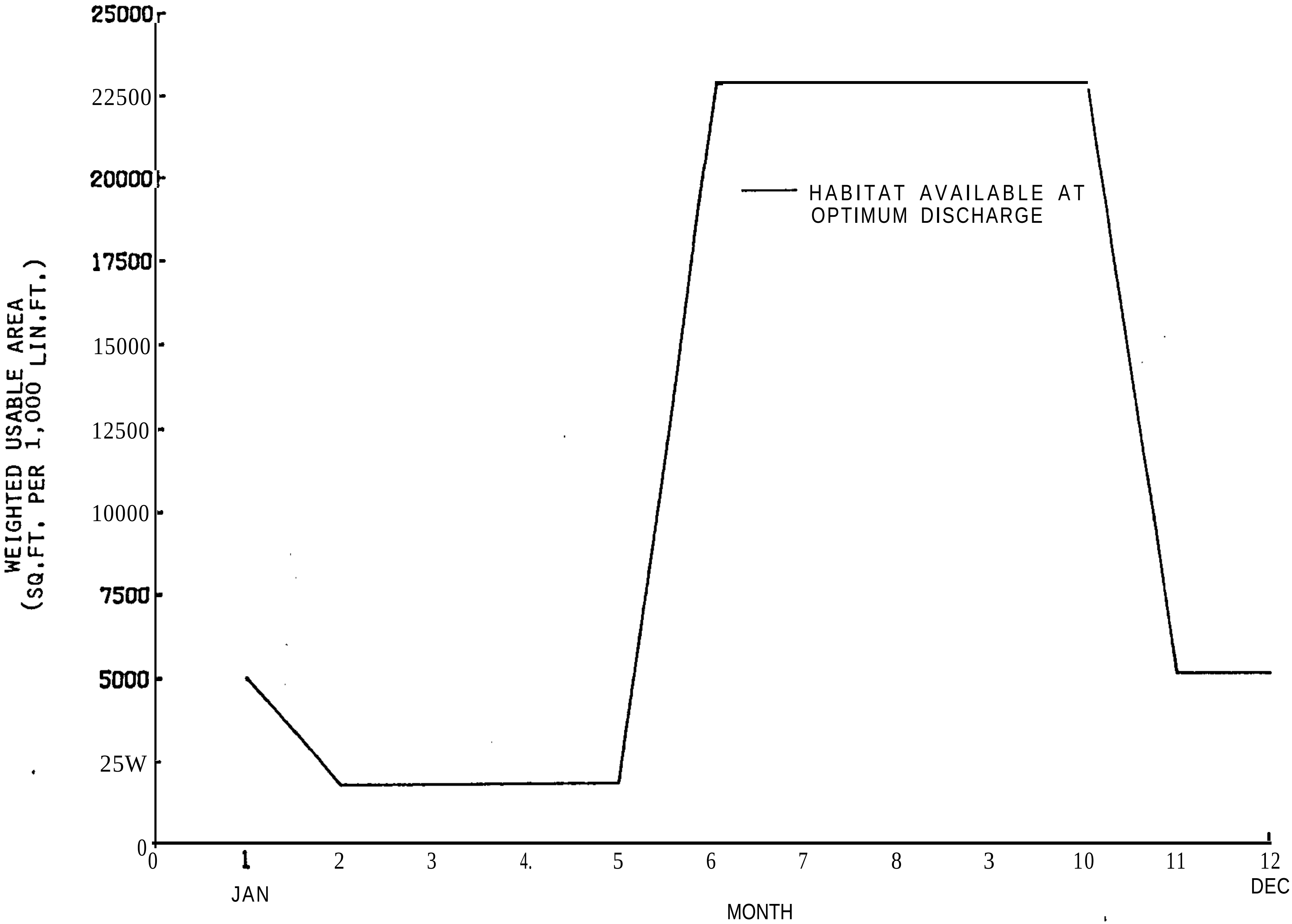


**Shitike Creek (S-2)**



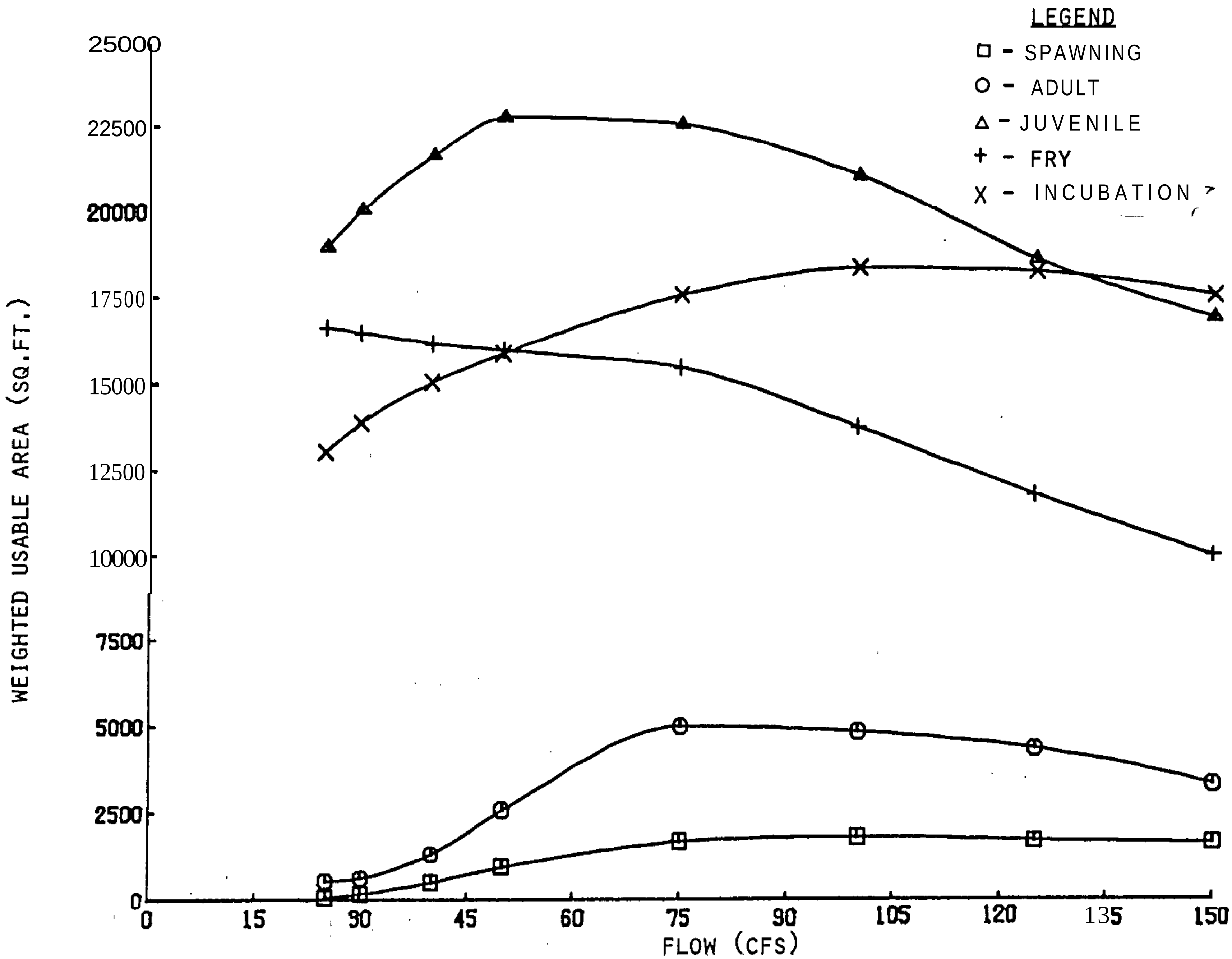

SHITIKE CREEK S-2

OPTIMUM DISCHARGE FOR STEELHEAD



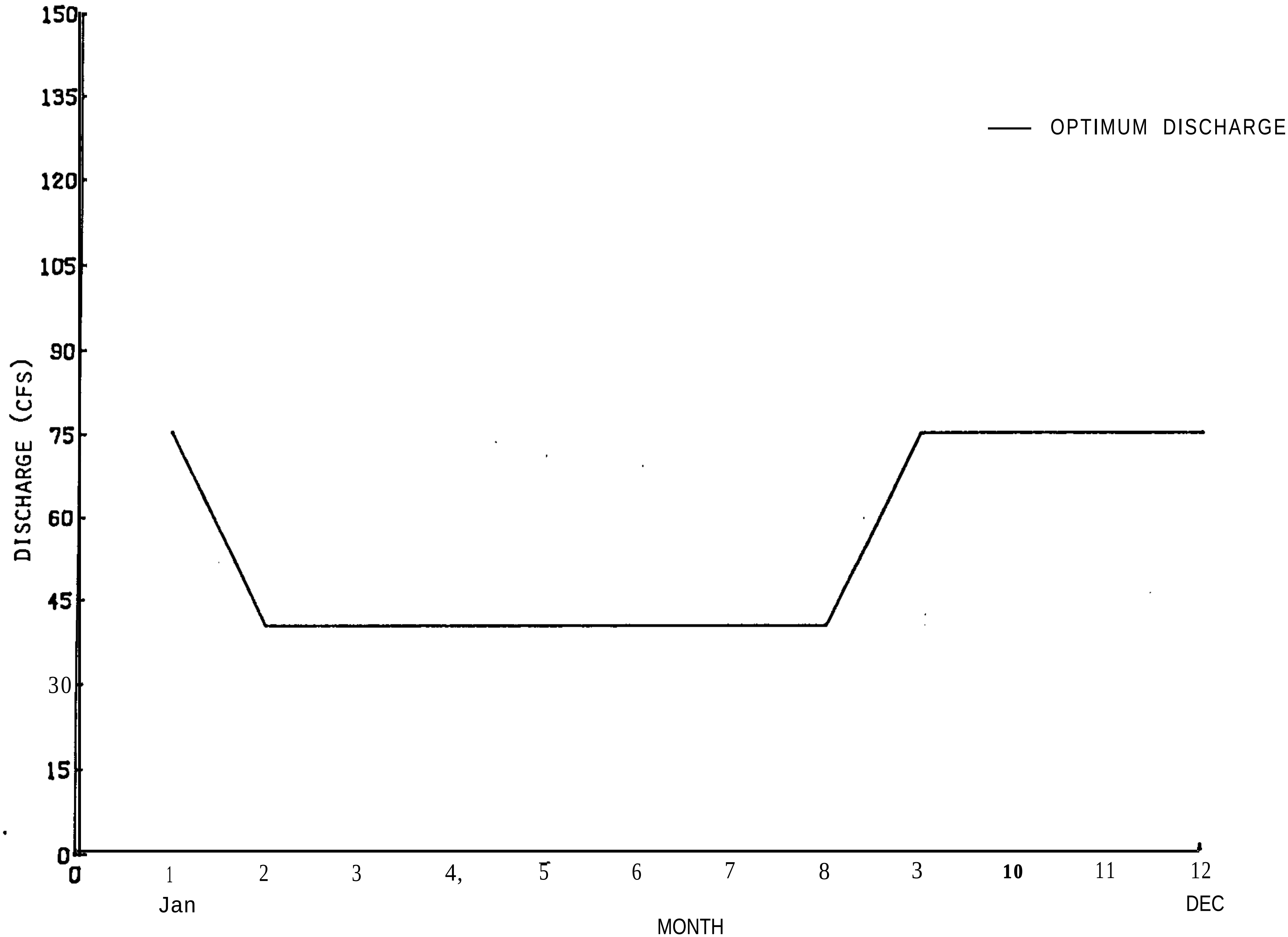

SHITIKE CREEK S-2

ANNUAL STEELHEAD HABITAT FOR SELECTED LIFESTAGES



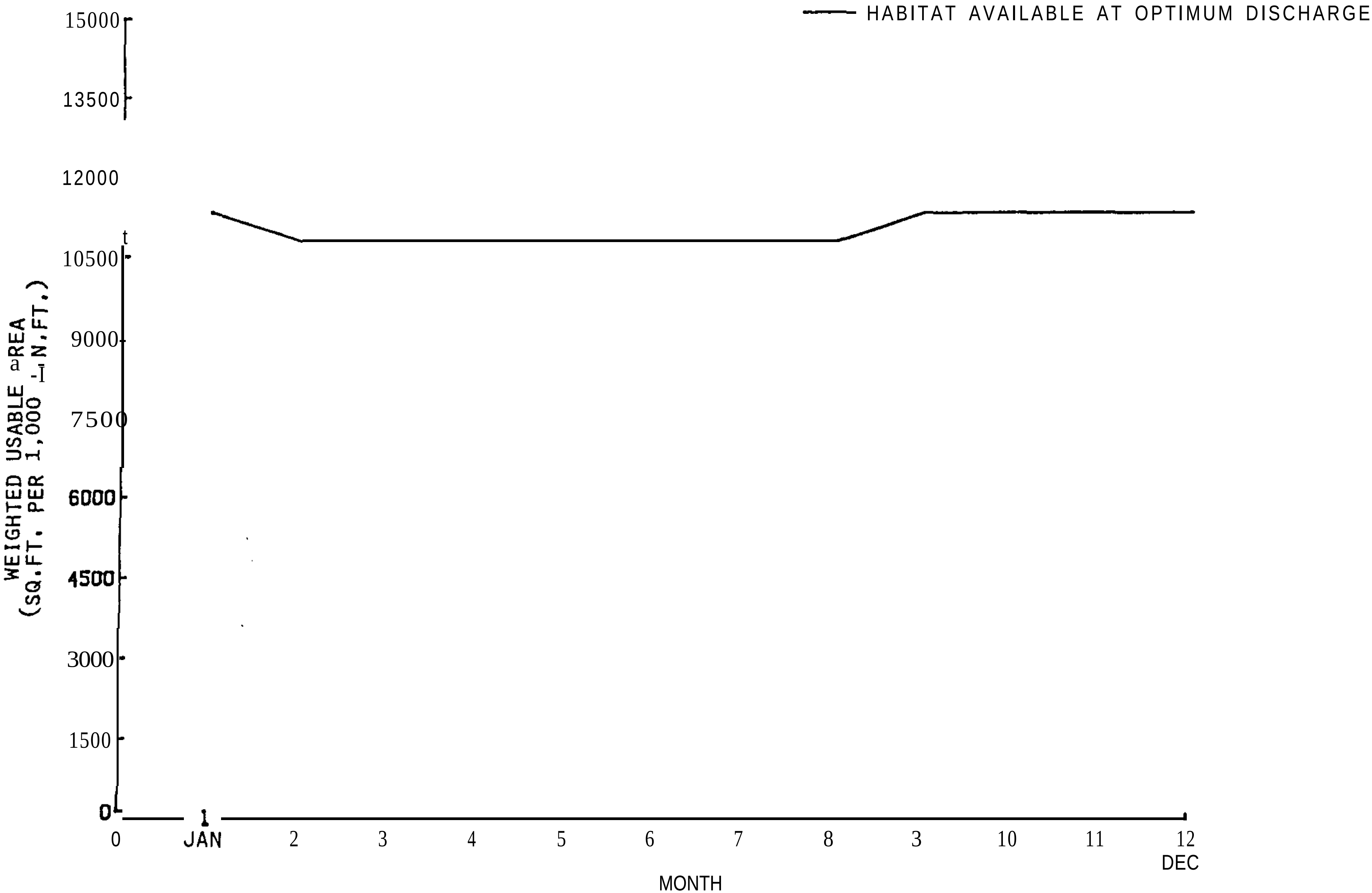

SHITIKE CREEK S-2'

STEELHEAD (CLEARWATER~ s = .004)



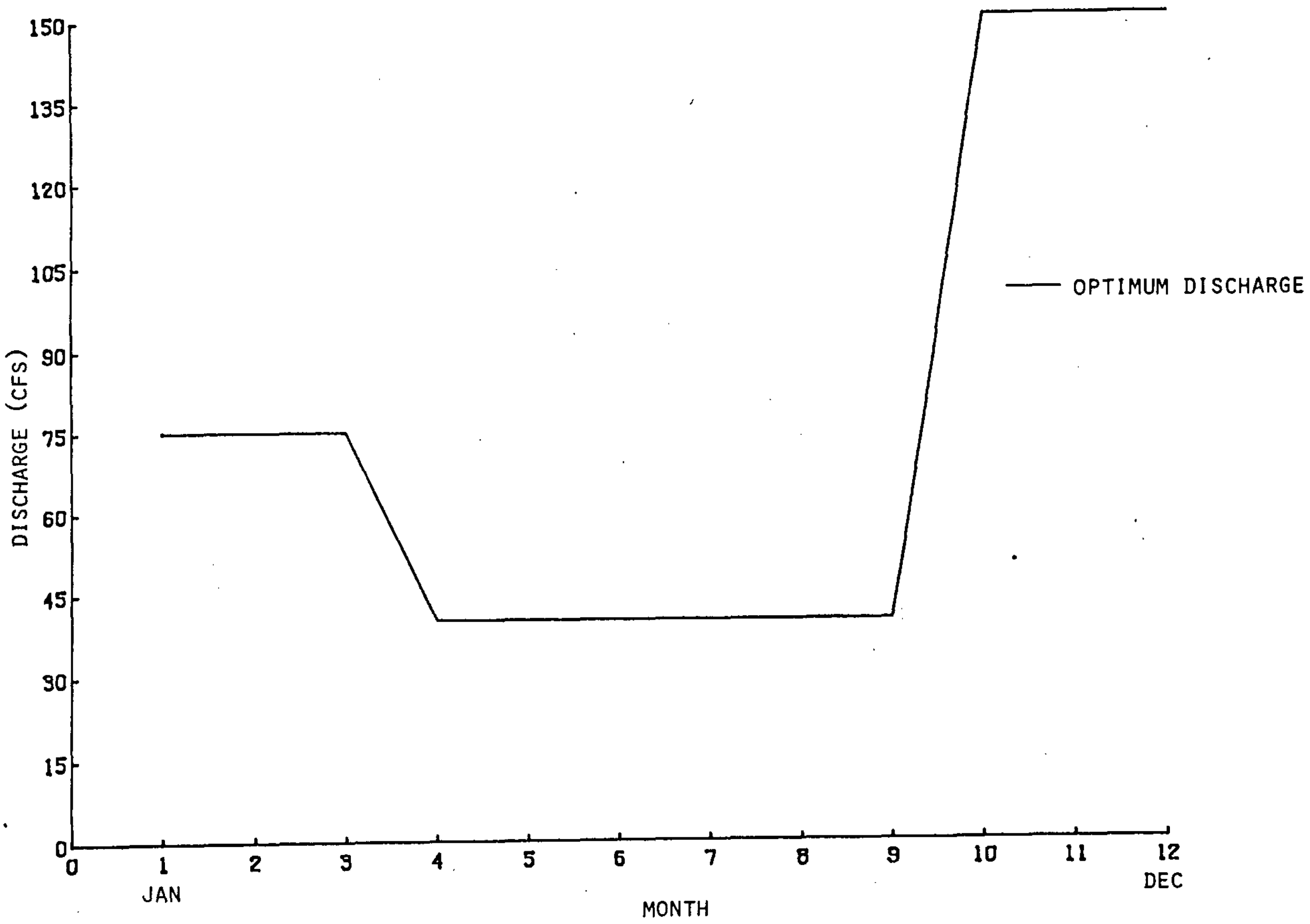

SHITKE CREEK S-2

OPTIMUM DISCHARGE FOR SPRING CHINOOK



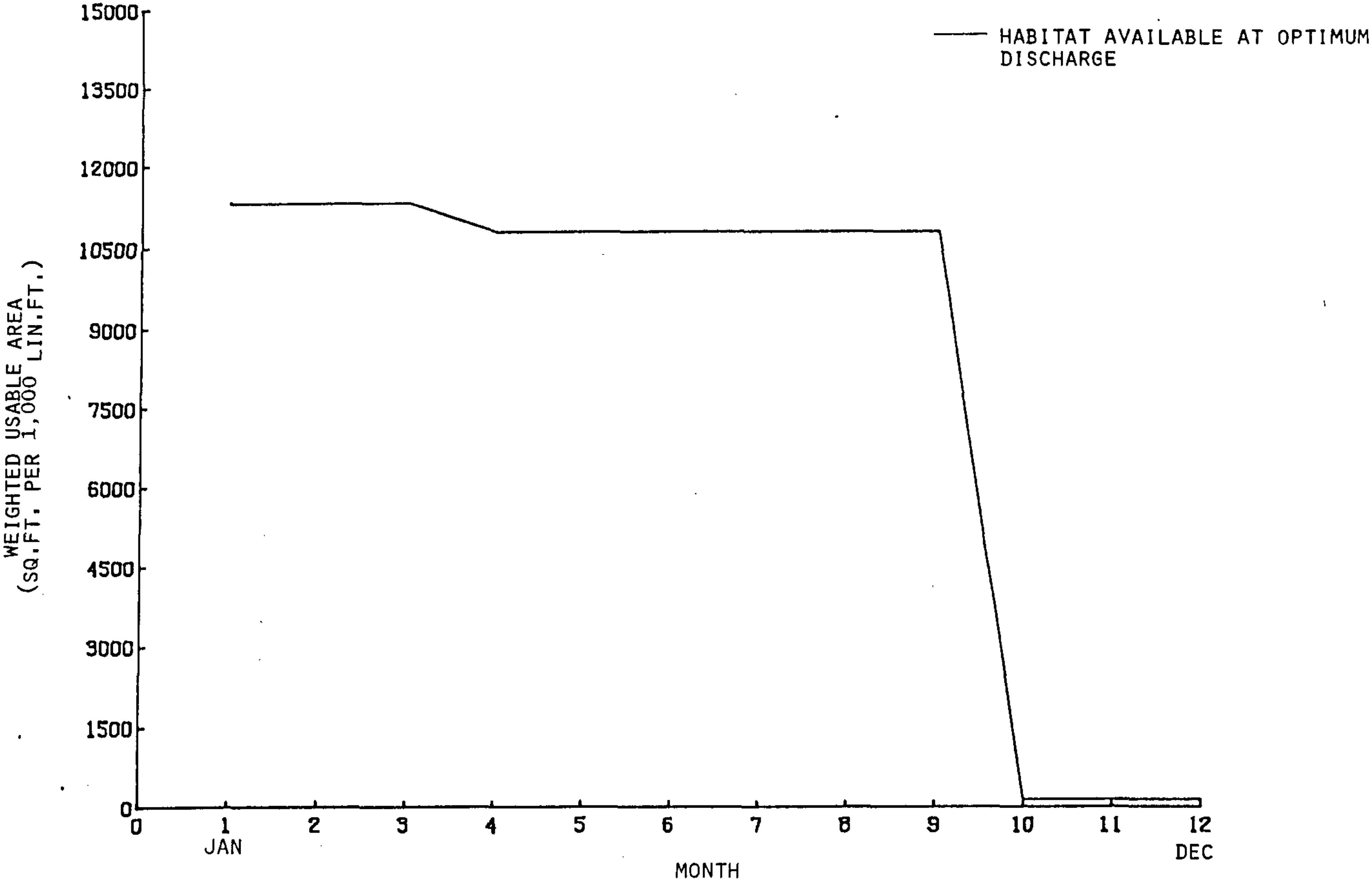

SHITIKE CREEK S-2~

ANNUAL SPRING CHINOOK HABITAT FOR SELECTED LIFESTAGES



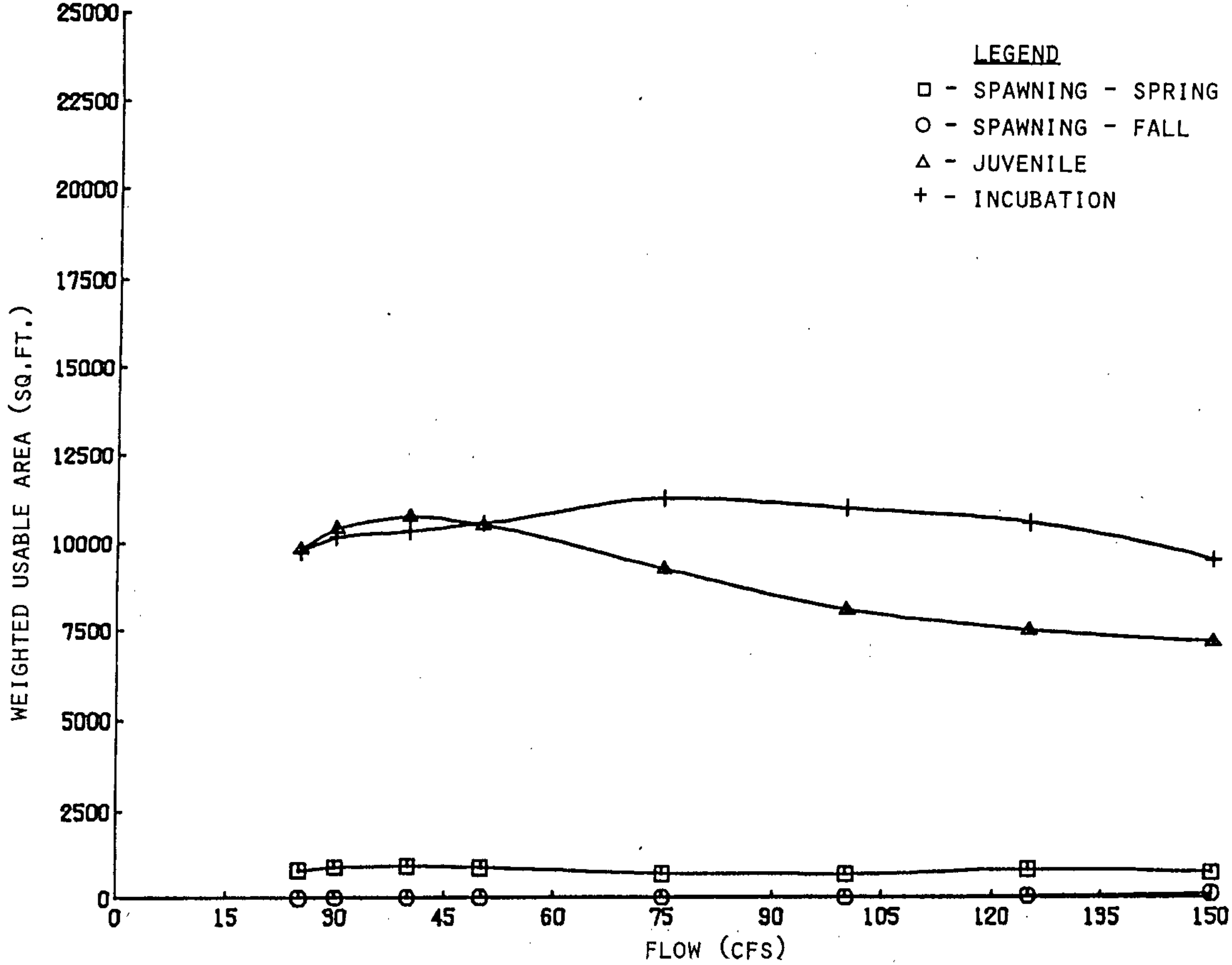

SHITIKE CREEK S-2

OPTIMUM DISCHARGE FOR FALL CHINOOK



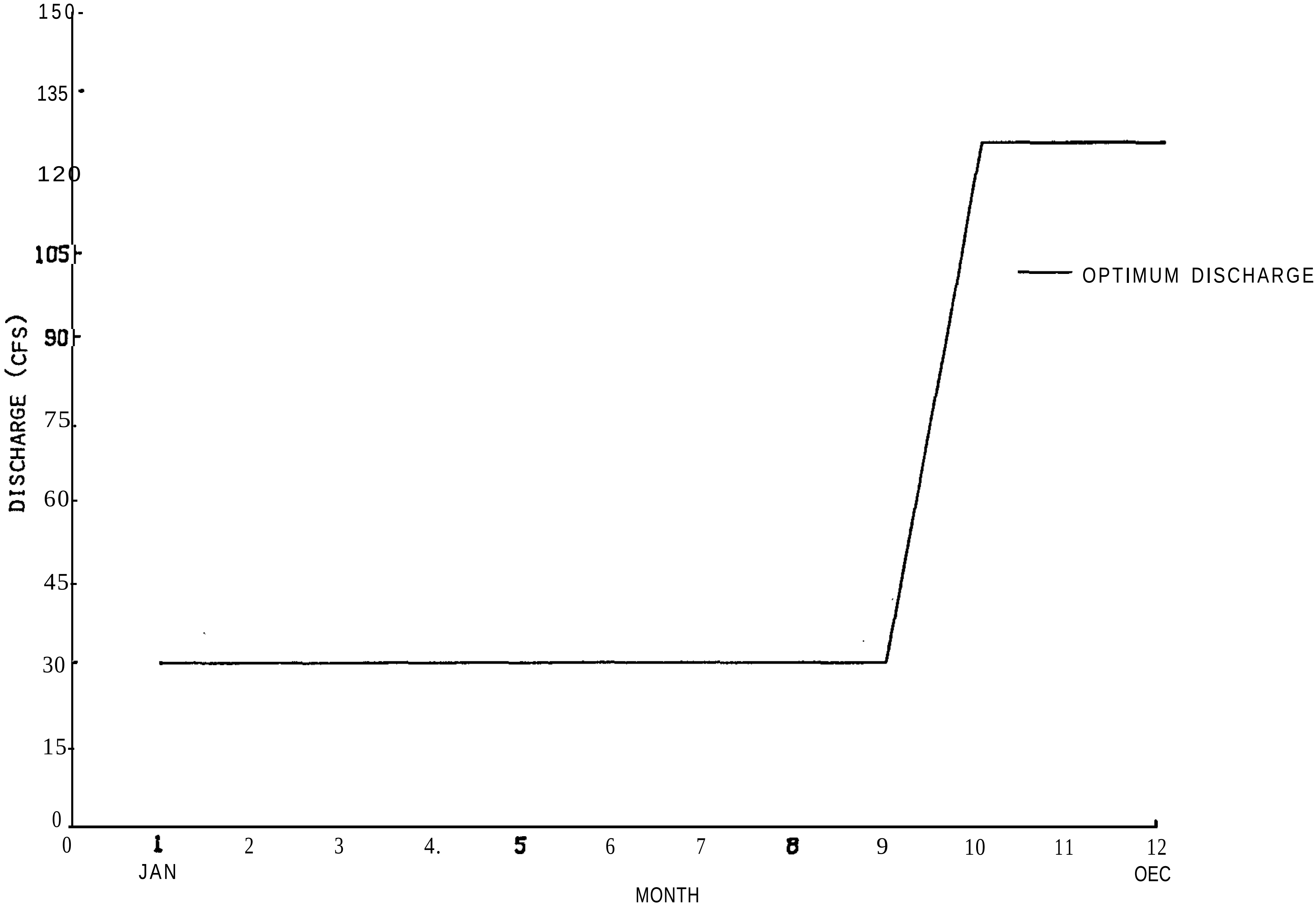

SHITIKE CREEK S-2

ANNUAL FALL CHINOOK HABITAT FOR SELECTED LIFESTAGES



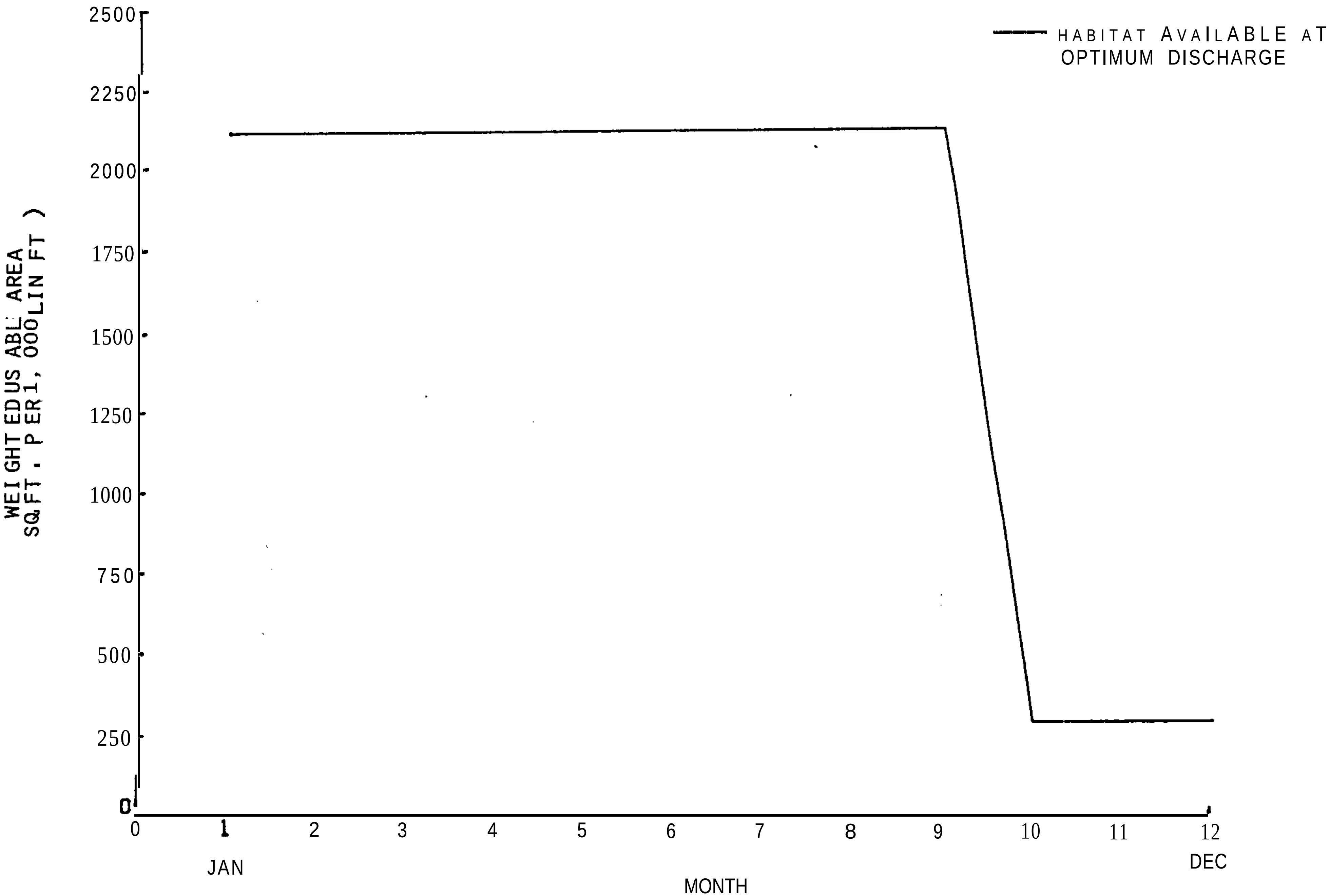

SHITIKE CREEK S-2

CHINOOK SALMON (CLEARWATER, S = .004)



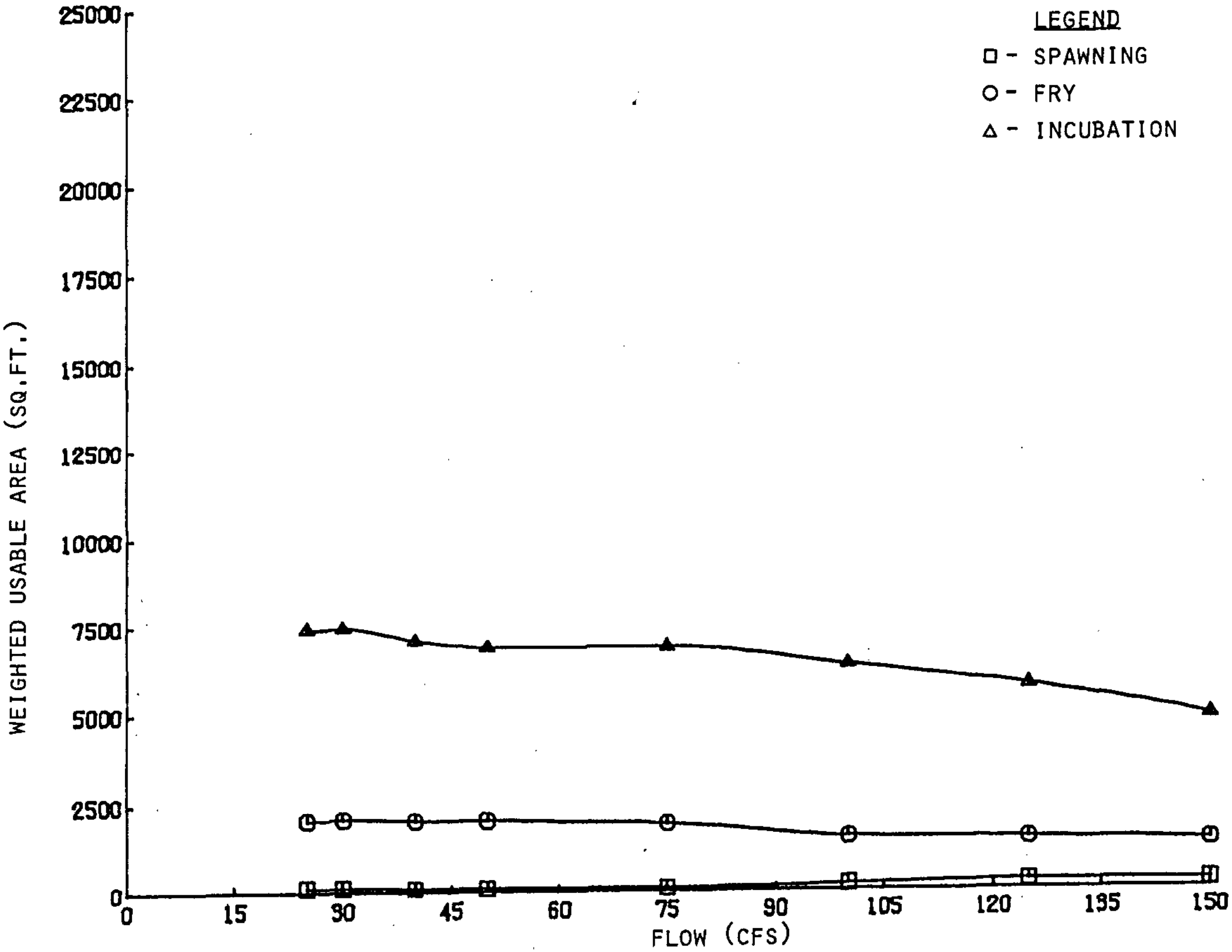

SHITIKE CREEK S-2

OPTIMUM DISCHARGE FOR COHO




SHITIKE CREEK S-2

ANNUAL COHO HABITAT FOR SELECTED LIFESTAGES




SHITIKE CREEK S-2

COHO SALMON (CLEARWATER, S = .004)

## SHITIKE CREEK (S-2)

### DISCHARGE (CFS) VS. AVAILABLE HABITAT AREA (SQ.FT.) PER 1000 FEET OF STREAM

#### STEELHEAD

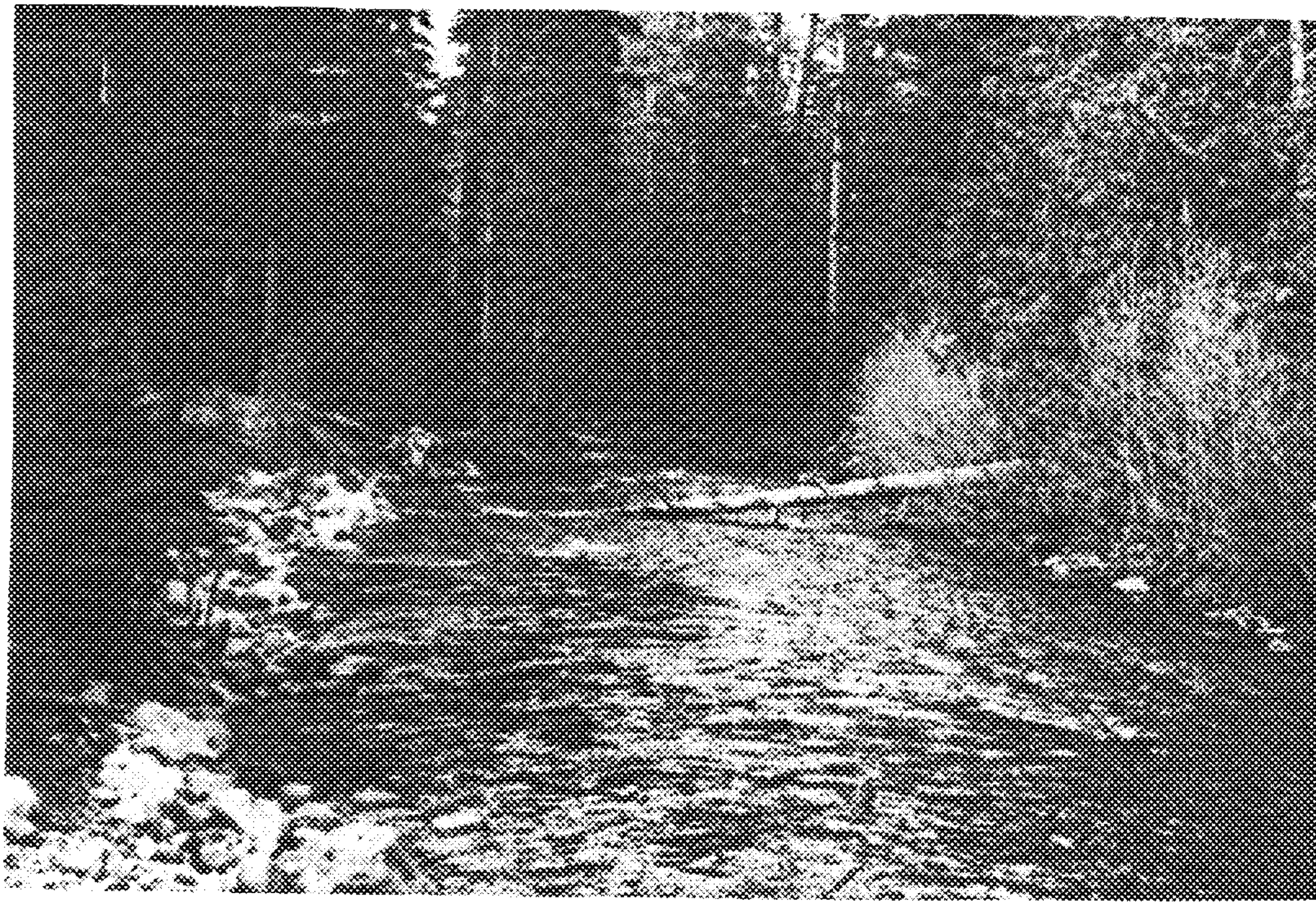
| DISCHARGE | SPAWNING | ADULT | JUVENILE | FRY | INCUBATION |
|---|---|---|---|---|---|
| 25 | 84 | 557 | 18936 | 16602 | 13059 |
| 30 | 190 | 646 | 20038 | 16443 | 13884 |
| 40 | 518 | 1333 | 21635 | 16133 | 15038 |
| 50 | 967 | 2587 | 22730 | 15940 | 15851 |
| 75 | 1714 | 5017 | 22510 | 15448 | 17554 |
| 100 | 1837 | 4851 | 20998 | 13750 | 18335 |
| 125 | 1731 | 4368 | 18561 | 11787 | 18215 |
| 150 | 1668 | 3344 | 16894 | 10006 | 17532 |

#### CHINOOK SALMON

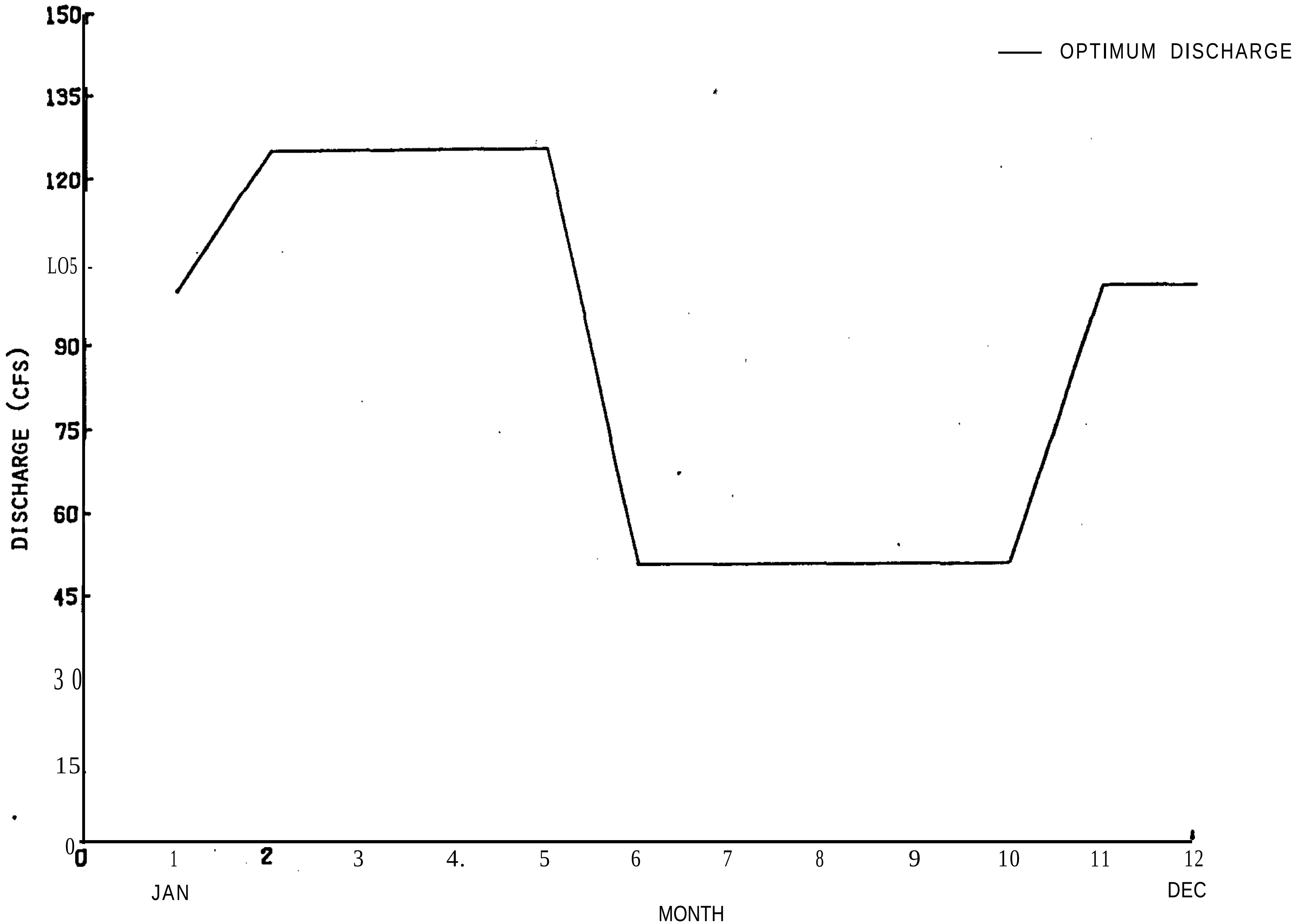
| DISCHARGE | SPAWNING-SPRING | SPAWNING-FALL | JUVENILE | INCUBATION |
|---|---|---|---|---|
| 25 | 819 | 18 | 9837 | 9772 |
| 30 | 926 | 27 | 10428 | 10184 |
| 40 | 951 | 31 | 10777 | 10370 |
| 50 | 904 | 28 | 10525 | 10589 |
| 75 | 719 | 26 | 9286 | 11307 |
| 100 | 703 | 25 | 8106 | 11015 |
| 125 | 851 | 65 | 7533 | 10604 |
| 150 | 752 | 138 | 7197 | 9556 |

#### COHO SALMON

| MONTH | DISCHARGE | SPAWNING | FRY | INCUBATION |
|---|---|---|---|---|
| 1 | | 146 | 2083 | 7437 |
| 2 | 25 30 | 139 | 2110 | 7448 |
| 3 | | 116 | 2066 | 7083 |
| 4 | 40 50 | 104 | 2056 | 6871 |
| 5 | 75 | 106 | 1957 | 6885 |
| 6 | 100 | 194 | 1575 | 6348 |
| 7 | 125 | 280 | 1512 | 5752 |
| 8 | 150 | 263 | 1425 | 4877 |

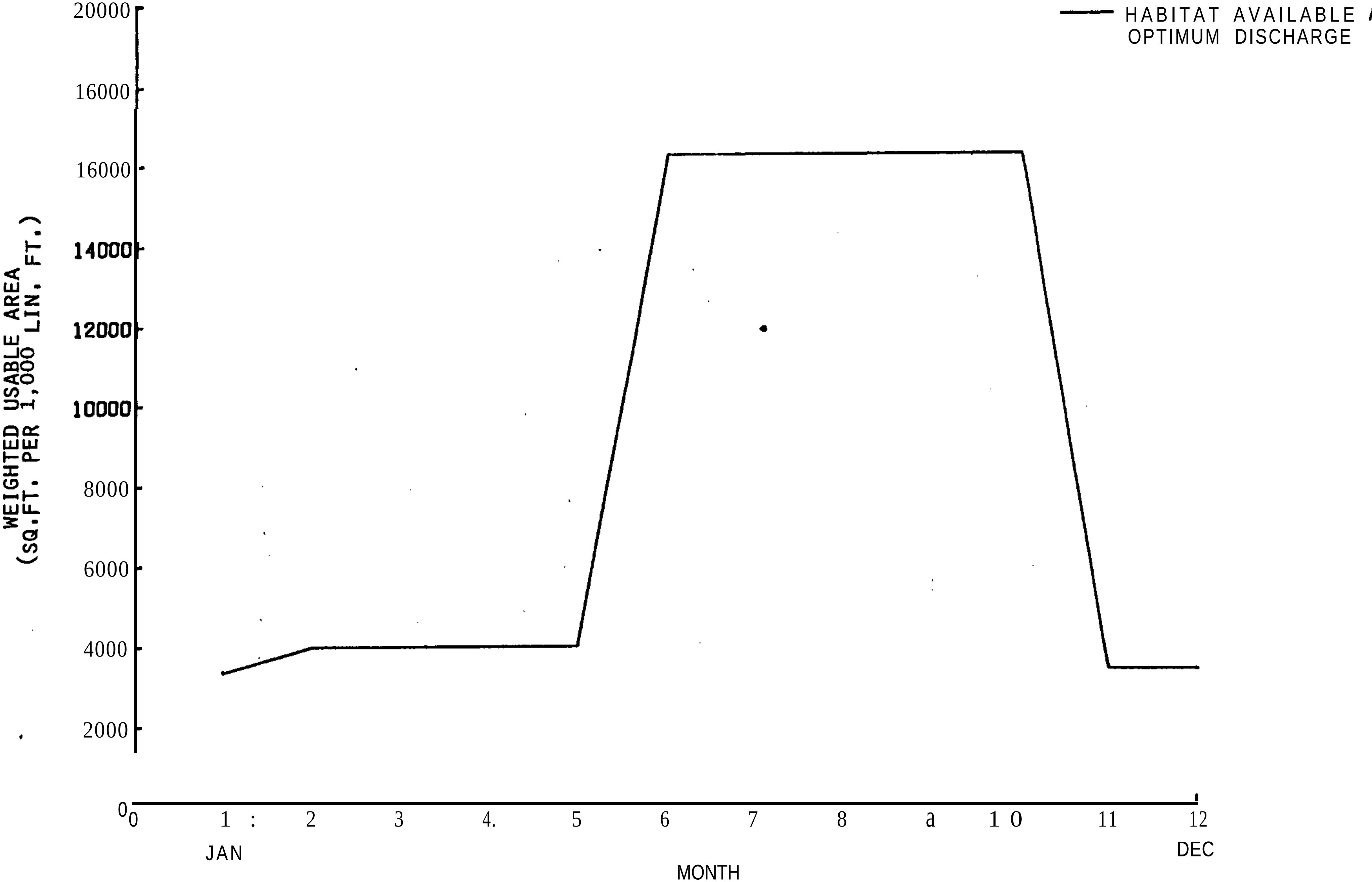


**Shitike Creek (S-3)**



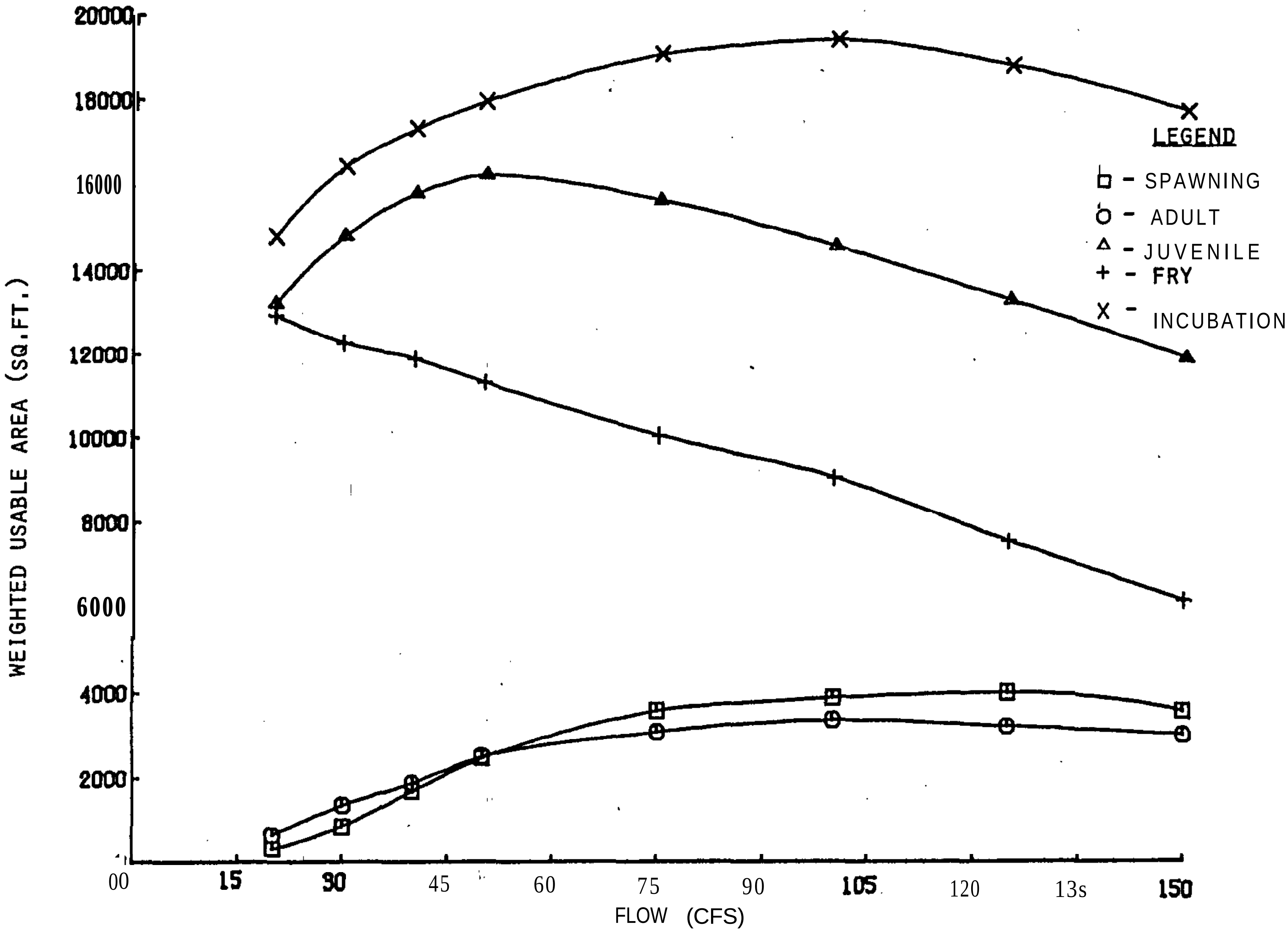

S H I T I K E  C R E E K  S - 3

OPTIMUM DISCHARGE FOR STEELHEAD



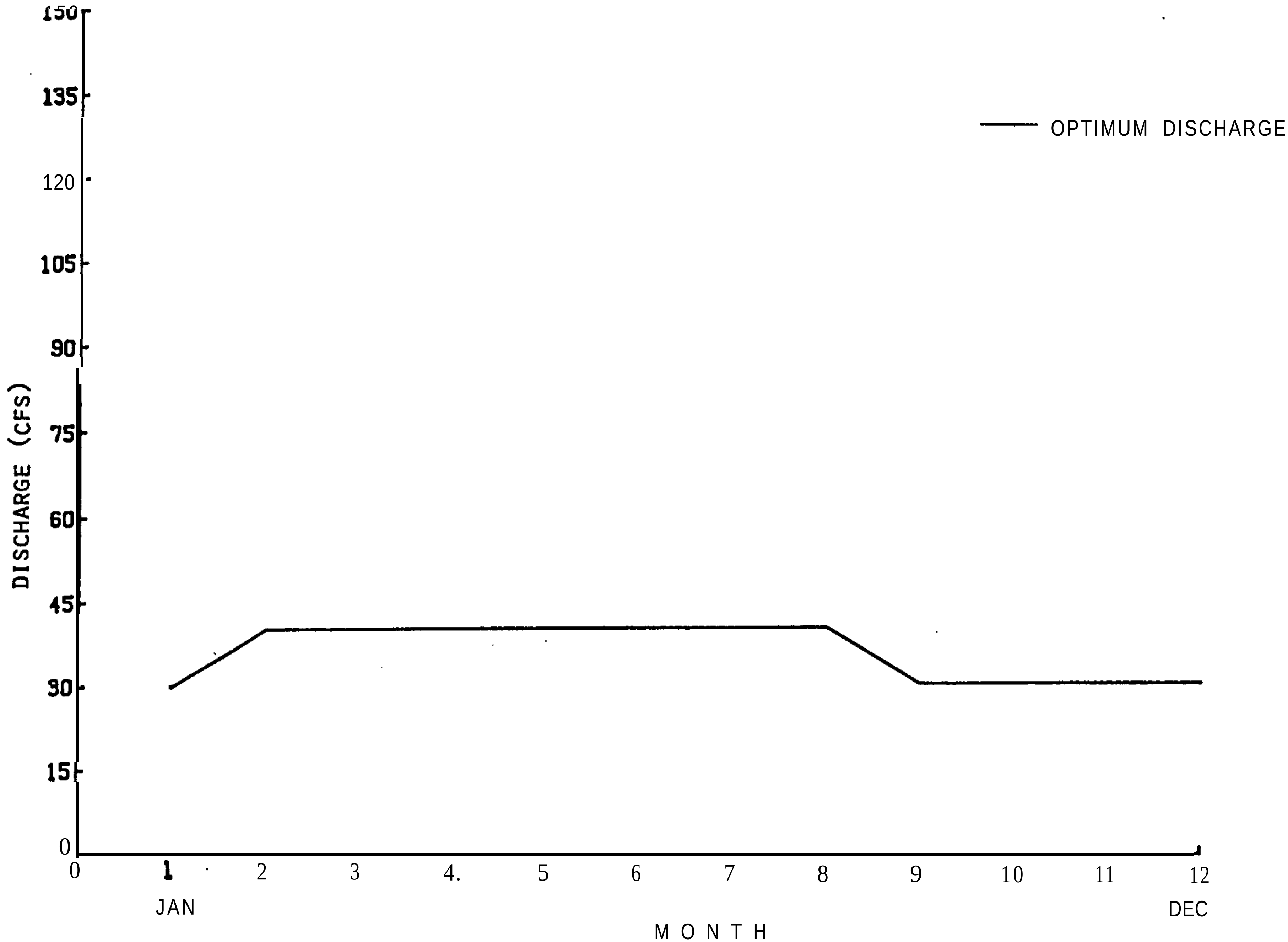

SHITIKE CREEK S-3

ANNUAL STEELHEAD HABITAT FOR SELECTED LIFESTAGES



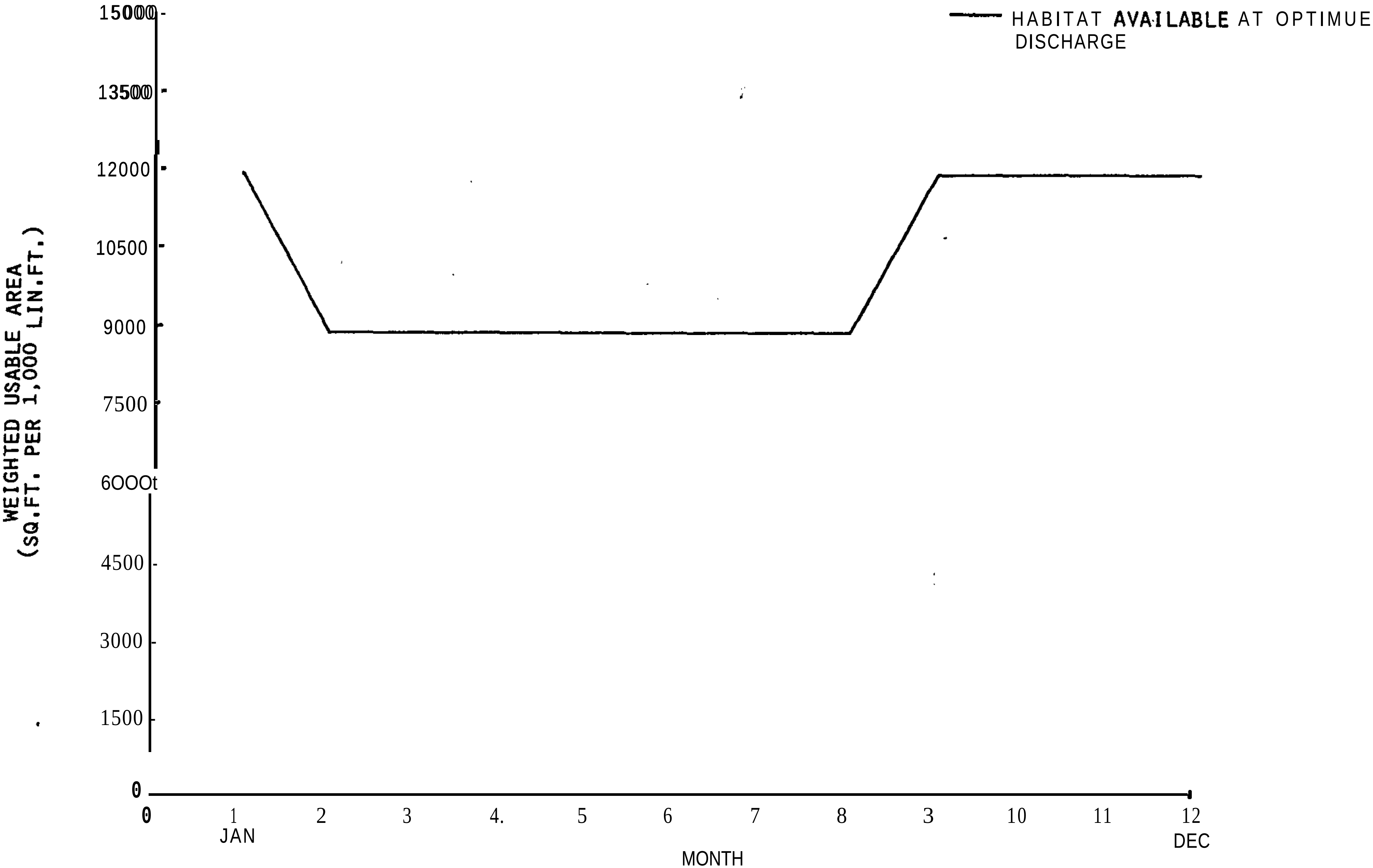

SHITIKE CREEK S - 3

STEELHEAD (CLEARWATER, s = .004)



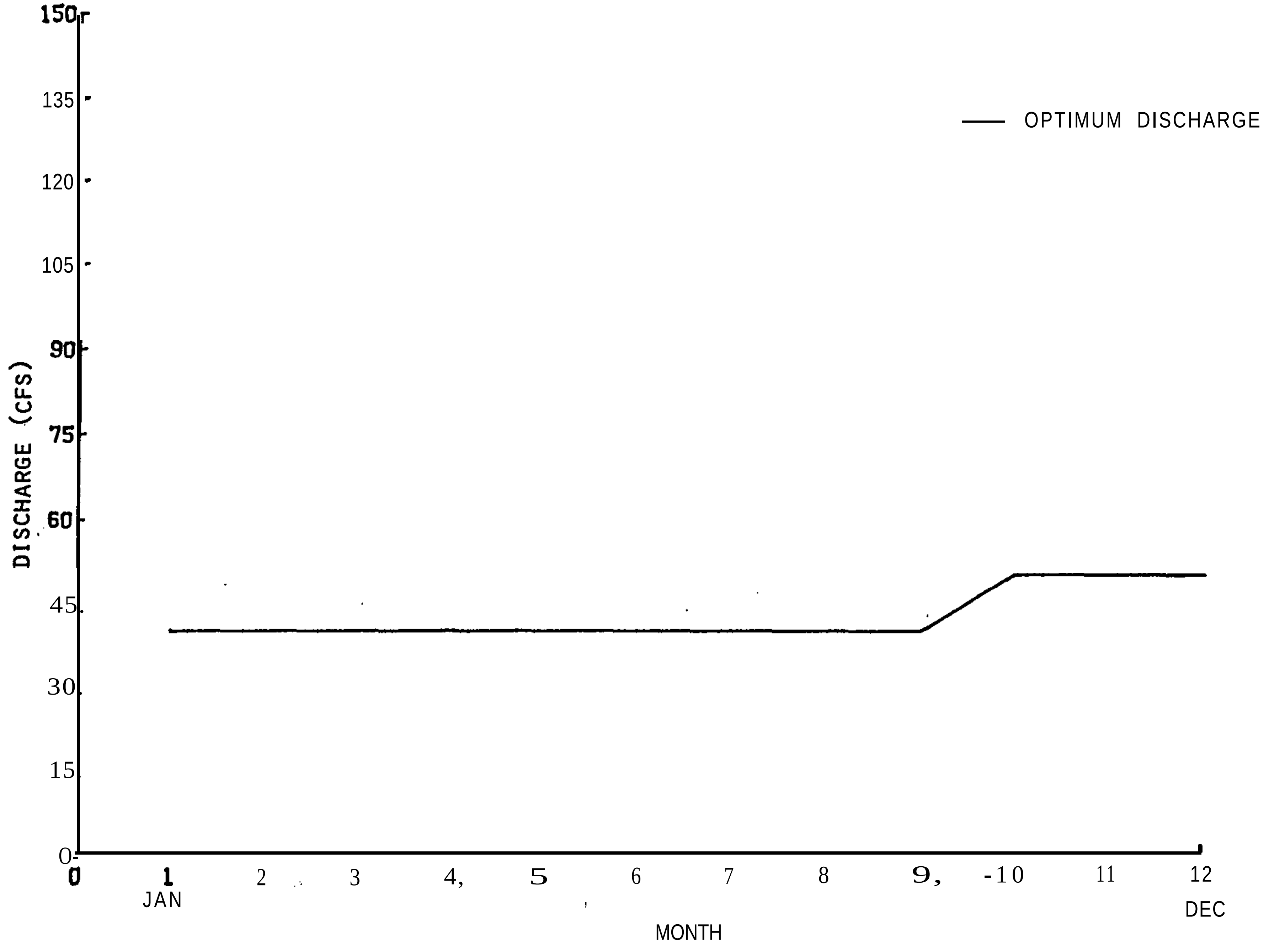

SHITIKE CREEK S-3

OPTIMUM DISCHARGE FOR SPRING CHINOOK



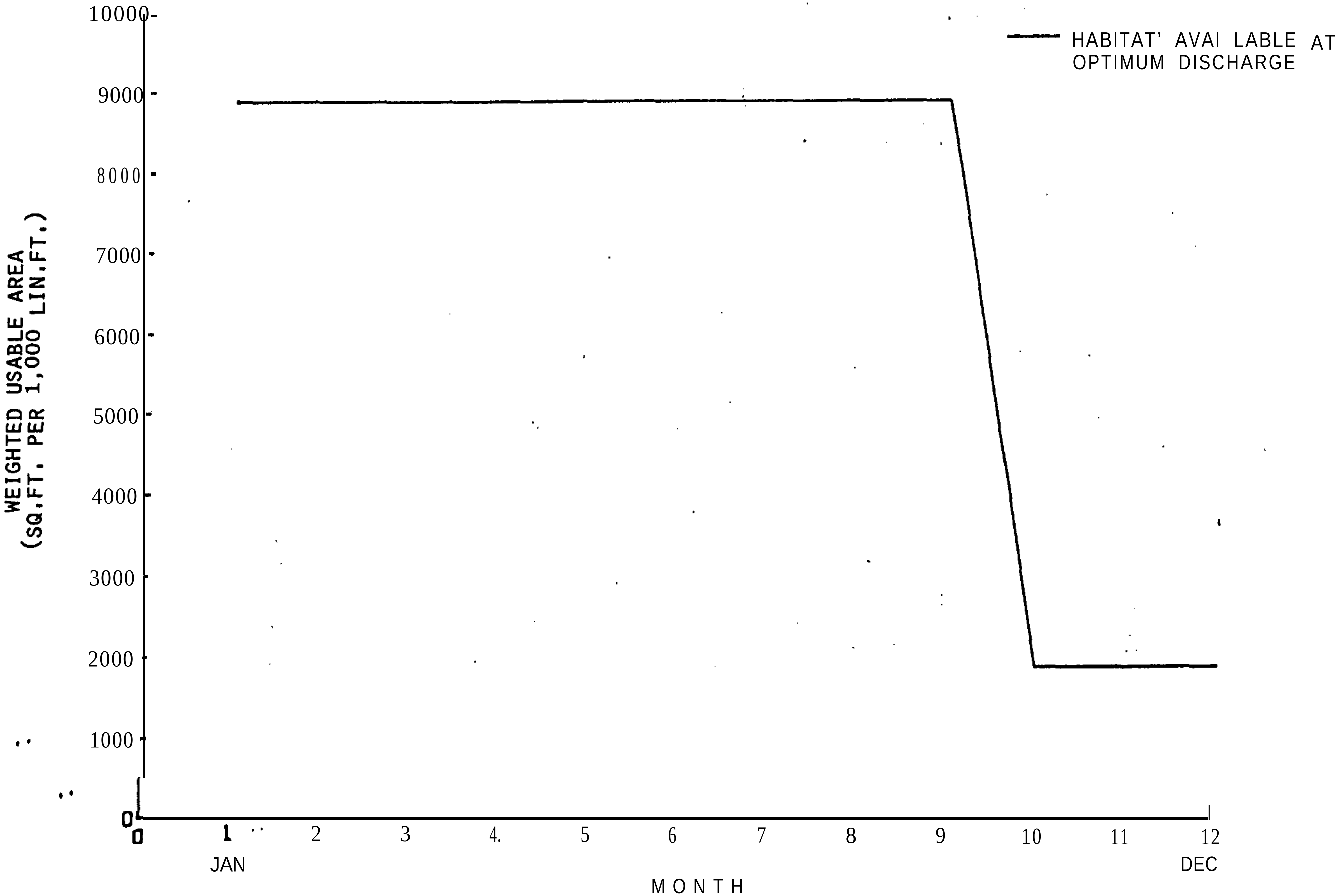

SHITIKE CREEK S-3

ANNUAL SPRING CHINOOK HABITAT FOR SEKECTED LIFESTAGES



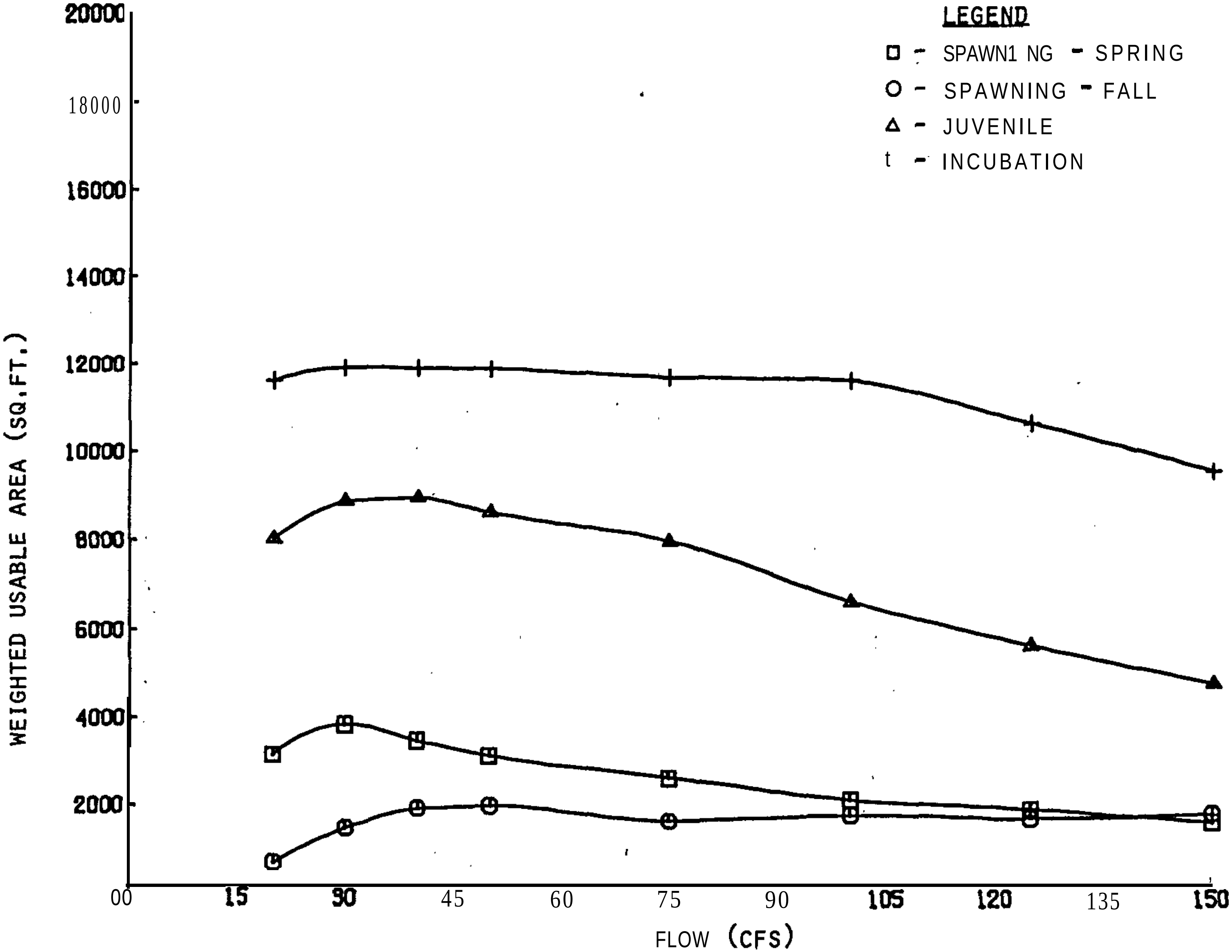

SHITIKE CREEK S-3

OPTIMUM DISCHARGE FOR FALL CHINOOK



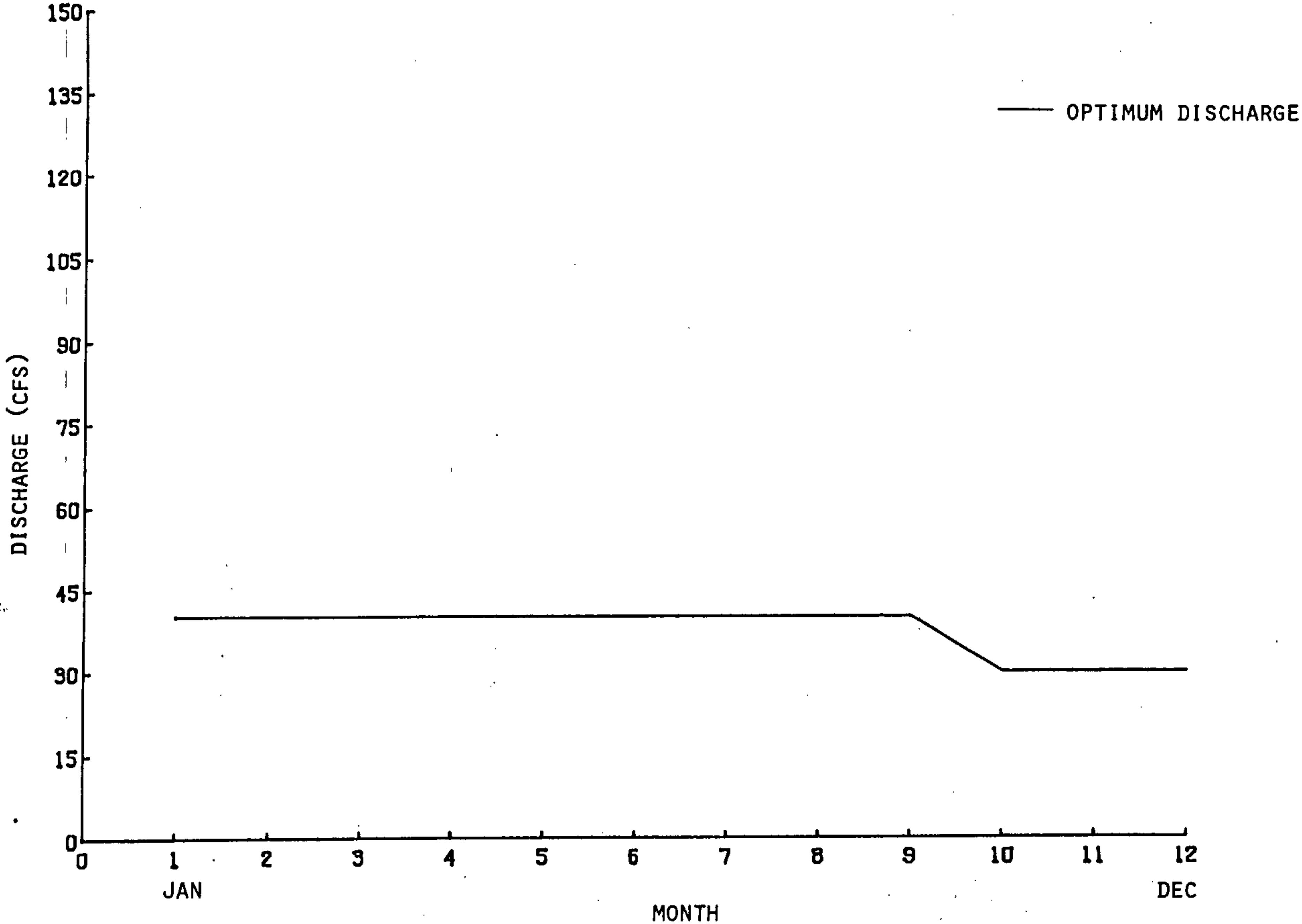

SHITIKE CREEK S-3

ANNUAL FALL CHINOOK HABITAT FOR SEKECTED LIFESTAGES



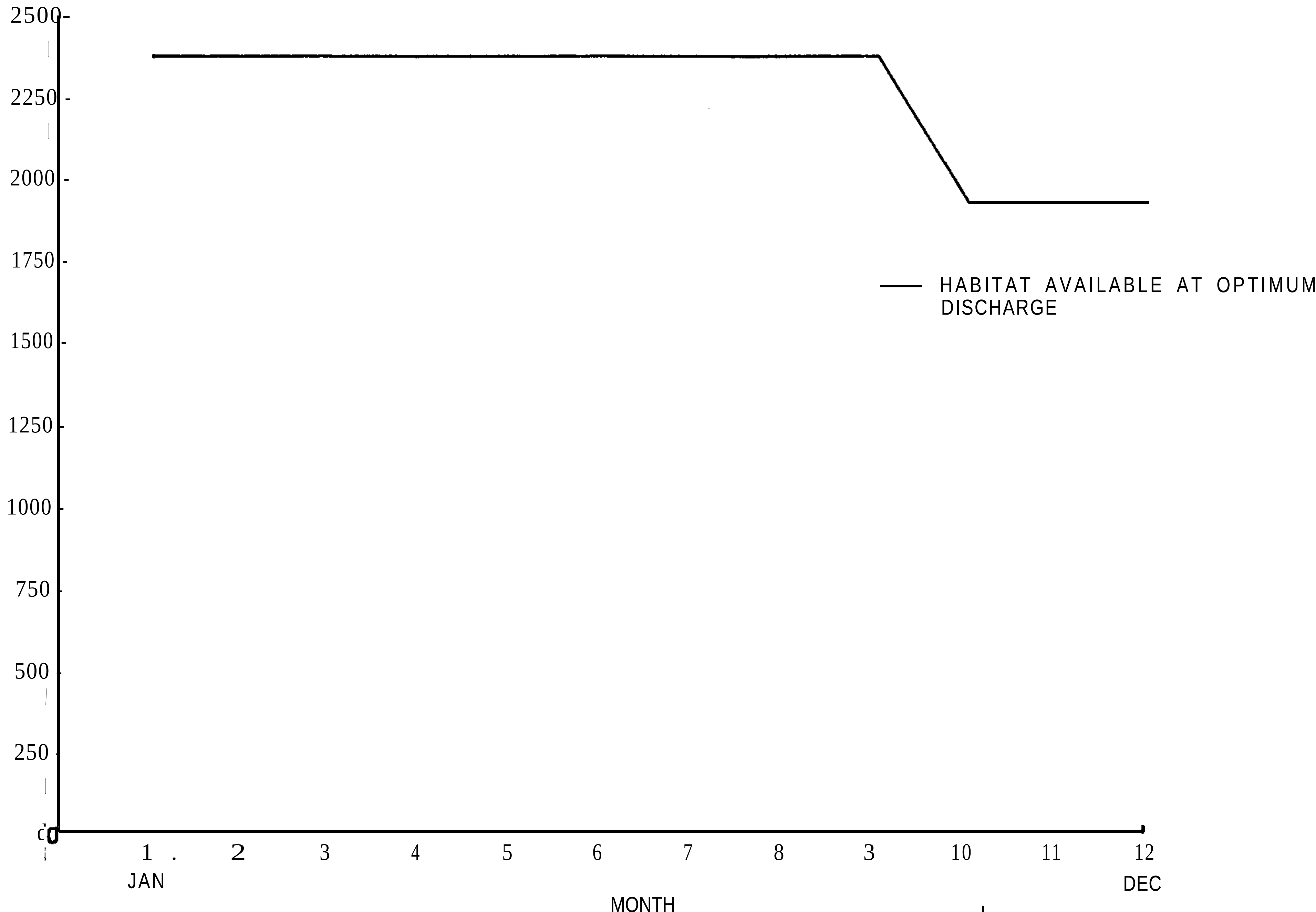

SHITIKE CREEK S-3,

CHINOOK SALMON (CLEARWATER, s = ,004)



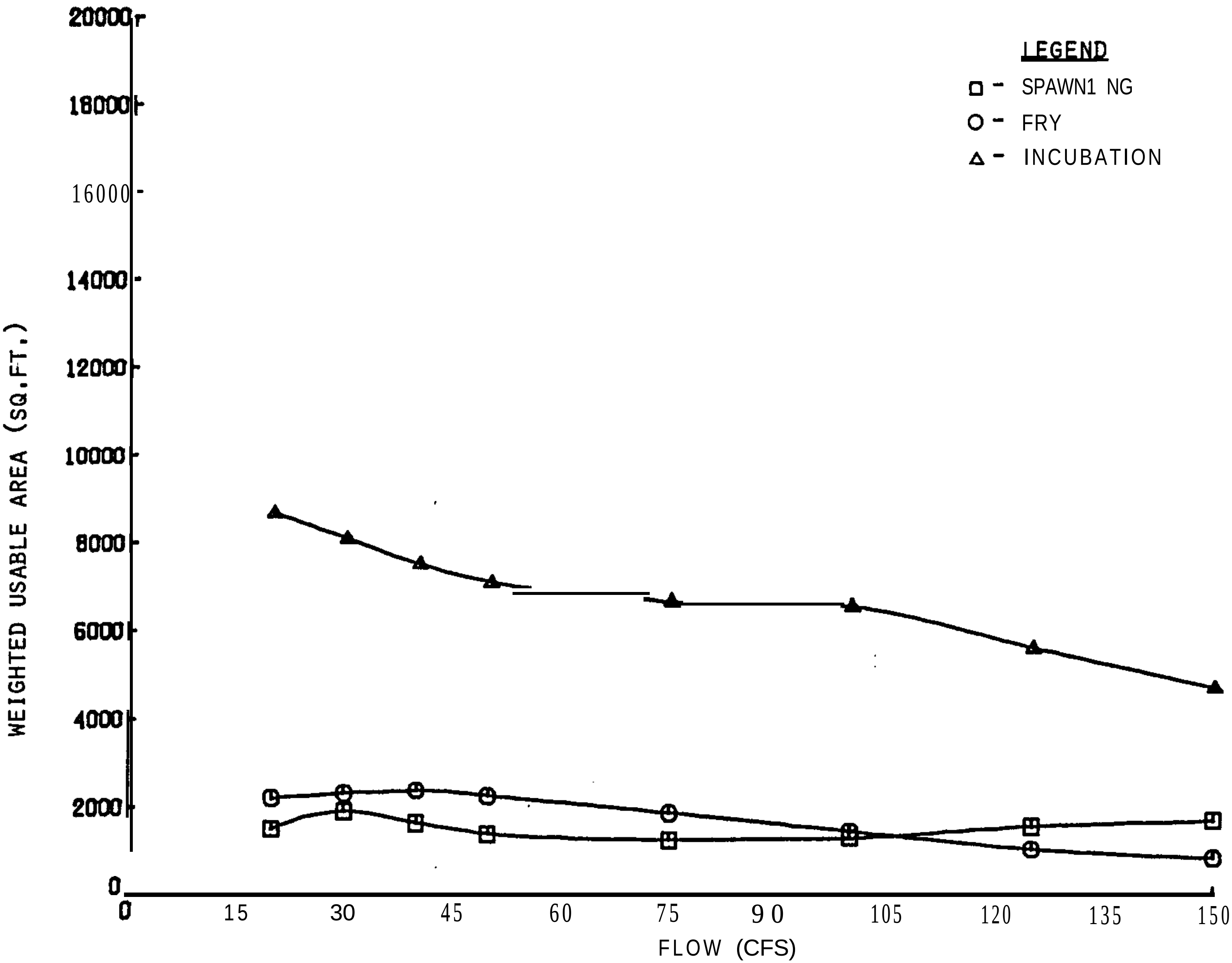

SHITIKE CREEK S-3

OPTIMUM DISCHARGE FOR COHO




# SHITIKE CREEK S-3

ANNUAL COHO HABITAT FOR SELECTED LIFESTAGES




SHITIKE CREEK S-3

COHO SALMON (CLEARWATER, s = -004)

## SHITIKE CREEK (S-3)

## DISCHARGE (CFS) VS. AVAILABLE HABITAT AREA (SQ.FT.) PER 1000 FEET OF STREAM

### STEELHEAD

| DISCHARGE | SPAWNING | ADULT | JUVENILE | FRY | INCUBATION |
|---|---|---|---|---|---|
| 20 | 335 | 658 | 13216 | 12930 | 14817 |
| 30 | 867 | 1370 | 14824 | 12273 | 16432 |
| 40 | 1703 | 1899 | 15814 | 11897 | 17323 |
| 50 | 2479 | 2528 | 16235 | 11338 | 17963 |
| 75 | 3603 | 3104 | 15649 | 10071 | 19068 |
| 100 | 3911 | 3385 | 14580 | 9075 | 19405 |
| 125 | 4028 | 3227 | 13278 | 7546 | 18783 |
| 150 | 3570 | 3009 | 11892 | 6124 | 17699 |

### CHINOOK SALMON

| DISCHARGE | SPAWNING-SPRING | SPAWNING-FALL | JUVENILE | INCUBATION |
|---|---|---|---|---|
| 20 | 3120 | 643 | 8014 | 11609 |
| 30 | 3782 | 1436 | 8838 | 11888 |
| 40 | 3382 | 1857 | 8887 | 11839 |
| 50 | 3015 | 1878 | 8533 | 11800 |
| 75 | 2457 | 1481 | 7843 | 11566 |
| 100 | 1894 | 1555 | 6440 | 11447 |
| 125 | 1628 | 1415 | 5406 | 10405 |
| 150 | 1276 | 1489 | 4498 | 9290 |

### COHO SALMON

| DISCHARGE | SPAWNING | FRY | INCUBATION |
|---|---|---|---|
| 20 | 1532 | 2214 | 8668 |
| 30 | 1919 | 2318 | 8079 |
| 40 | 1649 | 2372 | 7507 |
| 50 | 1391 | 2237 | 7082 |
| 75 | 1250 | 1844 | 6663 |
| 100 | 1286 | 1428 | 6540 |
| 125 | 1517 | 990 | 5617 |
| 150 | 1632 | 766 | 4706 |

## OVERVIEW

Shitike Creek was divided into three geographical areas: (1) Shitike Creek's confluence with Deschutes River to 1.0 mile above P-670 road crossing, (2) One mile above P-670 road crossing to 3.5 miles below road P-ZOO crossing and (3) confluence of unnamed creek 3.5 miles below P-200 crossing to 1.5 MILES above P-200 crossing.

### Section 1

The lower section of Shitike Creek offers the most potential habitat for the anadromous species investigated. Steelhead have the most potential habitat at optimum flows and are.presently the most numerous anadromous fish species in the system. The optimum flows for steelhead are in closest agreement with flows actually OCCURRING IN this section than for the other species evaluated. The actual use of available rearing habitat for steelhead may be reduced by the warm water temperatures occurring in SUMMER. If that occursactual monthly flows could be providing more usable SUMMER rearing habitat.than would be present at the lower optimum flows calculated by the model.

Spring chinook are known to also spawn in this area of stream. The amount of spawning habitat at actual flows is approaching optimum but juvenile rearing habitat is much reduced due to higher than optimum flows. This would also be the case with fall chinook, which are not present in the system. Optimum rearing flows for chinook during spring and summer are much. below those actually occurring, however, optimum flows would probably result in warmer water temperatures which would actually reduce usability of the habitat. Coho production would be hampered by these same factors.

### Section 2

The potential amount of spawning habitat for anadromous salmonids is much reduced in this section of stream. Fry and juvenile rearing habitat is more plentiful for all anadromous species within this area as compared to the other sections. Water temperatures in this section are cooler than in Section 1 and should not hinder the full utilization of the available habitat.

Steelhead are the only anadromous species presently utilizing this portion of Shitike Creek and a few are known to be spawning at least one mile above the study reach (S-2). This section's greatest value to a fishery may lie in its rearing potential.

### Section 3

The upper areas of Shitike Creek appear to have iess variable flow regimes than downstream areas. This is probably a result of spring inflows. Table 3 shows the discharge calculated at each reach during the study period. If these flows are representative of what normally occurs in this section, then it has considerable available spawning habitat,especially for steelhead and spring chinook (Table 4). Optimum spawning flows for each specie appear to be very near the flows actually occurring. The main drawbacks to the utilization of the potentials in this section are (1) passage problems due to the diversion dam in the lower drainage and periodic log jams plus (2) the cold water temperatures that would slow the growth of juveniles.

Table 3. Discharges measured at time of velocity measurements.

| Reach | Date | Discharge(cfs) |
|---|---|---|
| S-l | Nov. 14, 1979 | 39 |
| | March 4, 1980 | 118 |
| | April 29, 1980 | 171 |
| s-2 | April 3, 1980 | 57 |
| | April 30, 1980 | 147 |
| | August 13, 1980 | 47 |
| | | 38 |
| s-3 | April 2, 1980 | 94 |
| | August 13, 1980 | 36 |
| | April 30, 1980 | |

Table 4. Spawning habitat available per 1,000 feet of stream at optimum discharge.

| Reach | Species | Discharge | Spawning Habitat |
|---|---|---|---|
| S-l | Steelhead | 100 | 3559 |
| | Spring Chinook | 40 | 2642 |
| | Fall Chinook | 75 | 3438 |
| | Coho | 50 | 2291 |
| s-2 | Steelhead | 100 | 1837 |
| | Spring Chinook | 40 | 951 |
| | Fall Chinook | 150 | 138 |
| | Coho | 125 | 280 |
| s-3 | Steelhead | 125 | 4028 |
| | Spring Chinook | 30 | 3782 |
| | Fall Chinook | 50 | 1878 |
| | Coho | 30 | 1919 |

## ENHANCEMENT POTENTIAL

Shitike Creek is a free flowing steam that presently supports a good run of steelhead and some spring chinook. These two species appear to be the best adapted to the current conditions in the system. Fall chinook do not enter Shitike Creek even though they spawn in the Deschutes above its confluence with Shitike Creek. Coho have not been found in the system.

Enhancement of the creek by flow manipulation would be difficult. Not only would it require a storage area upstream that would flood valuable habitat, but the needs of each species are different and trade offs would have to occur. For instance, the high flows needed for spring spawning steelhead greatly reduce the rearing habitat for juvenile fall chinook. High spring flows are needed for steelhead while fall flows for chinook and coho would be higher than desired for steelhead.

The best possibilities for enhancing anadromous fish in Shitike Creek at the present time are (1) improving passage at the Shitike Creek diversion and any log jams upstream plus (2) investigating possibilities of species introductions in the upper drainage.

Passage at the diversion is difficult for anadromous fish. Some steelhead and very few spring chinook pass this partial barrier. Many miles of potential habitat are relatively unused at present, especially the areas near Peter's Pasture (S-3). Good spawning areas exist for any of the anadromous fish examined in the upper drainage, although steelhead and spring chinook have the most potential spawning habitat. The natural flows in the area appear to be good for anadromous fish whether they spawn in the fall or spring. Juvenile rearing habitat is reduced in this upper most area but the areas just downstream in Section 2 offer more rearing habitat than any other section.

The introduction of anadromous fish into the upper drainage could be more quickly accomplished by releasing juvenile anadromous fish in these areas. Returning adults would then return to these upper areas once passage is improved.

Accurate monthly discharge and temperature records are needed in the upper sections to determine which species are best suited to the prevailing conditions, however steelhead appear to offer much greater potential than any other fish examined.

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Prepared by: ____________________
Brian C. Cates
Fishery Management Biologist

Approved by: ____________________
Curtis L. Burley
Project Leader